



# X International Congress of Agroecology

World's agroecologies: United to face global crises

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## Ranchers' perception of resilience challenges in marginal agroecosystems

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**Abstract:** This study focused on the assessment of ranching systems' resilience in marginal agroecosystems, taking Magellan and the Chilean Antarctic Region as a case study. A questionnaire was designed to collect information on a range of attributes of ranch and ranchers that contribute to explain resilience capacities (robustness, adaptability, and transformability). A total of 68 ranchers were surveyed in the provinces of Magallanes, Tierra del Fuego, and Última Esperanza between November 2023 and May 2024. The survey allowed the characterisation of sheep and mixed, sheep-cattle, ranches in terms of family and labour, herd and land, production and marketing, sources of information, and so forth. This paper focuses on the ranchers' perceptions of the challenges they face now and in the future. The most significant challenges facing ranchers in the region are as follows: climate change (drought and variability), the loss of international markets for wool and lamb meat, the low availability of labour, the degradation of pastures and soils, the high costs of inputs, and the increasing wildlife conflicts. The paper concludes by commenting on some relevant aspects for the resilience of ranching in the region.

**Resumen:** Este estudio contribuye a la evaluación de la resiliencia de agroecosistemas marginales, tomando como caso de estudio a la región de Magallanes y Antártica Chilena. Se diseñó un cuestionario para recoger información sobre una serie de atributos de las explotaciones y los productores que contribuyen a explicar las capacidades de resiliencia (resistencia de las explotaciones, capacidad de adaptación y de transformación). Un total de 68 ganaderos fueron encuestados en las provincias de Magallanes, Tierra del Fuego y Última Esperanza entre noviembre de 2023 y mayo de 2024. La encuesta permitió caracterizar las explotaciones ovinas y mixtas ovino-vacuno en términos de familia y mano de obra, rebaño y tierra, producción y comercialización, fuentes de información, etc. Este trabajo se centra en las percepciones de los ganaderos sobre los retos a los que se enfrentan ahora y en el futuro. Los desafíos más importantes que enfrentan los ganaderos de la región son los siguientes: el cambio climático (sequía y variabilidad), la pérdida de mercados internacionales para la lana y la carne de cordero, la baja disponibilidad de mano de obra, la degradación de pastizales y suelos, los altos costos de los insumos y el aumento de los conflictos por la vida silvestre. El trabajo concluye comentando algunos aspectos relevantes para la resiliencia de la ganadería en la región.

**Keywords:** sheep production, survey, future challenges, Patagonia.

### Introduction

The resilience of agroecosystems is currently a topic of significant interest to politicians, scientists, agriculture stakeholders, and the media. The climate crisis and other unpredictable phenomena, such as the COVID-19 pandemic, or the war in Ukraine, have had a significant impact on livestock farming and ranching systems worldwide (Abay et al., 2023; Lopez-Ridaura et al., 2021), revealing their vulnerability and challenging food security. In the context of global change, which refers to large-scale changes that affect the functioning of the Earth system (e.g., climate change, biodiversity loss, and globalization processes), it can be predicted that these crisis situations will become more frequent and will be accompanied by slow long-term changes (e.g., sociodemographic and market trends). The convergence of crises and trends will challenge the sustainability of our agrifood systems and their capacity to provide essential private goods (e.g., food production, farmers' livelihoods) and public goods (e.g., provisioning,



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regulatory and cultural ecosystem services, and biodiversity). Within primary production, ranching and rangelands are particularly susceptible to these crises and trends, due to the greater complexity of animal production cycles and their management.

Agricultural systems need to be resilient to cope with challenges. Resilience can be defined as: *the capacity of socio-agroecosystems to resist, adapt, and even transform when necessary in response to long-term (un)expected crises and trends, in order to persist – i.e. continue to function–* (Meuwissen et al., 2019). Resilience analysis represents a paradigm shift in the conception of complex socio-agroecosystems, where social, economic, institutional, and ecological factors interact at different scales, facing the increasing uncertainty and unpredictability.

