# ASSESSING LIVELIHOOD RESILIENCE TO CLIMATE VARIABILITY BY LAND TENURE STATUS OF PASTORALISTS IN THE CHACO SALTEÑO

by

ALEJANDRO COLLINS

(Under the Direction of Jesse Abrams)

## ABSTRACT

The Chaco Salteño of Argentina is a global hotspot of land conflict and climate change pressures. This study was motivated by an interest in understanding how smallholding rural pastoralists in the area, many of whom live with land insecurity, anticipate and adapt to shocks and stressors for more resilient livelihoods. Qualitative methods (semi-structured interviews) were used to analyze the mechanisms controlling access to resources with potential to build resiliency in the face of disturbances and consider adaptive responses in terms of both the ecological and institutional operating contexts. Land titles and communal organizations, the primary mechanisms for securing resource access, were explored to better understand how, why, and to what extent they are employed by pastoralists. I found that land titles provide more significant adaptive benefits than communal organizations, but are substantially more difficult to achieve, indicating that communal organizations may be more effective overall.

INDEX WORDS: Adaptation, sustainable livelihoods, state capacity, peasant agriculture, agriculture frontier, producer organizations

# ASSESSING LIVELIHOOD RESILIENCE TO CLIMATE VARIABILITY BY LAND TENURE STATUS OF PASTORALISTS IN THE CHACO SALTEÑO

by

ALEJANDRO COLLINS

B.S.F.R., The University of Georgia, 2021

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2023

# ASSESSING LIVELIHOOD RESILIENCE TO CLIMATE VARIABILITY BY LAND TENURE STATUS OF PASTORALISTS IN THE CHACO SALTEÑO

by

ALEJANDRO COLLINS

| | |
|---|---|
| Major Professor: | Jesse Abrams |
| Committee: | Alicia Peduzzi |
| | Pablo Lapegna |

Electronic Version Approved:

Ron Walcott
Vice Provost for Graduate Education and Dean of the Graduate School
The University of Georgia
May 2023

# DEDICATION

To my loved ones.

To the Salteños without whom this would have been impossible and unimportant.

ACKNOWLEDGEMENTS

I extend sincerest appreciation to the people of the Chaco Salteño who graciously shared their experiences and intimate livelihood struggles. I thank them for their unparalleled kindness in opening their homes and lives for my research. Their stories served as a motivation to produce accurate reflections of their lived experiences to share with greater audiences; I owe it to them. Without the volunteered time and space of those interviewed, this research, and ensuing publications, would not have been possible. I thank them wholeheartedly.

I graciously thank Dr. Jesse Abrams. Jesse took me as a student because of our shared interests and goals to do meaningful research for people and conservation in Latin America. His motivational words, countless revisions (so far, and those to come), and support have been invaluable. I joined his lab as a freshly graduated, unfunded, and directionless student with aspirations to do fieldwork in Latin America. Two years later, with his unwavering mentorship, I am earning an M.S. after successfully securing research funding for an exceptionally specialized investigation. His advising style of adapting to each student's advisory needs allowed for just enough structure while also leaving room for self-discovery and accomplishment. I am especially thankful for his help in navigating the academic process and challenging situations (for example, while in Salta when my ride to the field, in the middle of the night, broke down on the side of a busy highway). Although the name on the diploma will be mine, it would have been

impossible without Jesse's continual attentiveness, support, and mentorship. For that, I thank him.

I thank my committee members, Drs. Alicia Peduzzi and Pablo Lapegna for their time and input throughout the research process. Their hands-on and academic expertise provided invaluable in the planning, execution, analysis, and completion of this research. Their willingness to challenge me and ensure I produce quality work was of great benefit and are values that will cherish as I pursue endeavors post-graduation.

I thank Drs. Mauricio Nuñez-Regueiro and Cristina Nuñez Godoy for their unrivalled support. Without their help in developing this research, coordinating on-the-ground work, guidance, and post-fieldwork revisions, this project may not have been able to be accomplished. Specifically, I thank Mauricio for his time in taking us to the field site and making essential introductions for which I owe substantial aspects of this research and Cristina for her flexibility in the timing for our trip to the field as well as her insightful feedback throughout the drafting process. I express personal gratitude to both Cristina and Mauricio for welcoming me to Salta with open arms (loaning me blankets when it was cold, hosting un asado, and countless other acts of kindness).

I thank Carlos, my host while in Salta, for opening his home to a foreign student he had never met before. Carlos' welcoming and kind-hearted spirit provided comfort while in an unfamiliar place. I enjoyed many days and evenings in fellowship with him and his friends while consuming the world-famous cuisine Argentina has to offer. I look forward to reuniting with him sometime in the future to revisit the kind of friendship that is sure to last a lifetime.

I thank the following:

My father, Michael, with whom I share a passion for the outdoors, who encouraged me to pursue my interests, provided for me, and was always happy to share fatherly advice. I hope to be just as successful as he is in the natural resources field.

My mother, Christine, with whom I share a passion to serve others, who never doubted me and is persistent in her unwavering encouragement, unconditional love, and support throughout my life. I hope to be just as generous and thoughtful as she is in her service to others.

My twin brother, Ian, and older sister, Lela, with whom I share a childhood, for their love and laughs.

My honorary sister, Marie, with whom I have spent more hours with than anyone else during my college years, for her friendship through thick and thin.

My coach, Donald Babbitt, for helping me decide to come to the University of Georgia and stuck with me through highs and lows.

All of those I shared life with at the University of Georgia, from my closest friends, teammates, officemates, and everyone in-between, I am so extremely thankful.

This work was supported by the University of Georgia Latin American and Caribbean Studies Institute, the Tinker Foundation, and The Georgia Way.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

# CHAPTER 1

## INTRODUCTION AND LITERATURE REVIEW

In recent decades, the Gran Chaco ecoregion of Latin America, one of the largest arid forests in the world, has been a global hotspot for deforestation (Faingerch et al., 2021; Zak et al., 2008). The Gran Chaco lies partly within Bolivia and Paraguay but is situated primarily in the northern Argentine provinces of Salta, Formosa, Chaco, Santiago del Estero, and others. Due to a significant increase in global demand for beef and livestock feed, agricultural production of these commodities has crept northward from the nutrient-rich Pampas of central Argentina where industrial agricultural activities are more traditionally the norm (Piquer-Rodríguez et al., 2018). As this agricultural frontier expands into the Argentine Chaco, land disputes between peasant farmers, Indigenous populations, and agribusinesses become more frequent and inhabitants with multigenerational ties to the land are now facing threats of displacement (Barbetta, 2019; del Giorgio et al., 2022; Goldfarb & van der Haar, 2016; Leguizamón, 2014; Seghezzo et al., 2011). Many of the subsistence peasant farmers, because of a historical lack of mapping, limited state capacity, and insufficient financial and legal resources, do not have official titles to the parcels on which they make a living, increasing their risk of displacement (Altrichter & Basurto, 2008; Paz, 2020).

As recorded thoroughly in the literature, the Gran Chaco is experiencing unprecedented changes in climate and environmental conditions that are negatively affecting local populations (Canziani & Carbajal Benitez, 2012; Seghezzo et al., 2020;

Tschopp et al., 2022). Although it is difficult to identify with certainty the causes of these changes, previous studies focusing on the Argentine Chaco and other similar landscapes theorize root causes to be deforestation, intensified agricultural activity, and global climate change (Hiltner et al., 2021; Seghezzo et al., 2020; Zak et al., 2008). Shifts in seasonality, water availability, and extreme weather are symptoms of climate variation and have consequences for marginalized populations with precarious livelihoods inhabiting the area.

The conjunction of an expanding agricultural frontier, contested land tenure, changes in climate patterns, and limited state capacity to enforce laws or resolve disputes leaves small producers particularly vulnerable to a loss of livelihood (Barbetta, 2019; del Giorgio et al., 2022; Goldfarb & van der Haar, 2016; Leguizamón, 2014). Addressing adaptation and mitigation at all scales of community is a focus in the 2015 Paris Agreement, United Nations Climate Change Conferences, and incorporated into the United Nations Sustainable Development Goals (*COP27 Official*, n.d.; UNFCCC, 2015). To effectively do so, it is essential to consider the complex realities that local communities face in experiencing livelihood stressors. The livelihood resilience approach, which stems from sustainable livelihoods and resilience discourse, emphasizes lived experiences, agency, and local perspectives to analyze stressors creating insecurity and identify the collection of resources that build capacity for adaptation and anticipation to shocks and stressors (Marschke & Berkes, 2006; Tanner et al., 2015).

The current research seeks to examine the role of land tenure security in adaptation to climate-related disturbances for criollo campesino pastoralists (subsistence farmers of mixed racial and ethnic background, hereafter referred to as “producers”) in

the Chaco Salteño (the Gran Chaco region of the province of Salta, Argentina). I do this by adapting the Livelihood Resilience Indicator Framework (Ifejika Speranza et al. 2014) to adaptation resources within the reality of the ecological and institutional contexts for the region. I focus, in particular, on mechanisms that control access to adaptation resources, including but not limited to mechanisms related to land title.

Chapter 2 is a manuscript-style piece of literature that presents the results of research conducted in the Chaco Salteño. It takes a qualitative methods approach, using formal semi-structured interviews, primarily with producers, to provide an in-depth exploration of the stressors experienced and most common respective adaptations employed by producers. Chapter 3 serves as a practitioner paper to provide an overview of these findings and specify a variety of recommendations, grounded in the perspectives of producers themselves, for actors tasked with implementing development projects. The research was approached with the purpose to produce both academic and accessible literature to represent the lived experiences of producers for audiences in academia and the field of development practice; in combination, Chapters 2 and 3 accomplish this purpose.

