Determinants of management techniques implementation on family-operated livestock farms.

by

Ines Soca Bruni
Bs in economics

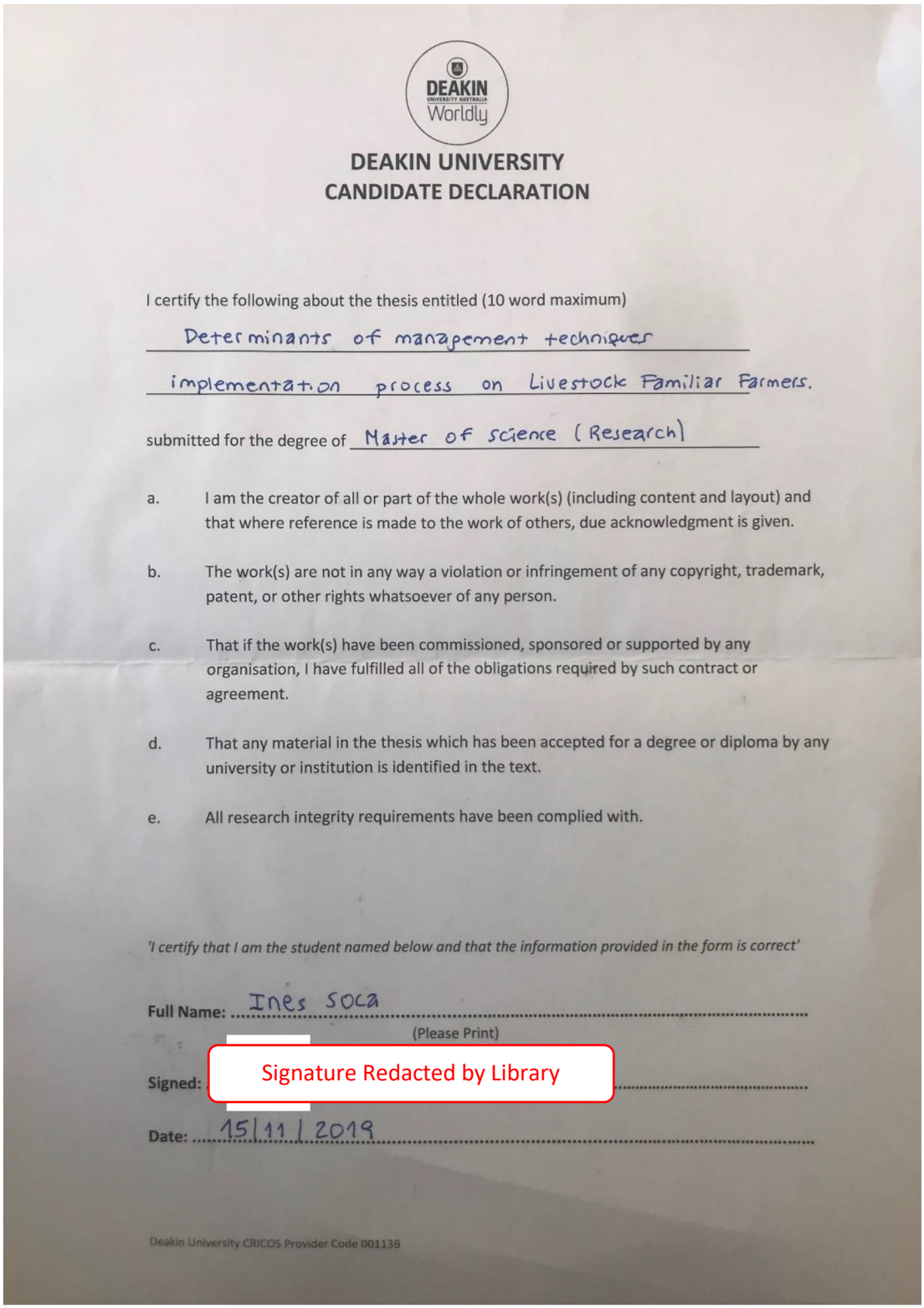
Submitted in fulfilment of the requirements for the degree of

Master of Science (Research)
Sustainable Regional Development

Deakin University

November 2019

Candidate declaration



DEAKIN UNIVERSITY
CANDIDATE DECLARATION

I certify the following about the thesis entitled (10 word maximum)

Determinants of management techniques implementation process on Livestock Familiar Farmers.

submitted for the degree of Master of science (Research)

a. I am the creator of all or part of the whole work(s) (including content and layout) and that where reference is made to the work of others, due acknowledgment is given.

b. The work(s) are not in any way a violation or infringement of any copyright, trademark, patent, or other rights whatsoever of any person.

c. That if the work(s) have been commissioned, sponsored or supported by any organisation, I have fulfilled all of the obligations required by such contract or agreement.

d. That any material in the thesis which has been accepted for a degree or diploma by any university or institution is identified in the text.

e. All research integrity requirements have been complied with.

'I certify that I am the student named below and that the information provided in the form is correct'

Full Name: Ines Soca
(Please Print)

Signed: Signature Redacted by Library

Date: 15/11/2019

Deakin University CRICOS Provider Code 00113B

Access to thesis form

DEAKIN UNIVERSITY
ACCESS TO THESIS - A

I am the author of the thesis entitled Determinants of management techniques implementation on family-operated livestock farms.

submitted for the degree of Master of Science (Research) Sustainable Regional Development

This thesis may be made available for consultation, loan and limited copying in accordance with the Copyright Act 1968.

'I certify that I am the student named below and that the information provided in the form is correct'

- **Full Name: Ines Soca Bruni**

Signed: Signature Redacted by Library

Date: 19/02/2020

Acknowledgements

To everyone that made this learning process possible.
Special thanks to my sister Lucia, for having every feedback and time dedicated to organising my mind, and for having my back on a mental and practical level.
To my partner, Ger, for the support and love offered every day, anywhere.
To my mum and dad for the support. To Victor, Rob and Jim for sharing their experience and making this process possible.
To Adrian and Pablo, for the time dedicated to enriching this research with complimentary, and exciting perspectives.
To all of my Deakin classmates that enriched this process with so many debates and opinion exchanges and time shared.
To the FAGRO team and Ana Ines, Marcello and Varinia for the openness, and availability they had throughout this process.
To the OPP-FDI team: Nadia, Martin, Camila, Luciana, Miralba and the rest of the team for every mate and tea offered.
To my friends' Vale, Sofi, Fio, Luli, Vero, and everyone that support this process practically, emotionally, or mentally.
To the Uruguayan government, familiar farmers and citizens for supporting and financing this opportunity, acknowledging how privileged I am for the opportunity, and hoping the generated knowledge and my every day will make a positive impact on the country, especially the most vulnerable sectors of our society.

Table of contents

List of Figures

List of Tables

Acronyms and abbreviations list

AGEV – OPP: National Agency of Evaluation – Planning and Budgeting Office (Uruguay).

BTI: Breeding Technique Index

CONEAT: National Commission of the Eco-agronomic Study of the Earth

CIRCVC-UDELAR: Interdisciplinary Centre of Variability Response and Climate Change of the University of the Republic.

DGRN: General Direction of Natural Resources

DIEA: National Direction of Agricultural Statistics.

FO: Farmers organization

FAO: Food and Agriculture Organisation of the United Nations

FLF: Family- operated livestock farms

FLS: Familiar Livestock Systems

GDP: Gross Domestic Product

GHG: Greenhouse gases

GIS: Geographical Information System

GFCC Project: Project Familiar operated livestock Fars and Climate Change project ("Ganaderos Familiar y Cambio Climático ")

IPCC: Intergovernmental Panel on Climate Change.

MGAP: Ministry of Livestock, Agriculture and Fisheries

MVOTMA: Ministry of Housing, Land-Use Planning and Environment

OPYPA: Agricultural Planification and Programme Office

PNA- Agro: National Adaptation Plan to Climate Variability and Change for agriculture.

UDELAR: University of the Republic in Uruguay.

UG: Livestock equivalent Unit ("Unidades ganaderas")

Abstract

The implementation of effective management techniques among family-operated livestock farms (FLF) in Uruguay is currently scarce, despite the availability of simple, low-cost and easy to implement procedures, according to agronomic experts. This thesis examines how technical assistance, social capital and education might determine the FLF´s willingness to implement those effective procedures or management techniques.

This research delves into the relationship between a Breeding Technique Implementation index (BTI index) and the explanatory variables (technical assistance, social capital and education) using a quantitative logistic regression model. As a complementary research method, experts involved in public policy on the topic were interviewed. Experts perceptions were useful to gain a more in-depth understanding of the technique implementation process.

Through quantitative analysis, the impacts of explanatory variables and their magnitudes, on the probability of achieving a high level of implementation of management techniques was obtained. Meanwhile, through qualitative analysis, it was possible to obtained information regarding the mechanisms of these explanatory variables, providing relevant information to elaborate on further recommendations for public policy. This information was relevant to identify aspects that public policy must consider when promoting and ensuring the sustainability of groups through time.

Results showed a significant and positive effect between having regular technical assistance (greatest effect), social capital, having a higher percentage of the land under their ownership and a higher level of education, with a higher probability of implementing more management techniques on the field. Working outside the field was not associated with a higher level of implemented techniques, as previously expected in the context of this research.

Results also revealed that there are specific characteristics that technical assistants should whenever the aim is to increase resources efficiency and achieve successful results such as: offering farmers practical solution (not only theoretical), promoting flexible implementation processes , helping farmers overcoming practical difficulties and suggesting techniques through a succession of short-term milestones, that might lead to achieving long term goals.

In terms of research this study underlines the importance of combining quantitative and qualitative methods to understand complex real-world situations, which have provided valuable inputs for public policy design and evidence. Considering the diverse reality of FLF in the Uruguayan context is a sine qua non-condition to influence their management decisions and therefore increase effectiveness of public policy instruments in Uruguay.

1. Introduction

The following chapter introduces the most salient aspects towards the understanding of the topic of this research. It presents a summary of the motivation, followed by the general research aim and specific objectives. Finally, it presents the hypothesis established for this study.

Current research is contextualised on the sustainable intensification approach of livestock farmers in Uruguay. The main problem is that despite many innovative low-cost management techniques, have been proven efficient to increase productivity on breeding cattle farming, implementation levels among Uruguayan farmers are low.
Among cattle breeding sector, this research is focused on farmers classified as Livestock Familiar Farmers (FLF), which are considered those who carry specialized farming where at least half of the working labour force is from the family unit, lives in the farm or nearby areas, and has livestock production as the primary source of family income (Paparamborda, 2017). Also, a practical case was further studied: Eastern Sierra region in Uruguay.
The research hypothesises is that there are specific characteristics such as technical assistance availability, educational level and social capital that could be influencing the decision of implementing or not a set of low cost, management techniques that constitute "good practices" according to the scientific community.
Based on a mixed methodology, the specification and estimation of a logistic regression model with data on 206 farmers was developed. Additionally, interviews were implemented to technical assistants that oversaw the implementation of a practical public policy on FLF during three years among Eastern Sierra region, to capture influential aspects to consider on the implementation of public policy that aim to change the implementation of management techniques on the sector.
Based on this research, the main conclusions were that educational level, social capital and technical assistants are the most influential variables on the level of implementation of farm management techniques. Among those, regular technical consultation is the variable which has the most significant impact.
Despite the limitations, this research is considered relevant since it combines quantitively and qualitative approach on a topic that had not been approached with a similar method in Uruguay.

1.1 Research aims

To better understand the characteristics of the adoption of management techniques among family-operated livestock farms (FLF), the purpose of this research is *to critically assess and identify which internal and external factors might contribute to the implementation process of farm management techniques, that can ultimately increase farmers income and increase their economic, environmental and social resilience to climate change.*

This research intends to deepen the understanding of contextual aspects that might be influencing management techniques implementation on family-operated livestock farms (FLF). Finally, this research aims to generate inputs that might improve public

policy further, looking for an increase in the implementation of management techniques among FLF.

Figure 1, presents a summarised version of the specific aims, associated with the research hypothesis, followed by a further explanation of each hypothesis:

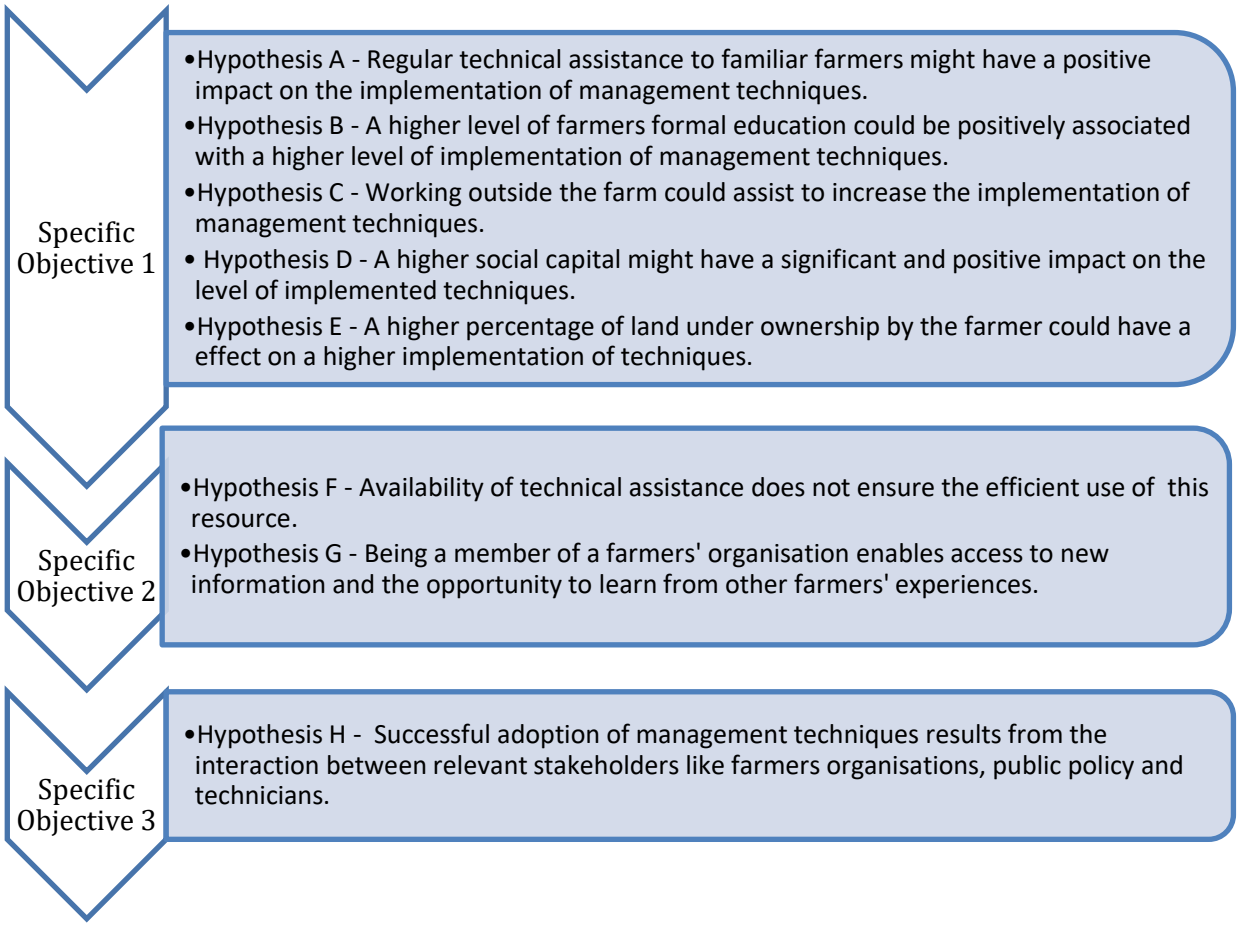


Figure 1. Research hypothesis related to specific objectives. Source: Author's own elaboration.