This study is part of a research project that aims to assess of the resilience of agroecosystems at farm or ranch level, i.e. the functional unit in ranching systems. Here, we focus on the Magellan and the Chilean Antarctic Region, as a case study representative of livestock systems in marginal environments due to remoteness and climate. The project uses a survey-based methodology for the evaluation and monitoring of the resilience of livestock farm that combines objective indicators (technical data of the farm) and subjective measures (perceived by ranchers). This paper analyses the perceptions of producers about current and future challenges of ranching in the region.

## Methodology

A semi-structured survey of sheep and goat producers in Spain was adapted to the conditions of the case study and focused on sheep or mixed sheep-cattle ranches. This survey included i) objective and subjective indicators of resilience attributes, ii) technical indicators of resilience in the face of specific crises and challenges, and iii) items to assess farmers' personal resilience and psychological profile. The survey was administered to 68 ranchers in the provinces of Magallanes, Tierra del Fuego, and Ultima Esperanza (Figure 1). We applied a quota sampling method to cover the variability of operation types (family vs. commercial), and sizes of the stays (ranches) in each province. For the purposes of analysis, two groups were considered: large and small ranches. The smaller livestock operations were characterized by a smaller size (less than 500 sheep or 70 suckler cows), an eminently family workforce, and a location in peri-urban areas (Puerto Natales and Porvenir). The survey was implemented face-to-face by a single interviewer between December 2023 and April 2024. The data analysis was conducted using descriptive methods, including means and frequency distribution. Here we present results of ranchers' perceptions on resilience challenges only.



Figure 1. Map of ranches location.



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## Results and Discussion

Producers were asked with an open question about the main challenges they will face in the future (spontaneous knowledge). Figure 2 summarizes the challenges that were mentioned twice or more. Other challenges were mentioned once: inadequate fertilization of soils, lack of summer pastures, lack of fencing, insufficient road infrastructure, null bargaining power for small ranchers, conflicts with new inhabitants, and deficient internet. Fifty-seven (84%) producers mentioned climate change as one of the main worries for the future of their farms. The main consequence of climate change in the region is drought (Pessacg et al., 2020), but also increasing wind intensity and uncertainty. The market for wool collapsed during the COVID-19 pandemic and has not recovered. This had a devastating impact on the sheep industry of Patagonia as it has historically been oriented towards wool production (Strauch & Lira, 2012). Meat markets are more stable, but ranchers expressed concerns for the future regarding global meat consumption trends. It is noteworthy that most meat produced in the region is exported outside the country, mostly to China. Labour was also an important issue, as in many other producing regions in extensive conditions (Strijker, 2005). Producers referred both to low availability and lack of skills for the job, which takes place in harsh circumstances. Another key problem was the degradation of soils and rangeland. As land managers themselves recognized, this is a consequence of poor adaptive management of grazing, which has largely remained the same for decades. The impact of high stocking rates in many areas has been exacerbated by droughts and strong winds that have a negative effect on bare soils. Regenerative grazing and other agroecological practices are being tested to evaluate its utility. The livestock systems in the region are low-input and low-output, so the dependence on off-farm inputs, especially feeds, is relatively low. However, the increasing prices of fuel and other inputs impact producers, especially the smaller ones that are less self-sufficient. Many ranchers mentioned feral dogs and conflicts with wildlife. The predation of sheep and lambs by feral and domestic dogs is specially worrying around cities, such as Puerto Natales and Porvenir. Wildlife conflicts were frequent in remote areas where large holdings are located. The most important species of concern were: Andean fox (*Lycalopex culpaeus*; mentioned by 36 ranchers), Guanaco (*Lama guanicoe*; 33), and Puma (*Puma concolor*; 17). The following problem in importance was the lack of innovation and adaptation, not only to climate change, but also to varying market conditions. The current way to conduct ranching is very traditional and there is room for technological improvements, especially around forage production, grazing management and product diversification. The need of adapting ranching systems to climate change, while reversing pasture degradation requires to define defoliation criteria for the rangeland, riparian, and meadows ecosystems within the region, with a focus on increasing the vegetation tolerance and recovering to grazing and climate change events (García-Favre et al., 2023). Low profitability was mentioned only by 6 producers and lack of ranch continuity by 5. In 33 cases (48%), ranchers affirmed that continuity was assured within the family. It is also important to note that 46 producers (67%) affirmed that ranching was mostly a “way of life”, which highlights the cultural heritage of sheep industry in the region. Other problems with lower number of mentions were the lack of knowledge for livestock operating, increasing policy regulations and taxes, the global context around agriculture (e.g. veganism), the installation of wind turbines for green hydrogen, rusting of sheep, deficient management, lack of diversification of production, animal genetics not adapted to the new conditions, and finally the invasive specie *Hieracium pilosella*.