References

Altrichter, M., & Basurto, X. (2008). Effects of land privatisation on the use of common-pool resources of varying mobility in the Argentine Chaco. *Conservation and Society*, *6*(2), 154. https://doi.org/10.4103/0972-4923.49209

Barbetta, P. (2019). Conflictos por la propiedad de la tierra en la provincia de Chaco, Argentina. Contribuciones a una agenda de investigación. *Revista de la Facultad de Derecho y Ciencias Políticas (Cusco)*, *4*(10), 223–238. https://doi.org/10.51343/rfdcp.v4i10.15

Canziani, P. O., & Carbajal Benitez, G. (2012). Climate impacts of deforestation/land-use changes in central South America in the PRECIS regional climate model: Mean precipitation and temperature response to present and future deforestation scenarios. *The Scientific World Journal*, *2012*, 1–20. https://doi.org/10.1100/2012/972672

*COP27 Official*. (n.d.). Retrieved December 6, 2022, from https://cop27.eg/#/vision#goals

del Giorgio, O., Robinson, B. E., & le Polain de Waroux, Y. (2022). Impacts of agricultural commodity frontier expansion on smallholder livelihoods: An assessment through the lens of access to land and resources in the Argentine Chaco. *Journal of Rural Studies*, *93*, 67–80. https://doi.org/10.1016/j.jrurstud.2022.05.014

Faingerch, M., Vallejos, M., Texeira, M., & Mastrangelo, M. E. (2021). Land privatization and deforestation in a commodity production frontier. *Conservation Letters*, *14*(4). https://doi.org/10.1111/conl.12794

Goldfarb, L., & van der Haar, G. (2016). The moving frontiers of genetically modified soy production: Shifts in land control in the Argentinian Chaco. *The Journal of Peasant Studies*, *43*(2), 562–582. https://doi.org/10.1080/03066150.2015.1041107

Hiltner, U., Huth, A., Hérault, B., Holtmann, A., Bräuning, A., & Fischer, R. (2021). Climate change alters the ability of neotropical forests to provide timber and sequester carbon. *Forest Ecology and Management*, *492*, 119166. https://doi.org/10.1016/j.foreco.2021.119166

Ifejika Speranza, C., Wiesmann, U., & Rist, S. (2014). An indicator framework for assessing livelihood resilience in the context of social–ecological dynamics. *Global Environmental Change*, *28*, 109–119. https://doi.org/10.1016/j.gloenvcha.2014.06.005

Leguizamón, A. (2014). Modifying Argentina: GM soy and socio-environmental change. *Geoforum*, *53*, 149–160. https://doi.org/10.1016/j.geoforum.2013.04.001

Marschke, M. J., & Berkes, F. (2006). Exploring strategies that build livelihood resilience: A case from Cambodia. *Ecology and Society*, *11*(1). https://www.jstor.org/stable/26267795

Paz, R. G. (2020). Agricultural holdings with undefined boundaries, communal systems and counter-hegemonies: The persistence of the peasantry in Argentina. *Journal of Agrarian Change*, *20*(4), 562–578. https://doi.org/10.1111/joac.12363

Piquer-Rodríguez, M., Butsic, V., Gärtner, P., Macchi, L., Baumann, M., Gavier Pizarro, G., Volante, J. N., Gasparri, I. N., & Kuemmerle, T. (2018). Drivers of agricultural land-use change in the Argentine Pampas and Chaco regions. *Applied Geography*, *91*, 111–122. https://doi.org/10.1016/j.apgeog.2018.01.004

Seghezzo, L., Huaranca, L. L., Vega, M. L., Jeckeln, G. V., Avalos, M. A., Iribarnegaray, M. A., Volante, J. N., Serrano, F. H. M., Mastrangelo, M., Sun, Z., & Müller, D. (2020). Sustainable farmers, deficient State? Self-reported agricultural sustainability in the Argentine Chaco region. *International Journal of Agricultural Sustainability*, *18*(6), 473–491. https://doi.org/10.1080/14735903.2020.1793645

Seghezzo, L., Volante, J. N., Paruelo, J. M., Somma, D. J., Buliubasich, E. C., Rodríguez, H. E., Gagnon, S., & Hufty, M. (2011). Native forests and agriculture in Salta (Argentina): Conflicting visions of development. *The Journal of Environment & Development*, *20*(3), 251–277. https://doi.org/10.1177/1070496511416915

Tanner, T., Lewis, D., Wrathall, D., Bronen, R., Cradock-Henry, N., Huq, S., Lawless, C., Nawrotzki, R., Prasad, V., Rahman, Md. A., Alaniz, R., King, K., McNamara, K., Nadiruzzaman, Md., Henly-Shepard, S., & Thomalla, F. (2015). Livelihood resilience in the face of climate change. *Nature Climate Change*, *5*(1), 23–26. https://doi.org/10.1038/nclimate2431

Tschopp, M., Ceddia, M. G., & Inguaggiato, C. (2022). Adoption of sustainable silvopastoral practices in Argentina's Gran Chaco: A multilevel approach. *Journal of Arid Environments*, *197*, 104657. https://doi.org/10.1016/j.jaridenv.2021.104657

UNFCCC. (2015). *Paris Agreement*. 27. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Zak, M. R., Cabido, M., Cáceres, D., & Díaz, S. (2008). What drives accelerated land cover change in central Argentina? Synergistic consequences of climatic,

socioeconomic, and technological factors. *Environmental Management*, *42*(2), 181–189. https://doi.org/10.1007/s00267-008-9101-y

# CHAPTER 2

# ASSESSING LIVELIHOOD RESILIENCE TO CLIMATE VARIABILITY BY LAND TENURE STATUS OF PASTORALISTS IN THE CHACO SALTEÑO[1]

[1] Collins, A., Abrams, J., Nuñez-Regueiro, M., Nuñez Godoy, C., Lapegna, P., and Peduzzi, A. To be submitted to *Land Use Policy*

Abstract

The Chaco Salteño of Argentina is a global hotspot of land conflict and climate change pressures that, together, threaten the livelihoods of rural pastoralists. This study was motivated by an interest in understanding how smallholding pastoralists in the area, many of whom lack formal title to the lands they utilize, adapt and anticipate to shocks and stressors for more resilient livelihoods. We analyze the mechanisms controlling access to resources with potential to build resiliency in the face of climate, political, and other socio-economic disturbances and consider adaptive responses in terms of both the ecological and institutional contexts within which these pastoralists operate. Formalized land title documents and communal organizations are identified as primary mechanisms for securing resource access and explored to better understand how, why, and to what extent they are employed by pastoralists in the Chaco Salteño. A qualitative methods approach was utilized to investigate the role of varied mechanisms in confronting a changing climate in the context of land tenure insecurity. We find that adaptive mechanisms not only vary greatly in their feasibility to attain, but also in the efficiency, reliability, and longevity of resource benefits. Findings from this study contribute to efforts to advance sustainable development by contextualizing the importance of varied strategies in supporting resilient livelihoods.

## 2.1. Introduction

Anthropogenic climate change and the resulting shifts in seasonality, water availability, and extreme weather, among other changes, are recognized as a growing source of strain on marginalized populations with already precarious livelihoods (Foley et al., 2005; IPCC, 2022). Farmers, pastoralists, and others whose resilience is directly tied to the land, in particular, face the brunt of these negative effects (Cohn et al., 2017). Addressing adaptation and mitigation to stressors has emerged as a primary concern for the international community, being a focus in the 2015 Paris Agreement, United Nations Climate Change Conferences, and incorporated into the United Nations Sustainable Development Goals (*COP27 Official*, n.d.; UNFCCC, 2015). Strategies to effectively navigate the climate crisis require access to resources that contribute to livelihood resiliency (Ifejika Speranza, 2010; Tanner et al., 2015). Although implementation of livelihood strategies for adaptation and mitigation are encouraged by national- and global-level entities (such as governments and third party green governance promoters), they often do not consider the complex realities that local communities face in experiencing livelihood stressors (Johnson, 2019; Ribot & Peluso, 2003; Suchá & Dušková, 2022). Accordingly, the livelihood resilience concept focuses on lived experiences, agency, and local perspectives to address factors directly contributing to insecurity through emphasizing the continual combination of resources that build capacity for adaptation and anticipation to climate and non-climate shocks and stressors (Marschke & Berkes, 2006; Tanner et al., 2015).

The Gran Chaco ecoregion of South America, one of the largest dry subtropical forests in the world, exemplifies the complexity of many livelihood scenarios in the

Global South, entailing changes to climate patterns, unclear and contested land tenure, the expansion of intensive land uses tied to global capital circuits, and limited state capacity to enforce laws or resolve disputes (Amanor, 2012; Araghi, 2009; Zak et al., 2008). This conjunction leaves local rural populations, primarily criollo campesino pastoralists (subsistence farmers of mixed racial and ethnic background, hereafter referred to as "producers") in the case of the Argentine Chaco, particularly vulnerable to a loss of livelihood (Goldfarb & van der Haar, 2016; Seghezzo et al., 2020).[2] As producers attempt to adapt to a changing operational environment, their ability to access mechanisms for resilience is often strongly influence by their land tenure status (Seghezzo et al., 2020; Tschopp, Inguaggiato, et al., 2022). The purpose of this study is to examine the role that land tenure security plays in adaptation to climate-related disturbances for producers in the Chaco Salteño (Gran Chaco region of the province of Salta, Argentina). We do this through analyzing the mechanisms controlling access to adaptation resources within the reality of the ecological and institutional contexts for the region. This analysis provides an in-depth view from the perspective of producers themselves to help understand how and why they use formal land title, as well as other mechanisms of access, in their effort to adapt to varied stressors.

## 2.2. Background

### *2.2.1. Access and Institutions*

As defined by Ribot and Peluso (2003), access is "the *ability* to derive benefits" from resources and serves as a central concept in the analysis of the social dynamics of

[2] Indigenous populations in the area face many of the same livelihood insecurities as do criollo campesino populations, but due to legal differentiations between them, we focus solely on criollo campesinos in this study.

natural resource use and management. Actors use, draw, and bundle strands of power to exercise rights-based and relational mechanisms that control access. Ribot and Peluso's (2003) definition expanded upon previous concepts focused on formal property relations by considering complex social relationships that structure a dynamic web of powers for resource benefits. This interpretation of access emphasizes the relational interdependence of social structures and institutions in determining legitimacy and power to exercise authority over resource benefits (de Haan & Zoomers, 2005; Sikor & Lund, 2009). An actor's positioning within these networks determines their access to resources.

Marginalized populations living under weak state institutions (displayed in both the Global North and South, although more apparent in some cases than others) are particularly vulnerable to insecurity of access. Characterized by an inability to implement commitments or provide for ontological security, weak state institutions leave actors unable to consistently rely on the state for resource-granting infrastructure, resources, and conflict resolution (Antwi-Agyei et al., 2015; Johnson, 2019). The state's ability, or lack thereof, to enforce claims to resources figures prominently in the strategies actors use to gain and maintain access, leading them to seek diverse formal and informal mechanisms to access resiliency-building resources by necessity and design (Ribot & Peluso, 2003; Sikor & Lund, 2009). Because of this, the relationship between weak state institutions and livelihood resilience of those within its territorial boundaries is an important consideration when analyzing adaptation in practice.

