

# Land degradation in the Argentine Chaco

An assessment of regional land-use and rural livelihoods

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Land Transformation in the Chaco province, Argentina, in January 2020 (Source: Greenpeace Argentina)

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**Master's Thesis**  
**M.Sc. Sustainable Development**

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Utrecht, September 10, 2020

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## **Acknowledgments**

Even though I was not able to visit and experience the Argentine Chaco myself, various local contacts shared their insights and observations- without which I could have not conducted this research. In the light of increasing incidents of expansive deforestation and fires during these past months, a new critical phase for the region, many local actors are extremely occupied with work related to environmental and social activism.

Therefore, I highly appreciate the time that participants spent to provide me with information and to support me to their best abilities; *Gracias a todos los que participaron en mi investigación; Gracias por su apoyo y entusiasmo por mi enfoque, lo agradezco mucho. Les deseo éxito y fuerza en sus esfuerzos!*

Two people deserve a special thanks: first, Alex Ehrenhaus, from Solidaridad Argentina. By introducing me to the topic and the region, you provided me with a both urgent and interesting research direction. The calls and discussions with you led to countless insights that helped to shape my thesis- thank you so much for this research collaboration, it opened up a lot of opportunities!

Second, Raúl Montenegro: for building bridges, sharing your valuable understanding of the Argentine Chaco and being a constant guide. Raúl- I cannot thank you enough for your support and engagement with my thesis, the energy and optimism you sent all the way from Argentina kept me motivated: *Muchas gracias!*

## **Abstract**

The Argentine Chaco, a semiarid ecoregion with rapidly expanding agricultural frontiers, is facing two critical, interlinked challenges: first, the accelerating land degradation, which is strongly related to land-use changes and intensive agricultural production, and secondly, the simultaneous territory degradation, leading to further marginalization and impoverishment of rural communities. In order to comprehensively address land degradation, it is necessary to gain a clear overview of prevailing land degradation processes, considering how they are embedded in the regional context of land-use and rural livelihoods. This research set out to contribute to this overview by following a qualitative case-study design, aimed at providing insights and evidence related to land degradation dynamics in the Argentine Chaco.

Relevant information was gathered through multiple primary- and secondary data sources, leading to the integration of various forms of knowledge and insights in the data analysis based on constant comparison and data coding. By both exploring current processes and factors that contribute to land degradation dynamics, as well as explaining how these are related, the results of this research provide a comprehensive understanding of the regional context.

The Argentine Chaco is characterized by a complex mosaic of land-use systems and remaining native forest patches, each exposed to the consequences of varying degrees of land-use intensity. Therefore, the land degradation dynamics are influenced in different temporal scales across the region, with some areas already indicating critical processes that will sooner or later lead to changes in the ecosystem that might be irreversible if not addressed adequately. While this does not only threaten the conservation chances of the Argentine Chaco ecoregion, it also threatens the sustainability of any agricultural production in the region. Rural livelihoods are endangered, as communities are increasingly displaced to marginal lands with limited natural resources and often face extreme poverty due to limited subsistence production possibilities or alternative income opportunities.

Considering these land-use patterns in the context of land-use planning within the region, which has been found to not be efficient to limit degradation, there are various implications that the Argentine Chaco will experience continuous extensive land transformations. Resulting land degradation will progressively impact the functioning of ecosystems and with the decreasing capacities of ecosystems to provide essential services, the consequences of land degradation will become an increasingly pressing issue for global sustainability.

## **Resumen**

*El Chaco argentino, una ecorregión semiárida con fronteras agrícolas en rápida expansión, enfrenta dos desafíos críticos e interrelacionados: primero, la degradación acelerada de la tierra, que está fuertemente relacionada con los cambios en el uso de la tierra y la producción agrícola intensiva, y en segundo lugar, la degradación simultánea del territorio, que conduce a una mayor marginación y empobrecimiento de las comunidades rurales. Para abordar de manera integral la degradación de la tierra, es necesario obtener una comprensión clara de los procesos predominantes de degradación de la tierra, considerando cómo se integran en el contexto regional del uso de la tierra y los medios de vida rurales. Esta investigación se propuso contribuir a esta comprensión a partir de un estudio de caso cualitativo, con el objetivo de aportar conocimientos y evidencias relacionados con la dinámica de la degradación de tierras en el Chaco argentino.*

*La información relevante se recopiló a través de múltiples fuentes de datos primarias y secundarias, lo que llevó a la integración de diversas formas de conocimiento e información en el análisis de datos basado en la comparación constante y la codificación de datos. Tanto al explorar los procesos y factores actuales que contribuyen a la dinámica de la degradación de la tierra como al explicar cómo se relacionan, los resultados de esta investigación proporcionan una comprensión integral del contexto regional.*

*El Chaco argentino se caracteriza por un mosaico complejo de sistemas de uso de la tierra y parches remanentes de bosques nativos, cada uno expuesto a las consecuencias de diversos grados de intensidad del uso de la tierra. Por lo tanto, la dinámica de la degradación de la tierra se ve influenciada en diferentes escalas de tiempo en la región, y algunas áreas ya indican procesos críticos que tarde o temprano conducirán a cambios en el ecosistema que podrían ser irreversibles si no se abordan adecuadamente. Si bien esto no solo amenaza las posibilidades de conservación de la ecorregión del Chaco argentino, también amenaza la sostenibilidad de cualquier producción agrícola en la región. Los medios de vida rurales están en peligro a medida que las comunidades se trasladan cada vez más a tierras marginales con recursos naturales limitados y, a menudo, se enfrentan a la pobreza extrema debido a las limitadas posibilidades de producción de subsistencia u oportunidades de ingresos alternativos.*

*Teniendo en cuenta estos patrones de uso de la tierra en el contexto de la planificación del uso de la tierra dentro de la región, que se ha encontrado que es ineficiente para limitar la degradación, hay varias implicaciones de que el Chaco argentino experimentará transformaciones continuas y extensas de la tierra. La degradación de la tierra resultante tendrá un impacto progresivo en el funcionamiento de los ecosistemas. Con la disminución de la capacidad de los ecosistemas para proporcionar servicios esenciales, las consecuencias de la degradación de la tierra se convertirán en un problema cada vez más urgente para la sostenibilidad global.*

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## List of Abbreviations

DPSIR	Driving Forces-Pressures-State-Impact-Response
EM	Ecological Modernization
FAO	Food and Agriculture Organization of the United Nations
NGOs	Non-Governmental Organizations
OTBN	<i>Ordenamiento Territorial Bosques Nativos</i> - Territorial Regulation of Native Forests, land-use zoning policies
SLF	Sustainable Livelihood Framework
SOC	Soil Organic Carbon
SRL	Sustainable Rural Livelihoods



# 1. Introduction

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*This chapter provides an introduction to land degradation in the Argentine Chaco. Further, the identified problem and purpose of this research are presented as well as the guiding research questions.*

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## 1.1. Background

In the last two decades the Argentine Chaco, part of the second largest forested ecoregion in South America, experienced extensive land-use transformations from native forest to agricultural land, leading to substantial degradation of lands (Aguar et al., 2018; Gasparri & Grau, 2009; Torrella et al., 2018; Volante & Seghezzo, 2018). Depending on the extent and effect, land degradation can represent a critical challenge for sustainable development on both a local and international scale. When land ecosystems degrade, their functionality diminishes which directly impacts the natural resource base in the local context, and thereby the sustainability of agricultural production, biodiversity and ecosystem services, as well as rural livelihoods. Globally, land degradation thus threatens food security, the climate regulating function of land ecosystems and rural development (Barral et al., 2020; Busscher et al., 2020; Nkonya et al., 2013; Scherr, 2000; Seghezzo et al., 2020). Therefore, sustainable land-use and addressing land degradation to protect and restore land ecosystems is essential (Barral et al., 2020; Bucher & Huszar, 1999; Nkonya et al., 2013; Torrella et al., 2018; Volante & Seghezzo, 2018; Zak et al., 2004). But how can agricultural production be balanced with environmental conservation and improved rural livelihoods?

Despite an increasing body of literature addressing this question, the search for an answer remains inconclusive, with the exception of the recognition that there is no universal formula to address these three-competing land-uses in an equitable way (Alcorn et al., 2010; Duraiappah, 1996; Scherr, 2000). This leads to a difficult task for land-use planners and policy makers, as almost any land-use decision involves a cost for competing demands, and therefore the land-use options with the least perceived trade-offs need to be determined in order to develop adequate regulations (Barral et al., 2020; Recatalá Boix & Zinck, 2008b; Rudel & Meyfroidt, 2014). To come closer to an answer to this controversial question, it is essential to develop a comprehensive understanding of how and where land-use activities impact the functionality of land ecosystems in the regional context, while considering both social and environmental consequences (Giménez et al., 2016; Mastrangelo & Aguilar, 2019; Mastrangelo et al., 2019; Seghezzo et al., 2011, 2020; Torrella et al., 2018; Zak et al., 2004).

In the case of the Argentine Chaco, the regional context is complex and characterized by a mosaic of different land covers, including both natural grasslands and woody vegetation, with different degrees of transformation for land use practices (Macchi et al., 2013; Mastrangelo et al., 2019). Land-use competition in the region is mainly related to trade-offs between local communities and their access to ecosystem services, and the global demand for both agricultural commodities and conservation (Gasparri, 2016). The main land-use actors include medium to large-scale, commercial farmers, who use modern agricultural production to serve the global market, and rural communities following traditional agricultural practices including subsistence farming and livestock grazing (Busscher et al., 2020; Gabay & Alam, 2017; Gasparri, 2016; Marinaro et al., 2015; Marinaro et al., 2017; Piquer-Rodríguez et al., 2018). While land degradation in the region also occurs due to natural pressures, the pressures related to human activities, and specifically land-use, play an increasingly critical role in the dynamics. Both land-use actors in the Argentine Chaco can be related to activities that contribute to degradation: commercial farmers through high land-use intensity and agricultural expansion, and rural communities who often struggle with extreme poverty and limited resources, which can lead to unsustainable resource use (Aguiar et al., 2018; Alcañiz & Gutierrez, 2020; Duraiappah, 1996; Tanner, 2003a; Volante & Seghezzo, 2018).

These contrasting land-use strategies lead to intense land conflicts, as rural communities struggle to defend their rights due to drastic power inequalities and widely insecure land tenure rights. With increasingly large land transformations and far-reaching degradation in the region, rural communities are more and more marginalized in their production possibilities, facing further impoverishment (Altrichter & Basurto, 2008; Busscher et al., 2018, 2020; Gabay & Alam, 2017; Lapegna, 2013; Wald, 2015). The transition of the Argentine Chaco into a major modern agricultural frontier and global deforestation hotspot, created a highly politicized environment where ecological modernization (EM) narratives strongly influence the design of policies that are implemented to address social and environmental problems. EM narratives propose that state- and market-led processes such as modernization, urbanization and agricultural intensification can lead to a ‘win-win-win’ situation in regard to social, ecological and economic outcomes. While the dominant development approach based on agricultural intensification and land sparing is expected to limit degradation, promote reforestation and enhance rural livelihoods, the local reality in the region indicates that rather the contrary is true: the agricultural expansion continues to encroach on the Argentine Chaco, leading to the degradation of land ecosystems, substantial

losses in biodiversity, and increasingly vulnerable rural communities (Mastrangelo & Aguiar, 2019; Matteucci et al., 2016).

## 1.2. Problem

The current land-use planning in the Argentine Chaco seems to not only fail to effectively limit further degradation of an environmentally sensitive ecoregion but also threatens the livelihoods of rural communities (Altrichter & Basurto, 2008; Busscher et al., 2020; Busscher, 2012; Ceddia & Zepharovich, 2017; Lapegna, 2013; Wald, 2013). It is therefore necessary to address the two critical, interlinked challenges: the prevailing land degradation processes, which are strongly related to dominant, intensive agricultural production, and the increasing impoverishment of rural communities. In recent studies, it has been suggested to move away from EM narratives to design more adequate land-use policies and effectively address degradation and rural poverty (Mastrangelo & Aguiar, 2019; Matteucci et al., 2016). This is in line with criticism related to a too simplistic approach towards land degradation. Poverty has been recognized as a major cause of environmental degradation and is widely perceived as a constraint to agricultural growth, and thereby development. In this context, livelihoods of rural communities are widely perceived as inefficient land-use activities, and their subsistence production is devaluated as it is not competitive in the global market (Ceddia & Zepharovich, 2017; Duraiappah, 1996; Scherr, 2000; Tanner, 2003a; Wald, 2013). However, existing research implies that the concentration on a single relation is insufficient for assessing the causes of prevailing degradation. By focusing on one presumably key driver for example, other causes of the degradation dynamics, such as underlying processes and structures that influence the decision-making of land-users, are not considered. As the causes of land degradation are numerous and interrelated, various factors that contribute to the degradation dynamics need to be taken into account to effectively prevent or mitigate destructive processes (Biot et al., 1995; Jones, 2008; Tanner, 2003a; Watts, 2000).

## 1.3. Purpose

The purpose of this research is to explore current land-use and degradation dynamics in the Argentine Chaco, with a specific focus on the role of rural communities. The aim is to provide insights on the local context of land-use and planning as well as of the rural livelihood context, in order to contribute to a more comprehensive understanding of prevailing land degradation and rural poverty dynamics, and thereby, to bridging knowledge gaps between science and policy.

## 1.4. Research Questions

In order to fulfill the outlined purpose, the following main question guides this research: *What are the current dynamics of land-use and degradation in the Argentine Chaco, and how are they embedded in the regional context?*

It is answered by addressing six sub-questions that are related to three conceptual dimensions: Part I: Land-Use & Planning, Part II: Land Degradation Types & Causes and Part III: Rural Livelihoods (Figure 1).

Figure 1: Research Questions

<b>RQ:</b> What are the current dynamics of land-use and degradation in the Argentine Chaco, and how are they embedded in the regional context?	
<b>Part I:</b> Land-Use & Planning	<b>SQ1:</b> What are common land-use patterns of local actors? <b>SQ2:</b> How is land-use planning currently addressed?
<b>Part II:</b> Land Degradation Types & Causes	<b>SQ3:</b> Which types of land degradation can be observed? <b>SQ4:</b> What prevalent causes influence the degradation dynamics?
<b>Part III:</b> Rural Livelihoods	<b>SQ5:</b> How do rural communities maintain their livelihoods? <b>SQ6:</b> How do the current land-use and degradation dynamics affect rural livelihoods?

## 2. Research Framework

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*In this chapter, the study area of this research is outlined to provide relevant information on the regional context. Then, the theoretical framework is presented by introducing relevant theories and concepts that inform the research model which is depicted in the last section.*

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### 2.1. Study Area

The Argentine Chaco Region is part of the Gran Chaco, a forest ecoregion of around 1.3 million sq.km, extending in parts of Argentina, Bolivia, Paraguay and Brazil. The Gran Chaco is divided in two ecoregions, the Dry Chaco to the West and the Humid Chaco to the East, leading to different semi-arid, highly seasonal climate conditions across the region with dry seasons that last 4-7 months and varying rainfall intensities (Bucher & Huszar, 1999; Macchi et al., 2013). The study area of this research includes four provinces in Northern Argentina that are part of the Argentine Chaco: Salta, Chaco, Formosa and Santiago del Estero (Figure 2).

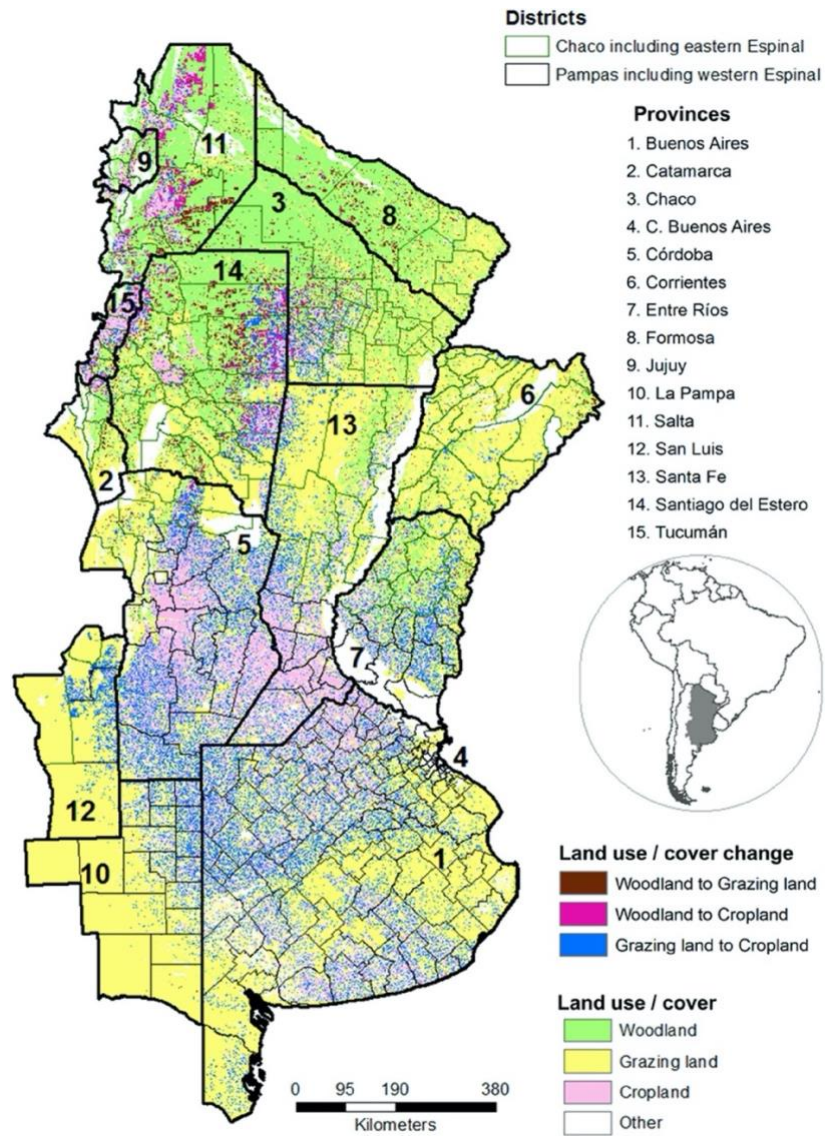
Figure 2: The provinces of Salta, Santiago del Estero, Chaco & Formosa in Argentina (Matteucci et al., 2016)



Combined these provinces cover a total area of 276,436 sq.km and contain a high bio- and cultural diversity. However, it is important to point out that this diversity substantially varies across the region and provinces. There are numerous different ecosystems embedded within the broader ecoregions, and their more specific local conditions, which makes this region very environmentally sensitive to disturbances and changes (Amdan et al., 2013; Boletta et al., 2006; Bucher & Huszar, 1999; Seghezze et al., 2017). Besides, the people living there represent a wide diversity in terms of language and customs, which is why a generalization among different indigenous and peasant peoples should be prevented. While a certain homogeneity in terms of their technological and material culture can be observed, there are profound differences in terms of the importance and meaning that the different people attribute to for example, natural resources and the use thereof (APCD, n.d.; Flores Klarik, 2019; The Nature Conservancy et al., 2005). Additionally, the provinces are among the most impoverished ones in Argentina; more than half of those living in dispersed rural areas have at least one unsatisfied basic need. Historically, rural poverty has been largely neglected by policymakers and there is a lack of timely data available as no regular household survey is conducted in rural areas (Demombynes & Verner, 2010; Verner, 2006).