1.2 Specific research objectives

1. Asses determinants and main characteristics on the implementation of management techniques, among FLF in two climatic vulnerable livestock productive regions in Uruguay.

2. Identify the influence and characteristic of variables of interest for public policy design and implementation (technical assistance and social capital), since they can be subject of contribution of public policy.

3. Promote a mixed methodology combining quantitative and qualitative methods to contribute to a complex vision of management implementation process to approach a high complexity and dimensional problem.

1.3 Hypothesis

The hypotheses studied in this research project, are all related to the implementation of farm management techniques. With the research objectives in mind, the central assumptions to carry out this research are:

i. Regular consultation with technical assistants for decision making might have a positive impact on the implementation of management techniques.
ii. Achieving a higher level of formal education can be positively associated with a higher level of implementation on management techniques, since education is expected to contribute to better information access and interpretation, therefore enabling broader access to knowledge on management techniques.
iii. Having work-related activities outside the farm in the case of farmers is expected to have a significant and positive impact on the technique's implementation, since it would allow farmers to access a more extensive social network, increasing practical knowledge of management techniques and innovative data.
iv. A higher social capital might have a significant and positive impact on the level of implemented techniques since it has the potential to expand access to information and innovative techniques and increase the social validation needed for farmers to implement them.
v. A higher percentage of land under the ownership of familiar farmers can influence a higher implementation of techniques, due to a higher sense of preoccupation, attentiveness and interest regarding the state of farm resources, its results and productivity.
vi. Availability of technical assistance does not ensure the efficient use of technician's resources since it is not enough to cause lasting management technique implementation.
vii. Being a member of a farmers' organisation enables access to new information and the opportunity to learn from other farmers' experiences, enabling access to training and new management techniques.
viii. Successful adoption of management techniques results from the interaction between key stakeholders such as farmers organisations, public policy and technicians.

2. Project background

In the following section, the most relevant aspect to understand the issue of study are presented. Firstly, the importance of the FLF situation on the international and local context is justified. Also, climate changes current and expected consequences on FLF and their productive activity were outlined. Finally, a description of the FLF complex ecosystem configurated in Uruguay is exposed.

2.1 Importance of livestock sector in Uruguay

Agroindustry, which includes livestock products and its processing is an essential activity for the Uruguayan economy, accounting for 8,4% of the total GDP generated in the country in 2018 (DIEA 2019). The agricultural sector is crucial in the Uruguayan economy not only for its direct contribution but also, as suggested by Terra (2009), since it has forward and backwards linkages with every other sector on the economy, and it exports over 50% of its production.

The importance of agricultural products among Uruguayan exportations is shown in Figure 2, where more than 70% of the total exportations of the country are conformed by-products with an agricultural origin. Livestock products and derivatives account for the highest percentage of exported products of the Uruguayan economy in 2017 (Figure 2). Among livestock products and sub-products frozen bovine meat is the highest exported product.

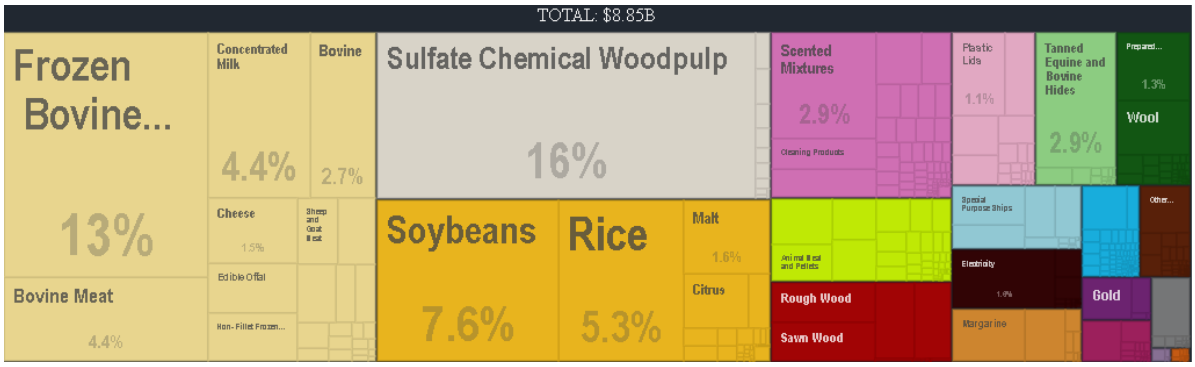


Figure 2. Main exported products for the Uruguayan Economy in 2017. Source: OEC (Uruguay).

These exports are generated by Uruguayan farmers among which 84,5% declared having a livestock specialisation on their farm, 6,5% dairy and 9% mixed agriculture and livestock specialisation. Among all livestock specialised farmers in Uruguay, 52% are dedicated to breeding cattle farming reflecting that the sector in which this research is focused constitutes a fundamental productive both in terms of the number of farmers and land occupied as evidenced on Table 1.

Table 1. Distribution of farmers and lands according to livestock production specialisation.

	Number of Farmers (in %)	Land occupied (in %)
Breeding cattle	52	55
Full Cycle	11	20
Wintering	10	15
Sheep only	3	1
No animals	20	8
Other	4	1
	100	100

Source: Author's own elaboration based on DIEA (2019).

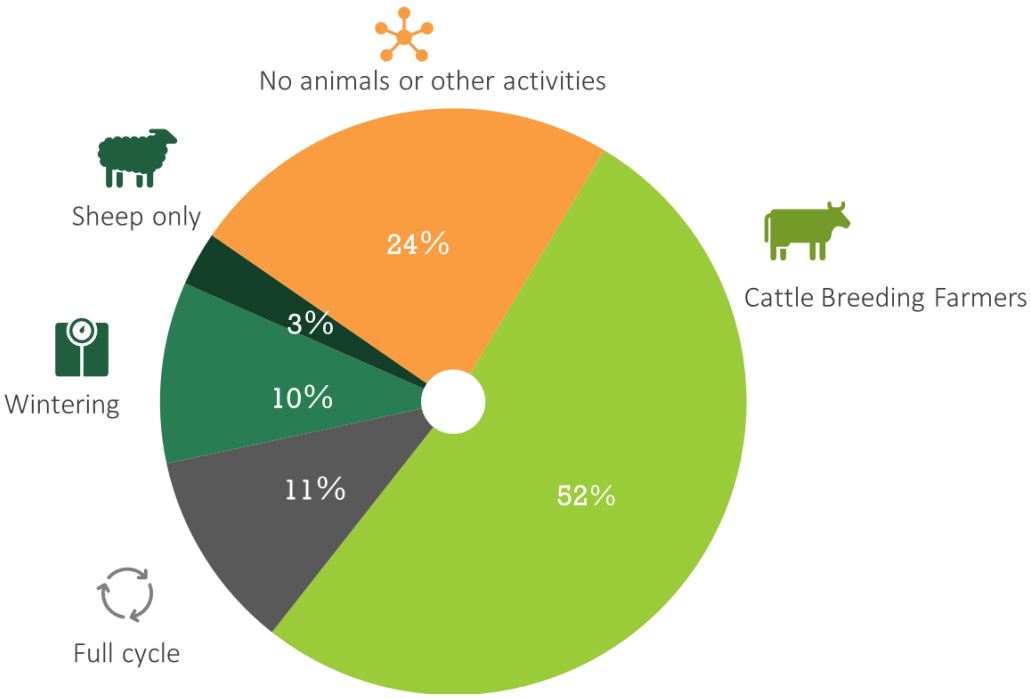


Figure 3. Distribution of farmers (in number) according to livestock production specialisation. Source: Author's own elaboration based on DIEA (2019).

Regarding the evolution of the sector in recent years, there has been a significant increase in the produced and exported volume of livestock product, increasing the importance of the sector in the Uruguayan economy. Figure 4 represents the recent evolution of the produced volume (green bars) and the value in current million USD dollars (orange line).

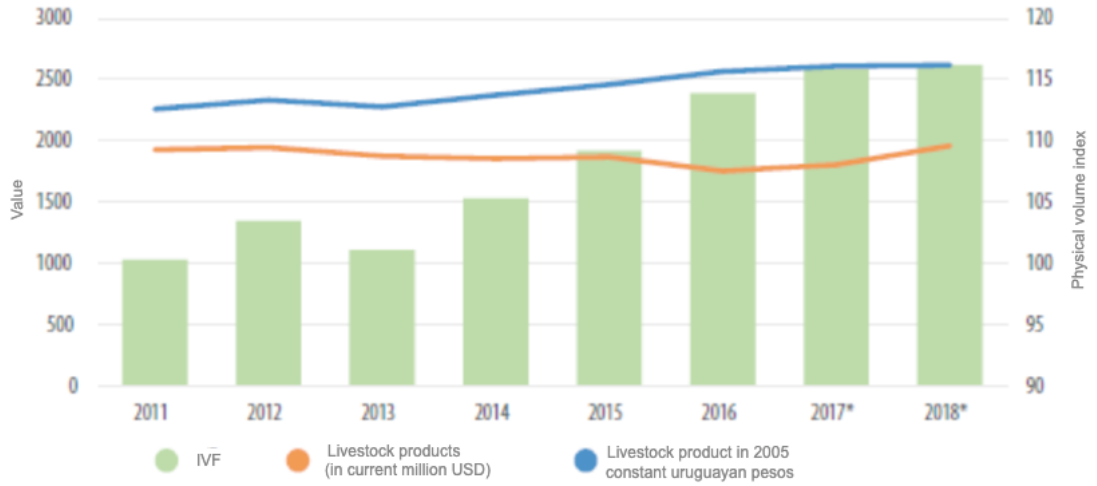


Figure 4. Livestock products volume and value evolution 2011- 2018.[1] Source: DIEA (2019)

2.2 Global context and challenges

Global population growth is estimated to increase from 7 billion in 2010 to 9.8 billion in 2050, causing an increase in food demand by more than 50% (Searchinger et al. 2014). Besides, expected changes in human diets associated with rising average incomes in developing countries are expected to cause an increase in demand for animal-based foods by 70% of the current demand (Tittonell et al. 2016).

This increase in demand constitutes a challenge by itself at a worldwide and national level, and it represents an opportunity for the Uruguayan economy based on the potential of the Uruguayan agricultural sector. Currently, Uruguay's primary sector is producing an amount of food that could feed 30 million people, with the expectation to increase this figure to be able to feed 50 million by 2055 (DIEA 2019).

Nevertheless, sustainably meeting this goal from a social, economic and environmental standpoint is a challenge for the Uruguayan society.
Searchinger et al. (2014), proposes a set of goals to address the necessary increase on food demand according to global population growth, while preserving the environment, promoting economic development and reducing poverty. Among the proposed measurements,[2] the necessity to increase livestock and pasture productivity using innovations is highlighted to achieve higher productivity of meat per hectare and per animal through improved grazing management, and related practices. (Searchinger et al., 2014). Therefore, increasing adoption of management techniques to increase productivity among the cattle breeding sector is a relevant issue to address global challenges at the national level, constituting therefore a relevant subject of study.

[1] Includes standing cattle, breeding cattle and livestock services.
[2] Aligned with FAO institutional approach

2.3 Family – operated livestock farms (FLF)

The definition of familiar farmer is a widely debated concept, and there are different definitions according to each country reality. For this study, the definition chosen was established by a Ministry of Livestock and Agriculture (MGAP) resolution [3] which considerate that: "familiar-operated livestock farmers (FLF) are physicals persons, that carry specialised farming and meet the following criteria simultaneously:

- Employs a maximum of 2 workers that do not belong to the family unit, (or the equivalent of 500 journals per year).
- lives in the farm or nearby areas (50km as a maximum)
- exploit land of 500 hectares or less in size
- consider livestock production as the primary source of family income.

According to the most recent Agricultural Census, elaborated in 2011, 56,4% of the total agricultural exploitations in Uruguay (25.285 units) were familiar farmers. Among them, most familiar farmers are specialised on animal production (79,3%), and the majority of them have beef cattle and sheep production as the main economic activity.

This project focus on farmers classified as family-operated livestock farms in two specific ecological geographic areas in Uruguay: Eastern Sierras and Basaltic Slope [4] that are considered particularly vulnerable to climatic shocks. According to DIEA (2011), the total size of the studied population is 1100 farmers located in Eastern Sierra and 951 in Basaltic Slope (2051 familiar farmers in total).

Regarding size, most familiar farmers produce in small farms with 70,5% of the familiar productive units having 100 hectares or less, and 59% of total farmers having less than 50 hectares of land to produce (DIEA 2015), as presented on Table 2.

Table 2. Familiar farmers exploitation according to size on 2011 and an approximation for 2014 (as % of the total number of Familiar Farms).