### *2.2.2. Study Area*

In recent decades, the Chaco Salteño has been at the center of complex land tenure conflicts while experiencing novel environmental stressors. As much of the Chaco

is agriculturally valuable to large-scale commodity production activities (particularly intensive genetically modified soybean cultivation and feedlot cattle production), the region has been faced with an extraordinary number of land-use disputes and changes in land control between criollos, Indigenous people, and large agribusinesses (Barbetta, 2019; del Giorgio et al., 2022; Goldfarb & van der Haar, 2016; Leguizamón, 2014; Seghezzo et al., 2011). This land-use change has led to deforestation rates of approximately 2% in the Argentine Chaco between 2002 and 2008, many times greater than the global (0.2%) and Latin American (0.51%) averages (Seghezzo, et al., 2011). More specifically, the province of Salta has experienced a net loss of 1.12 million hectares of tree cover from 2000 to 2020, leading to a decrease in ecosystem service functions (carbon storage, erosion control, rainfall retention, climate regulation, etc…) of up to 10 percent (Barral et al., 2020; Potapov et al., 2022). These regional land-use and environmental changes, as well as global climate change, are contributing to the accumulation of stressors for local inhabitants (IPCC, 2014; Seghezzo et al., 2020; Zak et al., 2008). In addition to this, many of the producers living in the greater Gran Chaco lack land titles for the parcels that they have occupied for generations (Altrichter & Basurto, 2008; Paz, 2020). The culmination of an expanding agricultural frontier, novel environmental patterns, and lack of adequate political representation leads to livelihood insecurity and marginalization for the producers of the Chaco Salteño.

As is apparent in regions throughout much of the world characterized by weak state institutions, the Chaco Salteño experiences land tenure conflicts due to discrepancies in power dynamics of those seeking land rights (Barbetta, 2019; Feder & Feeny, 1991; Hellin et al., 2018; Moore, 1998; Ravikumar et al., 2013). Numerous

scholarly analyses document inconsistency in the capacity of the Argentine provincial and federal state to fulfill some of the rights and goals outlined in legal documents, such as the National Forest Law (Act 26.331) and the Twenty-Year Law ("Ley Veinteañal", Art. 4015 and 2384 of the Civil Code) for secure land tenure, a focus of this paper (Barbetta, 2014; Cotroneo et al., 2021; Seghezzo et al., 2011; Tschopp, Inguaggiato, et al., 2022; Volante & Seghezzo, 2018). Although secure land tenure is often conceptualized as the formal right to resources through documents or alternative inscribed legal avenues, when agencies struggle to enforce these rights, as is common under certain weak institutions, secure land tenure may not function properly to reduce conflict and provide for predictability. Legally, secure land tenure within the study area is obtainable both through an official land title to the parcel on which one lives and through "possession rights". Possession rights, which are granted through the aforementioned Twenty-Year Law, are achieved by living on the same parcel of land for at least 20 years and conducting improvements upon it as if one were the owner (Jara & Paz, 2013). The methods to achieve, and claim, possession rights, as well as the difficulty in doing so, are discussed in more detail throughout this paper.

Identified by many studies and developmental organizations as an avenue out of poverty and a contributor to resilient livelihoods, secure land tenure, in certain variations, may nevertheless fail to provide secure access to resources. In a systematic meta-analysis, Fan et al. (2022) found income and food access as most correlated with livelihood resilience when compared to other factors, like land assets. Relatedly, Tschopp et al. (2022) found that membership in a producers' organization (hereafter "PO") and socio-economic factors, rather than land tenure status alone, were positively associated with the

adoption of adaptation strategies designed to cope with environmental stressors present in the Chaco Salteño. The current study, also focused on producers of the Chaco Salteño, assesses how and why land tenure (or lack thereof) facilitates—or hinders—adaptation, as well as the institutions influencing its efficacy and adoption of alternative mechanisms of access.

## 2.3. Methods

For this study, we developed a semi-structured interview protocol based in part on existing literature that documents stressors and adaptation strategies common among producers in the Chaco Salteño. We conducted interviews with experts and producers to confirm and contribute to these findings, while also investigating the effectiveness of certain mechanisms (formalized land tenure and POs) for adaptation. Interviews and data analysis were conducted in Spanish; excerpts reported here were translated to English. Interviews lasted approximately 45 minutes on average and were conducted in July of 2022 in the province of Salta. Eighteen interviews were conducted in the Chaco Salteño with producers, complemented by four interviews in the capital city of Salta with experts such as NGO representatives and lawyers. Most interviews with producers were conducted with multiple adult members of the family at their homesite, with a combination of adult children, parents, and grandparents present, and one interview was carried out with a group of families belonging to the same PO. Fifteen of these were recorded and transcribed. Interviews with experts were conducted either virtually or in-person, two of which were recorded and transcribed. Extensive notes were taken in cases where the interviews were not recorded.

The first author coded transcriptions using the qualitative analysis software Dedoose to develop and refine key contributions to our research questions. We used a round of first-cycle coding to describe and record attributes of interviewees for categorization, identify the processes and patterns of stressors and adaptation strategies, and contribute to the construction of the greater context through holistic, conceptual, and provisional coding. Deductive/a priori coding was conducted with pre-established themes from existing literature while inductive coding was established through iterative engagement with the transcripts. Codes were continually revised to best fit the categories identified and expressed by interviewees until a final codebook was established after several rounds of review. The constraints of this study are that it focused only on one limited geography of the Chaco Salteño and included only criollo interviewees (no Indigenous community members were interviewed). Additionally, it was limited by the relatively brief amount of time spent in the field site to conduct the field investigations and difficulty in locating titleholding producers.

## 2.4. Results

### *2.4.1. Livelihood*

All producers had some level of livestock production as a source of income. All but two (who opted for raising pigs) kept herds of cattle to engage in cow-calf production[3]. Interviewees discussed that they are ranchers by way of life, but when it does not provide sufficient income, secondary sources are sought. All but one interviewee had been pastoralists on the same parcel for at least 40 years, with most being at least third-generation ranchers; some families had been in the area for over 100 years.

[3] Cow-calf production entails keeping a herd of cattle for the purpose of producing and selling the calves, generally to feedlot operators.

When asked how much land they occupied, answers generally ranged from about 100 to 2,000 hectares, with one outlier simply not knowing and another living and producing on a 10,000-hectare area. All producers interviewed engaged in "campo abierto" ("open field") grazing, a common practice in the Gran Chaco, to some extent. Open field grazing allows herds to travel freely across the landscape to find sources of water and feed. This means that cattle consistently travel onto neighbors' claimed fields, but none of the interviewees objected as this was part of the expectation for this system. Most producers expressed a desire to eventually fence in their parcels (for benefits to improve production and increase chances of being awarded a land title), however, it is a process that requires extensive labor and financial capital that is practically impossible for most producers to implement.

### *2.4.2. Stressors*

*Land Tenure*

The land tenure status of interviewed producers was as follows: five were titleholders, seven claimed possession rights (as did all the families in the group interview), four did not explicitly claim possession status, and one did not have any legally recognized claim to the land. During the interviews, it became apparent that possessors did not feel secure in their continued access to the land and there was overwhelming consensus that the ultimate goal was obtaining a formalized title (Table 1). However, according to both experts and producers, the process to obtain a formal title is bureaucratically complex, with the main constraints being lack of financial capital and the persistence of land-related conflicts. To obtain a title, one must go to court with the territorial boundaries to one's land already surveyed and provide proof that no conflicts

on land claims exist with neighbors or current titleholders (who are often not locals, living in the capital of Salta, Buenos Aires, or abroad). The financial burden for a surveyor, lawyer, and other legal-related expenses for the court case are a substantial constraint of their own, while the lack of historical precedence of mapping and ownership is an obstacle to resolving boundary disagreements with neighbors.

Many interviewees emphasized that enclosing the entirety of their property with fences amounted to a *de facto* requirement to establish a lack of land conflicts and increase the chances of obtaining a land title. However, experts discussed that although it may provide some benefits, enclosures might limit resource access for the cattle, as there is no guarantee that the enclosed area will provide enough water and vegetation to sustain the herd without extensive land improvements to ensure those conditions. This contrast is exemplary of the complexity of land tenure existing in the Chaco Salteño; secure tenure is understood to be more likely obtained if movements of herds, currently sustained by open-field grazing, is limited.

Producers without land titles exist in a legal gray area of land rights. Although under law, possession provides the same legal protections as does being a titleholder, none of those claiming possession status (and all others without title) reported being able to access resources such as credit or participation in development projects (Table 1). Further, although all non-titled producers claimed they wanted land titles, none were able to articulate specific projects or steps they might take advantage of if they hypothetically had a title. Responses to inquiries as to why they would like to be titleholders indicated that obtaining a title would provide an intrinsic feeling of security and that they would be more motivated to invest in their land. The lack of ability to communicate specific

resources accessible with a title indicates either an actual lack of accessible benefits or simply a lack of knowledge (likely because they are not in a position to benefit from them). The following excerpt is illustrative on this point:

> *Researcher: Do you have a priority for the same day you obtain a title?*
>
> *P05: For now, it's not so much that, but rather it would be ideal to have the title to feel more secure, that would be fundamental.*

Displacement resulting from the advancing agricultural frontier was not prevalent in the area where interviews were conducted, presumably because it was far enough removed from expansion that the agribusinesses had not yet arrived, or because the climate was unsuited to intensive agriculture. No interviewed producers had experienced evictions, but almost all had "heard" of others who had been evicted and feared they would be as well. Those that had attempted to obtain the title to their land had varying degrees of success: some received a title after assistance by local NGOs, while others had been in the process for up to 19 years. Disputes on territorial boundaries between neighbors were common, but because the boundaries were inherently uncertain and funds were lacking to determine boundaries with certainty, interviewees characterized the disputes as largely inconsequential. These were generally resolved by all parties agreeing to avoid activity on the disputed territory.

> *P11: And well, that area, which we managed to talk to the neighbor about, with respect, it is not used by them nor by us, and we cannot use that land until the problem is resolved… Just out of respect between neighbors, not due to the government, but between us, the neighbors, until one day we see how it can be solved…*

Producers explicitly stated that, even if a land dispute for a given area exists, animals drinking water or grazing on it is inevitable:

*Researcher: On the land where there is a dispute, are either of you using it? Or is no one using it?*

*P12: No. I mean, we both use it with our animals, ours go there, theirs come over here, as always.*

*Climate*

The harsh environment of the Chaco Salteño presents many obstacles for producers (Seghezzo et al., 2020; Tschopp, Ceddia, et al., 2022). This region experiences extremely hot summers, with monthly highs regularly reaching 45 to 50 degrees Celsius. Additionally, producers consistently reported that the climate had worsened since the 2000s:

*P15: Before, nature gave you more favorable types of conditions for (agricultural) activity. So, as time goes by the heat is stronger, the sun burns more, the drought lengthens… it is very difficult now if you are going to raise calves… it is very difficult because many kinds of vegetation have been lost.*

Along the same lines, it seems that producers had been suffering from a particularly severe drought at the time the interviews were conducted, with explanations that it had only rained a handful of times in the years immediately preceding our interviews.