As the economies of all four provinces strongly depend on the agricultural sector, the region has experienced substantial land-use and cover changes over the last decades (Bucher & Huszar, 1999; Flores Klarik, 2019; Matteucci et al., 2016; Nolte et al., 2017). In the map below the agricultural land-use/cover changes between 2000 and 2010 in the Chaco region as well as the Pampas region, an adjacent agricultural frontier, are indicated in different colors (Figure 3, Piquer-Rodríguez et al., 2018). The study area of this research includes the provinces 3, 8, 11 and 14. All four provinces contain mainly woodland with varying expansive grazing and cropland and have experienced some form of woodland to grazing or cropland cover change. These changes are notably more apparent in Salta and Santiago del Estero, followed by Chaco and lastly Formosa. In the first three provinces the additional land cover change from grazing to cropland is evident. As concluded by Piquer-Rodríguez et al. (2018), these land cover changes and related agricultural intensification are likely to continue as long as the global demand for agricultural products continues to grow and net returns remain high.

Figure 3: Agricultural land-use/cover changes between 2000 and 2010 in the Chaco and Pampas region (Piquer-Rodríguez, Butsic, et al., 2018)



## 2.2. Theoretical Framework

This section presents existing literature about the three central concepts of this study: land-use planning, land degradation and sustainable rural livelihoods. The concepts are presented, and relevant processes and tools are discussed, considering the design of this research which adopts a political ecology perspective on environmental change.

### 2.2.1. Land-Use Planning

Land-use planning refers to public policies that aim to reconcile the process of economic development and the conservation of natural resources based on the regulation of land-use. Optimally the ultimate goal is increasing both the rural well-being and the equity in the distribution of benefits and costs associated with land-use decisions (Vallejos et al., 2020). The process of planning has been defined by the Food and Agriculture Organization of the United Nations (FAO) as *‘the systematic assessment of land and water potential, alternative patterns of land use and other physical, social and economic conditions, for the purpose of selecting and adopting land-use options which are most beneficial to land users without degrading the resources or the environment, together with the selection of measures most likely to encourage such land uses’*. The planning is intended to encourage and assist land users in selecting land-use options

*‘that increase their productivity, are sustainable and meet the needs of society’* (FAO, 1993). In this context, the instrument of land-use zoning has been proposed to both steer sustainable land-use and reduce deforestation. The process of zoning leads to the categorization of areas for different land-uses by for example implementing restrictions on land clearing or other land-use activities (Camba Sans et al., 2018).

As multiple interest groups are affected and attempt to influence decisions towards their preferred outcomes, the design, implementation and evaluation of land-use policies is often accompanied by controversy and conflict (Aguilar et al., 2018; Nolte et al., 2018; Rudel & Meyfroidt, 2014). While some synergies between different land-uses are possible, the same tract of land cannot maximize agricultural production and preserve environment and biodiversity, which inevitably leads to tradeoffs. In order to attain the maximum value from these tradeoffs, land-use planners attempt to identify the ‘optimal’ uses for tracts of lands through a rather



political process, considering not only material outcomes but also the values and interests of affected people.

However, the rational process depicted varies significantly from the actual practices of land-use planning: decisions about tradeoffs often favor more powerful stakeholders at the cost of marginalized ones (Rudel & Meyfroidt, 2014). In order to understand local power dynamics and the range of conflicting stakeholder interests, the stakeholder analysis is a widely adopted tool to gain relevant insights. Stakeholders can be defined as actors that can influence or be affected by a certain problem or action. The analysis involves three main steps: identifying stakeholders, categorizing stakeholders and investigating relationships between stakeholders (Chevalier & Buckles, 2015; Reed et al., 2009). In the context of this study, an actor that either influences and/or is affected by land-use and related degradation dynamics is considered a stakeholder.

### *2.2.2. Land Degradation*

Land degradation is widely defined as the temporary or persistent reduction of land's biological and/or economic production capacity, or as the long-term loss of land ecosystem functions (Nkonya et al., 2013, 2015; Scherr & Yadav, 1996). However, as many researchers highlight, degradation and its definition are highly perceptual and judged in terms of altered benefits and costs that accrue to the land-user. Therefore, one must accept plural perceptions, definitions and rationalities (Blaikie & Brookfield, 1987; Watts, 2000).

There are three major land degradation types: soil, vegetation and water resources degradation; which each can be related to several key processes (see Table 1-3 for a selective overview); (FAO, 2015). The different types and processes are likely to occur simultaneously in an area and are also likely to be caused by the same pressures within that local context. Land degradation processes are stimulated by several interrelated and complex driving forces related to social, environmental and political factors. These can be categorized into *proximate* and *underlying* causes (Nkonya et al., 2013). Proximate causes represent direct pressures on the land and are further divided into natural (biophysical) and human (unsustainable land management practices). Underlying causes include forces that indirectly affect the proximate causes and include institutional, socio-economic and policy factors. Due to the diversity of interlinked causes, targeting only one factor is not sufficient to efficiently address land degradation. When designing policies to prevent or mitigate land degradation, a number of both underlying and proximate

causes should be taken into account (Biot et al., 1995; Jones, 2008; Nkonya et al., 2013; Tanner, 2003a; Watts, 2000).

To gather a comprehensive understanding of the different factors and processes involved in land degradation dynamics, the Driving Forces-Pressure-State-Impact-Response (DPSIR) framework is a useful tool to gain a structural overview. It is associated with the European Environmental Agency and provides a scheme to structure cause-effect relationships by integrating economic, social and natural information in relation to environmental challenges. Besides, it is a useful approach to support decision-making by showing a contextual overview of the issue, based on knowledge integration and stakeholder involvement (Ness et al., 2010; Tscherning et al., 2012). The DPSIR framework contains five components: **Driving forces** represent underlying factors that indirectly influence the land degradation dynamics by triggering more **direct pressures** on the environment, which include both human and natural factors. These pressures in turn affect the **status of the land**, which describes the condition and observable changes. Resulting **impacts** are represented in terms of environmental and social damages, and the **responses**, are the measures that aim to address the issues of the previous components. The responses can be directed towards any of them and can be implemented by different actors.

Recognizing that land degradation results from interactions between the environment and society and thus involves social, political and economic processes at different levels and scales, is in line with the political-ecology approach towards environmental problems (Andersson et al., 2011). The concept of a politicized environment is central to political ecology, which implies that environmental problems, such as land degradation, cannot be understood in isolation from the regional political and economic context (Biot et al., 1995; Blaikie & Brookfield, 1987; Bryant & Bailey, 2005; Watts, 2000). This view advocates that land degradation is an interdisciplinary, predominantly social problem, as argued by Blaikie & Brookfield (1986). Therefore, a key investigative focus lies on the various factors that determine the access to natural resources and the subsequent patterns of use, as well as the social relations that shape the local context and resulting conditions for vulnerable actors. This is especially relevant as relations of production or marginalization for example can make certain land-use decisions and resulting degradation situationally rational (Tanner, 2003a; Watts, 2000).

Blaikie & Brookfield (1987) suggested an actor-oriented perspective to explain the land user's actions and decision-making within the context of dynamic political environments. This perspective focuses on assessing the interests, perceptions and actions of different types of land-use actors in order to understand environmental change (Bryant & Bailey, 2005). This research adopts the actor-oriented perspective by assessing the regional context of land-use and degradation in the Argentine Chaco, considering various local land-use actors.

Table 1: Soil degradation types and processes

Soil degradation	Key processes
Soil erosion	<ul style="list-style-type: none"> <li>• Soil destruction by water, wind or other influences</li> <li>• Removal (and re-deposition) of soil particles</li> </ul>
Soil pollution	<ul style="list-style-type: none"> <li>• Soil chemical imbalances and nutrient toxicities (e.g. due to application of inappropriate types and quantities of fertilizer)</li> <li>• Buildup of inorganic pollutants in soil (e.g. through overuse of agro-chemicals and deterioration of topsoil)</li> </ul>
Surface compaction	<ul style="list-style-type: none"> <li>• Surface crusting and compaction (e.g. through impact of rain, animal hooves and farm machinery) and burning</li> </ul>

Table 2: Vegetation and biodiversity degradation types and processes

Vegetation & biodiversity degradation	Key processes
Degradation of vegetation quantity and quality	<ul style="list-style-type: none"> <li>• Reduction in vegetative ground cover (expanding areas of agricultural land)</li> <li>• Reduction in vegetation biomass (fewer plants, lower density, lower productivity)</li> </ul>
Degradation of plant diversity	<ul style="list-style-type: none"> <li>• Reduction in species diversity and/or abundance (reduced numbers/populations of species, reduced local crop varieties)</li> <li>• Reduction in habitat for associated species</li> </ul>
Degradation of animal productivity	<ul style="list-style-type: none"> <li>• Reduction in livestock (or wildlife) stocking capacity and productivity (due to reduction in biomass and feed quality)</li> </ul>

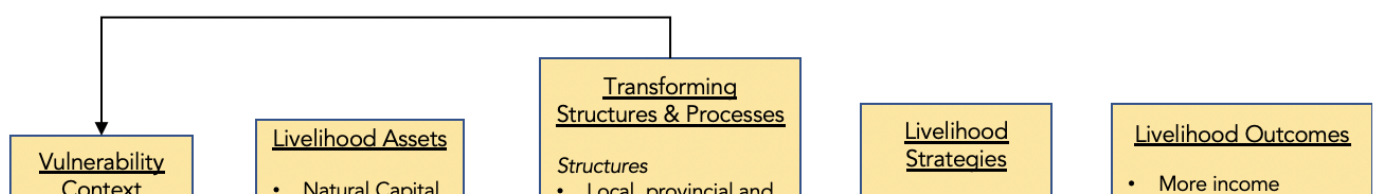
Table 3: Water resource degradation types and processes

Water resource degradation	Key processes
Change in water regime: surface and groundwater resources	<ul style="list-style-type: none"> <li>• Increased fluctuation in quantity of surface water flow (leading to increased storm peak flows and reduced dry season flow)</li> <li>• increased incidence of flooding; drying up of water sources</li> </ul>
Degradation of quality and storage capacity	<ul style="list-style-type: none"> <li>• Increased sediment load in streams and rivers (e.g. due to increased soil erosion in catchment areas)</li> <li>• Reduced water storage capacity (e.g. due to sedimentation of reservoirs)</li> <li>• Increased salinity of water resources</li> </ul>
Water pollution	<ul style="list-style-type: none"> <li>• Pollution of water resources (e.g. from leaching/discharge of wastes/agro-chemicals) affecting water quality</li> <li>• Decline in aquatic life and diversity due to water pollutants</li> </ul>

### 2.2.3. Sustainable Rural Livelihoods

The concept of sustainable rural livelihoods (SRL) is central to the debate about rural development, poverty reduction and environmental management. As defined by Scoones (1998) a livelihood comprises the capabilities, assets and activities required for a means of living. It can be viewed as sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base. However, defining what a sustainable livelihood is in a particular context is debatable, as there are likely to be substantial differences in opinions and views of local actors (Krantz, 2001; Lax & Krug, 2013; Scoones, 1998). Scoones (1998) proposed a framework to analyze sustainable rural livelihoods, showing how they are achieved in different livelihood contexts. This framework can be seen as a precursor to other widely used frameworks such as the Sustainable Livelihoods framework (SLF) developed by the Department for International Development (DfID) as shown in Figure 4 (DfID, 1999; Krantz, 2001). A specific focus of the analysis lies on the variety of formal and informal organizational and institutional factors that influence SRL outcomes. This characteristic reflects the broader view of the political ecology approach to land degradation, which also emphasizes the importance of examining multiple influential factors operating at different levels and scales.

Figure 4: Sustainable livelihoods framework based on DfID (1999)



The **vulnerability context** represents relevant trends, seasonality and shocks which impact the livelihood and wellbeing of rural households. It has two facets; exogenous influences (natural calamities; flood, fire, drought) and endogenous influences (trends, patterns, changes in policies, access rights) (DfID, 1999; Lax & Krug, 2013; Scoones, 1998; Serrat, 2006).

**Transforming structures and processes** directly influence the vulnerability context which includes both the public sector with its laws, policies and institutions as well as the private sector with its commercial production, non-governmental organizations, and societal norms and beliefs. These determine the access and availability of livelihood assets and can be of informal or formal nature, which is why an understanding of these institutions and their underlying social relationships and power dynamics is crucial (DfID, 1999; Scoones, 1998; Serrat, 2006).

**Livelihood assets** entail different types of capital: natural, financial, physical, human and social, (Table 4); (Lax & Krug, 2013; Scoones, 1998). Access to these livelihood assets reduces vulnerability and enables household to follow different **livelihood strategies**, which represent an organized set of lifestyle choices, goals, values and activities (Scoones, 1998; Serrat, 2006; Walker et al., 2001). Scoones (1998) identified three clusters of livelihood strategies for rural people: agricultural intensification or extensification, livelihood diversification, and migration. Livelihood strategies are often combined, attempting to achieve different **livelihood outcomes**, which can substantially vary between households since they are largely based on personal priorities. They can potentially include: more income, increased well-being, reduced vulnerability, improved food security and more sustainable use of natural resources (DfID, 1999; Serrat, 2006).

Table 4: Livelihood assets of rural communities

Livelihood Asset	Description	Examples
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Natural Capital	Natural resources and environmental services useful for livelihoods	Soil fertility, water, forest & grazing resources, land quality
Human Capital	Human resources, including skills and knowledge	Health, education, skills, employment opportunities
Social Capital	Social resources such as networks and associations	Social claims, relations, cooperatives
Physical Capital	Infrastructure access and household assets	Roads, public services; agricultural implements, production equipment
Financial Capital	Economic resources of the household	Saving, credit, income, remittances, state support

### 2.3. Research Model

The research model is presented below and depicts the three analytical dimensions of this research (Part I-III), which represent the sub-questions (see 1.4. *Research Questions*). Part I-III are related to the above described concepts and thereby conceptually linked to the theoretical framework, which provides relevant tools to operationalize the gathered information. Part I is addressed by assessing the regional context of land-use and planning in the Argentine Chaco, considering prevalent land-use patterns, local stakeholders, as well as existing institutions and regulations. Part II set out to identify soil, vegetation and water resource degradation processes in the region along with key causes. Part III is connected to the Sustainable Livelihood Framework, aiming to investigate the livelihood context of rural communities, with a focus on impacts related to prevailing land-use and degradation dynamics. Combined the results inform the answer of the main research-question, which is illustrated based on the DPSIR framework.

Figure 5: Research model

<b>RQ:</b> What are the current dynamics of land-use and degradation in the Argentine Chaco, and how are they embedded in the regional context?	
<b>Part I:</b> Land-Use & Planning	<ul style="list-style-type: none"> <li>• Regional context of land-use and planning</li> <li>• Existing institutions and regulations, stakeholder analysis, land-use patterns</li> </ul>
<b>Part II:</b> Land Degradation Types & Causes	<ul style="list-style-type: none"> <li>• Identification of soil, vegetation and water resources degradation processes</li> <li>• Proximate and underlying causes of land degradation</li> </ul>
<b>Part III:</b> Rural Livelihoods	<ul style="list-style-type: none"> <li>• Livelihood context of rural communities, impacts of land-use and degradation dynamics</li> <li>• Sustainable Livelihood Framework</li> </ul>
<b>Combined</b>	<ul style="list-style-type: none"> <li>• Driving Forces-Pressure-State-Impact-Response framework</li> </ul>

## 3. Method

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*This chapter presents the chosen research method. The data collection and method of analysis are discussed in the context of fulfilling the purpose of this research. Lastly, the complete research process is described and depicted to provide an overview.*

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### 3.1. Research Method

Qualitative research involves collecting data intended to understand dynamics of social life and linkages between processes and outcomes, often seeking to assess a given research problem from the perspectives of the local population it involves. This method is effective in gathering information about values, opinions, behaviors and local contexts of particular populations and thereby adds to the understanding of the complex reality of a given situation (Long & Godfrey, 2004; Mack et al., 2005). As this research seeks to investigate land-use, land degradation and rural livelihoods in the Argentine Chaco, a qualitative case study approach was found to be very suitable for this study. This method enables the researcher to closely examine data within a specific context, which allows for an in-depth investigation of complex situations or issues.

Following the recommendation of Yin (1994), the case study process contains four stages: 1. Design of case study; 2. Conduct case study and data collection; 3. Analyze case study evidence; 4. Develop conclusions, recommendations, and implications based on evidence. Typically, a case study selects a specific action, system or small geographical area as subjects of study and draws upon multiple sources of data to gain a representative and comprehensive understanding of the phenomenon of interest. This selective focus represents both an advantage and disadvantage of the case study approach; it enables a detailed contextual analysis of a rather small sample or area, yet exactly that focus is the reason for much criticism of this research method. Results of case studies are difficult to generalize due to the small number of subjects, which is why the design of the case study, and the communication thereof, is very important (Ogawa & Malen, 1991; Tellis, 1997; Zaidah & Zainal, 2007). In line with the focus of this research, the unit of analysis is a specific geographical area, the Argentine Chaco, which includes the four provinces of Salta, Chaco, Formosa and Santiago del Estero. Based on the provincial division, the research topic is addressed considering the context of each province, which provides a representative understanding of the region as a whole as patterns, trends and insights can be compared, assessed and combined.



In order to gather relevant insights, this research follows an exploratory-explanatory case study approach. The exploratory strategy allows the researcher to carry out a fairly open-ended and comprehensive investigation of the case and to identify major patterns and themes that are related with the topic. It is often used as a preliminary step before a more in-depth investigation to generate relevant insights and enhance the understanding of complex phenomena that have only been scarcely researched (Ogawa & Malen, 1991; Tellis, 1997; Zaidah & Zainal, 2007). For this case-study, the exploratory strategy was used to assess the local context of land-use, rural livelihoods and land degradation in the study area. Explanatory strategies are related to causal investigations, which aim to further expand the understanding of the researched phenomenon in terms of prevalent relations and processes as well as underlying influential factors (Tellis, 1997). This strategy was applied to gain insights on the perceptions of local actors on the topic and the current local situation. Thus, the exploratory-explanatory case study design allows for a research that both describes and explains the topic and prevalent relations and patterns embedded in the local context.

### 3.2. Data Collection

A case study typically draws upon multiple data sources to gather evidence, including direct observations, informal or in-depth interviews, questionnaires and documents or existing literature. Therefore, it is crucial to maintain clear chains of evidence and records, and it is suggested to incorporate informant reviews, to construct validity as well as reliability of the gathered data (Ogawa & Malen, 1991; Tellis, 1997; Zaidah & Zainal, 2007).

Originally, the research project was planned to include a field visit to gather data and insights in the local context. While these direct observations and interactions with local actors would have yielded invaluable information and evidence, the circumstances of the Covid-19 pandemic limited the data collection of this research to online inquiries. In an attempt to increase the reliability of the data, the following data sources were used to gather evidence: primary data sources- communication with local informants, interviews, questionnaires; and secondary data sources- existing documents and literature. By using multiple sources, the gathered data can be compared and corroborated, reflecting various observations and indications related to the research topic.

### 3.2.1. Primary Data Sources

#### Local informants

This research has been conducted in collaboration with the NGO *Solidaridad* in Argentina, which follows the mission of developing innovative solutions to improve agricultural production and to ensure the transition to a more inclusive and sustainable economy. The initial review of the topic and design of the case study was facilitated by various insightful conversations and discussions that set out the direction and purpose for this study. Progress and developments throughout the research process were communicated and discussed with the local contact, leading to a continuous review of the project. To corroborate the outline and intend of the research, an additional key informant has been consulted, who provided expertise knowledge and an extensive understanding about the Argentine Chaco.

This second key contact was *Raúl Montenegro*, an Argentine biologist, environmentalist and activist, who received the Right Livelihood Award for his work with local communities and indigenous people to protect the environment and natural resources. He is the president and founder of the NGO *Environment Defense Foundation- Fundación para la defensa del ambiente (FUNAM)*, director of the Right Livelihood College and professor of evolutionary biology at the University of Córdoba. *R. Montenegro* has been a key informant for this research, continuously providing valuable local insights and observations.