Land size category (in hectares)	Number of familiar farms – 2011 (%)	Number of familiar farms 2014[5] (%)
Less than 20	32.9%	38.5%
20 to 50	20.6%	20.5%
50 to 100	17%	16.7%
100 to 300	22.6%	19.5%
More than 300 ha	6.9%	4.8%
Total	100%	100%

[3] Resolution MGAP numbers 219 and 387/14 approved on 1/3/1014.
[4] English translation for "Sierra del Este" and "Cuesta Basáltica" Basaltic Slope" in Spanish.
[5] Based on Familiar Farmer Registration, which is compulsory registration for farmers who want to access to familiar farmers differential public policy. Therefore, despite it does not offer a complete coverage of the population it represents an approximation to more updated data.

Source: Author's own elaboration based on MGAP, (2015).

Evolution of FLF

During the last two decades, the number of FLF in Uruguay has decreased significantly; as demonstrated by Frugoni et al., (2008): while in 2000 there were 32.696 FLF by 2011 this figure had decrease until 25.285 FLF, which represent disappearance of 7411 familiar farms (22,6%)in almost a decade. This decreasing trend has continued over the years, according to the most recent data available of the Familiar Farmer registration, as presented in Table 3.

Table 3. Familiar farmers evolution in the number of familiar farms

Data source	Number of exploitations	Absolute change	Percentual change
Census 2000	32692		
Census 2011	25285	-7407	-23%
Familiar Farmer Registration 2014	22858	-2427	-10%

Source: Author's own elaboration based on Frugoni et al. (2008) and DIEA (2015).

Following Dogliotti et al. (2014), the reduction in the number of FLF evidenced in Table 3, could be partially explained by the low productivity achieved by family operated productive systems. Uruguayan Familiar Livestock Systems (FLS) were characterised by Ruggia et al. (2015), to achieve low productions of cow and sheep meat, generating limited income, which could explain their lack of sustainability and high vulnerability to weather fluctuation. Therefore, as suggested by Dogliotti et al. (2014), the decrease of familiar farmers would be caused by an insufficient economic result of the system to cover family maintenance and production infrastructure.
Several studies agree that fluctuant and insufficient income generated by the low productions levels of cow and sheep meat, and a highly vulnerable productive system to weather fluctuations are causes of the reduction of familiar farmers in Uruguay (García et al. (2011), Soca et al. (2013), Ruggia et al. (2015)).

FLF reduction consequences

Decrease of familiar farmers has social and economic consequences for a wide range of aspects in the country. From a social standpoint, farmers when going out of business, are forced to relocate themselves and their families on cities contributing to increase already existing problems of overpopulation, lack of housing and insufficient quality jobs sources. Since statistics evidence that most familiar farmers have primary education as the highest formal educational level achieved, they have limited options for employment, which could represent a significant loss of life quality when comparing rural with urban jobs opportunities.

Despite the high percentage that familiar farmers represent concerning the total productive units (56%), in terms of land usage, familiar farmers exploit only 13,77% of the total agricultural land available in Uruguay (DIEA 2015).

An international comparison is presented in Figures 5 and 6, regarding the percentage of familiar farmers and the proportion of the total land in which they produce.

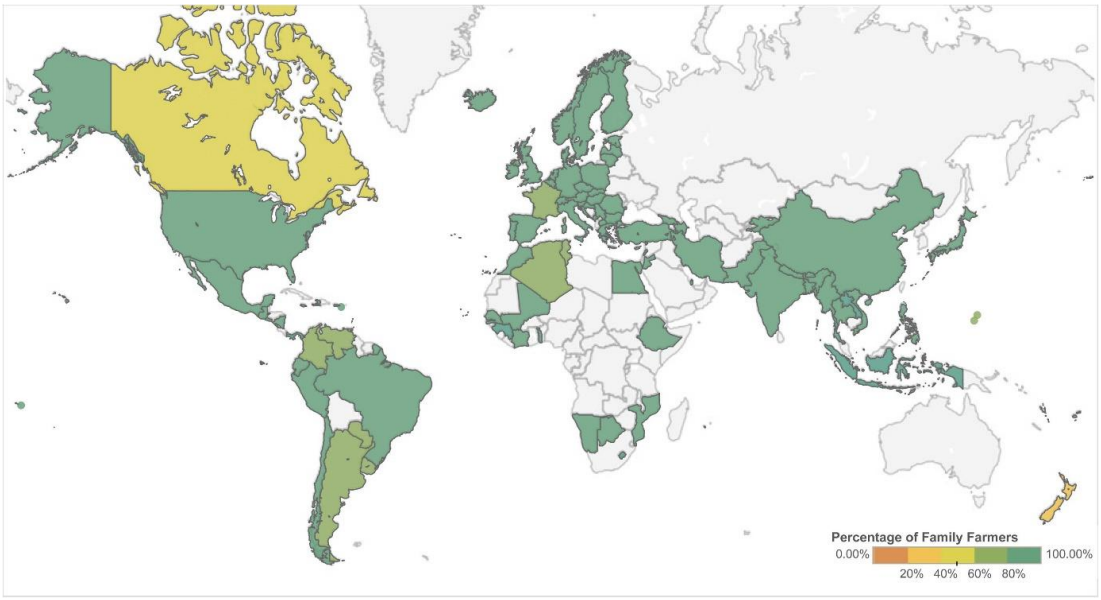


Figure 5. World map with a percentage of familiar farms in each country. Source: Graeub et al. (2016)

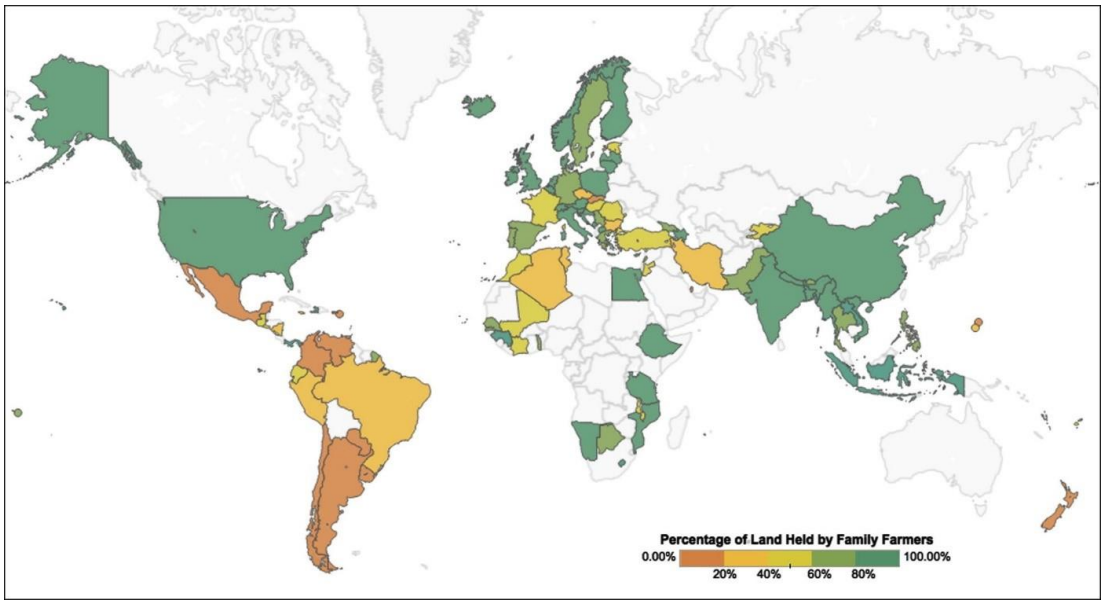


Figure 6. Percentage of total land held by familiar farmers. Source: Graeub et al., (2016)

As evidenced in Figure 5, Uruguay is classified as a country with a high proportion of familiar farms in comparison with the international context, confirming the importance of familiar farmers in the Uruguayan agricultural sector.

When considering the percentage of land held by familiar farmers, Uruguay is classified among the lowest in the global context, reflecting a severe land concentration phenomenon in Uruguay. This is also confirmed by data presented on Table 4. Considering all agricultural exploitations (including familiar units), the average size of each unit went from 287,40 hectares to 365,27 hectares per productive unit, showing a 27% increase on the average size. While among familiar farmers, this increase was only 15%. These figures could be an indication that there was a

transference of land that was from familiar farmers and was transferred to non-familiar farms unit.

Table 4. Reduction in number of familiar farmers and land concentration process

Total farm units	Census 2000	Census 2011	% Change
Farm exploitations	57131	44781	-22%
Average size (hectares)	287.4	365.27	27%
Familiar farm units			
Familiar farm exploitations	32692	25285	-23%
Average Size (hectares)	77.17	89.08	15%

Source: (DIEA 2015)

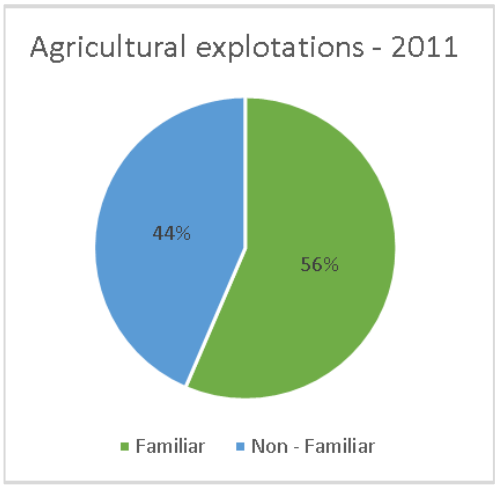


Figure 7. Number of agricultural farms in Uruguay. Source: DIEA (2015)

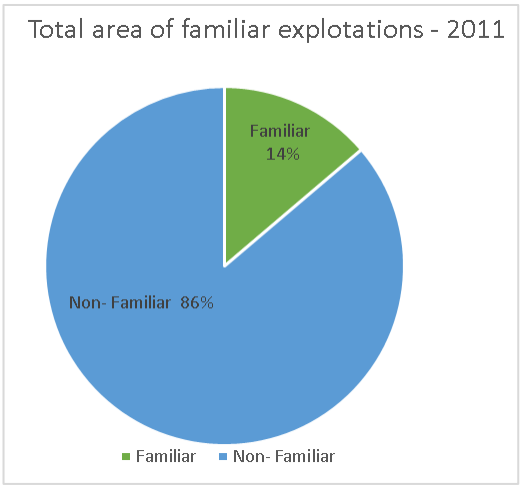


Figure 8.Area distribution among familiar and non-familiar farmers. Source: DIEA (2019)

The tendency of land concentration is evidenced on Figure 7 and 8 showing that event though familiar farmers constitute a higher number of productive units, non-familiar farmers use most of the available land.

In addition to the land concentration process, there are additional difficulties and sources of vulnerability that might affect FLF sustainability. FLF are inserted on a complex system that has stressors and linkages with factors, variables, and entities that are out of farmers control. Among this stressors climate change is expected to affect the livestock production and FLF sustainability due to the high exposure to weather conditions inherent to the agricultural activities. In the following section, the main expected climate changes impact on livestock productive sector in Uruguay are presented.

2.4 FLF as a complex system

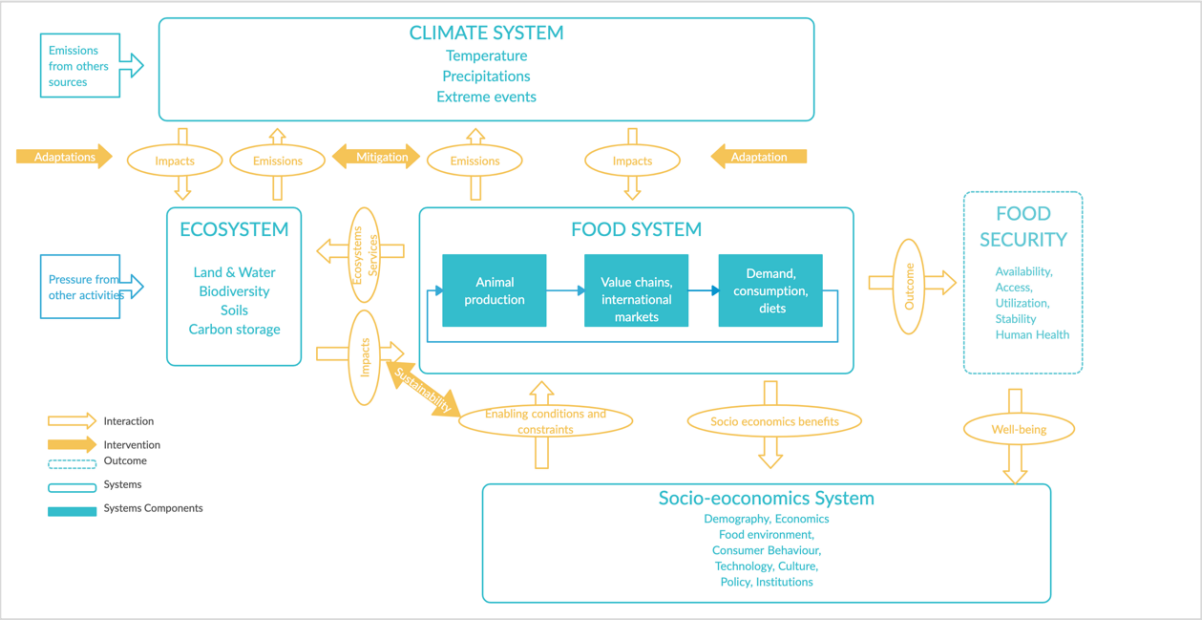


Figure 9. Climate impacts over ecosystems, food production and socio-economic systems. Source: IPCC 2019)

Figure 9 presents the linkages between ecosystems, food production and socioeconomic systems, showing the complexity of familiar farmers production activities when considered as a part of this complex system. FLF is a relevant agent among the food production system, generating emission of greenhouse gases during animal production and receiving impact from the climate system (e.g., temperature, precipitation, extreme events).
In 2016, the agricultural sector represented 74,3% of the net emissions in Uruguay, and meat production represents around 80% of the emissions of the agricultural sector due to the emissions of methane gas (MGAP, 2019).

When adding uncertainties and a long-term perspective to this scheme reducing the vulnerability of FLF becomes even more critical. Predictions of changes in climate and trends are simulated and studied by a wide range of climatic models, to reduce uncertainties and concentrate efforts on mitigating or adapting expected changes in climate. Adaptation measures might reduce the negative impacts of climate change on a system, while mitigation measures can reduce greenhouse gas emission coming from the system (IPCC, 2019).