*Climate and Livelihood*

The effects of decreased rainfall complicate production (Table 1). Decreased water in the region leads to reduced availability of natural vegetation and water for the

cattle and, ultimately, a loss of livestock and income. Interviewees noted the irony that when it does rain, runoff leads to flooding, making unpaved roads impassable, while erosion causes watering holes to become shallower, leading them to dry up more quickly. A common adaptation is the installation of shallow wells (about 10 to 15 meters deep to reach the water table) dug by hand. However, previous investigations have shown that much of the groundwater is at low levels and contains salt and/or arsenic (Grau et al., 2010). Interviewees confirm this and explain that it is not fit for human consumption:

> *P09: We don't have water for sure because we don't know if the water we have in the well is suitable for dinking because it is salty water that not even some animals have wanted to drink it… In the dry season, some animals didn't want to drink it, but they had to (there were no other options)… We don't have anything to tell us if it's suitable for either humans or animals…*

Wells with good water are used for humans only when other sources are not available, while wells with unfit water are used to irrigate small gardens or for livestock. Interviewees associated the decreased rainfall with an overall reduction of quality and quantity of water. Interviewees reported that wells that previously contained water fit for human consumption had turned salty or gone dry, while salt water or contaminated wells had become saltier, more contaminated, or dried up.

*Other Stressors*

Although insecure land tenure and a changing climate were consistently the greatest livelihood stressors identified by all interlocutors, poverty and political underrepresentation also acted as stressors in their direct and indirect consequences to rural livelihoods. As discussed, lack of financial capital is a barrier in obtaining a land

title, but it also manifests in an inability to make land improvements for increased livestock capabilities and being subjected to economic volatility, particularly that of gasoline, which is used in generators to pump water from groundwater wells. Producers also expressed discontent with the state's lack of services and infrastructure support, citing deteriorating and impassible roadways, inadequate local healthcare, and insufficient educational opportunities. Specifically, dissatisfaction in how laws exist, but are not being executed to their full extent was discussed in one interview:

> *P17: There is a provincial law, number 7658 and at the national level, the law is 27.118, Historical Reparation of Family Agriculture, which exist. Why are they not being executed?... They are not in practice… So, why is that law made if it is not going to be executed? If it is not put into practice? It serves for nothing that it is on paper, it is on paper, asleep, in a drawer, and when we have lots of problems and no one looks out for us?*

The laws discussed in this excerpt make guarantees related to quality of life for producers of rural Salta and Argentina, respectively, especially regarding regularization of lands for tenure security, equality of opportunity, and protection of human rights.

### *2.4.3. Mechanisms*

The two primary mechanisms utilized by interviewees to access resources that contribute to livelihood resiliency were formalized land tenure and participation in POs (Table 2). Here, we examine the role of these mechanisms in securing resilient livelihoods.

*Secure Land Tenure*

Although formal title and possession rights provide the same legal protections in principle, interviews revealed that possession rights are not necessarily assigned or enforced until one is at risk of immediate displacement. These rights seem to be something a producer would "claim", rather than "receive," as this producer explained:

> *P01: Possession is what you feel… It is to feel as though you are the owner… Suppose that you have to settle with the titleholder, it works for you, if you go to court, you will show that you have felt as the law says… That if you feel as though you are the owner, you'll work to improve the land, you'll care for and defend the land. And if they feel like that is enough, it's very difficult for a titleholder to come and drag you away, having all that work. It's more difficult.*

This individual explained that the value of possession rights only appears when at risk of displacement from the titleholder. Building on previous studies outlining the unreliable enforcement of possession rights in the judicial system, this finding suggests that the only method to genuinely achieve "secure tenure" is through a formal land title (Table 2).

The contrast that tenure status provides in accessing land improvement projects is notable (Table 2). Although all improvement projects in the area generally have the purpose of providing safe drinking water and increased income, titleholders were able to access large-scale projects through government programs, which are often assisted by development agencies, such as The World Bank and various United Nations programs. Specifically, titleholding producers reported that the Forests and Community project, financed by The World Bank, administered by the United Nations, and implemented by

the National Ministry of the Environment and Sustainable Development through the local National Agricultural Technology Institute offices had installed a rainwater catchment system and constructed a saltwater desalination plant on a nearby parcel owned by the national government. However, implementation of these by the coordinating local entity was often unreliable; the desalination plant was inoperable at the time interviews were conducted and cisterns for the rainwater catchment system were not delivered. Although none of the producers were enrolled, a payment for ecosystem services program exists through the National Forest Law (Act 26.331), which is only accessible to those with formalized land titles. One of the most tangible benefits discussed in literature associated with land titles is the ability to access lines of credit, which was discussed by producers as an option they would likely not use, but which would be beneficial if needed and desired. Lastly, perhaps the most important aspect of a land title as a mechanism for resilient livelihoods is security from displacement and peace of mind. Although none of those interviewed had experienced displacement, all expressed with certainty that they desired a title to avoid future risk of eviction.

*Producers' Organizations*

The importance and significance of POs was not fully contemplated by the authors prior to conducting interviews, as literature outlining their function and purpose in this context is limited. However, through interviews, the importance of POs in producers' livelihoods became clear. POs are formed by groups of between 10 to over 100 producers with the purpose of acting as a liaison and coordinator between members and project-enabling actors (primarily NGOs, but also government, development agencies, or others tasked with supporting producers) (Table 2). Each organization is

managed by elected executive members and requires fees for membership. Importantly, membership, and the associated benefits, is not contingent on land tenure status, allowing producers with insecure forms of tenure access to resource benefits for which they would otherwise be ineligible.

Interviews revealed that, for most producers, almost any access to outside resources occurred through a PO (Table 2).

> *P05: And with the (producers) organization, we sign up to get projects, benefits for everyone here in the area, that is the idea of working together… Specifically, those corrals that we are constructing… We have cisterns and other projects that have come down as well… And well, through (producers) organizations, small projects come from them…*

POs facilitate educational programming and distribution of new technology and emergency feed. Another important aspect is that when POs receive assistance for more families than they have members, projects are shared with non-member producers. The social capital and capacity of these organizations serve as an important resource for social movements aimed at improving the lives of producers and even defending the land of a neighbor who may be facing imminent eviction:

> *P17: (with POs) it is the only way to have a little more visibility, because if we go individually, imagine, it's just as if a fly comes out and that's it. On the other hand, when there are a lot of you, you want to protect each other.*
>
> *Researcher: There's strength in numbers.*
>
> *P17: Exactly. That's what it is.*

POs are ingrained into almost every facet of life, providing social capital for access to tangible resilience-building resources in production, educational workshops, and social capacity for the improvement and defense of livelihoods (Table 2). They provide not only access to resources but also serve as an alternative to dependence upon formal state processes for tenure security.

*Other Mechanisms - Support from Government Agencies*

Agencies at various levels of government provide programs and services to benefit producers. Many of the homes we encountered were equipped with solar panels for electricity installed by the local offices of the National Agricultural Technology Institute. In times of severe drought, the provincial government has enacted a state of emergency to supply essential feed for animals (although the producers concurred that it is never enough to sustain the herd in relation to the severity of the drought). Provincial and national government agencies administer payment for ecosystem services schemes that allow titled producers to benefit financially, if qualified. Certain programs provide welfare to the poorest rural inhabitants (regardless of tenure status) to increase productivity and thus, income (specifically, a producer cited they had received support from the national Social Agriculture Program before it was repealed in 2013). A rather robust network of national and provincial agencies exists to provide extension services that assist in production as well as in navigating legal cases concerning eviction or displacement. Lastly, rights contributing to the livelihoods of both titled and non-titled campesino criollos is inscribed in both national and provincial legislation, such as those mentioned in sections 2.2.2 and 2.4.2 (although the efficacy and implementation of these is often unreliable, as discussed).

## 2.5. Discussion

Although the provincial and national Argentine governments seek to provide services and infrastructure to promote the livelihoods of rural inhabitants in the Chaco Salteño, their inconsistent capacity to enforce rights, rules, and regulations is a barrier in operationalizing their efforts. This is evidenced by the laws and programs discussed in 2.2, 4.3.1, and 4.3.3 with the specific purpose of granting access to resilience-building resources for the producers in the Chaco Salteño while also considering existing literature and our finding that the only truly "secure" form of land tenure was achieved through land titles (Goldfarb & van der Haar, 2016; Tschopp, Inguaggiato, et al., 2022).

In our analysis, we found land titles to provide access to resources with the potential to address all four identified stressors listed in Table 1, while possession only provides an arbitrary recognition of habitation with limited potential to address security from displacement and ontological security. However, due to the financial, legal, and institutional challenges in obtaining a title, and the insecurity expressed by those with possession rights, most rural inhabitants of the Chaco Salteño live with land insecurity negatively affecting their livelihoods. This leads them to seek additional mechanisms to build resiliency, with POs and their underappreciated role in supporting rural livelihoods perhaps being the most important. Membership in POs also has the potential to address all four identified stressors, but barriers for membership are far less cumbersome than the barriers to securing a land title; membership, and the associated benefits, is not contingent on land tenure security. We theorize that although land titles are the only mechanism to provide access to large-scale projects and relative safety from displacement, the difficulty in obtaining them indicates that POs, with a lower barrier to

entry, might be more accessible mechanisms for resilience. POs' prevalence and relevance in providing access to resources directly supports the way in which producers make a living more holistically than land titles. The benefits associated with POs are accessible to all members, regardless of land tenure status. They serve as gatekeepers to facilitate projects between producers and funding entities and provide social and educational capacities that contribute to members' ability to navigate a changing legal, economic, and climatic landscape. Lastly, POs could be indicative of extensive institutions, not only due to the benefits they provide members and the greater community, but also due to their significance in the community-centered mindset that upholds rural livelihoods, whether as a contributor, a product, or both.

Although exploring perceptions of common-pool resources was not an objective of this study, interviews revealed that because of open-field grazing, multiple resources were generally accepted as communally shared. However, the desire of all producers to fence in parcels for privatization directly contradicts perceptions of communal resources and the successful raising of livestock. Fencing, specifically, appeared to be a key activity in establishing ownership (whether formally or informally) over a resource. Along the same lines, Paz (2020) found that fencing, and thus establishing definite boundaries of a producer's parcel, also made it easier for outsiders to privatize that land (due to the same legal benefits that fencing provides producers) and evict its inhabitants.