#### Interviews

In order to gather relevant and reliable data, semi-structured interviews with open-ended questions were conducted. A semi-structured interview means that while some questions are prepared to ensure the discussion of main topics of interest, other questions are developed during the course of the interview. Open-ended questions enable the interviewee to give longer answers, which subsequently enables the researcher to gain a deeper understanding of discussed topics (Wengraf, 2001). These interviews allow for meaningful and unanticipated responses, which is in line with the exploratory approach of this research. Additionally, there is flexibility to probe initial responses to gain insights on the underlying reasoning or more detailed explanations, the *why* or *how* (Long & Godfrey, 2004; Mack et al., 2005). The interview guide was designed on the basis of a literature review, the derived research model, as well as the initial conceptualization of the author (King, 2004).

As diverse local actors with varying backgrounds and experiences were interviewed, two different interview guides in both English and Spanish were prepared to ensure a relevant and information-rich data collection. The broader categories were *NGOs* and *Rural Communities*. The conducted interviews were mainly based on the *NGO* guide, however, some questions from the other guide were included to probe received answers or to go further in depth (Appendix 1). To ensure accuracy and the complete documentation of received answers, the conducted interviews were recorded, which was communicated to the respondents prior. To prepare the gathered data for analysis, all interviews were transcribed and in case they were conducted in Spanish, translated to English.

### Questionnaires

To offer a more flexible option to participate in this research, a qualitative questionnaire has been developed to gather additional local insights on the context and prevalent processes (McGuirk & O'Neill, 2005). The questionnaire was developed based on the prepared interview guides and contains open questions to yield in-depth responses. As the design is very similar, the received responses can be effectively combined with the gathered insights from the conducted interviews. By inviting the respondents to answer the questionnaire in a set time frame, a higher response could be reached as many participants indicated very limited available time as a reason for not being able to participate in an interview. Nevertheless, various respondents offered the opportunity to further discuss received questionnaire answers in case of follow-up questions. The prepared questionnaire can be found in Appendix 2.

### Selection process for participants

The respondents were selected based on their apparent knowledge and experience relevant to this research, following the concept of purposive sampling. In order to attain a sample of diverse local actors, stakeholders representing different interests and views were taken into account. Besides identifying some initial contacts through a literature review and online search, additional ones were provided by *Solidaridad Argentina*, collaborator of this research, as well as *R. Montenegro*, key local informant. All potential respondents were contacted via e-mail in English or Spanish, depending on their preference, and briefly introduced to the outline of the research project. To ensure an ethical research, all participants were informed and made aware of the

purpose of this study as well as the use of the gathered data. Additionally, the respondents remain anonymous, unless they wish to reveal their identity, in order to establish a basis of confidentiality and trust. The potential respondents were invited to either participate in an online-interview or to respond the questionnaire, depending on which form of participation suited the participant better. During the data collection process, many local actors were extremely occupied with the increasing trends of deforestation and illegal burning of hectares of land in the Argentine Chaco. By providing the two options to participate in this research, the reach of the data collection could be enhanced in the light of critical local developments, requiring the attention of local actors in the form of environmental and social activism. Nevertheless, respondents required access to internet to be able to participate, which represents a disadvantage for many local actors.

An efficient response to this limitation would be to visit the study area, which would have allowed for local networking and thereby reaching respondents without internet access. Yet, due to the Covid-19 pandemic, this limitation could only be addressed by incorporating the snowball sampling method. Thereby, respondents who participated in this research were invited to refer the researcher to other local actors who could participate in the study (Mack et al., 2005), through which various additional respondents could be identified. In the process of networking with local actors, various forms of personal communication led to unanticipated, yet highly informative and relevant insights on the research topic. This additional primary data source was hence added to allow for the consideration and incorporation of the received information in form of online dialogues, local news as well as more informal text or voice messages, explaining the local context and situation as perceived by the local actor (see Appendix 3 for examples).

Despite intending to cover a wide range of local actors, the various outlined selection and participation limitations above led to a sample of 13 primary data sources that can be categorized into two broad groups: NGOs and researchers. While this might seem like a homogenous sample, the individuals that make up both groups represent varying interests and roles within the local context. The NGOs who participated in different forms of data sharing, follow distinct missions in the Argentine Chaco, and sometimes specifically focus on the provincial context.

For example, one NGO can be described as one of the main indigenous-peasant movements, making them very familiar with challenges rural communities face in the ever-changing

environment as well as the context of land-use, degradation and especially land-conflicts. Another NGO that participated is a major agricultural production association, which works with commercial farmers to implement more sustainable practices and developed a sustainability certification for agricultural land-use practices. This diversity in respondents is also reflected in the group of researchers that participated in this research, who follow distinct research directions and cover a wide area of expertise including the topics of biodiversity, indigenous people, land-use, deforestation, land degradation and rural development. All researchers have carried out their own field research studies in the Argentine Chaco in the past, which provided information-rich insights of the local context. The table below presents an overview of the collected data from the four different primary data sources of this research (Table 5- Note that local informants were added in the total for the interviews).

Table 5: Overview of primary data sources

Primary Data Source	NGOs	Researchers	Total
Interview	2	2	4
Local Informants	1	1	2
Questionnaire	4	/	4
Personal Communication	3	2	5
Sum	9	4	<b>13</b>

### 3.2.2. Secondary Data Sources

Secondary data is information gathered from existing sources. By re-analyzing existing data more information is available that can be used to form a valid foundation for the research of this thesis and to gather evidence for the case study (Bryman, 2015; Saunders et al., 2007). The secondary data was collected through reviewing existing literature on the online database *Google Scholar*, and in order to find relevant documents search parameters such as the following were used: land-use, land-use planning, land degradation, livelihoods, deforestation, agricultural expansion, Argentine Chaco Region; Literature Type: Books, Peer-reviewed articles, Internet; Publication Languages: English, Spanish, German.

Additionally, various documents that can be classified as grey literature have been reviewed. Grey literature includes materials and research that have been published and produced by actors

or organizations outside of the traditional academic publishing. While a significant disadvantage of grey literature is that it is not peer-reviewed, the publications are often produced by experts in the local context and provide timely insights and evidence (Pappas & Williams, 2011). To identify relevant grey literature, an online search on local organizations and research facilities has been carried out to review their databases and consult published documents.

### 3.3. Data Analysis

In order to efficiently analyze and conceptualize the empirical data, the constant comparison method was applied, which combines inductive category coding with the simultaneous comparison of all data gathered (Glaser & Strauss, 1967; Lincoln & Guba, 1985; Maykut & Morehouse, 1994; Memon et al., 2017). It can be applied in four steps: 1. Inductive category coding and comparing of data across categories; 2. Refinement of categories; 3. Exploration of relationships and patterns across categories; 4. Integration of data yielding an understanding of topic being studied (Memon et al., 2017).

Step one involves reading the interview transcripts and questionnaire responses and starting the coding process of the data through open coding. Open coding is the initial breaking down of the data by comparing, conceptualizing and categorizing and results in a list of recurring themes and concepts. Identified themes are compared, grouped and assigned provisional codes to provide a basis for categorization. In the second step the provisional categories are refined by identifying criteria that are representative for the categories. Re-reading the gathered data and further comparing the collected data with other primary and secondary data, deepens the analysis and informs the axial coding, which represents the third step. Identified themes and categories are linked together based on contexts and patterns (Corbin & Strauss, 1990; Memon et al., 2017). Emerging data and insights were continuously compared with prior collected data to ensure a thorough and reliable analysis of the findings. The fourth step is the synthesis of the findings and clustering relevant categories around the research questions they inform, thus following selective coding. Identified categories were systematically related to the overarching topics of land degradation, land-use and rural livelihoods and subsequently, to related research questions. This threefold coding process establishes and validates the relationships between the mentioned topics and themes during the primary data collection. In addition to the analysis following the

constant comparison method, the strategy of ‘memo-writing’ was used to capture initial insights and connections throughout the research process. These memos can provide additional insights that enable the researcher to gather a more comprehensive understanding, as these notes are compared to the identified categories and patterns in the coding process (Corbin & Strauss, 1990; Murphy et al., 2017; Strübing, 2014).

### Research Quality

To ensure that the qualitative findings of this research are trustworthy, the quality criteria of credibility, transferability, dependability and confirmability were considered throughout the research process (Collis & Hussey, 2013; Lincoln & Guba, 1985).

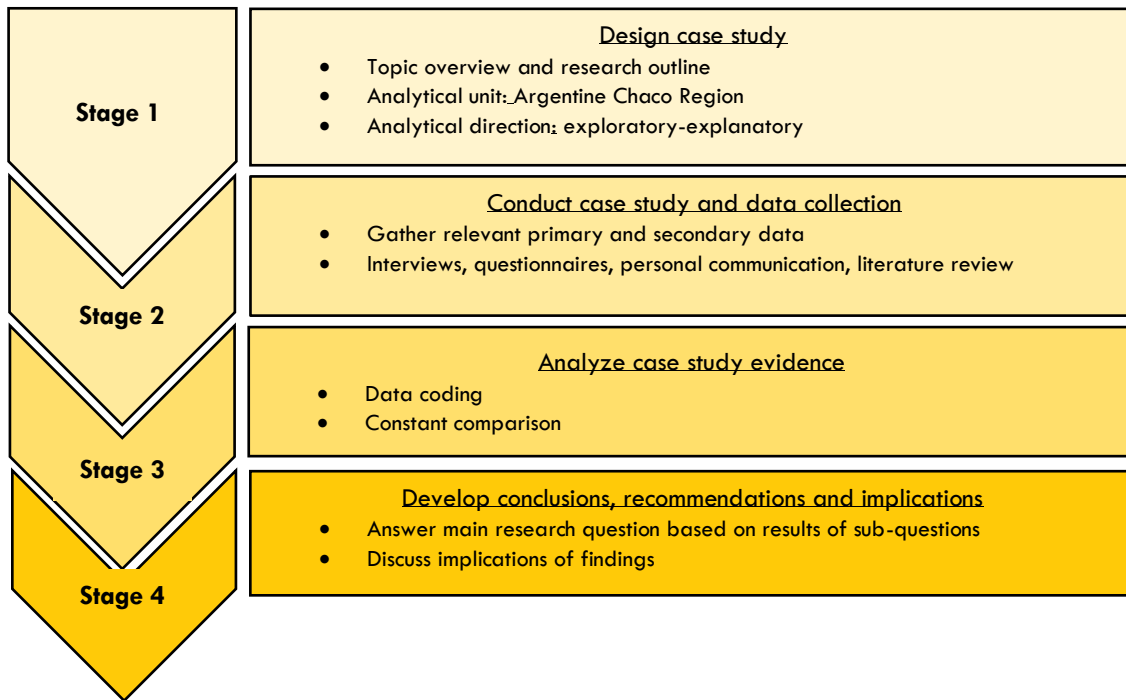
In regard to credibility, purposive sampling promotes the reliability, as various knowledgeable actors in the local context are chosen for the primary data collection. Thereby the local conditions can be assessed based on integrating novel primary insights with existing implications from secondary data, which combined enhance the credibility of the results. The transferability criterion is defined by Lincoln & Guba (1985) as whether the findings can be applied to another situation that is sufficiently similar to permit generalization. Qualitative research, such as this one, aims to understand a situation or topic from different perspectives and is bounded by the local context (Long & Godfrey, 2004). This quality therefore limits the transferability of this research’s findings as the local context differs within and between provinces of Argentina and even more between different countries. It is however intended that future researchers are able to use the findings of this study to extend their understanding of a different local context in a similar setting and semiarid environment. Dependability is considered by using multiple published secondary data as well as primary data sources, representing different perspectives on the research topic. This limits potential bias in the findings, as varying opinions and views from local actors are considered. Lastly, the criterion of confirmability is addressed by clearly communicating the processes and steps of the research as well as its intended objective, leading to transparency.

### 3.4. Research Process

This research started by designing the case study based on an initial understanding of the topics of land-use, rural livelihoods and land degradation in the local context of the Argentine Chaco,

which was gathered through communication with key informants as well as secondary data sources. Once the research project was outlined, the case study was conducted by collecting both primary and secondary data. The data collection gathered relevant information from primary data sources including communication with local informants, interviews and questionnaires as well as secondary data sources such as academic and grey literature. During the data collection, the gathered data was constantly compared with prior collected data to identify common themes and patterns, which was also the main aim of the three coding processes: open, axial and selective coding. The main research question is answered based on the results found for the sub-questions and lastly, the implications of the findings of this research were discussed. Aiming for a high research quality the criteria of credibility, transferability, dependability and confirmability were taken into account, whilst the thoroughness of the data analysis is ensured by the process of constant comparison. Figure 6 provides an overview of the research process.

Figure 6: Overview of research process





## 4. Results

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*This chapter presents the findings of this research: first, the background of the land-use trajectory of the Argentine Chaco is outlined, setting the scene for the current situation, which is assessed following the conceptual outline of this research (Part I- III). Lastly, the results are illustrated in a DPSIR framework that depicts the land degradation dynamics in the region.*

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### 4.1. Background

To be able to understand the current land-use and degradation dynamics of the Argentine Chaco, it is useful to understand how the region was originally developed and which events and transformations influenced its land-use trajectory, which is deeply intertwined with the regional degradation dynamics (Sawers, 2000). Therefore, in the following sections information related to the development trajectory of the Argentine Chaco is presented (4.1.1.) and then discussed in the context of the limited applicability of Ecological Modernization narratives to the regional context (4.1.2). Lastly, the results for the stakeholder analysis carried out for this research are presented. It highlights the local stakeholders involved in or affected by prevailing land-use and planning, painting a clear picture of local power asymmetries and marginalized rural communities within a highly politicized local environment (4.1.3.). Combined this part provides a comprehensive understanding of the processes and discourses that led to the current local context of land-use and degradation.

#### *4.1.1. Land-Use Trajectory of the Argentine Chaco*

Up until the 1880s, the Argentine Chaco was only scarcely inhabited and rural communities were the only active land-users, who traditionally used the forest and its resources for small-scale subsistence farming, gathering and hunting. Through a railroad expansion, the accessibility of the region improved, leading to more extensive cattle ranching and wood extraction, and the onset of land degradation processes. Around this time these were rather spatially limited and temporal, driven by mainly seasonal overgrazing and overexploitation of natural resources (Altrichter & Basurto, 2008; Gasparri, 2016).

Starting from the 1970s a process of neoliberal economic structural change was implemented across Latin America, leading to the increased focus on the agricultural sector in Argentina to exploit their comparative advantage in order to be competitive on the global market.

Development in this context, meant structural adjustment in the form of modernization that led to the intensification of agricultural production and the marginalization of peasant economies. The introduction of soybeans came along with extensive land-use changes to expand the crop cultivation in the light of increasing global prices, mainly at the cost of native forests and territories of rural communities (Gasparri, 2016; Recatalá Boix & Zinck, 2008b; Tanner, 2003a; Wald, 2013). This trend was further intensified in the 1990s with the introduction of a technological package that included genetically modified crops, agrochemicals and modern machinery. The agricultural production developed to be strongly export-oriented, capital-intensive, and economically incentivized by continuously high global demand for agricultural commodities. Commercial farmers could now expand their production into previously marginal land, resulting in the expansion of agricultural frontiers in the Argentine Chaco. The agricultural modernization coupled with neoliberal economic policies led to an increasing concentration of land ownership, intense land tenure conflicts and more extensive environmental degradation (Biocca, 2015; Tanner, 2003a, 2003b; Wald, 2013, 2015).

In the 2000s the agricultural frontiers continued to expand in the Argentine Chaco, with alarming conversions of 1,500-2000 sq.km of native forest into crop- and pasturelands per year between 2002 and 2010 (Mastrangelo et al., 2019). Here it is noteworthy that Argentina experienced a severe economic crisis in 2001, which led to the increased focus on and promotion of modern agricultural production destined for the global market and contributing significantly to the national economy. Large-scale land conversions in the region became more common, making the region a global deforestation hotspot for agricultural land-use change (Macchi et al., 2020; Piquer-Rodríguez, Butsic, et al., 2018). With increasingly intensive land-use and land degradation, the local and global concern about the control and regulation of the agricultural expansion and deforestation led to an unprecedented effort in environmental conservation by the national government.

In 2007, the national government implemented the Forest Law, introducing among other policy instruments, the Land-use Zoning of Native Forests (OTBN). This law mandates the provincial governments to set up and implement participatory land-use planning processes to both conserve native forests and regulate agricultural expansion. Based on the zoning policies, land zones are

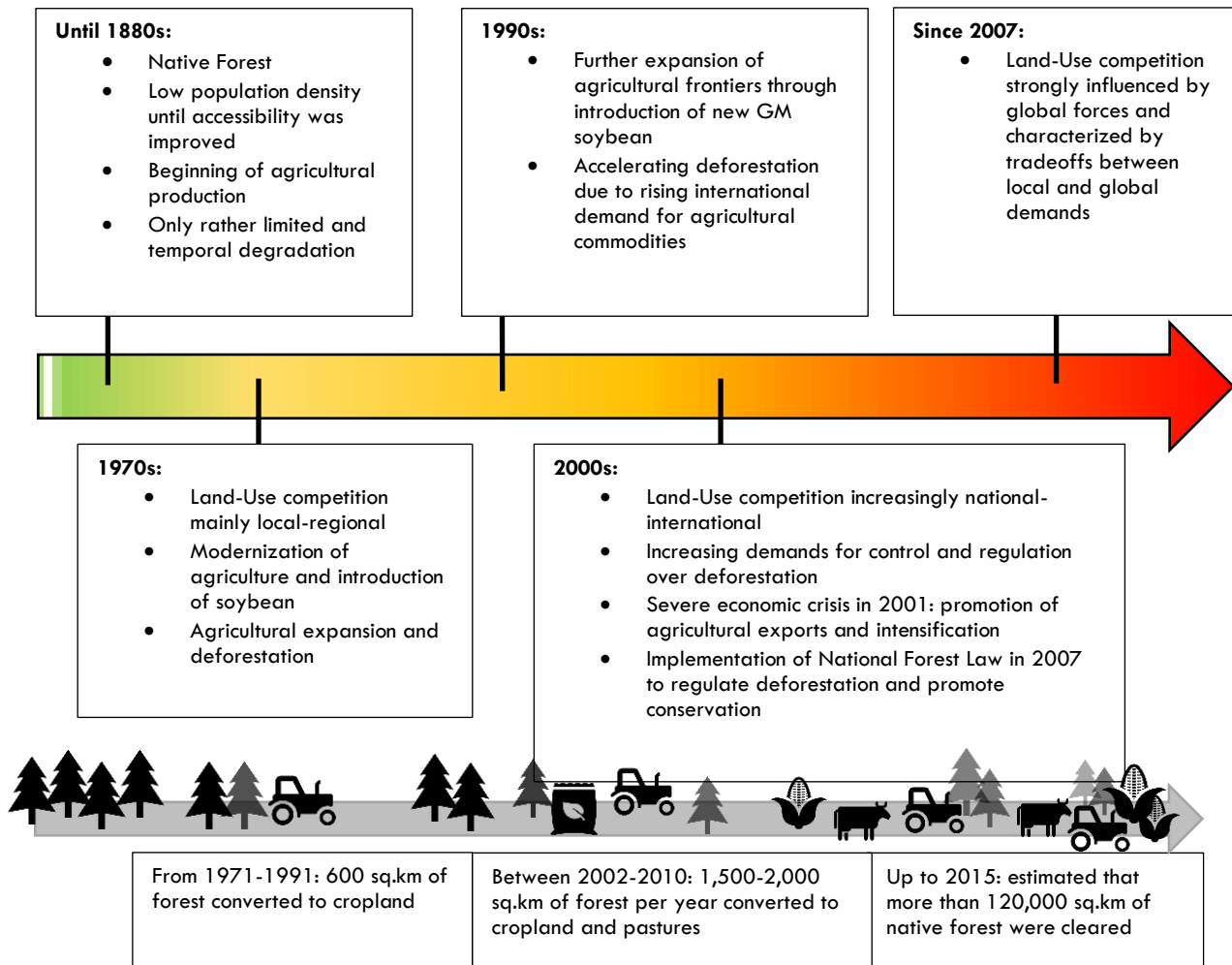
categorized into three conservation categories with varying restrictions related to land-use activities: I) red: high conservation value, no deforestation or clearing allowed, II) yellow: medium conservation value, sustainable use, tourism and research allowed, III) green: low conservation value, all activities are allowed. The law is a restriction-oriented policy which has direct implications for landowners and users (Aguiar et al., 2018; Busscher, 2012; Camba Sans et al., 2018; Ceddia & Zepharovich, 2017; Seghezzo et al., 2011; Torrella et al., 2018; Volante & Seghezzo, 2018). While indicating a new ‘era’ of land-use in Argentina and in the Argentine Chaco, there are continuous processes of agricultural expansion through deforestation and ongoing land degradation dynamics that threaten the sustainability of land-use altogether. Up to 2015 it was estimated that a total of more than 120,000 sq.km of native forest were cleared within the region and recent news indicate, that this land transformation trend is still prevailing (Ceddia & Zepharovich, 2017; Flores Klarik, 2019).