FLF high exposure to these climatic events might create negative economic impacts, attempting towards FLF sustainability. Only by implementing adaptation measures to the expected changes in climate FLF can become more resilient to future changes and dynamics, food security can be ensured, and the socioeconomic system can thrive.

In Uruguay, a local adaptation of global climate modelling data has been recently published by FAO and ONU (Bentancur et al. 2019), enabling more accurate and reliable models for the local context. According to this model, cattle and livestock production will be affected by the expected changes especially impacting the smaller farmers (Bartaburu et al. 2013). [6] The main findings of this research are summarized on Figure 10.

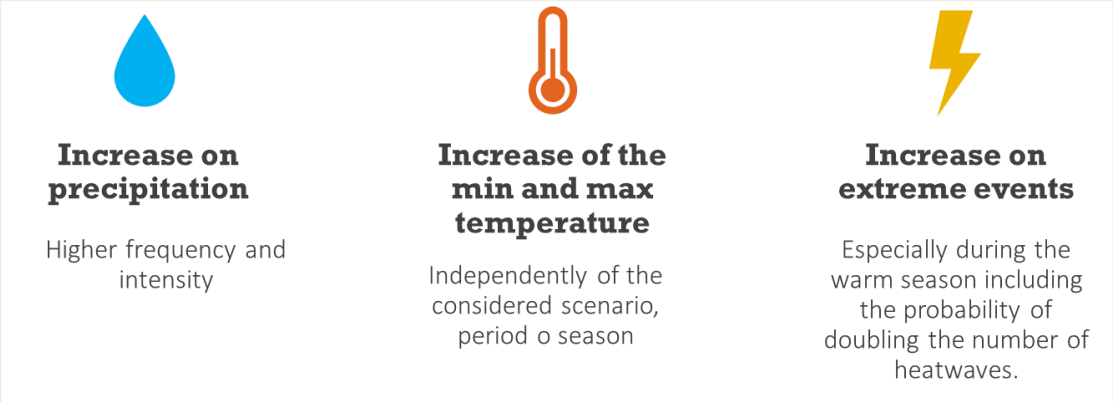


Figure 10. Main expected climatic change projections for Uruguay. Source: Authors elaboration based on Bartaburu et al. 2013.

According to Bartaburu et al. (2013) the expected changes in climate includes an increase on precipitation, minimum and maximum temperature, independently of the considered scenario, period o season. Maximum, minimum and average temperatures are expected to increase both on warm and cold season, with a most vigorous change on the cold season. Also, it is projected an increase in rainfall and extreme events, especially during the warm season, including the probability of doubling the number of heatwaves. Furthermore, it is expected a decrease in the total number of days with frosts and hydric deficits events (droughts), especially on cold seasons. A more detailed graphic evolution representation of relevant climatic variables for cattle production activities are presented on Appendix 1.

In the livestock production activity, in the Uruguayan context droughts are the climactic event that cause the most significant economic impact (Bartaburu, D. et al., 2013). According to CIRCVC-UDELAR[7], livestock production sensitivity to drought is determined by:

- the productive infrastructure,

[6] The projections were elaborated considering two greenhouse gases concentration evolution scenarios elaborated by the 5th Evaluation Report by IPCC (RCP 4.5 y RCP 8.5).
[7] CIRCVC-UDELAR: Centro Interdisciplinar de Respuesta a la Variabilidad y el Cambio Climático de la Universidad de la República

- soil characteristics,
- production systems,
- and information management and knowledge for decision making.

Droughts economic impacts are difficult to calculate since it can measured by the decrease of productivity indicators such as livestock birth or mortality rate or production of meat, but also drought also can decrease net income per hectare due to decrease of pasture availability which generates a deficit for animal consumption, forcing farmers to incorporate farmer to supplement thus increasing costs (MGAP, 2019).
According to OPYPA, for the 2008/2009 droughts, direct losses on the agricultural sector were estimated at USD 340 million, and the impact on the whole economy was estimated in more than USD 1000 million (MGAP, 2019).

As stated in the National Adaptation Plan to Climate Variability and Change for agriculture (PNA-Agro): "animal and pasture improved management would allow reducing cattle farmers vulnerability to climate variability and climate change impacts (MGAP, 2019)". Also, productive systems which have an adjusted animal load according to their pasture production, are less sensitive and have a higher adaptation capacity to droughts (MGAP, 2019). Therefore, to reduce climate change impact on FLF and improve their sustainability, it is crucial to address and improve animal and pasture management among Uruguayan FLF.

National Climate Change Policy (PNCC)[8] and international commitments

The vulnerability of the livestock sector towards the expected changes in climate has been approached by different strategies and institutions in Uruguay. Among these strategies towards adapting and minimizing climate change impacts a relevant effort was elaborated on the National Climate Change Policy (PNCC). This national policy elaborated strategic lines to achieve a more resilient livestock sector, improving productivity and competitiveness of meat value chain, while considering ecosystem services, social equity and food security.

On this matter, Uruguay has shown an institutional commitment with Climate Change adaptation and mitigation measurements, by submitting the voluntary First National Contribution to Paris Agreement. (República Oriental del Uruguay, 2017). On this document, approved by the Uruguayan Parliament, a commitment is made to achieve by 2025, the incorporation of good management practices of natural grassland and cattle breeding in an area between 1 million and 3 million hectares which equals to 10% - 30% of the total grassland area in Uruguay. In order to meet this goal, the implementation of "good management practices" aligned with the ecological intensification approach in familiar operated livestock farms, is crucial.

[8] National Climate Change Policy (PNCC) is an agreed strategic frame and lines of actions for 2050, elaborated in 2016 with a participation of over 300 people a 100 institutions which were approved in 2017 by the Uruguayan Parliament.

2.5 Ecological intensification

Currently, increase on food demand provoked by population growth has been met by intensifying productive processes based on increasing input, overexploitation of the natural resources, the concentration of the economic activities and displacement of the familiar farmers from the major productive chain (Tittonell et al. 2016). Those changes in the productive process, are associated with agronomical and cultural diversity loss and severe social and economic consequences for a country in which the economy is based on agricultural products like Uruguay. In order to achieve an effective and sustainable increase in food production, ecological intensification is chosen as a theoretical framework for this research.

The paradigm of ecological intensification is based on the hypothesis that it is possible to increase production and financial results with the same resources that familiar livestock systems (FLS) have available (Tittonell et al. 2016).
A schematic representation of the ecological intensification approach is presented on Figure 11.

Figure 11. Ecological intensification approach. Source: Authors elaboration

Even though, over the last two decades, the Uruguayan livestock sector had increase its overall productivity by introducing and implementing more technological management techniques, their implementation among breeding cattle farmers is still low, especially when considering FLF.

Increasing productivity of breeding cattle systems and addressing the issue of management techniques implementation among FLF becomes relevant if Uruguay wants to meet its climate change international commitments and promote a resilient livestock production sector. This research contributes to addressing an issue that is of paramount importance to the livestock sector and therefore to the Uruguayan economy.

2.6 Livestock Familiar Farmers in Uruguay

A schematic representation of the complexity of the livestock familiar farmers situation is presented in Figure 12. [9]

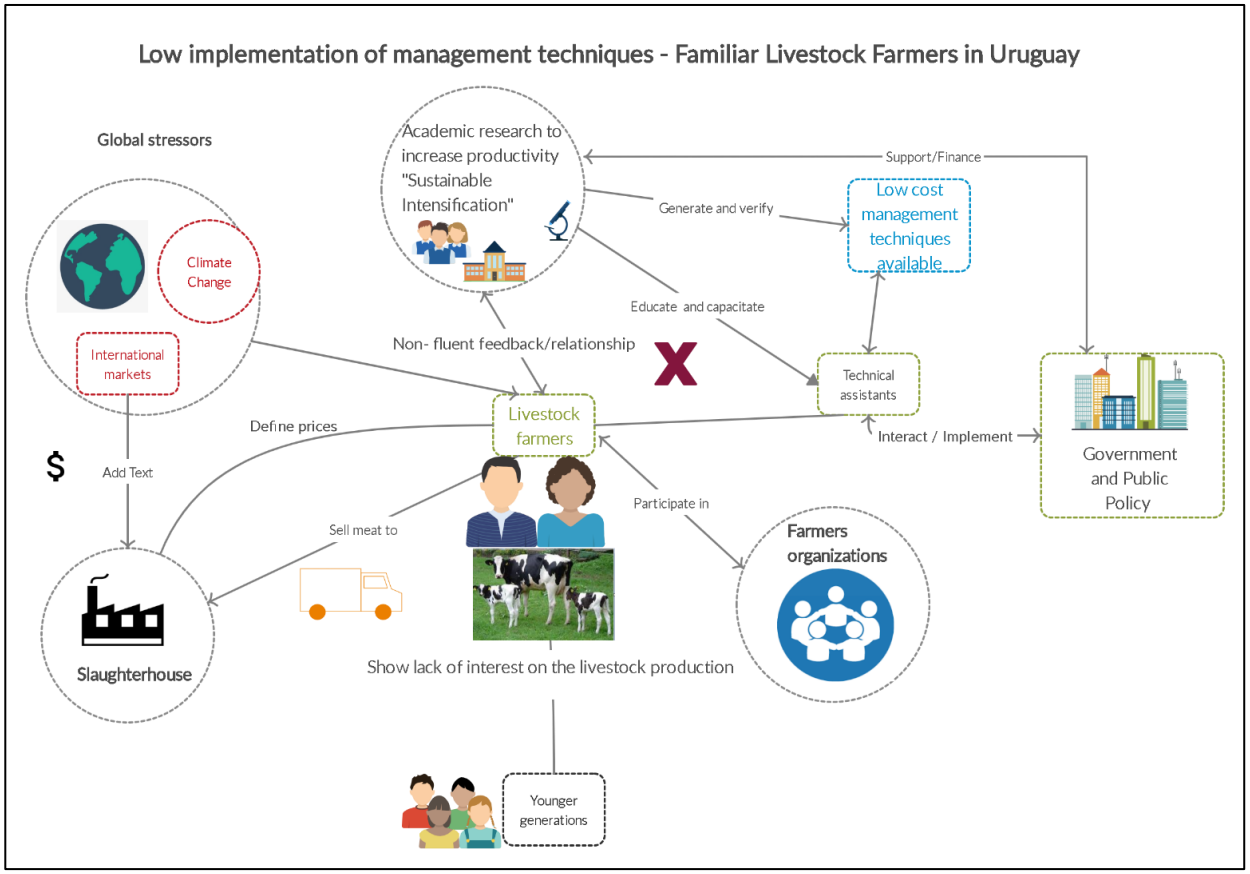


Figure 12.Rich picture Source: Authors elaboration based on Soft System Methodology tools from Checkland, P. (1989).

Figure 12 is an approximation to expos the main issue addressed by this thesis: the factors that influence the adoption of "good management techniques" for familiar livestock production systems. This research project is expected to deepen the understanding of a real world problem: FLF sustainability. Such complex problem is conformed and affected by several actors and dimensions that interact with each other requiring a holistic approach. A rich picture rationale constitute an attempt to capture how the familiar livestock production system operates in Uruguay and its main challenges.

[9] For this representation the chosen method is the elaboration of a Rich Picture, created by Checkland (1989), on the context of the development of Soft Systems Methodology (SSM). A Rich Picture constitute a drawing that include several influencing variables and represent relationships between different stakeholders. It constitutes a useful resource to gain understanding regarding a complex-real world situation, its context and peculiarities, explore relationships between interested stakeholders and to allow a common baseline to acknowledge the situation and promote discussions and agreements. As Checkland refers to rich picture rationale: "complexity of human affairs is always a complexity of multiple interacting relationships; and pictures are a better medium than linear prose for expressing relationships. Pictures can be taken in as a whole and help to encourage holistic rather than reductionist thinking about a situation." (Checkland 2000, p.22)

As represented on Figure 12, FLF is an agricultural farmland unit that consists of multiple complex and dynamic systems, which are affected by variables such as climate, market conditions, prices of inputs and products (Cros et al. 2004). Many of those influential variables on FLF are not under farmers control (e.g: climate and international meat prices) and the effect of these variables, uncertainties and unstable conditions are exacerbated on small-size farmers.
However, FLF does have control and agency over other processes happening in the ecosystem. Depending on their decision, they can be more sustainable in the long term from an economic, environmental and social perspective.
Decisions that FLF with respect to their productive system make can be characterised as management techniques. These are tools that determine livestock production system productivity overall. Papanamborda (2017) identifies three types of management techniques:
a) strategic decisions: mid and long-term decisions that define the system and determine the main events related to production.
b) decision making support: control measure of the production process, to obtain quantitative information regarding the system status and it constitutes the raw data to guide next management steps in the system.
c)tactic techniques: are short term decisions that correct or mitigate unexpected results.

An additional factor that increases the complexity of the system is that most of the workforce is part of the family, generating an overlap between the domestic unit resources and productive unit ones.
This complex productive system has been broadly approached from agronomic production sciences (Paparamborda and Soca, 2017), but the relationship between technical assistance, groups and networks belongings have not been approached so widely for the Uruguayan case, representing a gap of knowledge in the literature. In addition to this, there is a diverse reality among FLF in terms of social dimensions such as the degree of involvement in social networks, technical assessment levels, education level, familiar characteristics, age, extra-farm employment, among others.

According to García and Méndez (2004), the social network that farmers belong can provide opportunities or restrictions, depending on which is the position they held on it. Nevertheless, it was not possible to find a research that linked the social net of FLF with their economic reality in Uruguay.
Improving the understanding the positions FLF have on their networks and other aspects that determine the decision-making process is an essential resource to implement efficient public policy that seeks to increase familiar farmers results. As proposed by Long (2013) "A better understanding of the decision-making process will help deliver information more effectively, speed adoption processes and improve communication, which will result in better outcomes for agricultural business owners".
The critical situation of FLF and the lack of specific studies on this topic from an economic and social standpoint demonstrate the need of further quality research on the topic.