Our conclusions can be coupled with results from previous studies to produce more comprehensive public policy that aligns with conservation goals for social-ecological systems. Various studies link deforestation in the Argentine Gran Chaco to global commodity markets, public policy that supports land-use change to agriculture,

and conservation policies implemented with varying degrees of success (Cotroneo et al., 2021; Goldfarb & van der Haar, 2016; Salas Barboza et al., 2020; Seghezzo et al., 2011; Vallejos et al., 2021; Volante & Seghezzo, 2018). Faingerch et al. (2021) found that land held by non-local private agents experienced deforestation at far greater rates than land held by local private (titleholders) and non-private (possessors) agents, while others have found that forest management practices employed by producers, when appropriately supported with funds and materials, can be effective for ecosystem conservation (Cotroneo et al., 2018; Tschopp, Ceddia, et al., 2022). We support the findings and recommendations in these studies to strengthen standards in conservation laws, recognition of possession rights as secure forms of tenure, and extension of payments for ecosystem services programs to possession status landholders. Further, we expand on these to recommend financial, administrative, and logistical assistance to POs, who, as supported by our results, have proven to be effective in supporting resilient livelihoods of producers while also facilitating sustainable practices (Cotroneo et al., 2021). An important consideration is that POs are inherently the most familiar with stressors and respective adaptations that ultimately lead to resilient livelihoods for the rural inhabitants of the Chaco Salteño.

Our results indicate that both secure land tenure and communal organizations play a significant role in the resilience of rural livelihoods. However, it is important to acknowledge that the concept of "secure" tenure must be considered carefully. Technically, our results indicate that secure tenure, as defined in law, does not contribute to resilient livelihoods of producers in the Chaco Salteño. It is only because of our exploration of the differentiation between land tenure status variations, and determination

that land titles are the only *de facto* form of secure tenure, that we identify secure tenure as a contributor to resilience with certainty. It is essential for future research concerning land tenure and livelihood resilience to explore the nuance in tenure security and consider the institutional reality of the study area to draw reliable conclusions.

## 2.6. Conclusion

Our findings that stressors and mechanisms are interrelated in their influence on producers' ability to adapt and anticipate to climate variability support our initial research goal of assessing the role of land tenure in livelihood resilience to climate variability. This study expands current research from the Chaco Salteño and beyond to support and further the notion that livelihood scenarios and socio-ecological systems are dynamic, complex, and require prioritization of human agency within larger systems and institutions. Evaluating factors that build livelihood resilience to further adaptation practice discourse requires consideration of the relevant adaptation and anticipation options specific to the area of interest. Due to the prominence of land conflicts in the Chaco Salteño, we prioritized examining how and why land tenure security contributes to livelihood resilience within the existing ecological and institutional contexts. By considering these, we acknowledge the complexity of livelihood scenarios and provide an in-depth analysis of land tenure in contributing to resilient livelihoods when compared to other strategies.

Resilience is best achieved when one has a collection of different strands of power to grant access to resources that benefit anticipation of and adaptation to disturbances. In this study, pastoralists living in a commodity frontier exercised powers to employ the mechanisms at their disposal to gain, maintain, and control benefits from

resource access. As is the reality of the current state of Argentina, and much of the rest of the world, communal organizations serve a significant role in contributing to livelihood security that is difficult to match even by the strongest state institutions. This type of collaboration that promotes mutual agreements as an unquestioned social norm could be indicative of a robust institution existing at the smallest scale of community. Exploration of this topic is an area for potential future research inquiry. The findings of this study, which represent the reality of those producers interviewed, serve as an important consideration for actors implementing development projects in the Chaco Salteño and other arid forest environments.

# Tables

***Table 1.1***. *Primary climate and non-climate livelihood stressors. Each stressor's implications for producers are listed with examples from interviews. Identifiers are assigned to each stressor.*

| | **Stressor** | **Implication** | **Examples** |
|---|---|---|---|
| **Climate** | | | |
| *C1* | Climate variability | Water scarcity, warm temperatures, and decreased vegetation | More extreme drought, changes in weather patterns, worsening groundwater quality and quantity, erosion, evaporation of open-air water sources, flooding |
| **Non-Climate** | | | |
| *NC1* | Insecure land tenure | Physical and ontological insecurity, lack of security for investments | Actual threat of displacement, continual sense of impending displacement and instability, inability to access programs, projects, services only available to titleholders |
| *NC2* | Poverty | Low financial capital | Sensitivity to economic shifts, inability to pay for legal fees necessary to obtain a title, and hinderance in executing projects for improved agricultural production |
| *NC3* | Political underrepresentation | Insufficient government services and infrastructure | Nearly impassible roadways, inadequate local education and healthcare, lack of electricity and internet |

***Table 1.2***. *Mechanisms for adaptation. Resource accessed, benefits of the resource, and implications of the benefit are listed for each corresponding adaptation mechanism (POs and Land Tenure). Stressor identifiers from Table 1 are included adjacent to the implications addressing them. There are no additional benefits for non-members of POs other than those listed in the "All" column. There are no benefits associated with not having a legally recognized claim to land.*

| *Resource* | *Benefits* | Implication | |
|---|---|---|---|
| **Land Tenure** | | ***Land Title*** | ***Possession*** |
| *Entitlement* | *Land rights* | Full recognition of ownership (*NC1, NC2, NC3*)<br>Development Agency Projects (*C1, NC2*)<br>Government Services (*C1, NC2, NC3*)<br>Ontological Security (*NC1*) | Recognition of habitation (NC1) |
| **Producers Organizations (PO)** | | ***All*** | ***Members*** |
| *Social Capital* | *Communication with outside actors* | Legal/political representation (NC3) | Project Access (C1, NC2)<br>Educational courses (C1)<br>Legal facilitation (NC1, NC2 |
| | *Community support* | Collective negotiation for higher calf prices (*NC2*)<br>Defend against displacement (*NC1*) | Project access (*C1, NC2)*<br>Educational courses (*C1*)<br>Legal facilitation (*NC1, NC2*) |
| | *Logistical coordination* | Distribution of government information, services, and projects (*NC3*) | Ontological security (*NC1*) |

References

Altrichter, M., & Basurto, X. (2008). Effects of land privatisation on the use of common-pool resources of varying mobility in the Argentine Chaco. *Conservation and Society*, *6*(2), 154. https://doi.org/10.4103/0972-4923.49209

Amanor, K. S. (2012). Global resource grabs, agribusiness concentration and the smallholder: Two West African case studies. *The Journal of Peasant Studies*, *39*(3–4), 731–749. https://doi.org/10.1080/03066150.2012.676543

Antwi-Agyei, P., Dougill, A. J., & Stringer, L. C. (2015). Impacts of land tenure arrangements on the adaptive capacity of marginalized groups: The case of Ghana's Ejura Sekyedumase and Bongo districts. *Land Use Policy*, *49*, 203–212. https://doi.org/10.1016/j.landusepol.2015.08.007

Araghi, F. (2009). Accumulation by displacement: Global enclosures, food crisis, and the ecological contradictions of capitalism. *Review (Fernand Braudel Center)*, *32*(1), 35.

Barbetta, P. (2014). Aportes a la cuestión jurídica campesina en la Argentina del agronegocio. *Trabajo y Sociedad*, *22*.

Barbetta, P. (2019). Conflictos por la propiedad de la tierra en la provincia de Chaco, Argentina. Contribuciones a una agenda de investigación. *Revista de la Facultad de Derecho y Ciencias Políticas (Cusco)*, *4*(10), 223–238. https://doi.org/10.51343/rfdcp.v4i10.15

Barral, M. P., Villarino, S., Levers, C., Baumann, M., Kuemmerle, T., & Mastrangelo, M. (2020). Widespread and major losses in multiple ecosystem services as a result of

agricultural expansion in the Argentine Chaco. Journal of Applied Ecology, 57(12), 2485–2498. https://doi.org/10.1111/1365-2664.13740

Cohn, A. S., Newton, P., Gil, J. D. B., Kuhl, L., Samberg, L., Ricciardi, V., Manly, J. R., & Northrop, S. (2017). Smallholder agriculture and climate change. *Annual Review of Environment and Resources*, *42*(1), 347–375. https://doi.org/10.1146/annurev-environ-102016-060946

*COP27 Official*. (n.d.). Retrieved December 6, 2022, from https://cop27.eg/#/vision#goals

Cotroneo, S. M., Jacobo, E. J., & Brassiolo, M. M. (2021). Degradation processes and adaptive strategies in communal forests of Argentine dry Chaco. Integrating stakeholder knowledge and perceptions. *Ecosystems and People*, *17*(1), 507–522. https://doi.org/10.1080/26395916.2021.1972042

Cotroneo, S. M., Jacobo, E. J., Brassiolo, M. M., & Golluscio, R. A. (2018). Restoration ability of seasonal exclosures under different woodland degradation stages in semiarid Chaco rangelands of Argentina. *Journal of Arid Environments*, *158*, 28–34. https://doi.org/10.1016/j.jaridenv.2018.08.002

de Haan, L., & Zoomers, A. (2005). Exploring the frontier of livelihoods research. *Development and Change*, *36*(1), 27–47. https://doi.org/10.1111/j.0012-155X.2005.00401.x

del Giorgio, O., Robinson, B. E., & le Polain de Waroux, Y. (2022). Impacts of agricultural commodity frontier expansion on smallholder livelihoods: An assessment through the lens of access to land and resources in the Argentine

Chaco. *Journal of Rural Studies*, *93*, 67–80. https://doi.org/10.1016/j.jrurstud.2022.05.014

Faingerch, M., Vallejos, M., Texeira, M., & Mastrangelo, M. E. (2021). Land privatization and deforestation in a commodity production frontier. *Conservation Letters*, *14*(4). https://doi.org/10.1111/conl.12794

Fan, Y., Shi, X., Li, X., & Feng, X. (2022). Livelihood resilience of vulnerable groups in the face of climate change: A systematic review and meta-analysis. *Environmental Development*, *44*, 100777. https://doi.org/10.1016/j.envdev.2022.100777

Feder, G., & Feeny, D. (1991). Land tenure and property rights: Theory and implications for development policy. *The World Bank Economic Review*, *5*(1), 135–153.

Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Coe, M. T., Daily, G. C., Gibbs, H. K., Helkowski, J. H., Holloway, T., Howard, E. A., Kucharik, C. J., Monfreda, C., Patz, J. A., Prentice, I. C., Ramankutty, N., & Snyder, P. K. (2005). Global consequences of land use. *Science*, *309*(5734), 570–574. https://doi.org/10.1126/science.1111772

Goldfarb, L., & van der Haar, G. (2016). The moving frontiers of genetically modified soy production: Shifts in land control in the Argentinian Chaco. *The Journal of Peasant Studies*, *43*(2), 562–582. https://doi.org/10.1080/03066150.2015.1041107

Grau, J. B., Antón, J. M., Tarquis, A. M., Colombo, F., de los Ríos, L., & Cisneros, J. M. (2010). An application of mathematical models to select the optimal alternative for an integral plan to desertification and erosion control (Chaco Area – Salta

Province – Argentina). *Biogeosciences*, *7*(11), 3421–3433. https://doi.org/10.5194/bg-7-3421-2010

Hellin, J., Ratner, B. D., Meinzen-Dick, R., & Lopez-Ridaura, S. (2018). Increasing social-ecological resilience within small-scale agriculture in conflict-affected Guatemala. *Ecology and Society*, *23*(3), art5. https://doi.org/10.5751/ES-10250-230305

Ifejika Speranza, C. (2010). *Resilient adaptation to climate change in African agriculture*. DIE, Deutsches Institut für Entwicklungspolitik.