In information provided by a local NGO, the recent deforestation of an area of 4,2 sq.km in the province of Chaco is documented in July 2020 (Participant 7). This area is categorized as yellow under the Forest Law, which makes the land transformation very controversial, as it is assumed that there will be no consequences for the responsible actors despite illegal actions. In 2019 there were more than 75 sq.km of forest illegally cleared within the Chaco province, which clearly shows that despite the implementation of the Forest Law, deforestation and degradation continues. This trend can also be observed in the other provinces of the Argentine Chaco, especially now during the Covid-19 pandemic, which has led to a peak in deforestation and land clearing in the region. A local expert indicated, that since the beginning of the pandemic, around 210 sq.km of forest have been officially reported as deforested and cleared in the Argentine Chaco over the last few months in 2020, and fires for land clearings are becoming more frequent and extensive (Participant 1).

The infographic below depicts a timeline of the land-use development, highlighting relevant characteristics and changes over time. It additionally provides insights on the enduring deforestation trends that go along with the agricultural expansion, leading to drastic reductions in forest cover and increasing crop- and pasturelands (Figure 7). Provided insights and data was gathered from secondary and primary data sources and compiled by the author with the intent to provide background information on the current local context in the Argentine Chaco (Camba Sans et al., 2018; Gasparri, 2016; Mastrangelo et al., 2019; Piquer-Rodríguez, Baumann, et al.,

2018; Piquer-Rodríguez, Butsic, et al., 2018; Sawers, 2000; Seghezzo et al., 2020; Wald, 2013; Zoomers & Goldfarb, 2013).

Figure 7: Timeline of land-use change and degradation in the Argentine Chaco



#### 4.1.2. Ecological Modernization

The Forest Law is an example of a policy that is informed by the land sparing hypothesis, which has been widely applied to solve environmental problems and has been discussed in the context of ecological modernization (EM) narratives. It assumes that agricultural intensification on the most suitable lands allows for increased production without further affecting the environment, disincentivizing agricultural expansion and thereby sparing land for conservation and ultimately limiting degradation (Mastrangelo & Aguiar, 2019). Further it implicitly suggests that modern

agriculture will competitively displace traditional agriculture, leading to the migration of rural people to urban lands where they are expected to be able to improve their quality of life. Thus, the land sparing hypothesis is expected to lead to less pressure on lands and thereby allows for conservation and reforestation, assumptions that are also supported by the forest transition approach. The forest transition approach is based on the idea that reforestation starts with the last stage of socio-economic development: the migration of the rural population to urban areas, allowing the forest cover to expand on the abandoned lands. Traditional use of land by rural communities is viewed as inefficient and therefore the migration to urban areas is assumed to lead to improvements in their livelihoods.

Combined these two theoretical concepts inform the EM narrative that dominantly informs the formulation of policies aimed at socio-environmental problems (Cáceres et al., 2016; Mastrangelo & Aguiar, 2019; Matteucci et al., 2016). The EM narrative proposes positive social, ecological and economic outcomes and promotes agricultural intensification as the solution for more food production, improved nature conservation and reduced poverty. However, in order to be efficient in the regional context, underlying key assumptions of the EM narrative have to be verified. Both recent studies by Mastrangelo & Aguiar (2019) and Matteucci et al. (2016) provide clear evidence, that none of the underlying assumptions of the EM narrative can be confirmed in the regional context of the Argentine Chaco (in Table 6 the tested assumptions of the studies are presented next to the results). Continuous degradation of both lands and rural livelihoods within the region illustrate that EM narratives are not useful to understand the regional context or to steer development towards sustainable resource management.

On the contrary, EM narratives appear to be leading to counterproductive results by providing problematic arguments for agricultural intensification and neglecting the local context and socio-ecological dynamics. The expansion and intensification of modern agriculture in the Argentine Chaco region has increased local power asymmetries, especially related to the access to means of production and ecosystem services. This critical development led to shocking regional outcomes: in 2010, there was enough food produced within the region to feed a population 30 times larger than its number of inhabitants, yet it was the region with some of the highest levels of hunger, malnutrition and poverty in Argentina (Mastrangelo & Aguiar, 2019).

Table 6: EM narrative assumptions and applicability in Argentine Chaco

Assumption	Result	Reference
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Environmental impacts of large-scale modern agriculture are proportional to land area used	Multiple studies prove that there are leakage or spillover effects of agricultural intensification in the region (e.g. herbicide use).	Mastrangelo & Aguiar, (2019)
Modern agriculture is more efficient and competitively displaces traditional agriculture	Traditional agriculture cannot be viewed as inefficient as it leads to local benefits and serves the local market; the latter is reason why indirect, competitive displacement does rarely occur (instead, direct forms of displacement such as evictions).	Mastrangelo & Aguiar, (2019)
Land-use intensification disincentivizes agricultural expansion	Land sparing does not occur in region, intensification seems to promote expansion rather than contraction, forest conversion is highly determined by proximity to already cleared land.	Mastrangelo & Aguiar, (2019)
Rural depopulation promotes forest recovery in marginal lands that offsets conservation sacrifice in suitable lands	Forest recovery unlikely to compensate forest loss due to agricultural expansion; abandoned land in case of depopulation often highly likely to be used for modern agricultural production; traditional farming does not convert forest and only leads to localized degradation.	Mastrangelo & Aguiar, (2019)
Rural-urban migration improves quality of life of migrants and agricultural jobs of non-migrants	Decreasing amount of required labor in modern production; experienced living conditions of rural people often worse in urban areas and depend on social assistance from the State.	Mastrangelo & Aguiar, (2019)
Low income peasants use land inefficiently	Difficult to sustain, unless inefficiency refers to food production for export if related to natural ecosystem sustainability, assumption does not hold. Rural communities adapted to local environmental conditions and depend on continued ecosystem functioning.	Matteucci et al., (2016)
Development drives rural-urban migration of low-income peasants in search of better life quality	No benefits of development for low-income people in livelihoods or labor opportunities; migration often occurs to city outskirts where people live in slum-like conditions.	Matteucci et al., (2016)
Expansion of intensive agriculture occurs in most productive lands	Soils in Chaco region have many limitations; main limitation for agriculture is climate due to dryness and rainfall irregularity, however production is expanding in soils with low suitability for agriculture.	Matteucci et al., (2016)

### 4.1.3. Stakeholders

In order to gain a comprehensive understanding of the local institutions, relations and context, a stakeholder analysis was carried out to identify the key stakeholders related to land-use and land-use planning, and to analyze their social relations. The identification of key stakeholders was based on insights gained from secondary data sources and resulted in the following six stakeholder groups: rural communities (including both peasant and indigenous people), commercial farmers, the local, provincial and national government, and non-governmental organizations (NGOs) (Alcorn et al., 2010; Busscher, 2012; Cáceres, 2015; Gabay & Alam,

2017; Gasparri, 2016; Marinaro et al., 2015; Marinaro et al., 2017; Recatalá Boix & Zinck, 2008; Seghezzi et al., 2017). These stakeholders were also mentioned by all participants during the data collection (Participant 1-13). To explore the characteristics and relationships of the identified stakeholders, a social analysis based on interest, power, legitimacy and existing social relations was carried out as outlined by Chevalier & Buckles (2015).

**Interest (I)** in this context refers to the gains and losses experienced by the stakeholder as a result of land-use and degradation dynamics. These in turn affect the power, legitimacy or social relationships and include gains or losses over access to resources. The interest for each stakeholder is briefly described and represented on a scale of five values: high gains, middle gains, low gains/losses, middle losses, high losses.

**Power (P)** is understood in terms of the ability to influence others and to use resources to achieve goals. There are four different forms of power: economic wealth, political authority, ability to use force/threats of force, and access to information. To describe the level of power of each stakeholder group, relevant forms of power were identified, and a high, middle or low/no power value was assigned.

**Legitimacy (L)** refers to the recognition of a stakeholder's rights and responsibilities by other parties based on law or local institutions. Rights and responsibilities related to land-use and planning include for example land tenure rights, the Forest Law as well as local institutions. The level of legitimacy is indicated based on a high, middle or low/no legitimacy value, where the middle value demonstrates that a stakeholder's legitimacy is contested.

**Social relationships** include both collaboration and conflict with other stakeholders related to land-use and planning, which affect the local context.

#### Rural Communities

Rural communities mainly follow agricultural and forest activities to maintain their livelihoods, including subsistence farming, livestock grazing as well as traditional hunting and gathering (Gasparri, 2016; Macchi et al., 2013; Marinaro et al., 2015; Marinaro et al., 2017; Mastrangelo & Aguiar, 2019). Instead of providing benefits, the expanding agricultural frontier and increasing global market integration of the region represents extensive challenges and losses for rural communities (I: high losses). In the current context of land-use and planning, their territories become increasingly reduced, leaving them only limited access to land and natural resources.

Their form of life is widely seen as incompatible with modernization and their production systems are labeled as inefficient due to limited, if any, produced surplus (L: low); (Tanner, 2003a; Wald, 2013). Accepting that the current characteristics of the export-oriented economic model will not radically change in the short to medium term, rural communities need to increase their production and commercialization in order to improve their standard of living. However, due to various challenges such as land tenure insecurity, water scarcity and lack of credit, many rural households are not able to sustain their livelihoods let alone to increase their production and market integration (P: low); (Alcorn et al., 2010; Wald, 2013, 2015).

Despite the historical marginalization and increasing vulnerable livelihood conditions of the rural people, they remain a significant part of both the agrarian sector and society. Over the past decade, the civil mobilization of peasant and indigenous people to counter the neoliberal transformation of local economies has become prominent, calling for an agrarian reform and inclusive, integral development (Lapegna, 2013; Tanner, 2003b; Wald, 2013, 2015). Many NGOs within the region support them in their endeavors, especially in solving land conflicts between local and commercial framers, which are strongly backed by provincial governments (Alcorn et al., 2010; Busscher et al., 2020; Busscher, 2012; Ceddia & Zepharovich, 2017; Gasparri, 2016; Huaranca et al., 2019; Seghezze et al., 2017; Wald, 2015).

### Commercial farmers

Commercial farmers represent modern, industrial agriculture producers that serve the global market and drive the agricultural expansion. They are direct beneficiaries of increased production and largely neglect social as well as environmental consequences for wealth accumulation through intensive crop and cattle cultivation (I: high gains). This stakeholder group mainly includes land-use actors which are often not local, but from other provinces or countries (Altrichter & Basurto, 2008; Mastrangelo et al., 2019; Piquer-Rodríguez et al., 2018; Recatalá Boix & Zinck, 2008; Wald, 2013). Commercial farmers widely enjoy strong ties with the provincial and national government, allowing for powerful lobbying and subsequent influence on policy design. Additionally, the prosperity brought about by high revenues from the agricultural production provides these stakeholders abundant resources to further expand, intensify and influence the development of the region (P: high); (Cáceres, 2015; Mastrangelo et al., 2019; Wald, 2013). As the interests and vision around agricultural intensification as a development



approach align with those of the governments, demands and request for further land clearings or evictions of rural inhabitants are perceived as legitimate by many local actors. Evictions and the encroachment of the agricultural frontier into territory that has been occupied by rural communities for centuries, however, have led to the increasing social mobilization of peasant and indigenous communities as well as the involvement of various NGOs, supporting the claims of the rural people (L: middle); (Busscher, 2012; Flores Klarik, 2019; Tanner, 2003a; Wald, 2013, 2015).

### National Government

Generally, the national government supports the agricultural expansion as grain exports are one of the main sources for economic growth, and for example favorable export taxes clearly incentivize modern production for the global market. Prevailing degradation and deforestation are thus a seemingly accepted tradeoff for economic gain, as the issues remain to be inefficiently addressed under current regulations (Cáceres, 2015; Volante et al., 2016; Wald, 2013). This implies that the national government also experiences negative impacts of the current land-use situation, as the unsustainable land management conflicts with the increasing global scrutiny related to sustainable production as well as national sustainable development plans (I: middle gains). The implementation of the Forest Law in 2007 can be seen as a response to growing public concerns about land-use and degradation dynamics. While it is a significant effort by the national government to enforce environmental protection, representing their power to influence the regional context (P: high), the effectiveness and legitimacy of the law, and thereby the government, remains to be debated (L: middle); (Aguiar et al., 2018; Baumann et al., 2016; Seghezze et al., 2011; Torrella et al., 2018; Volante & Seghezze, 2018).

### Provincial Government

For provincial government officials there are clear intentions to increase modern agricultural production as it leads to an economic gain through investments in lands. Additionally, many officials have been reported to invest in and own land themselves (I: high gains). There is therefore a lack of will to prevent land-use activities within certain regions, as provincial governments are beneficiaries of the agricultural expansion. Consequently, there are varying conservation and agricultural production policies between provinces, which is also reflected in the differing ways of implementing the Forest Law (Busscher et al., 2018; Busscher, 2012;

Gabay & Alam, 2017; Gasparri, 2016; Mastrangelo et al., 2019; Seghezze et al., 2017). Provincial governments possess political authority, economic wealth, the ability to use force/threats of force as well as access to information, making them very powerful actors within the regional context (P: high). Combined with strong alliances to commercial farmers with high lobby power, national laws are implemented according to provincial priorities (Alcorn et al., 2010; Busscher et al., 2018; Mastrangelo & Aguiar, 2019; Volante et al., 2016). Although the provincial governments are responsible for the management of natural resources, their legitimacy has been widely questioned in existing literature as they have formed strong alliances with the private sector and are able to seize economic gain from increased agricultural production within their province (L: middle).

#### Local Government

In Argentina, each province is divided into departments and municipalities, which have local governments. These are organized by provincial governments, which both own and manage the local natural and financial resources. Local governments implement and enforce policies and regulations related to land-use as imposed by their provincial laws (Alcañiz & Gutierrez, 2020; Cedia & Zepharovich, 2017). They are relatively powerful actors as they can use their political authority and are ultimately responsible for monitoring and enforcing provincial laws (P: middle). Limited information in existing literature indicates that the legitimacy of local governments is ambiguous as rural communities have expressed high levels of distrust due to their involvement in forceful evictions, supporting the interests of provincial governments and commercial farmers (L: middle) (Flores Klarik, 2019; Lapegna, 2013; Wald, 2013, 2015). Therefore, it can be expected that local governments gain some benefits from the current land use patterns (I: middle gains).

#### NGOs

There are numerous social and environmental NGOs active within the region of the Argentine Chaco, promoting rural welfare and solving issues that endanger the natural conservation. They focus on varying issues such as land-tenure insecurity, poverty, environmental conservation as well as rural production and commercialization improvement (Alcorn et al., 2010; Busscher et al., 2020; Busscher, 2012; Cedia & Zepharovich, 2017; Gasparri, 2016; Huaranca et al., 2019; Seghezze et al., 2017; Wald, 2015). While the related experienced gains

or losses related to current land-use patterns are low (I: low losses/gains), NGOs have moderate levels of power and legitimacy within the regional context. They possess resources, access to information and the ability to gather public attention to local issues and injustices (P: middle). Their legitimacy is only contested by actors whose interest and development vision is not in line with the vision of the NGO, as they question and contest prevalent land-use management and marginalizing development approaches (L: middle); (Ceddia & Zepharovich, 2017; Gasparri, 2016; Huaranca et al., 2019; Recatalá Boix & Zinck, 2008a; Seghezze et al., 2017).

## Results

The results of the social analysis are presented in Table 7, providing an overview of each stakeholder group and their assigned values in regard to interest (I), power (P) and legitimacy (L).

Table 7: Overview of social analysis of stakeholder groups

Stakeholder group	Interest	Power	Legitimacy
Rural Communities	high losses	low	low
Commercial Farmers	high gains	high	middle
National Government	middle gains	high	middle
Provincial Government	high gains	high	middle
Local Government	middle gains	middle	middle
NGOs	low gains/losses	middle	middle

Based on their respective scores, the stakeholder groups were classified into three broader stakeholder categories: dominant, influential and marginalized; clearly reflecting the local power dynamics in the context of land-use in the Argentine Chaco.

**Dominant stakeholders** represent middle/high levels of all three factors and include provincial governments and commercial farmers, as well as the national government. All are direct beneficiaries of the agricultural expansion which requires intensive land-use, and combined they have the authority, resources and power to influence the regional situation to their benefit.

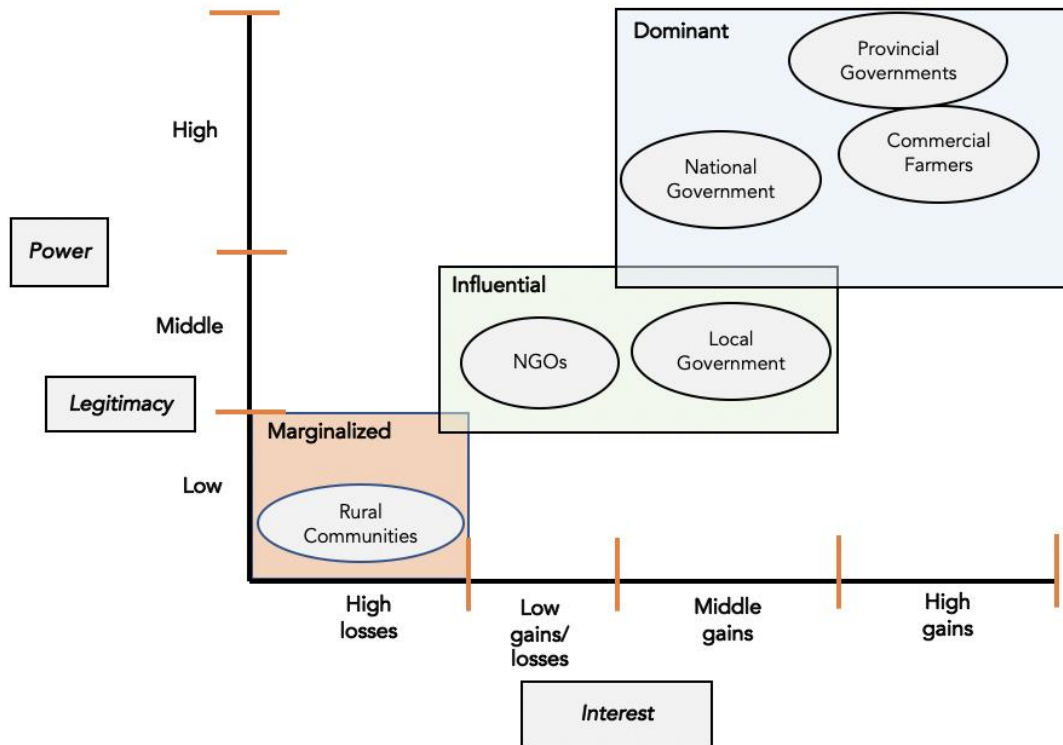
However, the national government is only related to middle gains as the prevailing degradation in the region represents a serious challenge for sustainable development.