Experiences implemented in Uruguay to address the Familiar Livestock vulnerability situation: Familiar Livestock Farmers and Climate Change Project (GFCC)[10]

Among the public policy experiences that have taken place in Uruguay to increase resilience levels among familiar livestock farmers to face climate change and climate variability, the Familiar Livestock Farmers and Climate Change Project (GFCC) is one of the greatest efforts implemented by MGAP from 2013 to 2017. (AGEV-OPP, 2017). GFCC project focused on two geographic areas which are considered the most vulnerable to climatic events, due to their location on regions with soils characteristics that configure a less suitable soil for livestock production and present a high vulnerability to droughts and hydric stress. The areas of intervention according to the mentioned criteria, were the landscape units known as Eastern Sierras and Basaltic Slope[11] (AGEV-OPP, 2017).In terms of resources, the GFCC project represents a significant public policy effort where US$ 9.471.000 were financed by the Adaptation Fund, created in the context of Kyoto Protocol contributions. These funds were distributed among the three main components of the project, as described in Table 5.

Table 5. GFCC project components

Component	Main goals and implementation	% of total resources
Component 1. Adaptation Investment	Familiar farmers received subsidies for infrastructure investment and technical assistance oriented to reduce vulnerability and increasing adaptative capacity of systems to climatic variability through: Non-refundable and partial support of maximum U$S 8000 per farmer And technical assistance for up to 15 workdays per farmer.	69%
Component 2: Local network strengthening	Training and support which are related to local network strengthening with a focus on adaptation to climate change and climatic variability.	9%
Component 3: Knowledge management	Increase understanding regarding impacts of climate change and climate variability, increasing capacities to anticipate and evaluate adverse events, extracting learned lessons, as well as identify and validate management practices. Monitoring systems of the agroclimatic and productive variables Studies related to adaptation to climate change problems and climatic variability on livestock production.	8%
Other components	Coordination and other remunerations	14%

Source: Authors elaboration based on GFCC Did evaluation (AGEV-OPP, 2017)

[10] Ganaderos Familiares y Cambio Climático (GFCC) which is the shorter name assigned to the program "Construyendo Resiliencia al Cambio Climático y Variabilidad en Pequeños Productores Vulnerables" (AGEV-OPP, 2017)

[11] Name of the regions in Spanish: "Sierra del Este" and "Cuesta Basáltica."

3. Literature review

In the following chapter, the main concepts and theories behind the decision of FLF to adopt certain management techniques are presented including contributions of previous research that made significant advances. Firstly, suboptimal farmers decision making the process and the influence of previous experiences are presented. Followed by the presentation of relevant research regarding management techniques adoption among FLF farmers in Uruguay. Finally, co-innovation is presented as an alternative and successful knowledge transfer paradigm.

3.1 FLF suboptimal decisions and path dependency

The following section presents the main distinctive aspects and considerations to examine FLF decision making processes on productive units and its dynamics from an economic and social standpoint.

Several studies have concluded that the decision-making process, followed by farmers, does not follow the rational maximising rationale assumptions presented by classical economic models. These behaviour and decision-making processes are highly influential when explaining economic and productive results from small and familiar farmers. In this decision-making process, context, knowledge and networks have been proven to be highly influential (Figari, Rossi & Nougué 2002).

As described in Piñeiro (1994), the main concern among FLF is to maximise their income as a household, not the benefit per invested capital, as a traditional enterprise would aim. This maximising exercise in many cases, can involve the search for other sources of income, such as non-rural employment. (Gutierrez et al. 2008). Thus, FLF has a different set of priorities and characteristics in the decision-making process than those used in a traditional business. Theories from sociology are aligned with this theory suggesting that during farmer decision making process, farmers seek to balance economic, social and lifestyle goals (Howley, 2015).

In the described context, FLF accepts satisfactory arrangements, despite not being the optimum from a rational standpoint, due to lack of time or resources (Gutierrez et al. 2008). The non-optimal decisions are mostly taken based on their own experience, or peer experiences, following non-explicit criteria that are fundamental to identify and comprehend the functioning of these farms. (Gutierrez et al. 2008).

Chhetri et al. (2010), evidenced the strong path dependence among farmers on a study that even on a scenario where farmers were well informed, they were not able to exit from their current technological regimes to adapt to climate change. Also, farmers ability and availability to successfully introduce changes in techniques and management practices are highly influenced by their educational level as evidenced by Kilpatrick (2000).

An alternative approach has been instrumental in examining the issues related to a voluntary change of farmer behaviours, such as sustainable farming, and mitigation and adaptation to climate change with behavioural economics experiments and approaches (reviewed in OECD, 2012).

3.2 Implementation of management techniques on Uruguayan Familiar Livestock farmers

Prior studies have proven **although there are available management techniques proven effective to improve productive results and efficiency, without increasing costs or having adverse effects on the environment, the implementation of this available knowledge/technology is medium to low among the Uruguayan FLF** (Pereira et al. 2003; Figari, Rossi & Nougué 2002; Gómez Miller & Saravia Díaz 2016).

Gómez Miller & Saravia Díaz (2016), examine the supply of technological innovations available in Uruguay, with a qualitative method[12], elaborating a priority index according to:

- the declared difficulty of implementation and
- expected impact of each technique, according to experts' opinions.

Some of the analysed technologies were aligned with the ecological intensification approach that is focus of this research.
Among those cattle breeding technologies with higher impact and lower implementation difficulty is possible to find differential cattle management according to corporal state, bull review, weaning in autumn, and reproductive disease control. Among other techniques that are important in terms of impact but represent a high-level difficulty for its implementation are: early weaning, rearing management (preferential feeding) and two years old mating. These techniques that are perceived as difficult to implement but with a positive impact on the production are included on the techniques suggested by the ecological intensification approach.

The technical management decisions that are implemented been by FLF farmers have been approached from social, production sciences and more interdisciplinary approaches, that aim to involve social aspects (related to the decision-making process and the operative system), the biophysical components, productive, economic and environmental results. (Doré *et al.* 2011). However, no studies are available regarding the relationship between those technical management decisions, and social dimensions are available for FLF on the studied areas.

3.3 Coinnovation approach

The co-innovation approach constitutes an alternative method of knowledge transfer to the current low-level implementation of management techniques since the traditional extension, or knowledge transfer paradigm has been proven ineffective to generate technological transference (Pereira, 2003; Oyhancabal, 2003), as evidenced among FLF.
In order to promote changes in agricultural practices towards more sustainable production systems, a collective learning process involving all stakeholders is needed (Dogliotti et al., 2014). A successful collective learning process approach implemented in Uruguay are co-innovation processes which include working within a network of

[12]through interviews to 11 qualified technicians.

researchers, extension agents, farmers and local actors, focused and exchanging knowledge (Klerkx et al., 2009). The co-innovation approach combines complex systems theory, social learning and dynamic project monitoring and evaluation to stimulate strategic reorientation of family farm systems. Coinnovation processes identify the farmer as a fundamental component of the system (Walker 2002, Dogliotti et al. 2014) as active agents of experimenting, implementing and learning new techniques working within a network of researchers, extension agents, farmers and local actors, focused on innovation and sharing and exchanging knowledge among them (Klerkx, Van Mierlo et al. 2012). The co-innovation approach is sensitive to differences in farmers' priorities and access to production resources, avoiding a "receipts" approach.

Results from practical co-innovation experiences with Eastern Sierra FLF farmers have shown an increase in meat production of 24% and the net family income increased by 40% in three years, mainly explained by an increase in net income with a similar level of production costs. Demonstrating that when farmers implemented the suggested managements techniques, with similar resources, the system can increase production level, net income and quality of the natural resources. (Dogliotti et al., 2014; Albicette et al., 2016).

Changes promoted by a co-innovation process would enable in the long term to increase the sustainability of natural grazing systems by reducing productivity losses caused by extreme climatic events and increase the productivity in average climatic years. This would reflect on an economic income increase, transforming the activity as an engaging opportunity to involve human resources from new generations with high qualification.

4. Methodology

The following section presents materials and methods, procedures and decisions made during the research process. Firstly, research design, methods and sources used are presented and justified. The following section presents a descriptive analysis, multiple logistic regression model and complementary qualitative interviews- that were used on this research to analysed data.

A schematic summary of the research approach is attached in Figure 13 to structure this section.

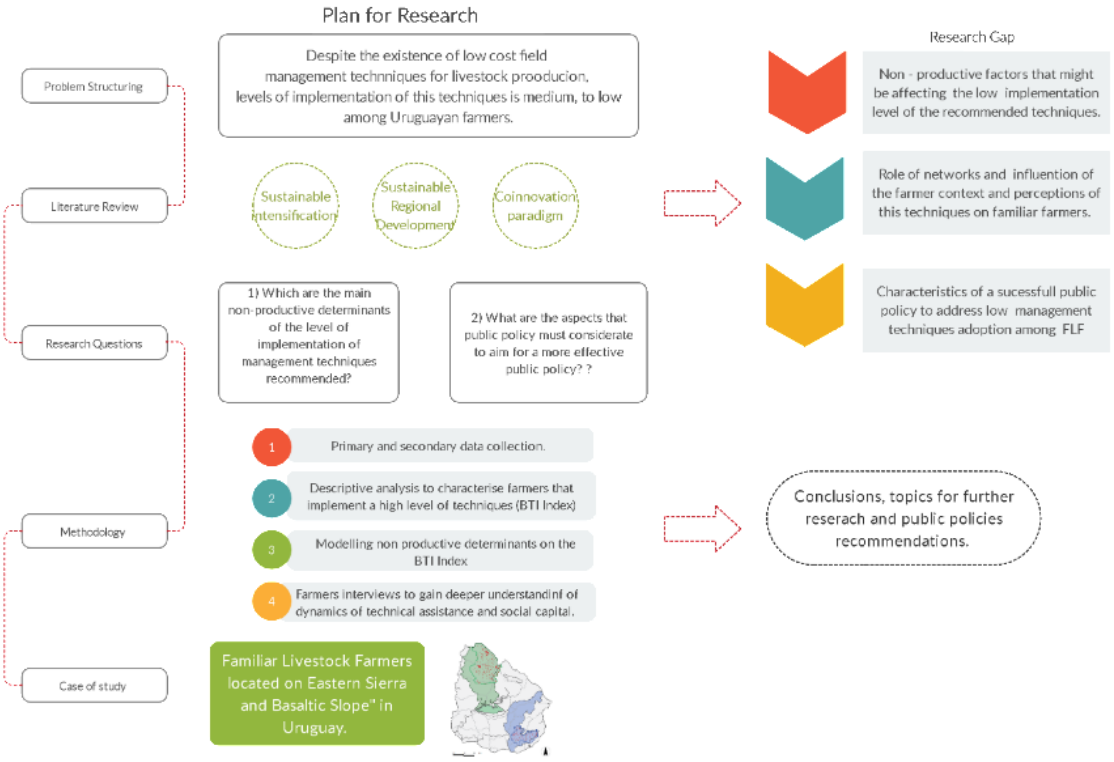


Figure 13.Plan for research. Source: Author's own elaboration.

The chosen approach is an exploratory research which intends to identify the contextual factors that influence the adoption of management technologies among familiar livestock farmers in two vulnerable climatic regions in Uruguay.

As defined by Stebbins (2001): "*Social science exploration is a broad-ranging, purposive, systematic, prearranged undertaking designed to maximise the discovery of generalisations leading to description and understanding of an area of social or psychological life*" (Stebbins, 2001 p. 43).

Following the author, exploration research emphasises on the development of theory and generalisations from data, and it is commonly used when there is little scientific knowledge about a group, process, activity, or situation to study (Stebbins, 2001).Therefore, the chosen approach is considered appropriate to address the aims

of the research since the objective population (FLF) and the proposed implementation of low-cost techniques on a rural context, constitutes a complex issue with incipient approaches from the academic body in Uruguay.

According to Stimson (2014), exploratory design has the advantage that it enables it to explore datasets and without constraints from prior expectations. Therefore, exploratory research was chosen to achieve the specifics objectives proposed by this research since it enables to combine methods, explore the topic, identify key concepts and help to set priorities for further research (Dankhe, 1986). This openness and flexibility of the exploratory design could contribute with the aims of this research, such as the objective of creating resources to extend research into a broader study of the determinants, obstacles and barriers that familiar farmers might have to adopt low-cost techniques, increase their resilience as farmers and reduce the impacts of climate change in the context of familiar Uruguayan farmers.

4.1 Research methods

A summarised version of the chosen methods is presented in Figure 14.

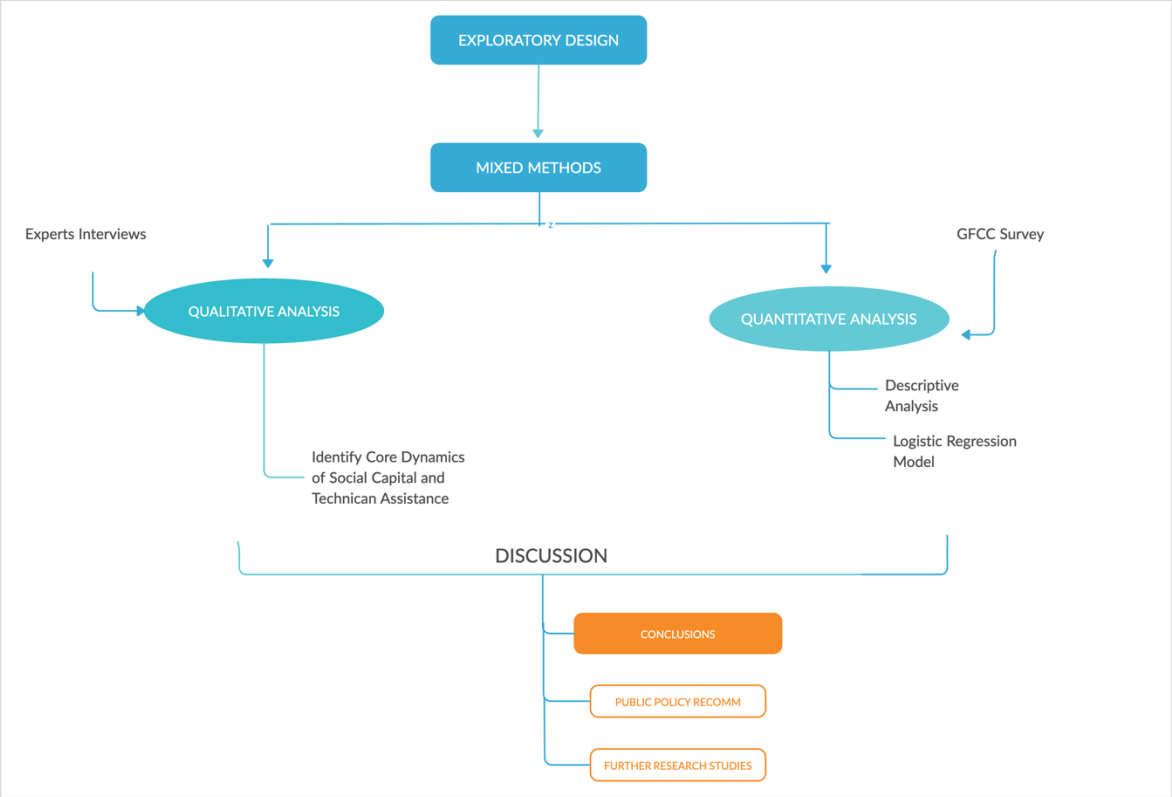


Figure 14. Chosen methods. Sources: Authors own elaboration

Regarding the selected methods, research was conducted following a mixed approach of quantitative and qualitative methodologies. A quantitative method was used to analyse information from the GFCC survey to identify patterns on farmers behaviour and characteristics that could be associated with a higher implementation of innovative techniques.