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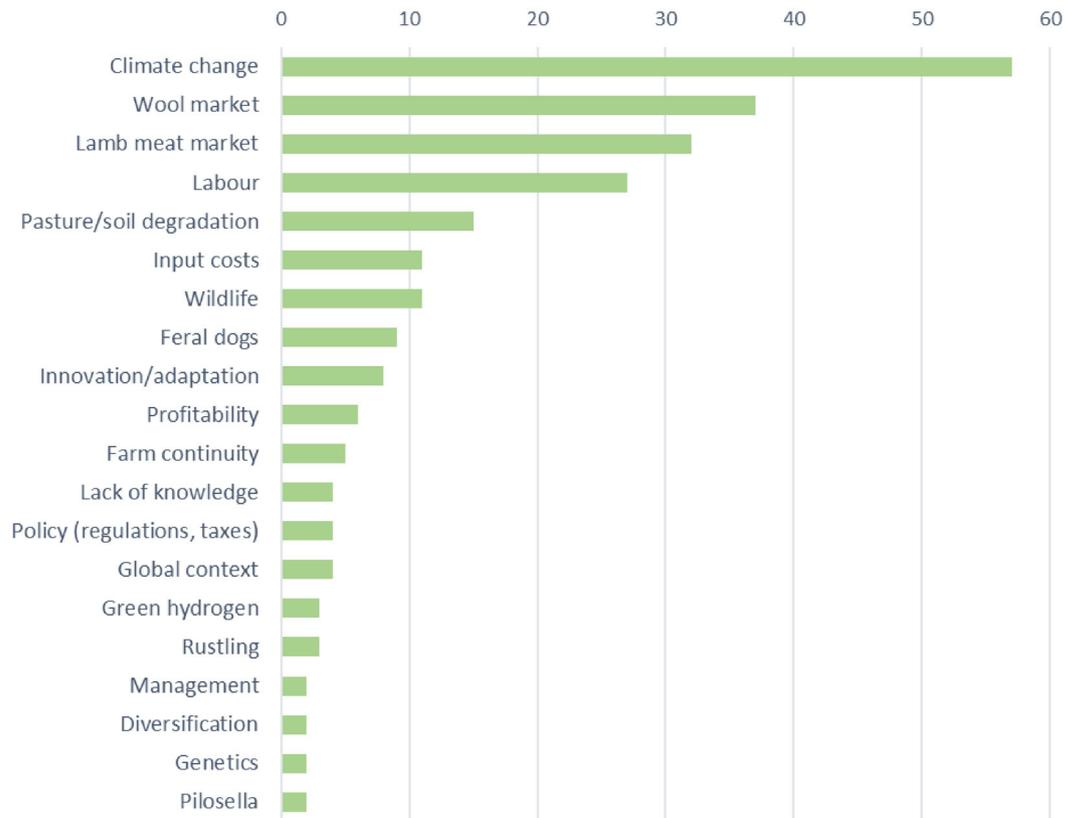


Figure 2. Number of mentions of ranching challenges (spontaneous knowledge).

The larger producers face greater labour challenges, both in terms of the availability of suitable labour and the level of training required for the job. Additionally, they encounter greater difficulties in coexisting with wildlife, particularly the guanaco (*Lama guanicoe*) whose numbers are increasing in the region. Small producers face greater challenges with predation by feral dogs (in peri-urban areas) and higher inputs' costs.

In addition, ranchers were asked to rate the current impact of a series of challenges (induced knowledge) with a 7-point Likert scale from 1-no impact to 7-extreme impact (Figure 3). Some of the challenges were chosen according with the reality of the region, particularly the potential development of large-scale green hydrogen industry. The impact of drought and the variability of markets constitute the main challenges of livestock industry today, as also indicated in Figure 2. It is worthy to note that, in contrast to the result obtained in the open question, the wildlife conflicts are placed in the third position, above labour issues. The impact of agricultural policies, green hydrogen industry (see below), and the COVID-19 pandemic are lower. The main differences between small and big ranches relate to the impact of changes in the international markets, as they depend on local markets in the cities where they are located.