**Influential stakeholders** have middle levels of both power and legitimacy and are related to low/middle interest. This category includes the local government and NGOs. The role of the local government is largely unexplored in existing literature; however, they have a political authority within the local context and enact laws and regulations as imposed by the provincial government. NGOs represent resourceful actors that collaborate with rural communities to improve their wellbeing and/or strive for a more sustainable resource use within the region by implementing various initiatives and projects and reporting on local developments and injustices.

**Marginalized stakeholders**, the rural communities, are very vulnerable and lack both power and legitimacy to influence the current situation which leads to detrimental livelihood impacts. Current land-use and degradation dynamics represent an immense threat to the livelihood strategies of indigenous and peasant households, which are widely perceived as inefficient land-use activities by other stakeholders.

In an attempt to illustrate these results, the framework below was developed to highlight local social relations and drastic power inequalities, which are further deepened based on unequal distributions of gains and losses related to land-use in the Argentine Chaco (Figure 8). On the x-axis, the interest values are represented in steps from high losses, to low gains/losses, to middle gains and lastly, high gains. The y-axis depicts both power and legitimacy, where the values of power are spread across the axis from low to middle to high, and legitimacy only covers low and middle values.

Figure 8: Stakeholder categories



## 4.2. Part I: Land-Use & Planning

This section presents the results for sub-questions one: *What are common land-use patterns of local actors?* and two: *How is land-use planning currently addressed?* Current land-use patterns are discussed and present a clear overview of the landscape in the region, which presents strong tendencies to experience continuous substantial land transformations and degradation. Both the federal government system of Argentina and the implemented land-use zoning by provincial governments are outlined, which then are reflected upon based on insights gathered from primary data sourced that shared their perceptions and opinions on land-use planning in the provinces of the Argentine Chaco.

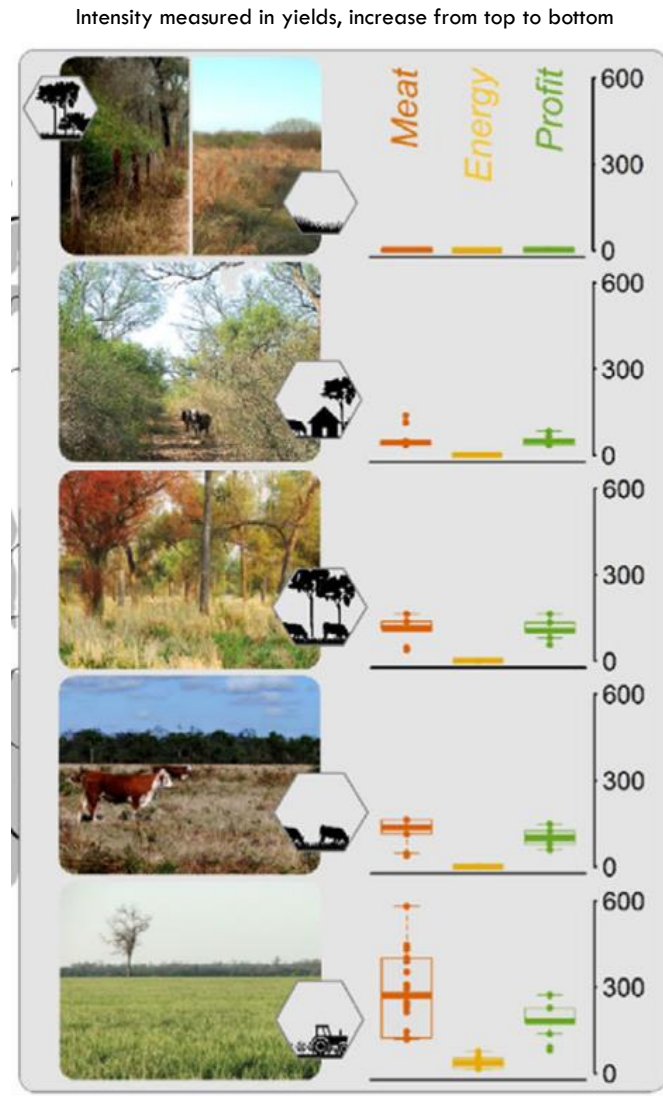
### 4.2.1. Land-Use

The current landscape in the Argentine Chaco is characterized by large variations in farm types, land-use intensities and related environmental consequences. To understand this heterogeneity of land-use systems, it is useful to consider the related land-use intensity as it strongly influences

the biodiversity tradeoffs. Depending on the relationship between biodiversity and agricultural intensity, the biodiversity adapts to the pressures of the agricultural intensification (Macchi et al., 2020; Mastrangelo et al., 2019). In their very recent study, Macchi et al. (2020) explored this relationships in the changing landscapes of the region and present five land systems along a land-use intensity gradient: from natural wood or grasslands without significant land-use, to subsistence farming, silvopastoral systems and implanted pastures to intensified cropping, as depicted in Figure 9. The respective agricultural intensities were measured using three metrics that describe the agricultural production and farmer's financial expectations: meat yield (kg/ha\*year), energy yield (GJ/ha\*year) and profit (USD/ha\*year).

The resulting gradient highlights the different yield values when agricultural production increased from natural to intermediate to highly intensified systems. After natural wood- and grasslands, which are scarce today, subsistence farming represents the land system with the lowest total intensity yields as it occurs largely inside woodlands. Silvopastoral systems combine crop and pasture production under remaining tree covers, while intensified pasturelands lead to tree cover loss just like intensified croplands which are cultivated for commodity production.

Figure 9: Land systems characterized by different agricultural intensity



The local land-use actors can be broadly categorized as commercial farmers and subsistence farmers. Commercial farmers implement both intensive crop and cattle production on average 10-time larger lands than local farmers (86.6 sq.km vs. 8.5 sq.km) to serve the global market and are related to intensive land-use and deforestation (Mastrangelo et al., 2019). The drastic differences in cultivated land size reflects the trend of land concentration in Argentina, where around 43% of the productive arable land is in the hands of only 1.3% of agricultural producers and subsistence production is increasingly marginalized through diminished access to land and natural resources (Wald, 2013). Agricultural intensification leads to immense pressures on the natural resources in the region, as indicated by Participant 5: ‘*Commercial Farmers intensify*

*production and increase the level of pressure on the ecosystem in only one direction and this leads to the homogenization of the environment, where there was native forest or natural grassland, there is now cleared land for crops or pastures.*’ This dynamic has also been observed by various other participants (7, 9, 11, 12), and Participant 1: *‘In most areas land-use changes transform rich biodiversity into simple ecosystems.’*

Subsistence farming is largely carried out by rural communities, concentrating their activities around a *puesto* systems, which consist of small homesteads, sheds for livestock, a watering source, minor local crop plots, and herds of livestock grazing freely. Additionally, some local households engage in wood extraction and charcoal production as well as hunting and gathering in the areas around their *puestos* (Gasparri, 2016; Macchi et al., 2013; Marinaro et al., 2015; Marinaro et al., 2017; Mastrangelo & Aguiar, 2019; Seghezzo et al., 2020). This was also outlined by various participants of this research, indicating that *‘the peasantry mainly uses the land for community production for self-sufficiency and for the local market, especially to supply meat.’* (Participant 6) and that rural households *‘carry out a mixed use of the land, generally including cattle ranching complemented with some agricultural or forestall activity.’* (Participant 5).

Agricultural modernization and expansion remain to be the dominant development approach, as described by Participant 2, *‘provinces rely on agricultural production and forestry to increase income, so they want to follow that path and expand the agricultural frontier’*. Therefore, provincial governments have little incentive to adopt land-use zoning plans that would efficiently control land degradation and deforestation yet inhibit the further expansion of the agricultural frontier (Nolte et al., 2017). More and more land in the Argentine Chaco is devoted to the cultivation of major commodity crops including soybean, corn, wheat and sorghum, as well as to livestock grazing on natural or planted pastures (Seghezzo et al., 2020).

#### *4.2.2. Land-Use Planning*

In Argentina, the federal government system combines both provincial and national regulations, where the national government steers the provincial government which has large autonomy in the implementation of imposed laws and policies. Natural resources such as soil, water and vegetation are under provincial jurisdiction, so provincial governments determine the related



regulations (Busscher et al., 2018; Busscher, 2012; Ceddia & Zepharovich, 2017; Mastrangelo et al., 2019; Nkonya et al., 2015). While they are guided by the national government, decisions concerning deforestation, land-use and natural resource management thereby are largely made autonomously (Alcorn et al., 2010; Volante et al., 2016).

Following the outlined land-use zoning policies (OTBN) in the Forest Law, the lands of each province have been categorized based on their conservation value. As indicated on the representative land-use zoning maps of each province in the study area (Figure 10-13), the majority of land is classified as green or yellow zones, where agricultural activities are allowed, and only contain few red zones, in which land clearing and deforestation is completely prohibited (RED Agroforestal Chaco Argentina, 2013). There exist many controversies resulting from inconsistent categorization of forest areas between provinces, power inequalities among the different

involved stakeholders, inefficient funding as well as the prioritization of agricultural potential over conservation value for categorization. Ultimately these debates lead to the questioning of the effectiveness of current zoning practices, as land degradation and deforestation continue, and profound land conflicts developed. The governments appear to not effectively enforce the Forest Law and there remain challenges to improve its performance in terms of effectiveness, equity and social legitimacy (Aguar et al., 2018; Baumann et al., 2016; Camba Sans et al., 2018; Seghezzo et al., 2011; Torrella et al., 2018; Volante & Seghezzo, 2018).

Figure 10: OTBN Salta

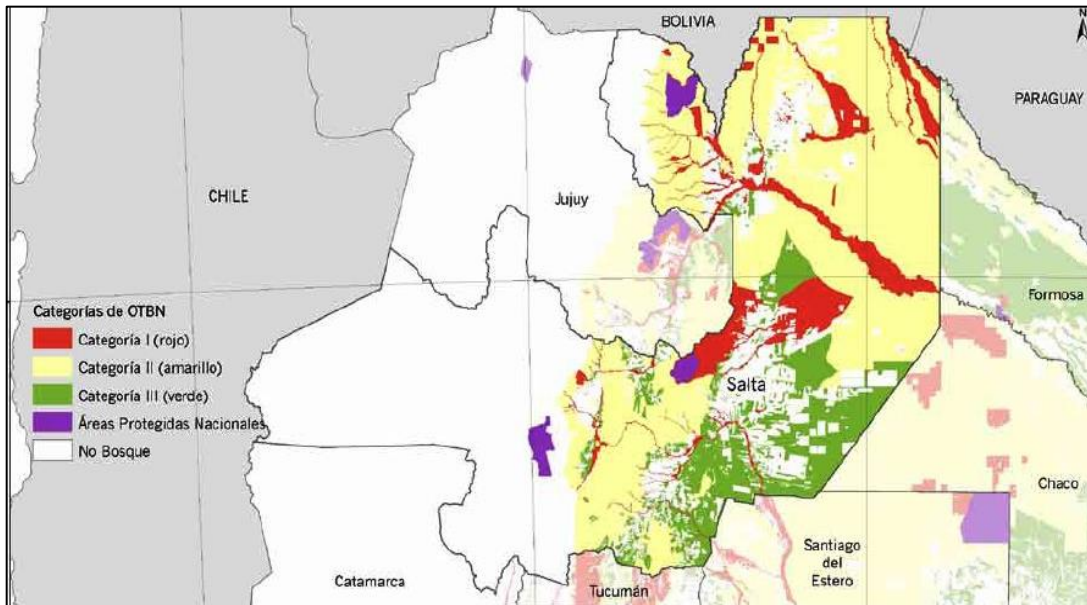


Figure 11: OTBN Chaco

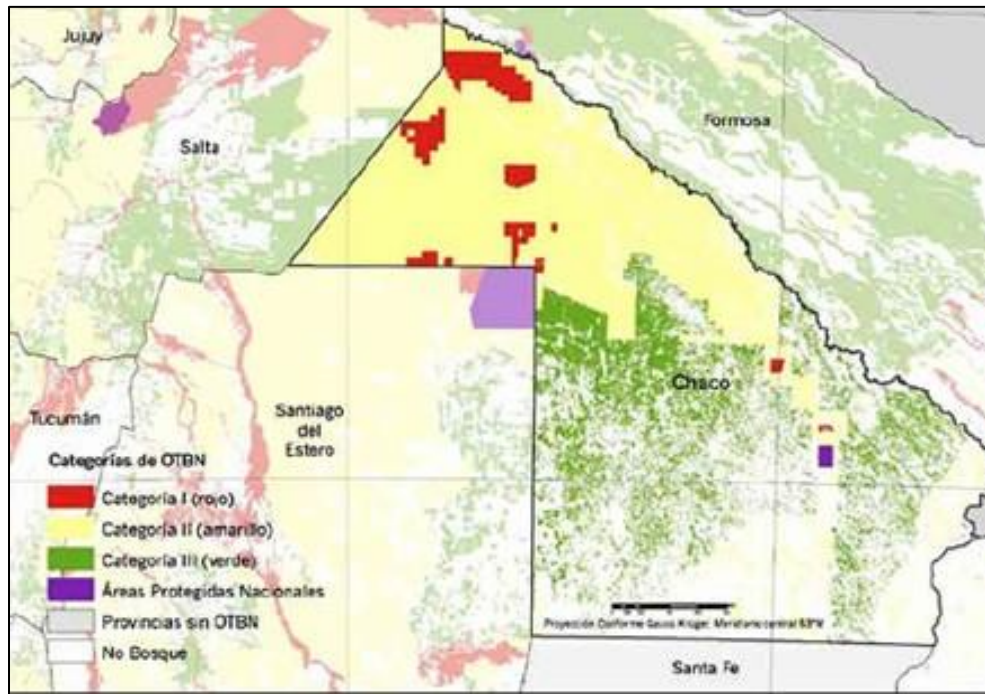


Figure 12: OTBN Formosa

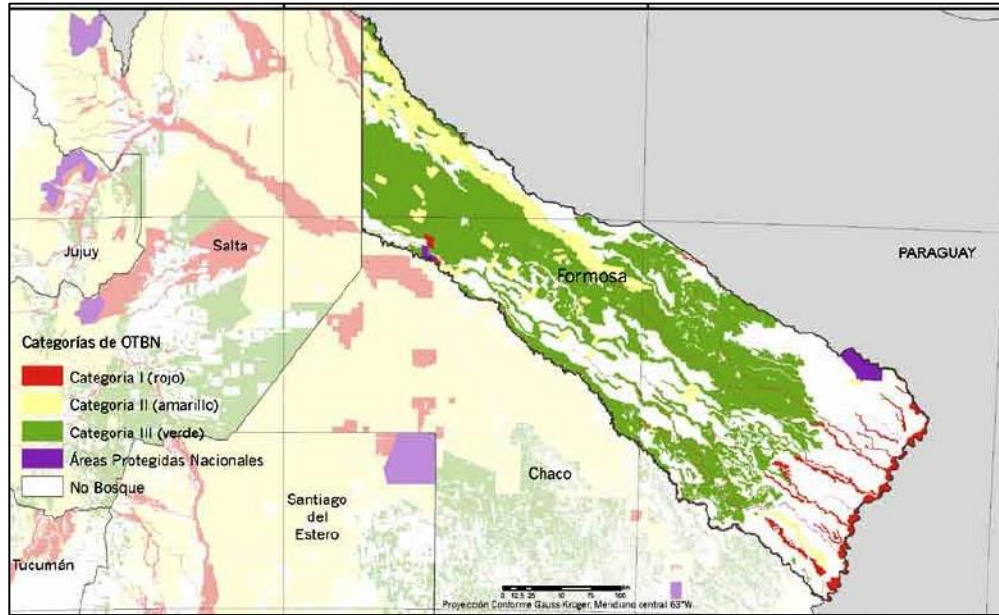
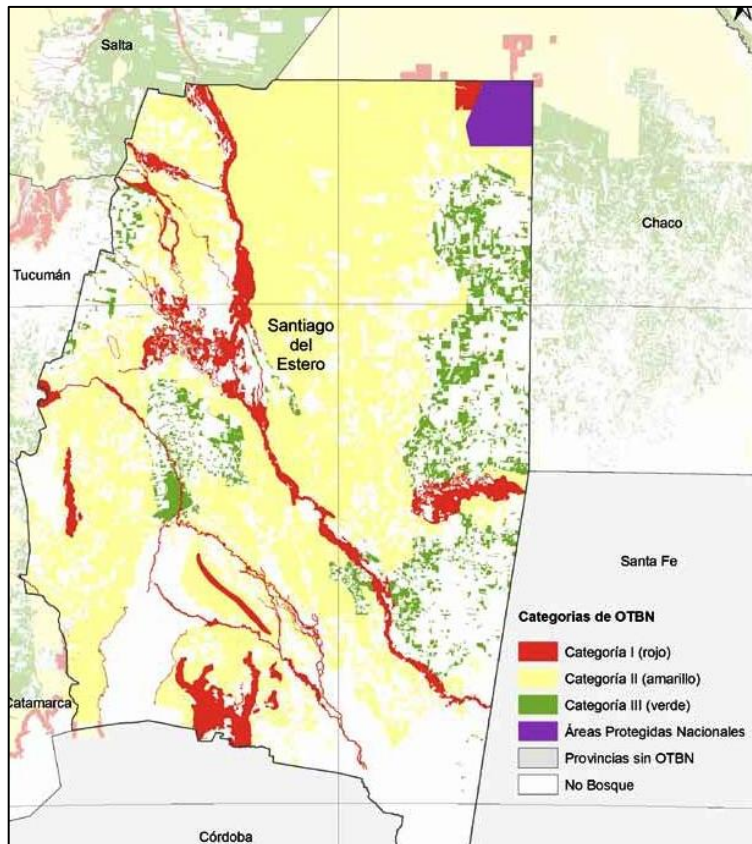


Figure 13: OTBN Santiago del Estero



### Local Perceptions

In an interview, a participant indicated that while the design of the Forest Law is ‘*relatively good*’, considering the regional context of agricultural expansion and intensification, the issues clearly lie in the implementation and enforcement (Participant 2). This view is supported by all participants (1-13), as well as existing studies that have focused on assessing the effectiveness of the Forest Law (Aguiar et al., 2018; Baumann et al., 2016; Camba Sans et al., 2018; Seghezze et al., 2011; Torrella et al., 2018; Volante & Seghezze, 2018). It was further highlighted that the context is complicated as the interest of the provinces is not well aligned with the national government- an implication that can also be drawn from the stakeholder analysis of this study and insights provided by other participants (Participant 1, 2, 11, 12, 13). Participant 2 explained that provinces want to develop and increase income, so they are incentivized to expand the agricultural frontier; the national interest, however, lies more on environmental regulation as the global population increasingly demands more care for the environment and less deforestation and fires.

Additionally to the differences between the national and provincial scale, another important challenge is related to the varying policies and visions between the provinces: ‘*Each province has its own policy, its own laws for forests and natural resources...it is a bit chaotic, and depending on which political parts is in power, there are different visions about development and the use of land. There is no over-reaching policy for the region.*’ (Participant 1). Therefore, the incentives at the different scales and levels are very different which leads to only limited desired outcomes originally intended by the Forest Law.

Another participant, representing the commercial farmers perspective, added that a big barrier related to the implementation and enforcement of the law is the lack of government capacity: ‘*There is a strong need to work on the involved processes, they need to be more efficient. Right now, if farmers want to produce, they have to present a lot of paperwork- which is good, but the process is very time-consuming and complex. This then often leads to illegal land activities, like clearings, because it can take up to 1-2 years to finish the legal process.*’ (Participant 3).