Besides, a qualitative approach was taken to triangulate the quantitative studies with the perspective from stakeholders. More specifically, from those who participated in the implementation of the management techniques along with farmers (technicians). Interviews were conducted to contextualise and complement quantitative information, obtaining a different perspective of implementation of a process of change in management techniques to interpret or support quantitative findings and open new research questions.
Following Bryman et al. (1988) quantitative tools were chosen to show the existence of structural elements and patterns, while qualitative methods are used to investigate further into process issues in order to produce an integrated picture of a phenomenon.

This complementary qualitative approach contributes to deepen the understanding of non-productive variables that could be differential on the implementation process of the management techniques, contributing to achieving specific objective number two in the context of this research
Qualitative methods used included not only interviews but also access to unpublished data produced by relevant stakeholders from the Coinnovation project implemented by Faculty of Agronomics from the University of the Republic (FAGRO) and MGAP. Among documents that were reviewed, there are monthly monitoring reports that documented the implementation process followed by each farmer as a participant of the project. Also, monitoring and evaluation reports were reviewed, which were elaborated based on information collected during two evaluation seminars with the participation of relevant stakeholders: farmers, technicians, institutions representative, among others.

Besides, a complementary qualitative approach can evidence critical aspects to consider when promoting a public policy to increase implementation of techniques.
Specific goal two will be achieved by identifying critical non-productive aspects that need to be considered to go from exclusively implement techniques to become managers farmers implementing and considering systemic management. This analysis is elaborated to identify variables that could influence a higher rate of adoption of a systemic approach to productive farm management.

Approaching the chosen topic of adoption of low-cost management techniques in familiar livestock farmers choosing a mixed methodology (quantitative and qualitative), constitute an innovative approach to the study field. Previous research on related topics was made following a qualitative (e.g., case study) methodology exclusively (through the elaboration of interviews). The current study contributes to deepened knowledge regarding difficulties on the implementation of low-cost techniques. A quantitative approach to the topic of adoption of techniques has been elaborated for different contexts (and farming specialisations) such as Pakistan (Abid et al., 2015) or Australia (Long, 2013). Nevertheless, records of mixed or quantitative approaches to study the influence of contextual variables on the implementation of management techniques has not been found for the Uruguayan FLF farmers population.

4.2 Data sources

Due to an inter-institutional coordination involving FAGRO and MGAP, previously collected data could be accessed and used as input for the elaboration of this study. On this context, the accessed data (collected by MGAP) was mainly used in the context of the quantitative analysis.

The accessed database was elaborated based on a survey elaborated between July and October in 2015, in the context of the GFCC project. The survey captures information regarding 271 farmers, through 86 questions with information related to composition and relationship between family farm members, size, ownership of the farm, land use and pasture management, livestock stock and classification, livestock management, spatial-temporal grazing management, inputs and costs, technical assistance, access to information and networks, among others and represented a significant effort in terms of resources for the country and the institutions involved.

The studied regions are presented in Figure 15, showing the two ecoregions chosen for this survey and this research. The respondents were distributed between the two selected study areas: 131 of the respondents were farmers located in Basaltic Slope geographic region, whereas 140 farmers are in Eastern Sierra. Region[13]. In Figure 15 it is also represented with red dots, each farmer identified according to their location. Is important to highlight that they do not represent the totality of farmers in the geographic region, but it is limited to highlight the project participants, as shown on Figure 15.

[13] Basaltic Slope region involves Artigas, Rivera and Paysandú, Salto and Tacuarembó departments, whereas farmers located in Eastern Sierra involved departments of Lavalleja, Maldonado and Rocha in Uruguay.

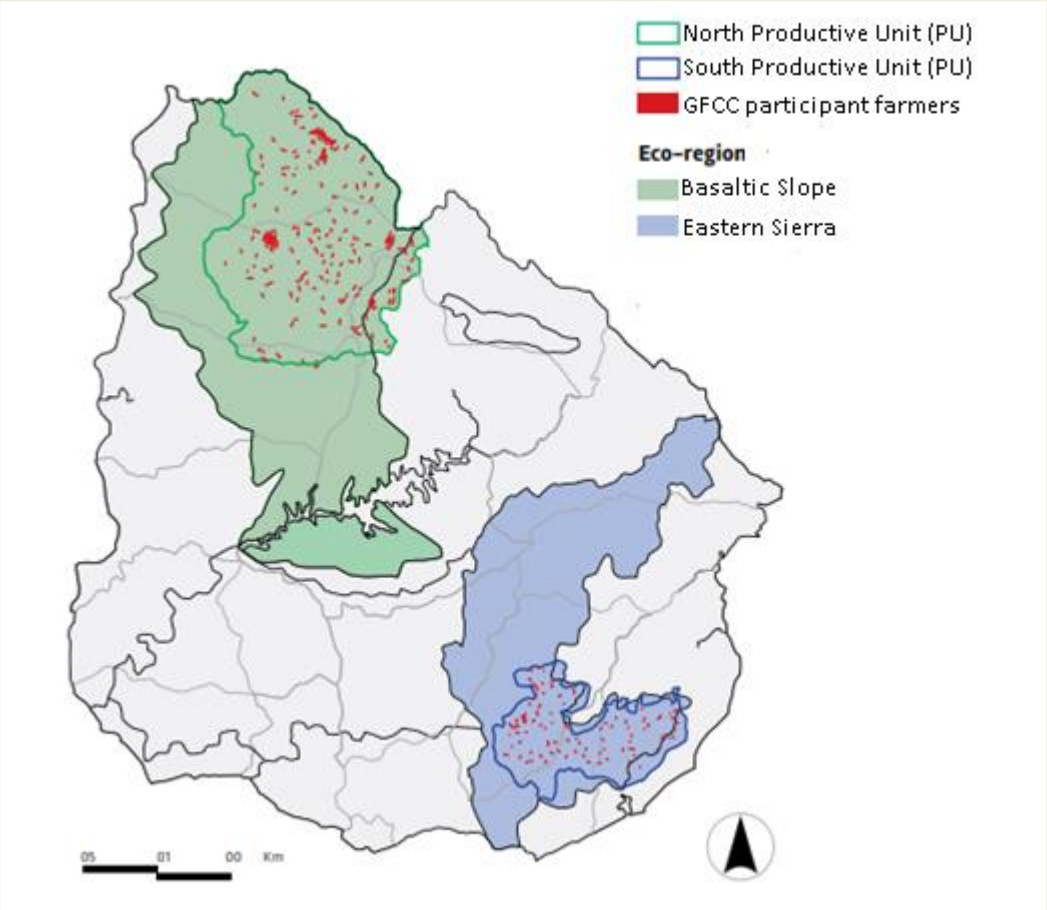


Figure 15. Farmers distribution among study areas. Source: GFCC project, DID Evaluations- AGEV OPP

Survey selection criteria were elaborated based on data provided by the General Agricultural Census elaborated in 2011. The sample size was established following Neyman criteria (Cochran 1952) ensuring representativeness of the number of participants that were beneficiaries from the GFCC project. According to these criteria, the resulting sample size included 30% of the respondents that were GFCC beneficiaries, whereas 70% were not beneficiaries of the project.

Additional sample selection process was implemented for this research, following the recommendations made by Paparamborda (2017) to ensure that all respondents were familiar farmers which are the objective population of this study. Among the criteria followed for this selection, there are location and total animal stocking rate filters to ensure that it would be representative of the total population of family operated livestock system in Uruguay.

In terms of animal stocking rates, those farmers who declared having more than 2,5 livestock unit (UG)[14] per hectare, were subtracted from the database. This decision

[14] Livestock Equivalent units (UG) is an equivalent number used on the Uruguayan livestock sector that measure the animal load that a certain productive system has in one hectare. This measurement converts animals different categories (e.g.: heifer, calf, sheep, lamb) to a standardized unit that allows making comparison between different productive systems.

was agreed with the FAGRO pasture research team since a stocking rate of animals higher than 2,5 UG per hectare, is not considered representative of a livestock productive scheme, but they might correspond to an unstable or subsistence livestock tenure system (e.g.: they have animal feeding on the road or have a very small number of animals). Therefore, farmers that declared UG higher than 2,5 were extracted from the sample since it is considered as an extraordinary high animal load in comparison with the pastureland capacity for the Uruguayan context.
Additionally, farmers that did not meet the criteria to be considered as familiar farmers according to the definition adopted by (Paparamborda, 2017) were also not considered on the sample for this research.

The implemented filtering criteria were chosen to ensure possible comparison with relevant previous research on the farm and provide continuity of the research line that is currently being implemented and strengthened in the context of the institutional agreement between FAGRO, MGAP, INIA and other relevant knowledge institutions.

GFCC database was used to elaborate descriptive and quantitative analysis through the elaboration of multiple statistical analysis, by creating a model to explain a change in the implemented level of management techniques, through modelling with the functional form a logistic regression model.

4.3 Interviews

This research outlined in this thesis was conducted within the auspices of a broader scale (co-innovation) project, implemented by FAGRO and funded by the Adaptation Fund through the GFCC project. The dataset used for the formulation of the regression model was based on farmers' interviews designed by and conducted by FAGRO and MGAP staff, within the bounds of standard ethical and privacy norms as governed by the University of the Republic (UDELAR). The author conducted additional and complementary interviews with project staff. The questions posed during interviews were discussed with the Uruguayan supervisor Dr Adrian Rodriguez and conformed with the overall framework of the co-innovation project implemented by FAGRO. The two data sets were used in this research (see Appendix 6).
The semi-structured interviews with project staff conducted by the author had the following purposes:

- gain a different perspective of the subject and region
- gain better insight into the adoption of technologies in farmers
- open new queries and research aspects
- gain deeper perspective regarding obstacles during the implementation of techniques.

Data collected in those interviews was used as an input for the qualitative analysis and was elaborated following a set of interviews to technicians that have been involved in the practical experience of public policy that intended to increase the level of

implementation of management techniques, to increase productivity among familiar livestock systems through a co-innovation approach.

Technicians interviewed were chosen for being responsible for the implementation of the project among farmers located in the Eastern Sierra region during 2016-2018 (3 years). During this time technicians were the main responsible for the implementation of the co-innovation project on the Eastern region.

4.4 Analysis Criteria

On the following section, the main procedures to analysed data followed on this research are presented. Chosen criteria are aligned to reach the aim of the proposed objectives, and methods selections are justified accordingly.

Table 6. Dimensions, concepts and variables used on this study

Dimensions	Concept	Variables that operationalise the concept
Contextual factors	- Educational level - Technical assistance - Social capital – a broader and diversified social network might promote a higher implementation of techniques - Diverse source of knowledge	- The maximum level of formal education achieved by the primary decision taker - Assistance to training and capacitation
Management techniques implementation	- There are agronomic low-cost management techniques on which the scientific community agreed to be efficient to increase productivity, but the actual implementation on the Uruguayan cattle breeding activity is low.	- BTI index as a measure of the implemented management techniques, a summary of the current scientific agreement for the Uruguayan context.
Coinnovation	- Holistic knowledge transfer/ generation method that involves the active participation of farmers on the knowledge generation process	Coinnovation project was analysed as a successful practical case of public policy to achieve a change on-farm management
Spatiotemporal systemic management	Systemic approach to farm management that classifies farmers according to the quality of their decision-making process.	Classifies each farmer as a non-manager, manager or spatiotemporal manager (best management techniques implemented).

Sources: Author's own elaboration.

Managemnt techniques implementation among FLF will be measured by the Breeding Technique Index[15] (BTI). BTI is an index that summarises the implementation of farm management techniques on a livestock productive system compared with an agreed set of measures and techniques proposed by a board of agronomical experts. The index was proposed by Paparamborda (2017) and intends to capture breeding cattle management on three dimensions: strategic, decision making support and tactics

[15] "Índice de Técnicas de Cría" in Spanish.

techniques. These dimensions and techniques were assigned a weighted value that enables to classify them according to expert knowledge (Paparamborda, 2017).
Table 7 presents a summary of the main techniques and attributes measured by the BTI index. Table 7 mode and absolutes values assigned are omitted for presentation purposes. A full description of the variables that were involved in the calculation of the BTI index and their ponderations is attached in Appendix 5.

Table 7. BTI index

Management techniques	**Desirable attributes**
Strategic	Stational Mating
	Differential adult's management
	Differential heifer's management
	Does autumn paddock reserve
	Definitive weaning month: March
Decision support	Classification according to corporal condition
	Ovarian activity diagnosis
	Pregnancy Diagnosis
	Bull review
Tactical	Implement breast-feeding control
	Supplementation

Source: Author's own elaboration based on Paparamborda, I. 2017).

Finally, BTI index was calculated with the sum of the assigned weighted values, [16]reflecting farmers actions and quality of those decisions in the farm. In this context, achieving a higher BTI index represent farms that implement not only a higher number of techniques but also techniques are implemented through the correct time and manner based scientific standards.

For this research, BTI was chosen to represent a recognised scientific measurement to summarise agronomical management techniques that are recommended to implement on the Uruguayan livestock sector, for the specialisation of cattle breeding. [17]

[16] It is important to highlight that on the cases that farmers declared implementing continuous mating throughout, BTI index was assigned a value of 0. According to on Paparamborda, (2017), if other management techniques were implemented, they would represent aims not related with farm management.