IPCC. (2014). *Climate change 2014: Synthesis report. contribution of working groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (R. K. Pachauri, L. Meyer, & The Core Writing Team, Eds.). Intergovernmental Panel on Climate Change.

IPCC. (2022). *Climate change and land: IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* (1st ed.). Cambridge University Press. https://doi.org/10.1017/9781009157988

Jara, C., & Paz, R. (2013). Ordenar el territorio para detener el acaparamiento mundial de tierras. La conflictividad de la estructura agraria de Santiago del Estero y el papel del estado. *Proyección*, *15*, 171–195.

Johnson, M. F. (2019). Strong (green) institutions in weak states: Environmental governance and human (in)security in the Global South. *World Development*, *122*, 433–445. https://doi.org/10.1016/j.worlddev.2019.06.010

Leguizamón, A. (2014). Modifying Argentina: GM soy and socio-environmental change. *Geoforum, 53*, 149–160. https://doi.org/10.1016/j.geoforum.2013.04.001

Marschke, M. J., & Berkes, F. (2006). Exploring strategies that build livelihood resilience: A case from Cambodia. *Ecology and Society*, *11*(1). https://www.jstor.org/stable/26267795

Moore, S. F. (1998). Changing African land tenure: Reflections on the incapacities of the State. *European Journal of Development Research*, *10*(2), 33. https://doi.org/10.1080/09578819808426715

Paz, R. G. (2020). Agricultural holdings with undefined boundaries, communal systems and counter-hegemonies: The persistence of the peasantry in Argentina. *Journal of Agrarian Change*, *20*(4), 562–578. https://doi.org/10.1111/joac.12363

Potapov, P., Hansen, M. C., Pickens, A., Hernandez-Serna, A., Tyukavina, A., Turubanova, S., Zalles, V., Li, X., Khan, A., Stolle, F., Harris, N., Song, X.-P., Baggett, A., Kommareddy, I., & Kommareddy, A. (2022). The global 2000-2020 land cover and land use change dataset derived from the Landsat Archive: First results. Frontiers in Remote Sensing, 3, 856903. https://doi.org/10.3389/frsen.2022.856903

Ravikumar, A., Andersson, K., & Larson, A. M. (2013). Decentralization and forest-related conflicts in Latin America. *Forest Policy and Economics*, *33*, 80–86. https://doi.org/10.1016/j.forpol.2012.07.005

Ribot, J. C., & Peluso, N. L. (2003). A theory of access. *Rural Sociology, 68*(2), 153–181. https://doi.org/10.1111/j.1549-0831.2003.tb00133.x

Salas Barboza, A. G. J., Cardón Pocoví, J. M., Venencia, C., Huaranca, L. L., Agüero, J. L., Iribarnegaray, M. A., Escosteguy, M., Volante, J. N., & Seghezzo, L. (2020). Ten years of contested enforcement of the Forest Law in Salta, Argentina. The role of land-change science and political ecology. *Journal of Land Use Science*, *15*(2–3), 221–234. https://doi.org/10.1080/1747423X.2019.1646333

Seghezzo, L., Huaranca, L. L., Vega, M. L., Jeckeln, G. V., Avalos, M. A., Iribarnegaray, M. A., Volante, J. N., Serrano, F. H. M., Mastrangelo, M., Sun, Z., & Müller, D. (2020). Sustainable farmers, deficient State? Self-reported agricultural sustainability in the Argentine Chaco region. *International Journal of Agricultural Sustainability*, *18*(6), 473–491. https://doi.org/10.1080/14735903.2020.1793645

Seghezzo, L., Volante, J. N., Paruelo, J. M., Somma, D. J., Buliubasich, E. C., Rodríguez, H. E., Gagnon, S., & Hufty, M. (2011). Native forests and agriculture in Salta (Argentina): Conflicting visions of development. *The Journal of Environment & Development*, *20*(3), 251–277. https://doi.org/10.1177/1070496511416915

Sikor, T., & Lund, C. (2009). Access and property: A question of power and authority. *Development and Change*, *40*(1), 1–22. https://doi.org/10.1111/j.1467-7660.2009.01503.x

Suchá, L., & Dušková, L. (2022). Land access mechanisms of Soweto farmers: Moving beyond legal land tenure for urban agriculture. *Land Use Policy*, *119*, 106169. https://doi.org/10.1016/j.landusepol.2022.106169

Tanner, T., Lewis, D., Wrathall, D., Bronen, R., Cradock-Henry, N., Huq, S., Lawless, C., Nawrotzki, R., Prasad, V., Rahman, Md. A., Alaniz, R., King, K., McNamara,

K., Nadiruzzaman, Md., Henly-Shepard, S., & Thomalla, F. (2015). Livelihood resilience in the face of climate change. *Nature Climate Change*, *5*(1), 23–26. https://doi.org/10.1038/nclimate2431

Tschopp, M., Ceddia, M. G., & Inguaggiato, C. (2022). Adoption of sustainable silvopastoral practices in Argentina's Gran Chaco: A multilevel approach. *Journal of Arid Environments*, *197*, 104657. https://doi.org/10.1016/j.jaridenv.2021.104657

Tschopp, M., Inguaggiato, C., Saravia, R. C., & Ceddia, M. G. (2022). Using the constitutionality framework to understand alliances, collective action, and divisions between Indigenous and peasant communities in the Chaco Salteño. *Human Ecology*. https://doi.org/10.1007/s10745-022-00337-1

UNFCCC. (2015). *Paris Agreement*. 27. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Vallejos, M., Camba Sans, G. H., Aguiar, S., Mastrángelo, M. E., & Paruelo, J. M. (2021). The law is spider's web: An assessment of illegal deforestation in the Argentine Dry Chaco ten years after the enactment of the "Forest Law." *Environmental Development*, *38*, 100611. https://doi.org/10.1016/j.envdev.2021.100611

Volante, J. N., & Seghezzo, L. (2018). Can't see the forest for the trees: Can declining deforestation trends in the Argentinian Chaco region be ascribed to efficient law enforcement? *Ecological Economics*, *146*, 408–413. https://doi.org/10.1016/j.ecolecon.2017.12.007

Zak, M. R., Cabido, M., Cáceres, D., & Díaz, S. (2008). What drives accelerated land cover change in central Argentina? Synergistic consequences of climatic, socioeconomic, and technological factors. *Environmental Management, 42*(2), 181–189. https://doi.org/10.1007/s00267-008-9101-y

# CHAPTER 3

# RURAL RESILIENCE: LAND TITLES AND PRODUCERS' ORGANIZATIONS[4]

[4] Collins, A., and Abrams, J. To be submitted to *The Nature Conservancy – Reports*

## 3.1. Introduction

Land-dependent populations living on the margins of society face the brunt of the consequences induced by climate change (Foley et al., 2005; IPCC, 2022). Shifts in seasonality, water availability, and extreme weather are a strain on economic and food security for farmers, pastoralists, and others whose existence is intimately dependent on natural resources (Cohn et al., 2017). As a result, encouraging local climate adaptation and mitigation has emerged as a primary concern for the international community, being a focus in the 2015 Paris Agreement, United Nations (UN) Climate Change Conferences, and incorporated into the UN Sustainable Development Goals (*COP27 Official*, n.d.; UNFCCC, 2015).

The Gran Chaco of South America, the second largest ecoregion on the continent and one of the largest subtropical forests in the world, is experiencing a land-use transformation at rates three times the global average (Zak et al., 2008). Together with already harsh environmental conditions and a history of land conflicts, the expansion of genetically modified soybean cultivation and feedlot cattle operations is exacerbating livelihood insecurity for local rural inhabitants (Goldfarb & van der Haar, 2016). Primarily pastoralists by way of life, second, third, and even fourth generation ranchers seek diverse methods of accessing resources to anticipate and adapt to the changing climate, political, and socio-economic spheres around them (Tanner et al., 2015). This report focuses, in particular, on criollo campesino pastoralists (subsistence farmers of

mixed racial and ethnic background, hereafter referred to as "producers") in the Gran Chaco region of Salta Province, Argentina.[5]

Our research team conducted a study to explore the mechanisms that producers in the Chaco Salteño employ for anticipation and adaptation to climate-related disturbances. This study was grounded in concepts of access to resources for "resilient livelihoods," and we were especially interested in the role played by land tenure security in supporting adaptive strategies (Ifejika Speranza et al., 2014; Ribot & Peluso, 2003). Here, we provide an overview of the research while highlighting important considerations and providing recommendations of potential interest to policymakers, decisionmakers, NGOs, development agencies and others tasked with implementing development projects in the area. We deliberately approached the research process with the purpose to produce useful results through close attention to the perspectives of the producers themselves.

### 3.2. Methods

We conducted 18 formal semi-structured interviews with individuals, households, and groups of smallholding producers and four interviews with local topic experts to determine what the most common mechanisms to access livelihood resources are, identify why these specific mechanisms are employed, and determine how effective they may be at contributing to resilient livelihoods. All interviews took place in the Province of Salta, Argentina in June of 2022. Qualitative research and analysis methods were used to develop and refine key contributions to the research questions.

[5] Indigenous population in the area face many of the same livelihood insecurities as do criollo campesino populations, but due to legal differentiations between them, we focus solely on criollo campesinos in this study.

## 3.3. Findings

### *3.3.1. Livelihood and Land*

All producers engaged in livestock production (primarily cow-calf operations) as a source of income and employed open field grazing, a management style that allows herds to move freely across the landscape to find sources of water and feed.[6] All but one producer interviewed had lived on the same parcel for at least 40 years; each household, except for one outlier, occupied up to 2,000 hectares (the outlier occupied 10,000 hectares). Fencing between fields was non-existent and territorial disputes were common (producers emphasized that these were not "conflicts") but were generally settled through land-use agreements between neighbors. The fencing in of fields was expressed by most as an eventual goal, given its benefits in improving production and increasing chances of being awarded a land title. However, obtaining a title is often a bureaucratically complex process which also requires extensive financial and labor investment (legal fees, fencing, etc.), making it practically impossible for most producers.