Besides, participants raised two essential issues related to the design of the current framework. One is the limited inclusion of rural communities in current land-use planning, as they rarely seize benefits but instead experience extensive losses (Participant 2,4,5,7,9,10). Land grabbing

and decreasing territories are perceived as a major issue, as described by Participant 2: *‘wealthy farmers grab and acquire land in the Chaco mostly through unclear processes, but close ties to the provincial governments who facilitate the access to land...which then often leads to the displacement of peasant farmers.’* and Participant 4: *‘forest inhabitants are not adequately informed or considered in the planning’*.

Additional concerns are based on the simplification of land-use systems in the Argentine Chaco, ignoring the diverse trajectories of degradation and subsequent varying conditions of land areas (Participant 1, 2, 3, 8, 11, 12). One participant therefore suggested two different sets of land-use strategies: one for lands that have already been cleared of native vegetation, and one for lands that still have remaining forest cover (Participant 2). Both contexts offer various opportunities to improve the local conditions of the land, either through restoration or adaptation of different agricultural practices; or through a more stringent and enforced regulation based on the Forest Law. This approach would also allow for the consideration of more locally specific environmental indicators related to soil and vegetation quality as well as the water balance and hydrological processes. From the farmers-perspective this would present opportunities to adapt their land-use activities and thereby increase biodiversity and address prevalent local degradation issues, which could be required by land-users: *‘What can be done once the soils are degraded? The land-users should present plans on how they plan to tackle this, by for example using multiple crops or combining crop- and pasture activities. There could be a timeline for land-use plans of farmers, which if designed well could also lead to local opportunities for work and contribute to more inclusive rural development, because if you change cropping patterns, more labor might be needed.’* (Participant 3).

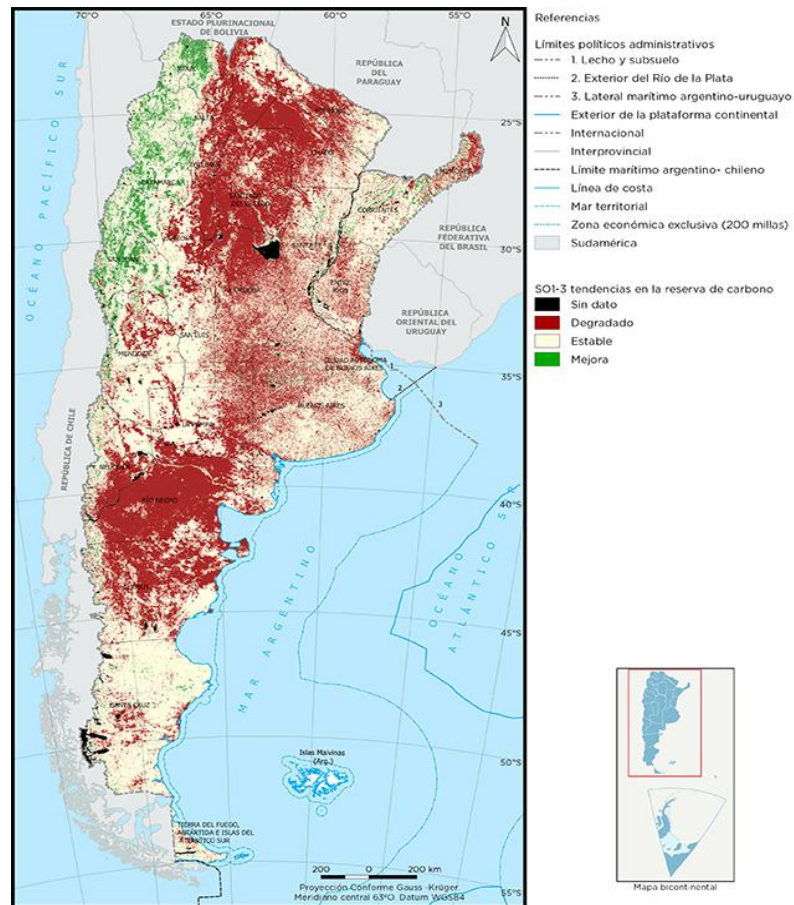
These suggestions are in line with the studies that addressed local degradation dynamics in the Argentine Chaco context, all suggesting to add additional specific indicators to measure the consequences of land-use, and to develop land-use alternatives that minimize or reverse the consequences of agricultural activities on the social and environmental dynamics in the region (Amdan et al., 2013; Giménez et al., 2016; Seghezzo et al., 2020; Villarino et al., 2017).



### 4.3. Part II: Land Degradation Types & Causes

This part presents information and results gathered for the third sub-question of this research: *Which types of land degradation can be observed?* and the fourth: *What prevalent causes influence the degradation dynamics?* In Argentina land degradation has been identified as a major challenge for sustainable development, threatening the productivity of the land, the functioning of ecosystems, as well as the wellbeing of rural communities (Aguiar et al., 2018; Bucher & Huszar, 1999; Busscher et al., 2018, 2020; Gasparri, 2016; Recatalá Boix & Zinck, 2008a; Seghezze et al., 2011; Torrella et al., 2018). As the map in Figure 14 indicates, large areas of land in Argentina are degrading, including the Argentine Chaco in the North, with only few improving lands towards the North West of the country. Therefore, it is no surprise that all participants from the local context were not only familiar with the concept of land degradation but also aware of ongoing processes in the region (Participant 1-13).

Figure 14: Proportion of degraded, stable and improving land in Argentina (SERNA, 2018)



Land degradation is highly perceptual and was defined in varying ways by the participants, reflecting their personal background and experiences. Participant 4 for example, indicated that land in this relation is a concept too productive to describe the phenomenon accurately: *‘I prefer to speak of territory. Territory is a land with history, it has a socio-political framework. The loss of territory has to do not only with the change of land-use, it has to do with the loss of biodiversity and especially the impossibility of social, cultural and spiritual reproduction of the groups that live in it.’* This definition puts a strong emphasis on the social consequences of land, or rather, territory degradation, while also including physical and biological relations, as conclusively summarized by Participant 5: *‘Land degradation means the loss of physical, biological and cultural diversity.’*

Participant 1 adds an additional focus on the environmental and political dimension as he highlights: *‘There are different steps in degradation: the first is when you destroy a portion of the natural environment and reduce the natural high biodiversity area, which here is widely perceived as development. But if you destroy the land, the soil is of course substantially degraded, which leads to the second step, disturbing the natural processes, which leads to the degradation processes we observe today.’* The perceptual definitions of land degradation by the participants reflect the complexity of the issue as well as its diverse consequences for socio-environmental systems in the Argentine Chaco.

#### *4.3.1. Types*

##### Soil degradation

Secondary data indicates that the soils of the Argentine Chaco are of marginal suitability for agricultural uses and therefore prone for rapid degradation, which was also widely discussed during the primary data collection. Land-clearings in the region are widely carried out using heavy bulldozers, the burning of remaining vegetation and lastly the plowing down of residues. These practices lead to immense changes in the soil through, for example, the increased surface exposure to precipitation, wind and solar radiation as well as aeration and temperature increases, resulting in a high soil vulnerability (Villarino et al., 2017). The loss of forest cover led to a diminished capacity of the ecosystems in the region to reduce wind or storms and thereby protect soils against erosion. Subsequently, processes of soil erosion have been observed as with increased wind, dust frequently reaches the urban areas surrounding modern agricultural frontiers

(Boletta et al., 2006; Fernández & Busso, 1999; Mastrangelo & Aguiar, 2019). As opposed to the soil in the Pampas region, an adjacent agricultural frontier with more fertile and deep soils, the soils in the Chaco *‘are not very deep, so by destroying the natural ecosystem they are embedded in, you destroy the factory that produces soil and also what protects the soil. In the semiarid climate, this is worse during dry periods with increasingly strong winds. It leads to soil erosion and this pattern is more or less the same in the whole region.’* (Participant 1).

This observation was supported by Participant 2 who had received recent reports from local farmers in the region about large dust storms of soil, which currently occur frequently, coinciding with the driest season of the year: *‘The agricultural frontier initiated a more rapid and invasive degradation; soil is left fallow for around 8 or 9 months a year and this practice is not suitable for the Argentine Chaco. Conditions during the dry season make the soils prone to erosion through wind and water.’*

Besides soil erosion, modern agricultural land-use can also be related to soil depletion, as the recent study by Villarino et al. (2017) clearly indicates that the soil organic carbon (SOC) stocks are critically affected by annual cropping patterns. The findings show that the total SOC stocks already change during the first year after deforestation, but then decrease substantially with increasing cropping time. This led to estimated losses after 40 years of continuous cropping, compared to native forest, at the top 5 cm of soil of around 61% of the SOC stocks. The drastic land-use change affects also the SOC stocks in deeper soil layers. Consequently, the soil quality and health are affected as the SOC influences nearly all soil properties related to the ecosystem functioning. A depletion thereof thus, does not only degrade the soil itself but also its functions that support wider ecosystem services for the society. This is especially relevant, because SOC is the main terrestrial carbon reservoir and the maintenance and restoration of its functions are essential to address the global environmental crisis (Villarino et al., 2017).

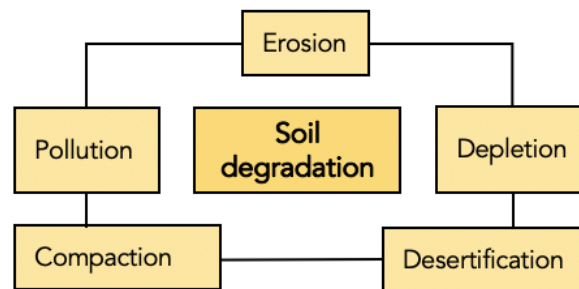
A further depletion of soil nutrients is related to the extensive use of pesticides, which can be described as soil pollution. Also adding to the soil vulnerability is the process of soil compaction, a critical threat to the soil quality, and mainly caused by either the use of heavy machinery or cattle trampling- both land-use activities related to agricultural production (Lapegna, 2013). This was also observed by Participant 5: *‘Soil degradation can be seen in many agricultural lands, like soil compaction, gullies and the increased use of fertilizers.’*, while Participant 2 explained



that ‘both agricultural technologies and pollution have a strong impact on the land quality and capacity of the ecosystems to provide services. This is already visible in many events that happened over the last 7 years, mainly droughts and floods. While some natural factors influence this, because the climate is highly fluctuating, this natural fluctuation has increased leading to changes in the local climate and changes in the capacity of soils to provide stability and other services.’

Overall these poor soil conditions have led to the onset of soil desertification process in various areas of the Argentine Chaco (APCD, n.d.; Boletta et al., 2006; Flores Klarik, 2019). This development is very critical, as it indicates increasingly extensive and damaging degradation processes: ‘There are growing levels of degradation and at the end you have desertification. The levels grow in exponential trends towards the carrying capacity.’ (Participant 1). In some areas soil degradation has already led to lower yields, but more areas are destined to experience the same once the land degradation dynamics have further progressed (Participant 2, Villarino et al., 2017).

Figure 15: Overview of prevalent soil degradation processes



### Vegetation and biodiversity degradation

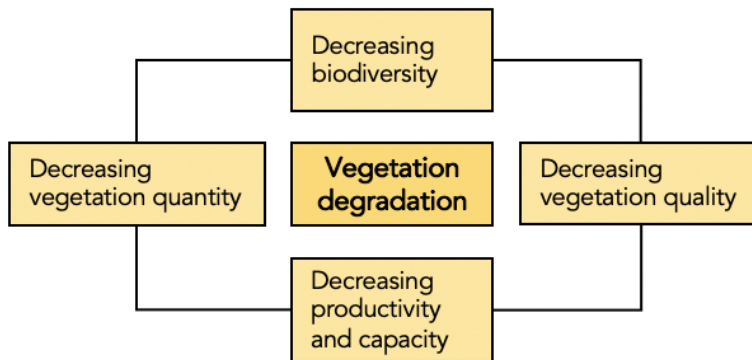
The extensive land-cover changes from native forest to agricultural land and its drastic consequences for the biodiversity and vegetation of the area have been widely discussed in existing studies of the Argentine Chaco as well as gathered primary data. Agricultural expansion and the implicit land clearing through deforestation has led to a widespread loss and fragmentation of natural vegetation and habitat over the last decades, representing a major threat

to biodiversity (APCD, n.d.; Boletta et al., 2006; Piquer-Rodríguez, Butsic, et al., 2018; The Nature Conservancy et al., 2005; Torrella et al., 2018).

Participant 1 summarized this trend: *‘In most areas land-use changes transform rich biodiversity areas into simple ecosystems. Now the region is totally divided with internally disturbed ecosystems and most protected areas are isolated, so remaining forest parts are fragmented and not connected.’* The few forest remnants today are, under current land-use change trends, of only limited value for the conservation of biodiversity, especially considering the negative environmental effects related to agricultural activities, such as the widespread use of agrochemicals, which can cause abrupt reductions in biodiversity (Gasparri & Grau, 2009; Mastrangelo & Aguiar, 2019). The habitat loss and fragmentation negatively affects the native flora and fauna even far from cleared lands, which can have consequences for the conservation for not only the Gran Chaco as a whole, but also the adjacent Yungas ecoregion (Camba Sans et al., 2018; Mastrangelo & Aguiar, 2019). In the Argentine Chaco, the expansive land-use changes have already led to a loss of avian diversity as well as predators such as the jaguar and puma, and other smaller mammals (Camba Sans et al., 2018).

These vegetation degradation trends in the region are critical and lead to the extensive loss of original high biodiversity across the region, making conservation efforts very urgent yet in the current regional context seemingly impossible. This is due to the high diversity of ecosystems that characterize the Argentine Chaco, as highlighted by Participant 1: *‘Each natural region, each portion of Chaco, is unique. So, conservation is only effective in that specific area, for that specific biodiversity. It does not represent the biodiversity in other areas of other provinces.’*, as well as due to the prevailing development narrative based on agricultural expansion and intensification: *‘The coming years will be very difficult because of the need to reactivate the economy after the pandemic. Our main resource is land, so most decisions will be oriented towards increasing agricultural production through intensification and expansion, so most of the progress that was made in the last 10 years in forest growth will be probably lost if the government thinks that is the only way of reactivating the economy...’* (Participant 2).

Figure 16: Overview of prevalent vegetation degradation processes

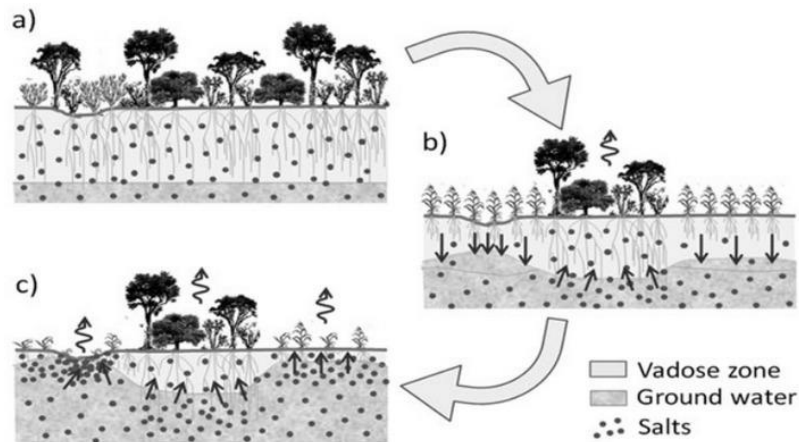


### Water-resource degradation

Two recent studies by Amdan et al. (2013) and Giménez et al. (2016) provide evidence that the semiarid Argentine Chaco presents various conditions that make the region prone for dryland salinity and indicate that in some areas, processes of salinization have already begun. The hazard of dryland salinity is increased by the extremely flat topography of the region, its high stocks of salt in the soil profile as well as the high variability in annual rainfall. Both studies set out to assess how the massive replacement of native forests with annual crops or pastures has altered the hydrological conditions of these lands. In other semiarid regions around the world, similar extensive land-cover changes strongly disrupted the regional water balances and progressively led to salinization processes, which are almost irreversible once initiated.

This phenomenon is known as dryland salinity: by clearing lands that were originally covered by native, deep-rooted forest and replacing it with crops that have shallower root systems and more seasonal lifecycles, the soil water storage and consumption patterns are altered. Thereby the deep drainage rates are increased, which leads to ground-water recharge and a general rise of the water table levels. Drainage causes the leaching of high amounts of salts, which are naturally stored in the vadose zone of the soil, and gradually moves them with the rising water table towards the soil surface. Once the salt reaches the surface through evaporation and root uptake, not only crops and pastures are affected but also the remaining native vegetation (Figure 17; Giménez et al., 2016).

Figure 17: Conceptual scheme of the dryland salinity process



The study by Giménez et al. (2016) focused on a main agricultural cluster in the province of Santiago del Estero, where the dry forest remnants only represent less than 20% of the area and the dominant crop cultivated is the soybean, covering 60-70% of the crop area, followed by maize, sorghum, cotton, sunflower and wheat. Presented results based on deep soil profiles, geoelectric surveys and monitoring of groundwater salinity, level and isotopic composition, clearly indicate that the conversion of native forests to agricultural lands has increased the deep drainage rates and triggered groundwater recharge processes. While these are the immediate effects of the land-use change, the more severe hydrologic consequences typically take a longer time to become evident. Until the time of the study, the groundwater table has been deep enough within the study area to not yet affect the crop growth and performance, which is why most local farmers remain unaware of the salinity hazard. However, as the rise of saline water tables is progressing, more visible effects of dryland salinity are expected to become evident, which can include waterlogging and surface salt precipitation.

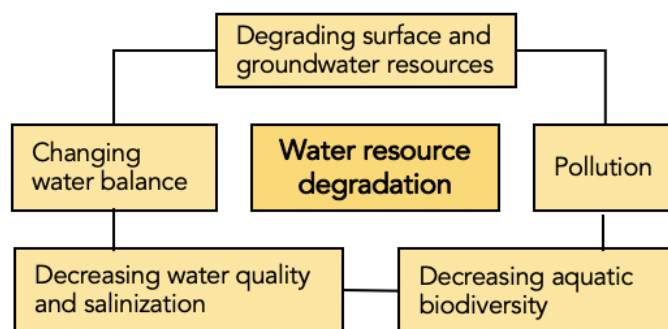
Given the similar environmental, land-use and development attributes of the four provinces in the Argentine Chaco, the observed development of dryland salinity in an area in Santiago del Estero, a rather advanced agricultural frontier, is likely to take place in other areas of the region as well. The study by Amdan et al. (2013) provides insights and evidence from the East of the Salta province, indicating the same critical changes in the hydrological balance and salt transport. They further highlight that the consequences of these processes could affect the level of provision of regulation ecosystem services, threaten the regeneration of the native forest and eventually jeopardize the sustainability of agricultural production within the region.

The prevailing annual crop production in the mostly marginal lands in the Argentine Chaco, appears to drastically impact the hydrological balance of the ecohydrological sensitive region, where already a small change in climate, soil or vegetation may significantly alter the water balance leading to often irreversible consequences. Besides impacting the water balance, the water quality is widely affected through contamination by the use of pesticides for modern agricultural production. Various existing studies based in the Argentine Chaco indicate not only the contamination of water streams, but also the already experienced consequences through health risks for local populations (Flores Klarik, 2019; Lapegna, 2013; Wald, 2015). This was also highlighted by various participants, including Participants 4, 7, 10, 12 and 5: *‘The use of agrochemicals is the main cause of contamination not only of rivers but also of groundwater, water extraction wells and surface reservoirs for animal consumption, but also of rainwater reservoirs for human consumption.’*

Furthermore, the region has experienced recurrent floods in Eastern parts of the Argentine Chaco, and desertification processes in the Western parts, indicating water resource degradation through changes in the water regime (APCD, n.d.; Wald, 2015). As Participant 3 explains: *‘In the last few years some areas experienced floods due to a higher frequency and amount of extreme rain fall. Combined with soil compaction, this leads to run-off due to limited water infiltration, which would be provided by the natural vegetation, but not by degraded lands.’*

The aquatic ecosystems have lost mainly all of their original biodiversity and are under equally strong pressures as the terrestrial ones (Participant 1). From the farmers-perspective it is already an issue to find sufficient water supply for crops in the semiarid region, but this issue will only further increase with increasingly changing water balances and triggered salinization processes (Participant 3; Amdan et al., 2013; Giménez et al., 2016).