[17] (Paparamborda, 2017) conclude on his master's Research Thesis, that recommended techniques implementation by themselves, grouped, represented and measured by BTI index, does constitute a significant variable when explaining productivity rates (kg of cattle meat per hectare) on an individual farm and therefore cannot be used to increase income on FLF.
Despite this finding, since the focus of this research is located on explaining contextual aspects that might influence the adoption or not of recommended management techniques, the appropriateness of BTI index is still valid on the context of this research, to reflect a summary measurement of management techniques that are implemented or not within Livestock farmers population in Uruguay. Also, data

For this research, it is possible to assume that a farmer that is currently implementing a high level of recommended management techniques, is in a better position in terms of knowledge resources, and farm management to implement a process in conjunction with public or private technical assistance to increase productivity levels and increase economic results, reduce vulnerability to climate change and increase resilience. This assumption was consulted with agronomical experts on the farm and was agreed to be consistent with the updated literature on the subject.

4.5 Descriptive and multiple regression analysis

Firstly, univariate and bivariate analyses were carried out on the variables that according to previous research would be of interest such as demographic characteristics of farmers, structural farm main variables, levels of participation on farmers organisation, management decisions implemented, access to information and technology, among others.

Descriptive analysis was elaborated to capture differences on the profile of those who achieve a higher level of implementation of the innovative techniques in comparison with other farmers that achieve low levels of implemented techniques. Its aim is to generate resources, identify and describe trends or patterns among familiar farmers that are implementing the recommended techniques and those who do not.

Secondly, a multiple regression analysis was elaborated through a General Linear Model (GLM) with the functional form of a binary logistic regression model with constant was implemented. [18]

Dependent variable and predictors variables were transformed to dummy variables since it was considered the best approach considering the goals of this research and data limitations. The aims of this research are focused on deepen the understanding between the differences in mean of the response for two groups: low BTI and high BTI farmers. It is not the interest of this research to understand the distance between the values of the predictors. Therefore, a binary logistic regression is expected to be the appropiate approach.

Also, there were data constrains since not enough observations were observed on some of the discrete values and therefore categorizing the BTI dependent variable and their predictors as dummy variables would improve this limitation.

As stated by Garavaglia, and Sharma, A. (1998) “by grouping an interval of values into a single dummy variable should increase the value, significance and contribution of the variable”, resulting in a generally more powerful and stable model. Furthermore, the authors highlighted further advantages of creating a logistic regression model using exclusively dummy variables such as: easier calculation and interpretation of

limitation regarding a more explanatory classification (such as spatiotemporal classification), does not allow any other valid alternative for this research.

[18] According to Heeringa, West, & Berglund, (2017), a generalised linear model aims to “estimate a regression equation that relates the expected value of the dependent variable *y* to one or more predictor variables denoted by *x”*.

odds for each predictor, and more consistency between the binary outcome and decision making (Garavaglia and Sharma, 1998)
Therefore, the chosen procedure was considered the most appropriate decision to help to understand the real relationship between the chosen variables.

Using different combinations and functional forms 56 explicative variables were tested before achieving the model with the best goodness of fit criteria possible, according to what is suggested by statistical literature. Regarding goodness of fit test, Robust White estimation of the matrix variance and covariances was implemented, probability of success in a positive or negative event was checked, ROC curve and Hosmer -Lemer goodness of fit was calculated as suggested by (Hosmer Jr, Lemeshow & Sturdivant 2013). Detailed results of the goodness of fit test are attached to Appendix 4.

The multiple regression analysis provides information regarding the relationship between the implementation level of techniques and individual farmers characteristic, regarding the sign and magnitude of the relationship among variables. Also, it can provide the probability of implementing a high level of management techniques, given a random farmer with specific characteristics that are contained in the sample.

Also, the number of cases contained in the databased was elaborated following representativeness criteria for the total population of familiar livestock; therefore, conclusion extracted from the model could be generalised to the total population of familiar livestock farmers in Uruguay. This generalizability offers a powerful tool for public policy for example to identify regions with groups of farmers with low BTI levels, and public policy can be designed to address this context and many farmers with the measurements. Furthermore, the possibility to extend finding to the rest of the population is a key aspect when making recommendations of public policy, being a fundamental aim of this research.

Managers classification

Paparamborda (2017) classified farmers based on the techniques applied to their farm management considering farmers as no- managers, managers and spatiotemporal managers. This classification is elaborated according to information regarding paddock Spatio-temporal usage, management techniques employed on cattle breeding and animal load per hectare. The “managers classification” was elaborated for 69 cases by Papanamborda (2017) and for 12 extra farmers in the co-innovation case study context of this research.

As a result, farmers classified as non-managers are those that kept bull with cows continuously throughout the year or does not have a paddock usage pattern.
Farmers classified as managers were those that applied stational mating and they achieved a paddock usage equal or greater than one and lower than 3. This paddock usage scale was assigned following the scale proposed by Papanamborda (2017) that is based on the number of paddock that each farm has and the presence of a conscious and constant pattern of use through seasons and years.

According to this author, those farmers that have one paddock on their farm would be less prepared to implement the proposed management techniques due to the lack of infrastructure, and therefore would be assigned a paddock usage index with the value one.
Farmers that have two or more paddocks but do not implement a consistent and mindful use of the paddock, based on the pasture availability, would be assigned a paddock usage of two. Farmers that have the appropriate infrastructure (two or more paddocks) and implement a conscious pattern of use according to the state of the grassland can be assigned the value three, four or five according to the appropriateness of the pattern usage based on the pasture availability and other characteristics of each productive system(see Papanamborda, 2017).

Spatiotemporal managers are those farmers that applied stational mating, showed a specific paddock usage pattern classified as higher than three and showed animal loads on their farm lower than 1,3 UG/ha.

Software and tools

Software Stata 13.0 was used to process the descriptive analysis and logistic model, which is appropriate to manage vast databases, like the one processed during research. In addition to this, auxiliary software and tools such as Excel spreadsheets, and Creatively webpage were used mostly for drawings and schemes.

5. Results and discussion

The following section presents a thorough analysis of the main studied variables that influence the process of management techniques implementation.
Firstly, it presents a descriptive analysis of the studied population and the characteristics of those farmers that achieved a high BTI index. Secondly, it exposes the main results of the quantitative analysis to identify determinants of the techniques implementation level. Thirdly, a study case and an alternative classification of management techniques, are presented to characterise successful farmers according to a more comprehensive classification. Finally, it presents the co-innovation experts' perception regarding the caveats for public policy in terms of technical assistance and social capital.

FLF characterization

Among the surveyed population ***50%*** has primary school as the highest level ***of formal education achieved,*** 32% declared secondary school, 9 % technical studies and 7,4% tertiary level.

Additionally, FLF tend to go through the productive without technician advice, evidenced by the fact that 71% of surveyed cases declared not ***having regular technical assistance from a vet or agronomist***, 14% receive assistance from an agronomist, 6% from a vet and 9% received assistance from both. Additionally, most FLF farmers declared going through the ***decision-making process by themselves*** (91% of total respondents), showing a deep-rooted individual structure of productive decision making among FLF (Table 8). These figures are relevant to analyse the proposed hypothesis that farmers with higher social capital would have a higher BTI index.

Table 8. Own decision-making process.

Own decision making	Frequency	%
Yes	221	91%
No	23	9%
Total	**244**	**100.00%**

Source: Author's own elaboration based on MGAP (2015).

Social capital was analysed considering three types of linkages with farmers organization (FO): weather farmer declared having linkages with an FO (Type 1), if farmers declared being member of an FO (Type 2) and, if farmer was member of a group of farmers (Type 3) that make decisions collectively. Thus, considered the highest level of engagement. Figure 16 represents data interpretation to study the

relationship between farmers and institutions for this research.

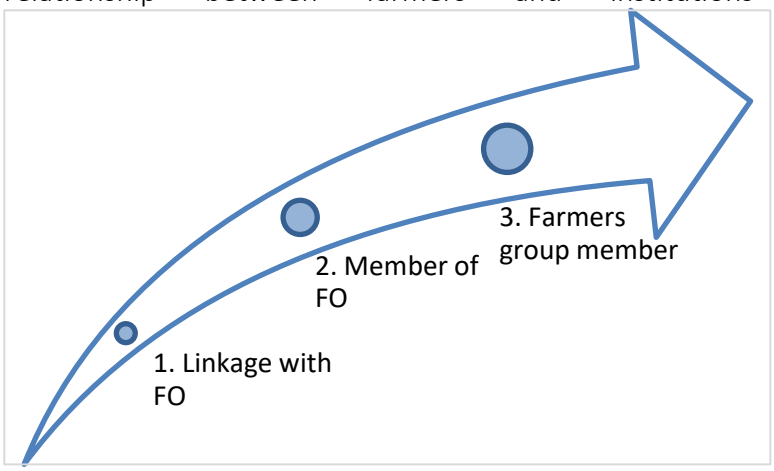


Figure 16. Social capital farmers interpretation scale. Source: Authors elaboration.[19]

Regarding ***social capital***, 54% of farmers declare not having linkages with any FO (Type 1), while 46% responded having links with one or more FO. Regarding membership to FO (Type 2) survey data revealed that among those that expressed having linkages with an FO, 11% declared not being a member of any FO, 77% declared being a member in one FO while 12% in more than one organisation.

In the following section, the main characteristics regarding the frequency of attendance, activities and media used among Type 2 farmers is presented.[20]

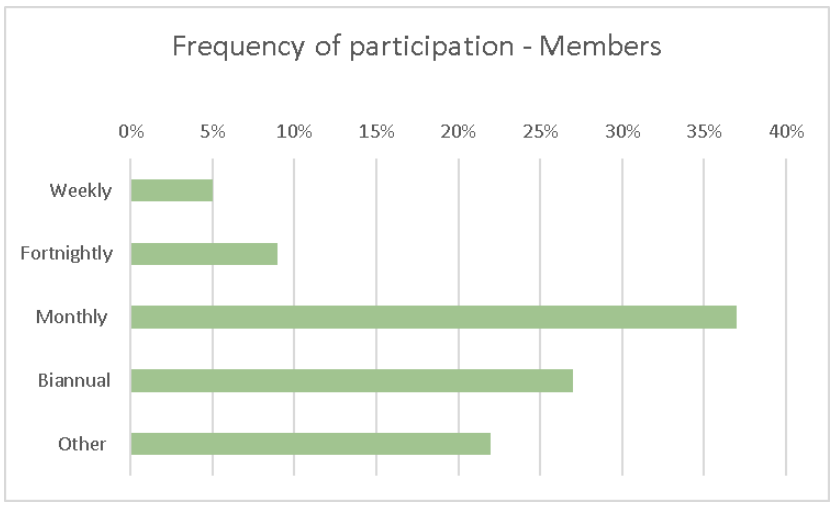


Figure 17. Frequency of participation among farmers that declared having Type 2 linkages. Source: Authors elaboration based on GFCC (2015).

[19] This scale is assuming, that declared having linkages with a FO, is a synonym for an occasional relationship with a farmer's organisation, whereas declaring themselves as members reflect a higher level of belonging to the institution. Being part of a farmers group is considered the highest level of linkages, since it often involves collective decision-making processes on institutional, commercial or other aspects/topics related to farm activities, according to the group aims

[20] This data is only available for type 2 members of FO

Figure 17 evidence that among FO members, the majority (64%) had a medium to a low frequency of participation (monthly or biannual frequency).[21]

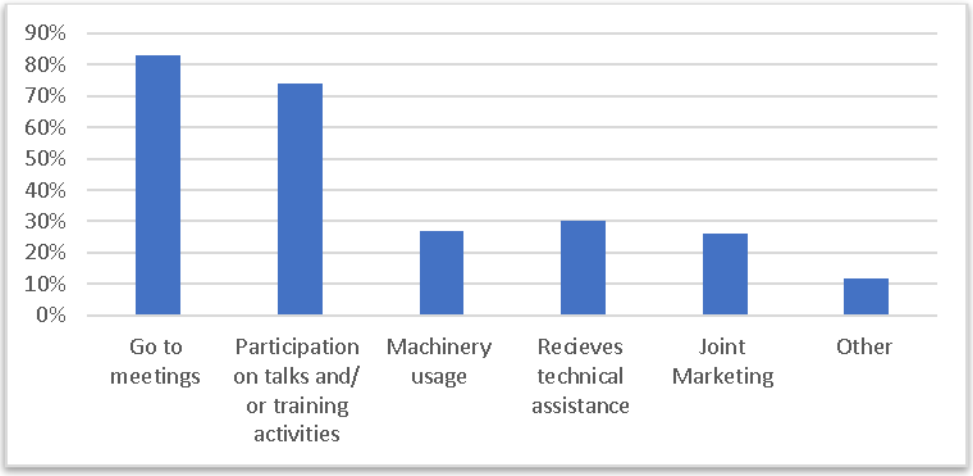


Figure 18. Activities declared by FO members (type 2) on the organisation. Source: Authors elaboration based on GFCC (2015).

In most FO ***members participation involved attending meetings or participating in talks and training activities,*** as presented in Figure 18. This is aligned with low participation rates presented before since activities that would require a higher frequency of coordination, such as shared machinery usage of joint marketing or commercialisation are the least utilised by farmers.

Considering type 3 of commitment, only 26% from 244 farmers declared being part of a farmers group. Most frequent activities on which group members farmers (Type 3) declared to participate are presented in Figure 19.

[21]The low engagement is increased when considering that 22% of farmers declared having "Other" frequency of participation, which is associated with an even lower frequency of participation such as "yearly" or "occasionally. according to the comments provided on the survey.