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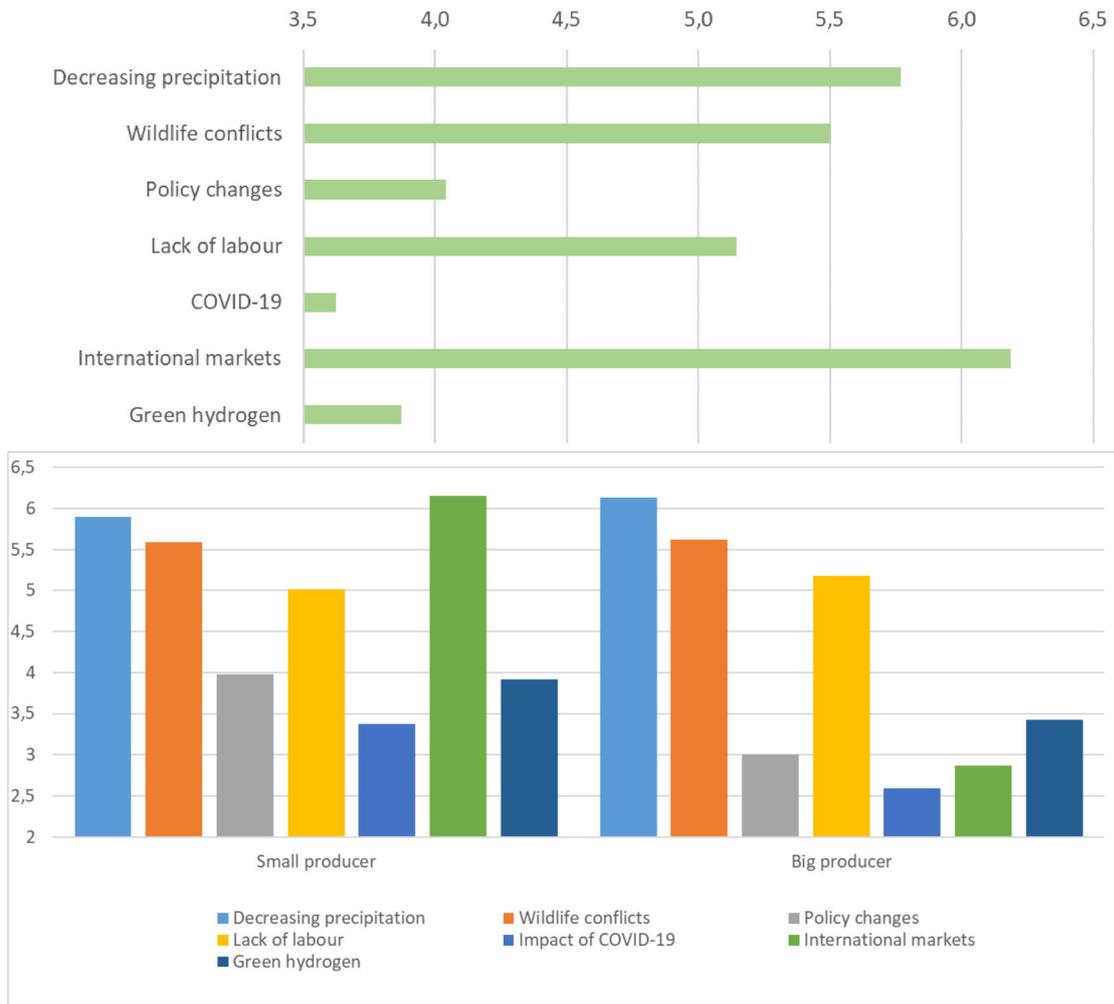


Figure 3. Impact of different challenges on ranching (induced knowledge) and differences between small and big producers (7-point Likert scale from 1-no impact to 7-extreme impact).