Figure 18: Overview of prevalent water resource degradation processes



### 4.3.2. Causes

Identified causes for land degradation in the Argentine Chaco have been divided into two broader categories: driving forces, which are indirect factors that influence the degradation dynamics and the direct pressures, which represent the second category and are further divided into natural and human factors. One main driving forces of land degradation in the region, identified by all participants and numerous existing studies, are the environmental preconditions which define the semiarid climate: relatively high temperatures, high varieties in rainfall and high sensitivity to changes or perturbations (Amdan et al., 2013; APCD, n.d.; Giménez et al., 2016; Villarino et al., 2017). Despite all these conditions and related challenges for agricultural production, its expansion continues into the marginal lands which are prone for degradation under current land-use activities, as explained by Participant 3: *‘The agricultural production and management in the region often lead to soil degradation, because of the high temperatures. Plowing, for example, can lead to the loss of organic matter in these conditions because the soil becomes more exposed to radiation. But in the last years, there was also a higher frequency of extreme rain fall, which lead to floods due to soil compaction that prevented water infiltration and created run-off.’*

As critically highlighted by Participant 1, 2, 11 and 13 prevailing land degradation within the Argentine Chaco can only be understood considering the global context of exports and imports, which makes land degradation to not only a problem of provincial and national policies but also policies of importing countries- the ‘demanding’ side of agricultural production: *‘Any kind of degradation is produced based on a complex system influenced by different levels and scales, also including countries outside the region. You cannot explain how this region is transformed into a less sustainable version solely by focusing on those things happening inside the country, this is a complex system involving local, national and international actors.’* (Participant 1); *‘The production is driven by importing countries, so until these and consumers elsewhere become more aware of the impacts of agricultural expansion in producing countries, until that happens it will be very difficult to address degradation.’* (Participant 2). This adds the underlying influence of global market prices in the context of low land prices and a land tenure regime, which strongly favors agricultural expansion over any other land-use. Combined with inadequate governance, which is perceived to be due to misaligned interests and visions of the national and provincial governments, these underlying forces impact the direct pressures on land degradation.

All participants agreed on the major importance of deforestation and land transformations in the trajectory of degradation within the region, followed by the intense land-use in modern agricultural production systems that are not suitable for the local context: *‘The main cause is deforestation or change in land-use. Then the pressure on natural assets to generate food production with highly intensified systems that are not appropriate for the semi-arid region.’* (Participant 5). Mono-cropping and annual cropping patterns were highlighted as big challenges as both trends have extensive consequences for biodiversity and land degradation dynamics: *‘The mono-cultivation of soybeans and other transgenic plantations generate the degradation of soil.’* (Participant 6); *‘There are places where farmers have grown soybean and maize for over 16 years, it would be better to at least increase crop rotations and some service crops to prevent erosion during fallow periods.’* (Participant 2); *‘Mono-cropping and the change in the root structures in the soil are a huge issue, the soil becomes very exposed.’* (Participant 3).

To enable cultivation in the marginal lands of the Argentine Chaco, technological inputs are required which include the widespread use of pesticides: *‘The transgenic monoculture uses many poisons...many agro-chemicals.’* (Participant 6), representing another direct pressure on land degradation dynamics. Participant 2 adds that while the agricultural frontier and the related commodity production initiated a more rapid and extensive degradation, *‘initially the degradation started with the overgrazing by cattle held by local communities that settled on the lands decades ago.’*

All these pressures can be characterized as anthropogenic, as they are related to land-use activities. Unsustainable land-use practices can exacerbate the negative environmental consequences of land transformation as well as of natural fluctuations. Increased rainfall is likely due to the climate change, yet the consequences and associated risks of flooding are more severe due to prevalent poor land conditions (Participant 2 & 3; Seghezze et al., 2020). This is the same for consequences of rising temperatures that, due to the vegetation cover loss and impoverishment of soils, can substantially contribute to soil degradation and desertification processes (Participant 2 & 3; APCD, n.d.; Villarino et al., 2017).

Thus, the land in the Argentine Chaco, and its degradation dynamics, have been identified to be indirectly influenced by the environmental preconditions, the trend of agricultural expansion, global market prices, land prices and land tenure regime, as well as marginalization, local power

inequalities and inadequate governance. These underlying driving forces have been related to the following direct, human pressures: exploitation of resources, land-use transformation, land-use intensity, monocropping and pollution. It is also likely that they influence the identified direct natural pressures, including rising temperatures and more frequent rainfall which result in droughts and floods in some areas of the region.



#### 4.4. Part III: Rural Livelihoods

This chapter presents the gathered results for the sub-question five: *How do rural communities maintain their livelihoods?* and six: *How do current land-use and degradation dynamics affect rural livelihoods?* Focusing on rural communities, two main groups need to be distinguished: peasant communities (*campesinos*) and indigenous communities. While both groups follow similar activities to maintain their livelihoods and well-being, they differ in cultural and social ways; indigenous communities for example, represent various languages and distinct cultural and spiritual practices, and have specific laws and regulations that protect their rights and territory (Ceddia & Zepharovich, 2017; Gabay & Alam, 2017; Seghezzo et al., 2017).

Traditionally, rural livelihoods in the Argentine Chaco were heavily based on agricultural and forest activities, depending on both access to and availability of natural resources, which were governed by territorial communal use. Today, productive land continues to be essential for the continuation of livelihood activities, such as subsistence farming and livestock grazing, and the reproduction of social, cultural and spiritual practices (Bucher & Huszar, 1999; Gasparri, 2016; Marinaro et al., 2015; Marinaro et al., 2017; Seghezzo et al., 2011). Participant 5 described the subsistence production of peasant and indigenous families in Santiago del Estero: *‘For livestock, it includes raising cows, sheep, goats, pigs and chickens. For crops, the cultivation of corn, squash and cucurbits mainly. And for forestry, the extraction of wood as well as the production of mixed charcoal.’*, Participant 4 indicates that in Formosa, indigenous people *‘are small producers with herds of cattle (50 heads) and smaller livestock (around 150 heads).’*

Considering the decreasing territories of rural communities, the remaining lands and natural resources that they have access to become increasingly critical for the maintenance of livelihoods, as they require the subsistence production and potential income of sold produce in local markets: *‘It is critical, especially in areas where the environment offers salty lands, highly degraded forests, or high advance of the agricultural frontier, where the territory available for production has been greatly reduced.’* (Participant 5).

In a recent study in the region, Flores Klarik (2019) concludes that rural communities nowadays face only two alternatives for subsistence strategies: they either resist the agricultural expansion and stay on lands with less and less available and accessible resources, or they migrate to urban areas, often facing conditions of exclusion and extreme poverty. Both are livelihood strategies

in response to the declining opportunities related to farm activities in rural areas. Over the last years nonfarm activities (wage labor) have become an increasingly important income source for rural communities in the Argentine Chaco. Combined with remittances from family members that migrated and welfare resources by the state, these income sources form the basis of many rural livelihood strategies today (Flores Klarik, 2019; Matthias & Wilde, 2010; Tanner, 2003b; Wald, 2013, 2015). This was supported by Participant 4: *‘Indigenous people, apart from what the forest provides them- which is scarce for the amount of people- have high support from state subsidies for their livelihoods. The same thing happens to small producers.’*, and Participant 5: *‘There is a great diversity in families in different areas and productive strategies vary. The livelihood comes from the production in the territory and the sale of meat, grains, fruits and wood. And a percentage comes from state subsidies, in some poorer communities this subsidy reaches more than 50% of income, and in others it is less than 10%.’*

The regional context of extensive agricultural expansion led to significant changes in the local environment and livelihood context of rural communities; the impacts on rural livelihoods can thus be seen as the social consequences of both the dominant development discourse based on agricultural intensification, and the related land-use activities and degradation. Under the traditional production systems of rural farmers, the land has been and continues to be degraded to varying degrees, however it is not transformed into agricultural lands, which marks the onset of more extensive degradation dynamics: *‘Their activities reduced the natural production of the forest, but it was a slow degradation process that has drastically increased with the agricultural frontier and commodity production.’* (Participant 2).

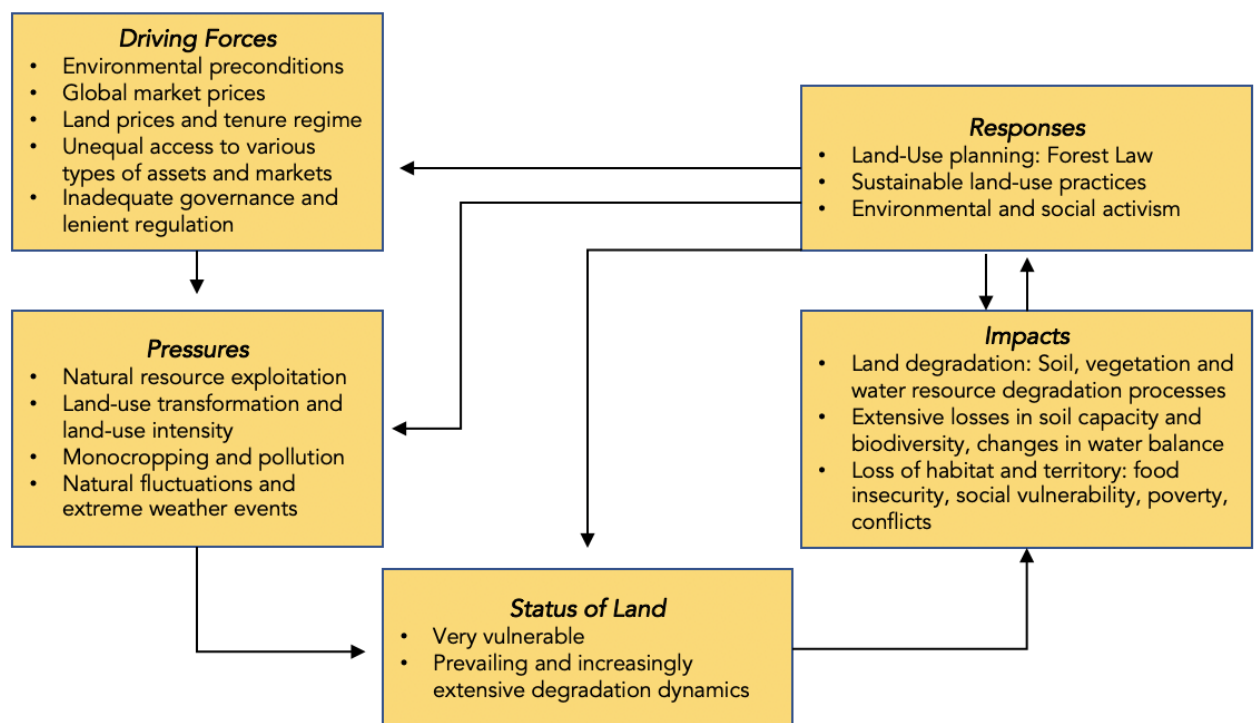
The agricultural frontier and its highly politicized environment in the Argentine Chaco are characterized by immense local power inequalities, numerous land conflicts and dramatic consequences for the territories of rural communities. These include the reduction in availability of natural resources as well as the trend of land grabbing and privatization. These trends limit the local communities’ access to natural resources and subsequently, their production possibilities. Rural communities thus, face further impoverishment through the disruption of their traditional livelihoods, degradation of available natural resources, forced migration and the reduction of their territory (Alcorn et al., 2010; Flores Klarik, 2019; Wald, 2015). This was also outlined by Participant 5: *‘The communities are affected mainly in the areas close to agricultural lands,*

*the used agrochemicals exceed these lands and enter their territories. Affecting the production of indigenous-peasant agriculture, the native forest and even the animals. But the health of families, this is the main threat.*' In the light of these critical trends that threaten rural livelihoods and health, communities face various challenges to maintain their well-being and cultural heritage, as highlighted by Participant 4: *'The critical challenges are the advance on their lands and resources, and the loss of autonomy.'*, Participant 5: *'The main challenge is to maintain the culture of community work, compared to the proposal of individual management of territory. Also, a threat is the impact of agrochemicals dumped into the environment by modern farmers.'* and Participant 6: *'The challenge for us is to continue to strengthen our unity and to denounce the consequences of agribusiness...to continue fighting for food sovereignty and a comprehensive agrarian reform to generate a return to the countryside. (We need to) generate structural and profound changes that are required in society so that we are respected and recognized as political, economic and social subjects.'* These statements were backed by other participants (Participant 7, 10, 12) and existing literature (Tanner, 2003b, 2003a; Wald, 2013, 2015).

## 4.5. Summary of results

To provide a comprehensive overview of the results and their indications for the regional land degradation dynamics, a framework based on the DPSIR framework has been developed. Thereby, the gathered results have been related, clearly indicating how the diverse factors and processes affect each other.

Figure 19: DPSIR framework of land degradation in the Argentine Chaco



## 5. Conclusion

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*In this chapter, the fulfilment of the purpose of this research is discussed and a brief summary of the findings is provided. Thereby, the answer to the main research-question is presented.*

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The purpose of this thesis has been fulfilled by presenting a framework that describes relevant factors and their role in land degradation dynamics in the Argentine Chaco (see Figure 19). This framework was based on the DPSIR framework and the result of the integrated analysis of gathered primary and secondary data for this research. It facilitates the understanding of prevalent land-degradation dynamics in a complex, ever-changing regional context that is influenced by local, national and international factors and thereby contributes to a more comprehensive understanding, combining insights from science, policy and society.

The framework also illustrates the answer to the research question: *What are the current dynamics of land-use and degradation in the Argentine Chaco, and how are they embedded in the regional context?*

To make sense of the current regional context of land-use and degradation, the development trajectory has been outlined to provide relevant insights on the local institutions, social relations and development discourse. The current dynamics of land-use are described based on the related land-use intensities to different levels of agricultural production and the prevalent land-use activities of commercial and subsistence farmers. Generally, the Argentine Chaco contains five broader land-use systems along a land-use intensity gradient: 1) natural wood or grasslands without significant land-use, 2) subsistence farming, 3) silvopastoral systems, 4) implanted pastures and 5) intensified cropping. Commercial farmers are related to intensified cultivation of crop and cattle which comes along with extensive land transformations through deforestation and fires, leading to devastating consequences for the environment. Subsistence farmers mainly follow small scale production activities including crop cultivation, livestock grazing and wood extraction, which represents a land-use system of low land-use intensity and limited subsequent environmental consequences. Considering these land-use patterns in the context of land-use planning within the region, which has been found to not be efficient to limit degradation or deforestation in the provinces of the study area, there are various implications that the Argentine Chaco will experience continuous extensive land transformations in the near future.

These concerns are based on the perceived inefficient enforcement and control of the Forest Law and related to two critical design dimensions: 1) the limited inclusion of rural communities in land-use planning, neglecting their interests and endangering their territories, and 2) the simplification of the landscapes in the region, neglecting the monitoring of critical variables related to diverse soil, water and vegetation dynamics to prevent further degradation. This is strongly related to the unsuitability of modern agricultural activities in the semiarid climate of the region, which makes it prone for degradation under prevalent land-use patterns.

In the context of the Argentine Chaco, land degradation needs to be considered in regard to its environmental dimension, which includes soil, vegetation and water resource degradation processes, as well as the social dimension which is related to territory degradation and increasingly vulnerably rural livelihoods. Current environmental degradation dynamics lead to substantial changes in the functioning of ecosystems, affecting biodiversity as well as soil and water quality, and subsequently cause their diminished capacity to provide essential ecosystem services. As critically highlighted in the very recent study by Barral et al. on the '*widespread and major losses in multiple ecosystem services as a result of agricultural expansion in the Argentine Chaco*' (2020), the widespread and drastic declines in ecosystem functions and services across the region are due to tradeoffs between agricultural production and ecosystem services. Combined the regional degradation processes result in limited provision of services related to climate and flood regulation, such as rainfall retention and erosion control, and thereby agricultural suitability. The agricultural expansion endangers the long-term sustainability of the region, with more and more evidence and implications for increasingly extensive degradation dynamics. Territory degradation dynamics happen simultaneously, as the changes in the access to and the availability of natural resources directly impacts the livelihoods of rural communities. These face increased impoverishment through the disruption of their livelihoods, the extensive reduction of their territories and the increasing degradation of land. Within the regional context, rural people have been historically, and remain to be, in a marginalized and vulnerable position, exposed to '*very rapid and widespread changes in ecological and social dimensions of rural areas.*' (Participant 2).

## 6. Discussion

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*This chapter discusses the contributions of this research in terms of implications, as well as the limitations and suggestions for future research.*

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### 6.1. Implications

This thesis contributes to the existing literature about land-use and degradation in the Argentine Chaco by presenting a clear overview of the interlinked dynamics and processes that are prevalent today, as illustrated in the developed DPSIR framework (Figure 19). It contributes to the research front of the topic; land degradation in semiarid agricultural frontiers, by assessing the issue in the context of the Argentine Chaco and integrating vast information related to both environmental and social factors that affect the regional degradation dynamics.

Such comprehensive and integrated approach to the topic was previously lacking; thereby this research deepens the understanding of the complex social-environmental context surrounding land in the region. The developed framework combined with the results, present both theoretical and practical implications that are discussed below.

#### *6.1.1. Theoretical Implications*

This research contributes to the debate surrounding the applicability of EM narratives to regions such as the Argentine Chaco, as they are criticized for neglecting the specific regional context and prevalent, interlinked processes that lead to environmental change (Mastrangelo & Aguiar, 2019; Matteucci et al., 2016). As outlined by Mastrangelo & Aguiar (2019) and Matteucci et al. (2016), the dominant development based on agricultural intensification and land-use planning based on land-sparing, does not lead to the outcomes that are expected based on the underlying theories and assumptions. This is also reflected in the results of this study, as both the environment and territories of rural communities are degrading, and the current land-use planning is perceived as inefficient considering the regional context. Therefore, to adequately steer sustainable land management it is suggested to move away from EM narratives to address socio-environmental issues, and instead, to develop an alternative narrative that is adequate for the regional context and based on local realities.

This narrative, as highlighted by Rudel & Meyfroidt (2014), needs to take into account that there are two increasingly important elements in rural land-use planning: first, the emergence of

trans-scalar land-use planning and second, the discourse surrounding ‘trade-offs’ in discussions about land-use. Trans-scalar land-use planning refers to a process that incorporates not only the views of actors that live in and around the land areas, but also of the ones living far away. This indicates an increasing influence of global forces as well as the strengthening of local ones, whereas the latter can only be observed to a limited degree in the context of the Argentine Chaco. The stakeholder groups with global interests on the other hand, clearly play an increasingly powerful role in the regional land-use planning. Without the strengthening of local forces however, this trend towards trans-scalar land-use planning takes a critical direction, as it directly influences decisions surrounding trade-offs that come along with different land-use activities. As highlighted in this study, every land-use decision in the region leads to widely extensive trade-offs, mainly to the benefit of agricultural production and at the cost of biodiversity and rural communities. Considering these developments, both the trans-scalar dimension and the decision-making surrounding trade-offs related to rural land-use planning, are two important factors to consider for the design and implementation of policies, but also for theoretical approaches to understand or explain processes and structures that define rural land-use planning, as well as to identify potential injustice issues.