### *3.3.2. Stressors*

*Climate*

The historical climate of the Chaco Salteño, characterized by extremely hot summers (monthly highs regularly between 45 and 50 degrees Celsius) and relatively low rainfall, as identified by both producers and experts, has worsened in recent years. A changing climate presents here in the form of decreased rainfall, longer seasonal droughts, and more extreme weather. Although the climate of the Chaco Salteño is recorded and discussed thoroughly in the literature, and interviews confirm those

[6] Cow-calf production entails keeping a herd of cattle for the purpose of producing and selling calves, generally to feedlot operators.

findings, our interviews detailed some of the tangible and direct consequences of the changes that are occurring:

> *P15: Before, nature gave you more favorable types of conditions for (agricultural) activity. So, as time goes by the heat is stronger, the sun burns more, the drought lengthens… it is very difficult now if you are going to raise calves… it is very difficult because many kinds of vegetation have been lost.*

Producers also explained that water scarcity, as a result from decreased rain, warmer temperatures, and landscape degradation, has negative effects on livestock health and groundwater wells, a primary source of water for many households. Livestock malnutrition, dehydration, and even death from decreased water and vegetation availability was common. Meanwhile, water from wells, used for human and livestock consumption, decreases in quantity and quality as the climate worsens:

> *P09: We don't have water for sure because we don't know if the water we have in the well is suitable for dinking because it is salty water that not even some animals have wanted to drink it… In the dry season, some animals didn't want to drink it, but they had to (there were no other options)… We don't have anything to tell us if it's suitable for either humans or animals…*

*Non-Climate Stressors*

The conjunction of low socio-economic status and uncertain land tenure directly hinders access to resources and limits livelihood options. Low socio-economic status, and the political underrepresentation accompanying it, is a barrier in making investments for improved agricultural production and appealing to the state for necessary infrastructure

projects, while insecure land tenure limits access to certain government programs and leaves producers at risk of displacement.

Although secure land tenure is theoretically attained through a formal land title or possession rights (the latter achieved by living on the same parcel for more than 20 consecutive years and treating it as an owner would, as outlined in Art. 4015 and 2384 of the Civil Code), we found, in practice, formalized land titles to be the only method to genuinely achieve secure tenure. Experts and producers emphasized the bureaucratic complexity and financial, technological, and labor limitations to seeking a formalized land title. They also stressed that although one might claim possession rights, continued access to land was uncertain under this status. This is backed by findings in other studies that documented displacement of those with possession rights.

### *3.3.3. Mechanisms for Adaptation*

The two primary mechanisms utilized by interviewees to access resources that contribute to livelihood resiliency were formalized land tenure and membership in communal producers' organizations (hereafter "POs"). Although, at the time the field investigation was conducted, literature outlining the function and purpose of POs in this context was limited, we found that they play an important role in producers' livelihoods and in their ability to adapt to change.

*Secure Land Tenure*

Although the rights from a *formal title* to owned land and rights of *possession* to occupied land are both defined in legal code to provide similar protections for inhabitants and act as secure forms of land tenure, our interviews revealed that possession rights are not necessarily legally assigned or enforced until a possessor is at risk of immediate

displacement from the titleholder. Rather, producers explained that possession rights are a notion to be claimed:

> *P01: Possession is what you feel… It is to feel as though you are the owner… Suppose that you have to settle with the titleholder, it works for you, if you go to court, you will show that you have felt as the law says… That if you feel as though you are the owner, you'll work to improve the land, you'll care for and defend the land. And if they feel like that is enough, it's very difficult for a titleholder to come and drag you away, having all that work. It's more difficult.*

A notable contrast exists in the land improvement projects accessible by producers according to their tenure status. Although all producers were able to access certain projects to increase agricultural production (primarily through POs), only those with formal titles received funding through large-scale projects administered by development agencies, such as The World Bank and various United Nations programs (examples are rainwater catchment systems and beekeeping supplies). One of the most tangible benefits discussed in literature associated with land titles is the ability to access lines of credit, which as discussed by producers, is an option they would likely not use, but would be beneficial if needed and desired. Lastly, one of the most important aspects of land title is what is sometimes called "ontological security:" security from displacement and peace of mind. Although none of those interviewed had experienced displacement, all expressed with certainty that they desired a title to avoid future risks of eviction.

*Producers' Organizations*

POs are membership-based, legally recognized communal organizations comprised of local producers whose primary purpose is acting as a coordinator and liaison between project-funding actors (primarily NGOs, but also government, development agencies, and others tasked with supporting producers) and members as the beneficiaries. Each organization is managed by elected executive members and requires fees for membership. Importantly, membership, and the associated benefits, is not contingent on land tenure status, allowing producers with insecure forms of tenure access to resource benefits for which they would otherwise be ineligible.

We found that, for most producers, almost any access to outside resources occurred through a PO. Project access is the most tangible benefit of membership, but POs also conduct educational workshops on the legal process to obtain a title, agricultural best practices, and provide a level of ontological security recognized by its members (although not to the same extent as would a land title). Further, POs offer a certain level of social capital that benefits the entirety of the community (member and non-member): extending projects to independent producers when receiving projects for a greater number of families than they have members, facilitating government distribution of information and new technology, and acting as a catalyst for social movements aimed at improving the lives of smallholding producers through organized demonstrations or defending the land of community members who may be facing imminent eviction:

> *P17: (with POs) it is the only way to have a little more visibility, because if we go individually, imagine, it's just as if a fly comes out and that's it. On the other hand, when there are a lot of you, you want to protect each other.*

*Researcher: There's strength in numbers.*

*P17: Exactly. That's what it is.*

Not only do POs provide access to tangible resilience-building resources for production, but they also serve as an alternative to dependence upon governmental processes for tenure security.

### 3.4. Recommendations

Throughout the interview process, discussions arose regarding solutions or adaptations that both producers and experts proposed as effective in anticipating and adapting to shocks and stressors. We compiled the following lists of recommendations based upon our research. These include both smaller household-level projects and larger widespread efforts that have the potential to directly contribute to resilient livelihoods for producers of the Chaco Salteño. As expected, these primarily concern water scarcity or livestock production. Any tools required to accomplish these recommendations can be shared and borrowed among POs to decrease individual cost and ensure security of investment for the funding entity.

To ensure the efficacy of these recommendations, it is imperative to take a bottom-up approach in the implementation of projects; projects must be responsive to the individual needs of producers and their communities. Producers themselves are the ones who are inherently most familiar with the stressors and respective adaptations required to sustain themselves in the Chaco Salteño. Meanwhile, POs have proven to be effective in supporting resilient livelihoods while also facilitating sustainable agricultural practices. Thus, we recommend collaborating with POs (or other on-the-ground organizations

whose stakeholders are primarily producers) in all stages of proposing, planning, and executing projects.

*Small-Scale Projects*

*1. Well Water Testing*

Water wells are widespread in the region but are often salty or contaminated with toxins and not fit for human consumption. Water testing technology, whether at the individual, PO, or community level can facilitate educated decision-making on the best use of well water.

*2. Well Construction*

Digging wells is a significant time and labor expense. Powered well-digging tools or well-digging initiatives by outside entities, in combination with services to locate hydrologically favorable placements for wells, can facilitate these costly operations.

*3. Pond Dredging*

Over time, ponds that serve as a source of water to the livestock have become shallower due to erosion and are evaporating more quickly. Dredging (or the tools used for it), although conducted previously in some places, can be implemented more consistently to ensure ponds hold water year-round.

*4. Pond Enclosures*

Enclosing ponds with fencing and pumping the water into troughs can decrease both erosion and the spread of disease among livestock. Further, covering the ponds with a structure to obstruct sunlight can decrease evaporation. However, continuous maintenance would be required to ensure water is accessible to livestock.

*5. Electricity*

Although electricity in the field from a power grid is non-existent, some producers have government-provided solar panels for domestic, in-home electricity usage. A greater distribution of panels (and compatible equipment) can decrease dependence on the standard gasoline generators (and the accompanying volatile prices of petroleum) that most producers use to pump water from wells or power home appliances. Increased availability of electricity can also serve as an incentive for youth to stay in the area.

*Large-Scale Efforts*

*1. Mapping & Surveying*

Mapping and land-surveying can facilitate demarcating territorial boundaries between properties, an essential step to obtain a land title.

*2. Possession Recognition*

Furthering possession rights to be a legally binding, enforceable guarantee of land security prior to a specific threat of eviction strengthens a producer's claim to land, allowing for greater access to resources and greater ontological security.

*3. PO Administrative Support and Acknowledgement*

POs are often dependent on their legal and financial status to continue operations; administrative support extended to POs can assist with compliance and prevent loss of legal status. Greater recognition of the benefits POs provide, and co-producing and implementing projects with them, can ensure effective use of resources.

*4. Internet*

Internet connection is virtually non-existent in the field, but can increase access to markets, information (legal, medical, veterinary, etc.), and be an incentive for youth to

stay in the area. Communication via the web can also decrease dependence on word-of-mouth to spread important program or project details, a time-consuming activity.

*5. Infrastructure*

Improvements in physical infrastructure (paved roads, power grid) and services (education, health, agricultural, legal, financial) are likely to be the most impactful, albeit costly, recommendations to improve the livelihoods of producers and other rural populations.

These recommendations were included because of their feasibility in implementation by both non-government and government actors while also addressing specific stressors and concerns discussed by interviewees. They are intended to be altered to be more appropriate, feasible, effective, and efficient for implementation not only in the study area, but also in other geographical regions with similar socio-ecological landscapes. Although significant improvements in physical infrastructure (paved roads, power grid) and services (education, health, agricultural, legal, financial) are likely to be the most impactful recommendations to improve the livelihoods of producers and other rural populations, they require far greater financial investment and political power to execute appropriately.

## 3.5. Conclusion

The greatest issues faced by producers of the Chaco Salteño are land tenure insecurity and lack of water access. These dynamic livelihood stressors are acutely intertwined, and the contrasting mechanisms employed to face them contribute to the complexity of the current situation. Producers employ mechanisms with varying degrees of resource access, land titles and POs, to facilitate anticipation and adaptation to

disturbances for resilient livelihoods. As is the reality of the current state of Argentina, and much of the rest of the world, communal organizations serve a role in contributing to livelihood security that is difficult to match even by the strongest state institutions. We conclude that it would be equally beneficial for both development agencies and producers to not only approach and coordinate implementation of projects through POs, but also to support POs in their function as robust social networks at the smallest scale of community. Producers, and collectively, POs, are the actors most attuned to the greatest livelihood stressors and respective solutions for the area's rural inhabitants.