Finally, the study included a specific section on the impact of many projects for the installation of large wind turbines to produce green hydrogen, given the enormous interest that this industry arouses in Chilean Patagonia. It is important to note that these projects would be located in pastoral areas where most large holdings are located, and that these holdings would receive large annual rents. Overall, 65% of farmers believed that green hydrogen would be beneficial for their operations, while 62% believed it would be beneficial for the livestock sector. Conversely, 13% of farmers believed that the green hydrogen industry would have a negative impact on their holdings, and 18% of ranchers believed it would have a negative impact on the livestock sector. The arguments for and against were diverse, and we present two examples below that we believe reflect the majority views well:

*The introduction of green hydrogen will provide us with the resources to make the necessary investments to improve and maintain our productivity, while also ensuring that the environment is not degraded. From a revenue and business perspective, it could prove to be a "lifesaver".*

*The green hydrogen industry will increase labour costs and labour shortages, the development of new settlements will increase animal rustling, and an increased number of feral dogs killing sheep for sport. Some of the abattoirs will likely close due to the decrease in animal numbers.*



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## Conclusions

The problems of livestock industry, particularly the sheep sector, in Magellan and the Chilean Antarctic Region are common to other regions of the world (climate change, prices of inputs and products, labour availability, wildlife conflicts, etc.). Climate change is widely recognized and greatly worries the livestock sector, which does not happen elsewhere.

The green hydrogen industry can radically change the region's economy, and especially its agriculture. Most ranchers see this industry as an economic opportunity. However, should the green hydrogen proposed projects be realised, the sector might contract significantly and become less dependent on off-farm labour, given the increased opportunity cost. Some actors in the chain, ranchers and abattoirs/exporters, will probably disappear, as some of the farmers recognized during the interviews.

Given that livestock management in the region has not changed substantially in the last century, and that climate change and socioeconomic trends will increasingly impact, adaptive and transformative changes will be needed to improve the resilience of ranching systems. Consequently, it is highly plausible that the livestock sector of Magallanes and Chilean Antarctica will undergo substantial changes in the near future. The capacity of livestock producers and their holdings to adapt and transform will be pivotal in the formation of the agroecosystems that will emerge. The solutions, including novel agroecological practices, must be tailored to the region, even at the level of individual holdings and their context.

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## Bibliographical references

- Abay, K. A., Breisinger, C., Glauber, J., Kurdi, S., Laborde, D., & Siddig, K. (2023). The Russia-Ukraine war: Implications for global and regional food security and potential policy responses. *Global Food Security*, 36. <https://doi.org/10.1016/j.gfs.2023.100675>
- García-Favre, J., López, I. F., Cranston, L. M., Donaghy, D. J., Kemp, P. D., & Ordóñez, I. P. (2023). Functional contribution of two perennial grasses to enhance pasture production and drought resistance under a leaf regrowth stage defoliation criterion. *Journal of Agronomy and Crop Science*, 209(1), 144–160. <https://doi.org/10.1111/jac.12602>
- Lopez-Ridaura, S., Sanders, A., Barba-Escoto, L., Wiegel, J., Mayorga-Cortes, M., Gonzalez-Esquivel, C., Lopez-Ramirez, M. A., Escoto-Masis, R. M., Morales-Galindo, E., & García-Barcena, T. S. (2021). Immediate impact of COVID-19 pandemic on farming systems in Central America and Mexico. *Agricultural Systems*, 192, 103178. <https://doi.org/10.1016/J.AGSY.2021.103178>
- Meuwissen, M. P. M., Feindt, P. H., Spiegel, A., Termeer, C. J. A. M., Mathijs, E., de Mey, Y., Finger, R., Balmann, A., Wauters, E., Urquhart, J., Vignani, M., Zawalińska, K., Herrera, H., Nicholas-Davies, P., Hansson, H., Paas, W., Slijper, T., Coopmans, I., Vroege, W., ... Reidsma, P. (2019). A framework to assess the resilience of farming systems. *Agricultural Systems*, 176. <https://doi.org/10.1016/j.agsy.2019.102656>
- Pessacq, N., Flaherty, S., Solman, S., & Pascual, M. (2020). Climate change in northern Patagonia: critical decrease in water resources. *Theoretical and Applied Climatology*, 140(3–4), 807–822. <https://doi.org/10.1007/s00704-020-03104-8>
- Strauch, O., & Lira, R. (2012). Bases para la producción ovina en Magallanes. INIA-Kampenaiké, Punta Arenas.
- Strijker, D. (2005). Marginal lands in Europe - causes of decline. *Basic and Applied Ecology*, 6(2), 99–106.