Lastly, in line with Amdan et al. (2013) and Giménez et al. (2016), this research’s findings clearly indicate that this region is following a similar degradation trajectory as other semiarid ecoregions, for example areas in Australia and the Paraguayan Chaco, that have experienced extensive land-use transformations. This opens up a new dimension for the transferability of findings in this type of region. For example, the partly irreversible outcomes in other regions around the world that followed a similar trajectory as the Argentine Chaco, can serve as a lesson for this region, which is still considered to be in the beginning of its land-use development. Likewise, the findings of this research might provide insights that can be transferred to other, similar regional contexts. This implies that a higher generalization of findings of relevant research in semiarid ecoregions with expanding agricultural frontiers, could potentially lead to valuable implications for the development of frameworks or theories that aim to support and guide local decision-makers.



### *6.1.2. Practical Implications*

Land degradation remains to be a critical challenge in the Argentine Chaco, that until now could only be partially controlled and addressed through the existing land-use planning, which is mainly based on land-use zoning. Prevailing land-use and transformation trends suggest that more effective enforcement of the existing framework, as well as additional measures, are urgently required to limit the rapid degradation of lands and territories in the region. Numerous researchers came to the conclusion that land-use planning needs to be more locally specific to be able to determine land-uses that do not diminish the natural ecosystems and their capacities to provide essential services for society.

The Argentine Chaco is characterized by a complex mosaic of land-use systems and remaining native forest patches, each exposed to the consequences of varying degrees of land-use intensity. Therefore, the land degradation dynamics are influenced in different temporal scales across the region, with some areas already indicating critical processes that will sooner or later lead to changes in the ecosystem that might be irreversible if not addressed adequately. While this does not only threaten the conservation chances of the Argentine Chaco ecoregion, it also threatens the sustainability of any agricultural production in the region. Rural livelihoods are endangered, as communities are increasingly displaced to marginal lands with limited natural resources and often face extreme poverty due to limited subsistence production possibilities or alternative income opportunities. The region thus represents two major challenges for sustainable development and land-use planning, first the increasingly degrading and sensitive ecosystems, and second, the impoverished rural communities that progressively grow dependent on state subsidies.

The Forest Law is a great step in the right direction but considering the already substantial environmental damages in the region, land-use planning decisions need to consider additional data related to the soil quality, the water balance and biodiversity changes. These three categories broadly represent the specific suggestions made by other researchers, which provide detailed recommendations on useful indicators and tools to improve land-use planning (Amdan et al., 2013; Bajocco et al., 2012; Barral et al., 2020; Giménez et al., 2016; Macchi et al., 2020; Seghezzi et al., 2020; Vallejos et al., 2020; Villarino et al., 2017). In the light of continuous rapid land transformations and extensive degradation, a new critical task is to determine the point

of time at which the ecosystems collapse and cease to provide essential functions and services. Some researchers have already set focus on assessing the consequences of land-use in the Argentine Chaco on the functioning and capacity of ecosystems, and indicated critical, decreasing trends (Barral et al., 2020). As stated by Participant 2: *'For some reason the negative feedback is not working yet, we are pushing the system to its limits and through some thresholds, but it is not reacting yet. Now the task is to anticipate when that point is.'* By determining this point and monitoring changes in the ecosystems, adequate actions and measures can be designed and developed to prevent likely irreversible changes and dramatic losses.

If land-use activities are adapted to the land tract specific conditions, degradation dynamics can be mitigated and someday prevented. However, in order to prevent the further deterioration of rural livelihoods, additional measures are required that directly address the environmental and cultural challenges that rural people face. As highlighted in the stakeholder analysis of this study, rural communities are in a marginalized position within the regional context and are threatened by the degradation of their territories but also by increasingly diminished livelihoods.

Considering the drastic local power inequalities, the role of the influential stakeholders, both the local government and NGOs, is to bridge the gap between the interests and visions of marginalized rural communities and the dominant stakeholders, which include the commercial farmers, the provincial governments and the national government. This can be done through the enforcement of the Forest Law, through enhanced control and monitoring, or by creating dialogues between involved stakeholders to negotiate trade-offs related to land-use in a more inclusive way, leading to a more balanced distribution of gains and losses. Additionally, further initiatives and projects can be developed which tackle local issues that remain insufficiently addressed yet represent a challenge for rural communities, as indicated by Participant 5: *'Support measures for communities should be comprehensive. Many programs target only one aspect of rural life, and that promotes inappropriate changes. They must be designed considering the aspects that the families propose to strengthen.'*

The main practical implication, however, is not related to local or national actors, but rather the global community. Current food supply chains are a major challenge for sustainable development and the global market integration often leads to transformations of large land areas

for agricultural production. As related activities are highly profitable in the local context, the agricultural expansion leads to *'changes in land-uses without limits'* (Participant 1) and is driven by the global demand for agricultural commodities. Participant 2 highlighted that without a change in the global mindset, this situation is unlikely to change: *'What we need to successfully change this dynamic are initiatives from the importing and consumption side. We need to raise awareness about the impacts and also the shared responsibility across the whole chain. Those at the top of the chain are in a better position to really change something.'*

Various local, national and international NGOs already work on raising awareness about the situation in the Argentine Chaco, even though as experienced by Participant 1, local environmental and social activism can be dangerous and has led to various death threats, and numerous violent conflicts in the region (Busscher et al., 2020; Flores Klarik, 2019; RED Agroforestral Chaco Argentina, 2011; Wald, 2013). This further strengthens the need for the global community to become more active and informed about the local realities in global agricultural frontiers. If the global community and market sets stronger incentives for sustainable production, exporting countries such as Argentina, can be dramatically supported in their national and regional endeavors to enhance natural conversation and limit the destructive agricultural expansion.

## 6.2. Limitations

Due to the circumstances of the global Covid-19 pandemic the author was not able to conduct field research and make direct observations, which represents the main limitations of this research. To engage with local actors and visit the study area would enrich the research with valuable and credible insights, which remained out of reach due to the reliance on online inquiries for the data collection. However, to compensate for this challenge, this research integrates information from multiple primary and secondary data sources which allows for the corroboration of gained insights based on comparing and identifying relevant themes and patterns. Thereby, various views, opinions and forms of knowledge are considered, which enhances the reliability and credibility of the presented results. Additionally, various reviewed studies about the Argentine Chaco, and the development of the agricultural frontier and its socio-environmental consequences, were published as recent as a few months prior to the conclusion of this research project (Alcañiz & Gutierrez, 2020; Barral et al., 2020; Macchi et al., 2020;

Seghezzo et al., 2020; Vallejos et al., 2020). Therefore, the potential lack of primary data could additionally be addressed with very timely information provided in existing literature.

A second limitation was the time constraint that did not allow for additional data collection to further enhance the credibility and representativeness of the results, or for testing the developed DPSIR framework for land degradation in the Argentine Chaco through consultation with local actors. While the framework is built on the results of this study, a verification of the identified components and influential factors would increase the legitimacy of the framework, as feedback from stakeholders could lead to implications for adaptations and changes.

Despite these limitations, this research contributes to a more comprehensive understanding of land degradation in the Argentine Chaco, which was widely addressed in more fragmented and specialized approaches in existing literature. The rapidly changing landscape in the region, with increasingly complex local, national and international dimensions, will remain to be an interesting study area as it has only been scarcely researched in regard to the social and environmental consequences. Building on the results and implications of this research, it would be promising to deepen the understanding of the land degradation dynamics as a system, where different components and factors interact with each other. A more extensive understanding of these relations would provide additional valuable implications for the regional land-use planning in the Argentine Chaco, as well as in other similar agricultural frontier regions.

## 7. References

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## 8. Appendices

### 8.1. Appendix 1: Interview Guide



#### **Interview Guide** **Respondents: NGOs**

Hello, my name is Saskia Hüsck and I'm currently studying my Masters in Sustainable Development at Utrecht University in the Netherlands. Thank you for taking some time to talk to me- I would have preferred to conduct these interviews in person and get the chance to meet you, but unfortunately the current circumstances prevent me from coming to Argentina.

I would like to briefly explain you what my research is about before we start with the interview. I'm conducting this research for my studies in collaboration with Solidaridad, an NGO that focuses on developing innovative solutions to increase agricultural production in both a resilient and efficient way that promotes inclusive economic development and nature conservation. The aim of my research is to gain an understanding of the local context of rural communities and to explore the land-use and land degradation dynamics in the Argentine Chaco Region.

Your answers are very valuable for me, and your identity will remain anonymous unless you wish otherwise. To make sure that I do not miss any information that you provide, I would like to record the interview. Do you agree to participate in my research?

I would like to begin with some questions about yourself and the NGO you work at, before asking you about your perception on land-use and rural livelihoods in the province you work in. Then we will move on to questions related to your experience and understanding of land degradation in Salta/Chaco/Formosa/Santiago del Estero.

Do you have any questions before we start?

#### **1. Can you please introduce yourself briefly? Where are you located? (province, department) What is your job?**

- Can you tell me a bit more about the NGO you work for? What is the mission and vision?
- What are projects that you work on in Salta/Chaco/Formosa/Santiago del Estero? What are your responsibilities?

#### **2. How would you describe the current land-use in the province/s your NGO is active in?**

- Who are land-users?
- What are the main forms of land-use in the provinces? (e.g. grazing, crop cultivation, subsistence production, agricultural expansion/intensification)
- Have there been any significant changes and trends related to land-use in the province/s over the last 10 years? (e.g. land tenure, access rights, policies, institutions)

#### **3. How would you describe the current situation of rural communities in the province/s?**

- How do they maintain their livelihoods?
- How critical is the access and availability of natural resources for rural livelihoods?
- How are rural communities affected by the current land-use/planning?
- How have their livelihoods changed over the last 10 years?
- What do you perceive as the main challenges for rural communities today?

**4. What are the main challenges that you see related to the current land-use in the province/s?**

- Are you aware of initiatives or projects in place or in the planning to address these?
- Who develops them, and how?

**5. What does land degradation mean for you?**

- Do you perceive land degradation as an issue in the province/s? Why? Can you give examples?
- How does land degradation affect rural communities and other land-users?

**6. Are you aware of soil degradation processes, such as soil erosion, soil pollution or surface compaction, in the province/s?**

- Where in the province can these be observed? Who and what is affected?
- What do you think causes the degradation?
- Are you aware of any response measures to limit soil degradation? How does it work?

**7. Are you aware of vegetation degradation processes on the lands?**

- Where can these be observed? Who and what is affected?
- What do you think causes the degradation?
- Are there areas where these processes have been mitigated through e.g. reforestation or forest corridors? Are there any response measures to limit vegetation degradation?

**8. Are you aware of water resource degradation processes?**

- Where can these be observed? Who and what is affected?
- What do you think causes the degradation?
- Are you aware of any response measures to limit water degradation?

**9. What do you perceive as the main causes for land degradation in the province/s?**

- Can you rank these by order of influence? Is one cause more dominant than another?

**10. How do you perceive current policies and regulations related to land-use (e.g. the Forest Law) in regard to their effectiveness to limit land degradation in the province/s?**

- How do they affect land-use practices? Are they supportive or hindering for different land-users? What are the consequences?
- Do they facilitate the engagement of landowners/users in more sustainable land management and/or in the prevention of land degradation? How so?
- What could be improved?

**11. Can you think of actions or support measures that would be appropriate for the province to limit land degradation and/or promote sustainable land management?**

- Who should design these and how?
- Who should implement them? What is required for the implementation e.g. investment, training, capacity-building?

**12. Can you think of actions or support measures that would be appropriate to support rural communities to sustain their livelihoods and improve their well-being?**

- Who should design these and how?
- What is required for the implementation (e.g. investment, training, capacity building)?
- What are projects that you have experienced as beneficial for rural communities? What is the project about? How has the livelihood/well-being improved?

**13. Lastly, what is your vision for the development of the province/s? What would you like to see improving? What is your NGO trying to achieve?**

**Thank you so much for sharing your experiences and insights with me, it was very interesting to learn about your perspective. We have reached the end of the interview- would you like to add anything?**

## 8.2. Appendix 2: Questionnaire



Utrecht University

### Cuestionario

Hola, mi nombre es Saskia Hüsck y actualmente estoy estudiando mi Maestría en Desarrollo Sostenible en la Universidad de Utrecht en los Países Bajos.

De antemano, Gracias por tomarte un tiempo para apoyarme con mi investigación sobre la Región del Chaco Argentino, hubiera preferido tener la oportunidad de conocerte en persona, pero desafortunadamente las circunstancias actuales me impiden ir [a Argentina](#).

Estoy haciendo mi proyecto de investigación final en colaboración con la ONG Solidaridad y el objetivo es comprender el contexto local del uso de la tierra y la degradación de la misma en las provincias de Salta, Chaco, Formosa y Santiago del Estero.

Otro enfoque, es investigar el contexto actual de los sustentos rurales y explorar diferentes perspectivas y opiniones relacionadas con el uso y la planificación del uso de la tierra. La combinación de estos conocimientos puede contribuir a una toma de decisiones más informada y adecuada a nivel local que puede ayudar a limitar las dinámicas de degradación de la tierra y mejorar los medios de vida rurales.

Las preguntas a continuación cubren una amplia gama de temas y te invitan a compartir perspectivas y experiencias relacionadas con el uso de la tierra, la planificación, la degradación de la misma y los sustentos rurales. Dependiendo de tu conocimiento y comprensión, no dudes en omitir preguntas si no te sientes cómodo respondiéndolas; cualquier información es muy valiosa para mí y agradezco mucho tu participación. Tu identidad permanecerá anónima, a menos que desee lo contrario y la información que proporciones solo se utilizará para mi investigación. Si tienes alguna pregunta relacionada con el cuestionario o la investigación, comunícate conmigo por correo electrónico: [s.j.husch@students.uu.nl](mailto:s.j.husch@students.uu.nl).

¡Muchas gracias!

Te deseo mucha salud y una linda semana.

Saludos cordiales,

Saskia Hüsck



**1. Preséntate brevemente, ¿Dónde estás ubicado? (provincia, departamento) ¿Cuál es tu trabajo?**

A) Por favor presentarte brevemente.

**Repuestas**

**2. ¿Cómo describirías el uso actual de la tierra en la/s provincia/s donde estas ubicado o haz trabajado?**

A) ¿Quiénes son los usuarios activos de la tierra?

B) ¿Cuáles son las principales formas de uso de la tierra en las provincias?

C) ¿Ha habido cambios y tendencias importantes relacionados con el uso de la tierra en la provincia durante los últimos 10 años?

**Repuestas**

**3. ¿Cómo describirías la situación actual de las comunidades rurales en la/s provincial/s?**

A) ¿Cómo mantienen sus sustentos?

B) ¿Cuán crítico es hoy el acceso y la disponibilidad de recursos naturales para los medios de vida rurales?

C) ¿Cómo se ven afectadas las comunidades rurales por el uso / planificación actual de la tierra?

D) ¿Cómo han cambiado sus medios de vida en los últimos 10 años?

E) ¿Cuáles percibes como los principales desafíos para las comunidades rurales de hoy?

**Repuestas**

**4. ¿Cuáles son los principales desafíos que se ven relacionados con el uso actual de la tierra en las provincias?**

A) Por favor describe los desafíos.

B) ¿Conoces de iniciativas o proyectos para abordarlos? ¿Quién los desarrolla y cómo?

**Repuestas**



**5. ¿Qué significa para ti la degradación de la tierra?**

A) Por favor describe tu perspectiva.

B) ¿Percibes la degradación de la tierra como un problema en la/s provincia/s? ¿Por qué? ¿Puedes dar ejemplos?

C) ¿Cómo afecta la degradación de la tierra a las comunidades rurales y a otros usuarios de la tierra? ¿Hay diferencias o similitudes?

**Respuestas**

**6. ¿Estás consciente de procesos de degradación del suelo, como la erosión del suelo, la contaminación del suelo o la compactación de la superficie, en la/s provincial/s?**

A) Por favor describe tu experiencia.

B) ¿En qué parte de la provincia se pueden observar? ¿Quién y qué se ve afectado?

C) ¿Qué crees que causa la degradación?

D) ¿Conoces alguna medida de respuesta para limitar la degradación del suelo? ¿Como funciona?

**Respuestas**

**7. ¿Estás consciente de procesos de degradación de la vegetación en las tierras?**

A) Por favor describe tu experiencia.

B) ¿En qué parte de la provincia se pueden observar? ¿Quién y qué se ve afectado?

C) ¿Qué crees que causa la degradación?

D) ¿Hay áreas donde estos procesos se han mitigado a través de, p. reforestación o corredores forestales? ¿Existen medidas de respuesta para limitar la degradación de la vegetación? ¿Como funciona?

**Respuestas**

**8. ¿Está consciente de procesos de degradación de los recursos hídricos?**

A) Por favor describe tu experiencia.

B) ¿En qué parte de la provincia se pueden observar? ¿Quién y qué se ve afectado?

C) ¿Qué cree que causa la degradación?

D) ¿Conoces alguna medida de respuesta para limitar la degradación del agua? ¿Como funciona?

**Respuestas**

**9. ¿Cuáles percibes como las principales causas de la degradación de la tierra en las provincias?**

A) Por favor describe las causas.

B) ¿Puedes clasificarlos por orden de influencia? ¿Es una causa más dominante que otra?

**Repuestas**

**10. ¿Cómo percibe las políticas y regulaciones actuales relacionadas con el uso de la tierra (por ejemplo, la Ley de Bosques) con respecto a su efectividad para limitar la degradación de la tierra en la/s provincia/s?**

A) Por favor describe tu perspectiva.

B) ¿Cómo afectan las prácticas de uso de la tierra? ¿Son de apoyo u obstaculizan a los diferentes usuarios de la tierra? ¿Cuáles son las consecuencias?

C) ¿Facilitan la participación de los propietarios/usuarios de tierras en una gestión de la tierra más sostenible y/o en la prevención de la degradación de la tierra? ¿Cómo?

D) ¿Qué podría mejorarse?

**Repuestas**

**11. ¿Puedes pensar en acciones o medidas de apoyo que sean apropiadas para que la provincia limite la degradación de la tierra y/o promueva la gestión sostenible de la tierra?**

A) Por favor describe tus ideas.

B) ¿Quién debería implementarlos? Que se requiere para la implementación, p. inversión, capacitación, desarrollo de capacidades?

**Repuestas**

**12. ¿Puedes pensar en acciones o medidas de apoyo que sean apropiadas para apoyar a las comunidades rurales a fin de mantener sus medios de vida y mejorar su bienestar?**

A) Por favor describe tus ideas.

B) ¿Que se requiere para la implementación, p. inversión, capacitación, desarrollo de capacidades?

C) ¿Cuáles son los proyectos que haz experimentado como beneficiosos para las comunidades rurales? ¿De qué se trata el proyecto? ¿Cómo ha mejorado el sustento/bienestar?

**Repuestas**

**13. Por último, ¿cuál es tu visión para el desarrollo de la/s provincial/s?  
¿Qué te gustaría ver mejorar?**

A) Por favor describe tu perspectiva.

**Repuestas**

**Muchas gracias por compartir tus experiencias y puntos de vista conmigo. Hemos llegado al final del cuestionario.  
¿Deseas agregar algo más?**

### 8.3. Appendix 3: Additional relevant data sources

The following two online dialogues about related topics to this research were considered as data sources for this study:

1. '*Defensa de la tierra y la vida*' (Defense of the land and the life) hosted by the Right Livelihood Foundation with several laureates in August 2020, retrieved at: <https://www.youtube.com/watch?v=TDYjkNb0Mko&feature=youtu.be>
2. '*Comisión de recursos naturales y conservación del ambiente humano.*' (Commission for natural resources and conservation of the human environment), in the context of deforestation, hosted in July 2020, retrieved at: <https://www.youtube.com/watch?v=ZMAdgZ0O5jA&feature=youtu.be>

Additional information and local insights gathered by watching these dialogues were captured in memos and considered in the research findings.