References

Cohn, A. S., Newton, P., Gil, J. D. B., Kuhl, L., Samberg, L., Ricciardi, V., Manly, J. R., & Northrop, S. (2017). Smallholder agriculture and climate change. *Annual Review of Environment and Resources*, *42*(1), 347–375. https://doi.org/10.1146/annurev-environ-102016-060946

*COP27 Official*. (n.d.). Retrieved December 6, 2022, from https://cop27.eg/#/vision#goals

Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Coe, M. T., Daily, G. C., Gibbs, H. K., Helkowski, J. H., Holloway, T., Howard, E. A., Kucharik, C. J., Monfreda, C., Patz, J. A., Prentice, I. C., Ramankutty, N., & Snyder, P. K. (2005). Global consequences of land use. *Science*, *309*(5734), 570–574. https://doi.org/10.1126/science.1111772

Goldfarb, L., & van der Haar, G. (2016). The moving frontiers of genetically modified soy production: Shifts in land control in the Argentinian Chaco. *The Journal of Peasant Studies*, *43*(2), 562–582. https://doi.org/10.1080/03066150.2015.1041107

Ifejika Speranza, C., Wiesmann, U., & Rist, S. (2014). An indicator framework for assessing livelihood resilience in the context of social–ecological dynamics. *Global Environmental Change*, *28*, 109–119. https://doi.org/10.1016/j.gloenvcha.2014.06.005

IPCC. (2022). *Climate change and land: IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* (1st ed.). Cambridge University Press. https://doi.org/10.1017/9781009157988

Ribot, J. C., & Peluso, N. L. (2003). A theory of access. *Rural Sociology*, *68*(2), 153–181. https://doi.org/10.1111/j.1549-0831.2003.tb00133.x

Tanner, T., Lewis, D., Wrathall, D., Bronen, R., Cradock-Henry, N., Huq, S., Lawless, C., Nawrotzki, R., Prasad, V., Rahman, Md. A., Alaniz, R., King, K., McNamara, K., Nadiruzzaman, Md., Henly-Shepard, S., & Thomalla, F. (2015). Livelihood resilience in the face of climate change. *Nature Climate Change*, *5*(1), 23–26. https://doi.org/10.1038/nclimate2431

UNFCCC. (2015). *Paris Agreement*. 27. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Zak, M. R., Cabido, M., Cáceres, D., & Díaz, S. (2008). What drives accelerated land cover change in central Argentina? Synergistic consequences of climatic, socioeconomic, and technological factors. *Environmental Management*, *42*(2), 181–189. https://doi.org/10.1007/s00267-008-9101-y

# CHAPTER 4

# CONCLUSIONS

The goal of this study was to explore and analyze the most common mechanisms employed by producers of the Chaco Salteño to anticipate and adapt to stressors within their ecological and institutional contexts and to produce findings for academic and professional audiences based in the perspective of the producers themselves.

Chapter 2 assessed land tenure status and producers' organizations in their accessibility and efficacy to provide adaptation benefits. Secure land tenure, although a significant avenue to receive projects with considerable adaptation capacities, is extremely difficult to obtain due to a complicated legal process and the extensive financial and labor capital required. Alternatively, producers' organizations, which are a primary coordinator for producers to receive projects from outside entities, have a comparatively low barrier of entry and provide indirect benefits to the greater community. Further, the implications of the process of land privatization have the potential for negative consequences on the types of agricultural activities most common among producers. Although producers' organizations seem to be the superior option over secure land tenure alone, it is important to note that secure tenure is the most certain option against displacement from land insecurity, and that in combination, producers' organizations and secure tenure provide the most comprehensive benefits available for anticipation and adaptation to climate and non-climate stressors. Chapter 3 provided recommendations based on these findings to potential practitioners conducting

development activities in the region. Most recommendations aim to alleviate issues of water scarcity at the household level. Recommendations for widespread implementation of services and infrastructure relating to mapping, land rights, support for producers' organizations, among others, are also included.

This research both supports and contrasts with existing literature on land tenure and community organizations as mechanisms for climate adaptation in the Chaco Salteño and other, similar, operational environments. On the one hand, land tenure provides access to the most significant adaptation resources encountered, supporting findings that land tenure security is a mechanism for resilient livelihoods (Aguiar et al., 2022; Antwi-Agyei et al., 2015; Daniel et al., 2019). Our findings that communal organizations are significant in adaptation to shocks and stressors aligns with previous studies outlining the importance of these types of organizations in the lives of smallholding peasant farmers (Hellin et al., 2018; Paz, 2020; Tschopp et al., 2022; Wald, 2015). However, this research differs in its approach and provides nuance related to specific land tenure statuses and their efficacy as adaptation mechanisms. Qualitative methods allowed for an in-depth exploration of the differences in land tenure regimes to make distinctions in the actual adaptation benefits provided. This allowed for the determination that the only truly "secure" form of tenure is through a land title, and importantly, other legal rights to secure tenure did not provide security from displacement or access to adaptation resources. For future research involving land tenure, it is important to carefully consider the reality of the tenure regimes in question to answer research questions comprehensively.

References

Aguiar, S., Mastrángelo, M. E., Texeira, M., Meyfroidt, P., Volante, J. N., & Paruelo, J. M. (2022). Roads and land tenure mediate the effects of precipitation on forest cover change in the Argentine Dry Chaco. *Land Use Policy*, *112*, 105806. https://doi.org/10.1016/j.landusepol.2021.105806

Antwi-Agyei, P., Dougill, A. J., & Stringer, L. C. (2015). Impacts of land tenure arrangements on the adaptive capacity of marginalized groups: The case of Ghana's Ejura Sekyedumase and Bongo districts. *Land Use Policy*, *49*, 203–212. https://doi.org/10.1016/j.landusepol.2015.08.007

Daniel, D., Sutherland, M., & Ifejika Speranza, C. (2019). The role of tenure documents for livelihood resilience in Trinidad and Tobago. *Land Use Policy*, *87*, 104008. https://doi.org/10.1016/j.landusepol.2019.05.027

Hellin, J., Ratner, B. D., Meinzen-Dick, R., & Lopez-Ridaura, S. (2018). Increasing social-ecological resilience within small-scale agriculture in conflict-affected Guatemala. *Ecology and Society*, *23*(3), art5. https://doi.org/10.5751/ES-10250-230305

Paz, R. G. (2020). Agricultural holdings with undefined boundaries, communal systems and counter-hegemonies: The persistence of the peasantry in Argentina. *Journal of Agrarian Change*, *20*(4), 562–578. https://doi.org/10.1111/joac.12363

Tschopp, M., Inguaggiato, C., Saravia, R. C., & Ceddia, M. G. (2022). Using the constitutionality framework to understand alliances, collective action, and divisions between Indigenous and peasant communities in the Chaco Salteño. *Human Ecology*. https://doi.org/10.1007/s10745-022-00337-1

Wald, N. (2015). In search of alternatives: Peasant initiatives for a different development in northern Argentina. *Latin American Perspectives*, *42*(2), 90–106. https://doi.org/10.1177/0094582X14534608

# APPENDIX A

# INTERVIEW GUIDE

Note: As interviews were semi-structured, the following was a general guide. The numbered questions were the standard questions, while the lettered questions served as prompts.

1. Can you tell me a little bit about yourself and your household?
    a. How long has your family lived here? Have you always lived on this property?
    b. What do you do for work? What do others in your household do for work?
    c. What is your role in the household? Are you the head of the household?
2. Can you tell me about your land?
    a. How large is it?
    b. What is the history of the land? (Size or use changes)
    c. What is the primary purpose of the land?
    d. How reliant are you on the land for your livelihood?
    e. [If reliant at all]
        i. How?
        ii. What is produced here?
        iii. [If livestock] What type? How many?
        iv. How much of your income is generated from the land? Is it self-sufficient?
        v. Do you have any structures or buildings that assist in the functions of the land?
        vi. What are some machines or tools that assist in this way?
        vii. Primarily, who does the labor on the land?

f. Have you made any changes in the way you use or access land in the last five years?

g. Are there any changes that you have considered making?

3. Do you feel vulnerable to losing your land?

    a. Why/why not?

    b. How so?

    c. What is the land tenure status of your land?

        i. Do you have the official title? Possession rights? Are you leasing it?

        ii. Can you elaborate what that means?

        iii. [If not official title]

            1. Have you considered trying to obtain official title? Why/why not?

            2. Are you currently in the process of obtaining official land title? Why/why not?

            3. Are you making any changes to your land to obtain an official title?

        iv. Is obtaining official titles expensive?

        v. Does [having / not having] official land title affect your decisions on what to produce here?

        vi. Are there benefits from having official title to the land?

        vii. Are there benefits from not having official title to the land?

viii. What would you do if you felt that someone were trying to kick you off of your land? Is there someone you would contact? Do you have other options for places to live and raise livestock?

4. What are some major challenges that you and your household face?
    a. Do you have conflict over your land with others?
    b. [If yes]
        i. Who? Why?
        ii. How long have they been in the area?
        iii. Do you know if they own land someplace else?
        iv. How does this affect your feeling of security/vulnerability?
        v. How does this affect your livelihood and the wellbeing of your household?
        vi. How does this affect the function of your land?
5. Have you experienced any changes in the environment in the last five years? [e.g. Pollution? Droughts? Heavy rainfall? Erosion?]
    a. What do you think is causing these changes?
    b. What is the effect of these on your wellbeing?
    c. Have you considered making any adjustments in response? Have you made any?
        i. [If no] Why?
        ii. [If yes]
            1. What, why, and how?
            2. How are you paying for it?

d. Have you seen other producers make changes in response?

6. Have you experienced any other changes in the last five years? [e.g., changes to prices, markets, neighbors, policies, interactions with the government, etc.]
    a. What do you think is causing these changes?
    b. What is the effect of these on your wellbeing?
    c. Have you considered making any adjustments in response? Have you made any?
        i. [If no] Why?
        ii. [If yes]
            1. What, why, and how?
            2. How are you paying for it?
    d. Have you seen other producers make changes in response?
7. Are you part of a producer's organization?
    a. What is the purpose of the producer's organization?
    b. Do you learn of new farm practices through this organization?
    c. What are some other sources of knowledge regarding new production practices or technologies?
        i. What do you think of these sources and new practices/technologies?
        ii. Do you implement any of these? Or invest in the new technology? Why/why not?
8. What do you think the future will look like here? Do you think the next generation will carry on the same activities that you do? Why / Why not?

    a. Do you think they will face a different situation? [E.g., ability to use the land, live on the land, produce livestock]
    b. What would you like the next generation to do differently?
9. Can you tell me about your community?
    a. Who is in your community?
    b. What are some characteristics that make it unique?
    c. Do you live in a paraje?
    d. Do neighbors and community members help each other when in need?
    e. How would you describe the quality of life and livelihood/well-being here?
10. Is there anything else you would like to tell us about any of the topics we discussed today?
    a. Yourself, community, land, risk of losing land, land conflicts, challenges to your wellbeing, environmental effects, or implementing new strategies?