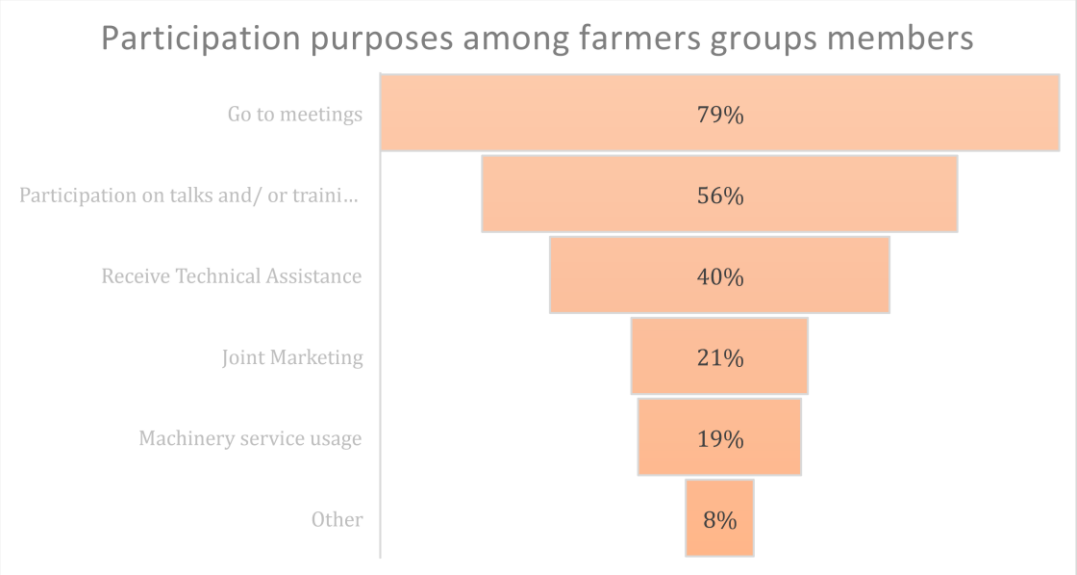


Figure 19. Participation purposes among farmers group members (Type 3). Only the farmer's groups members considered. Source Authors elaboration based on GFCC survey.

Among farmer's group members (Type 3) the most frequent activity is attending meetings, followed by attendance to training and receiving technical assistance. Comparing type 3 with type 2 farmers lower participation on talks and training activities is identified on type 3, evidenced by the decrease of participation from 72% to 56%. This could be associated with a lower frequency of training activities among groups comparing to other farmers organisations, but there are data limitations to understand this decrease in participation on a deeper level.

On the other hand, group members (Type 3) use technical assistance from the organisation on a higher proportion than Type 2 farmers. While among FO members (Type 2), 30% declared using technical assistance provided by the FO, on group members (Type 3), it increases to 40%. This more intense usage could be associated with the smaller scale of groups in comparison with organisations. Smaller groups allow more frequent contact with the experts that offer technical assistant.

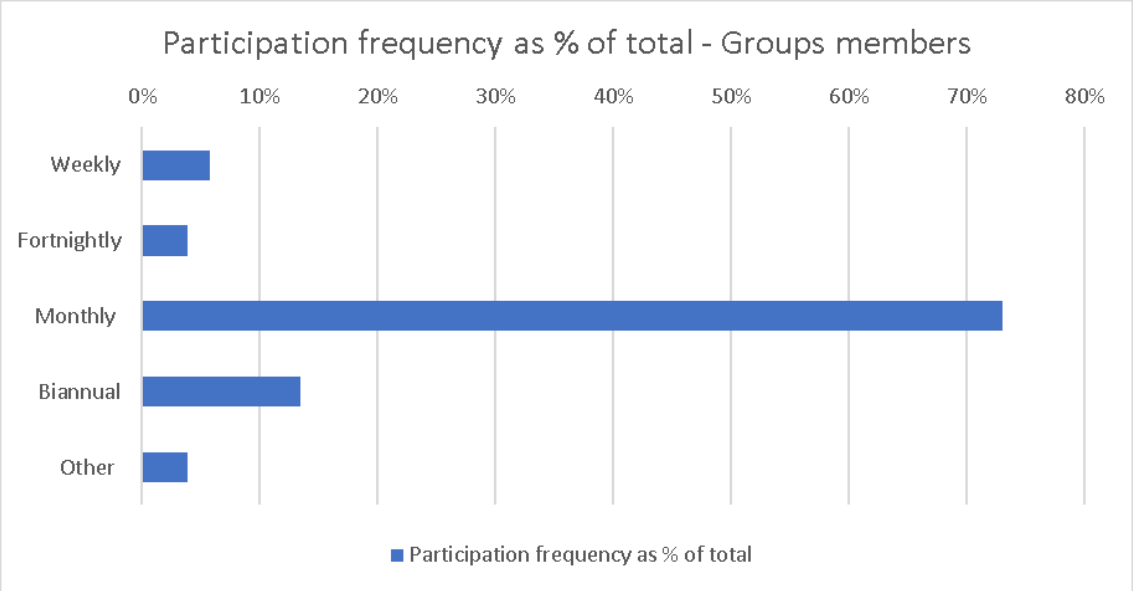


Figure 20. Participation frequency among groups members. Source: Authors elaboration based on GFCC (2015)

Participation among group members is concentrated on monthly participations, with 73% of groups members participating monthly. Patterns of participation among group members are substantially different from FO members, where only 37% of members participated monthly (compared with 73% of groups members), and 49% declared participating on a biannual or least frequent basis. This figure is showing more active participation among group members compared to FO members. This could be associated with the fact that for some groups, monthly participation could be compulsory to qualify for available funding, but further data would be needed to test this relationship.

Table 9 presents the most ***frequent reasons expressed by farmers for not being members of farmers groups***.

Table 9. Reasons for not being on a farmers group.

	Farmers declared reasons	Number of observations	% of total observations
1	Lack of time	23	31%
2	Lack of opportunity/ Not easy to enter	19	26%
3	Not consider necessary or interested/ Bad reputation of groups/Do not agree with working mode/	14	19%
4	The disintegration of previous groups	10	14%
5	Not enough farmers in the area	3	4%
6	No public project was open or offered	3	4%
7	Lack of transport	2	3%
	Total observations	74	100%

Source: Author's own elaboration based on GFCC survey (2015).

Lack of time to attend meetings and activities associated with the normal functioning of a group were indicated as the most frequent response from farmers for not being a member of a group. Secondly, it was highlighted the lack of opportunity to become a group member, mentioning not being invited, not knowing a group in the area, not

having many neighbours in the area with similar issues or problems as themselves or identifying difficulties to access (mentioning too close-knitted groups mainly).
Among the reasons to not be part of a group, previous bad experiences with groups were mentioned, including 14% that have already been part of a group, but the activity was discontinued. Most of these groups that are no longer functioning were created in the context of public policy funding[22] availability, but after specific objectives and project (as well as funding), was finished, groups dissolved. This response is associated with reason number 6 in importance, that reflects a portion of farmers that might only perceive the group's utility in the context of funding availability. No further conclusions are available from the existing data, but it does constitute an open line for future research.

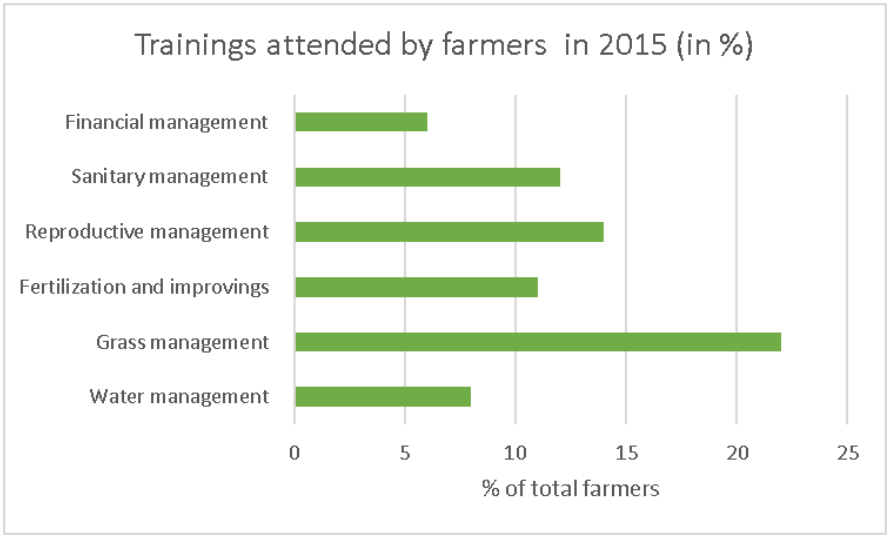


Figure 21. Training and capacitation attended. Source: Authors elaboration based on GFCC survey (2015).

Regarding training and capacitation, there was an ***overall low level of attendance*** to training during 2015. The ***most frequent capacitation and training attended by farmers were capacitation on grass management*** reaching 22% and reproductive management with 14% of the surveyed farmers having attended to training on the topic.

In farmers perceptions, reasons for not making changes after training did not have enough money to implement changes and methods were already implemented on the farm, as evidenced in Table 10.

Table 10.Main declared reasons for not making changes after training.

Reason	Frequency	%
Lack of information	3	9
Not enough money	13	40
Methods already applied in farms before training	8	24
Does not have counselling	2	6

[22] Based on data that was extracted and systematized from the comment section on the GFCC survey (2015)

Not applicable to their situation	2	6
Other	5	15
Total	33	100

Source: Author's own elaboration based on MGAP (2015).

Regarding media uses, ***mobile phones are the most frequent media used to communicate among organisation members***, followed by radio and personal meetings, as evidenced in Figure 22. This fact confirms the widespread use and coverage of mobile phones in rural areas in Uruguay. The accessibility and usage of mobile phones should be considered a priority when planning public policy since it allows low cost and efficient communication with farmers.

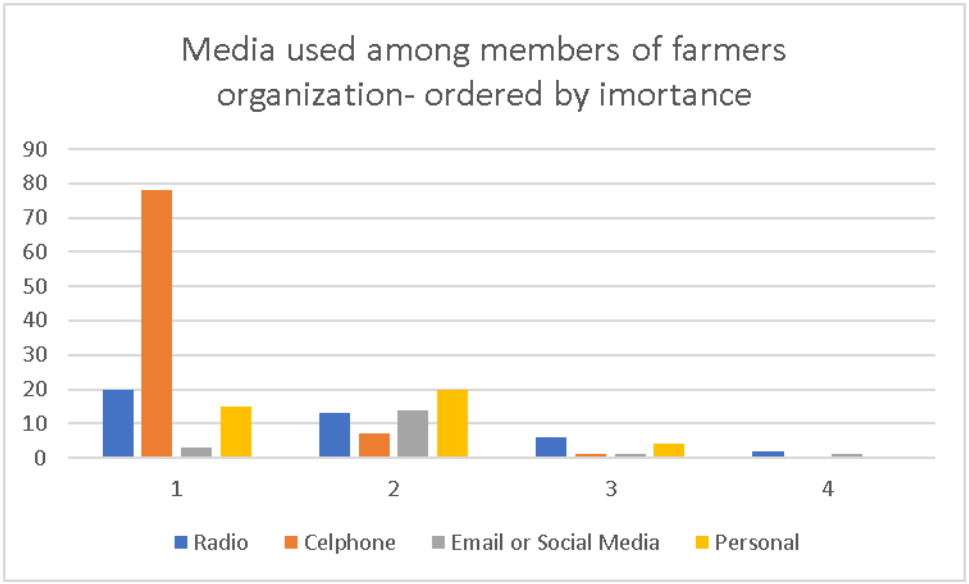


Figure 22. Most relevant media used to communicate between farmers organisation, ordered by importance (1 Most essential and four the least important).

Table 11 is evidencing that ***60% of farmers declared having internet access available at their houses or elsewhere***, reflecting a considerably widespread availability of internet access on rural areas. This is a relevant proxy to consider to study information access to technological updates and techniques, and it constitutes a reliable indicator of the current possibilities of connections with information available.

Table 11. Internet access declared among farmers (at the house or elsewhere)

Internet Access	Frequency	%
No	98	40%
Yes	146	60%
Total	244	100.00%

Source: Author's own elaboration based on GFCC (2015).

Table 12 shows the percentage regarding the used productive land of which they are owners, where it is notable that most FLF has between 75 to 100% of the land under their ownership (41%).

Table 12.Percentage of productive land under ownership.

Own Land Percentage	Frequency	Percentage
0-25%	80	33%
25- 30%	21	8%
30- 50%	32	13%
50 – 75%	14	5%
75- 100%	97	41%
Total	**244**	**100%**

Source: Authors elaboration based on GFCC (2015)

Among the 244 cases surveyed, 90 farmers (37% of total), declared ***having work activities outside the farm***, while 154 farmers declared not working elsewhere.

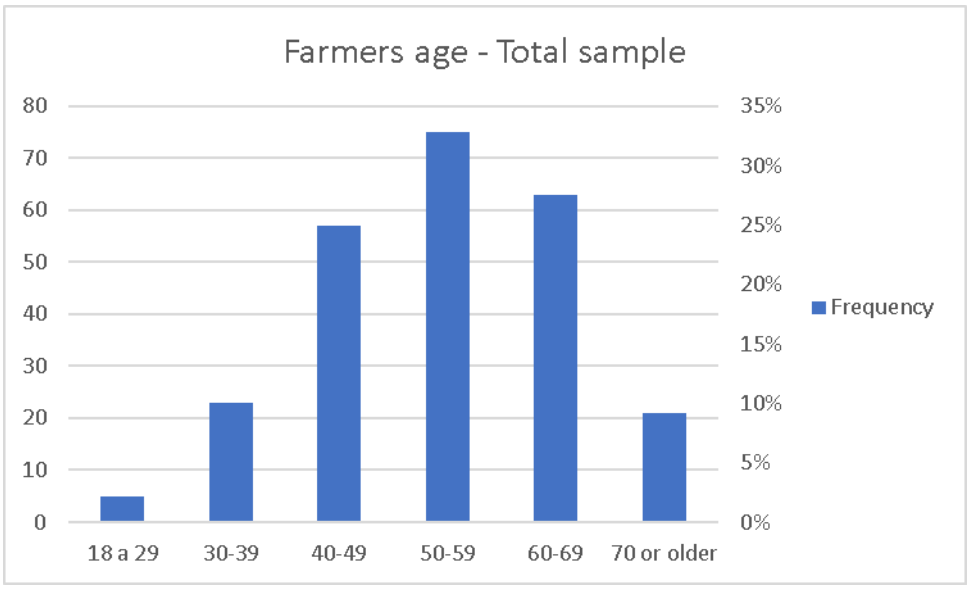


Figure 23. Age distribution among the total sample.

Most farmers declared having 50 years or more (65%), *representing an ageing productive sector.* ***Regarding experience on-farm management, most respondents (60%) have been 20 years or more as responsible of the farm****, whereas* just 6,5% have been in charge less than five years in the farm, showing that most FLF has extensive experience on the decision-making process at the farm.

Out of the 244 cases analysed, ***41% of the surveyed farmers declared having participated in previous experiences of public policy where technical support was provided***.

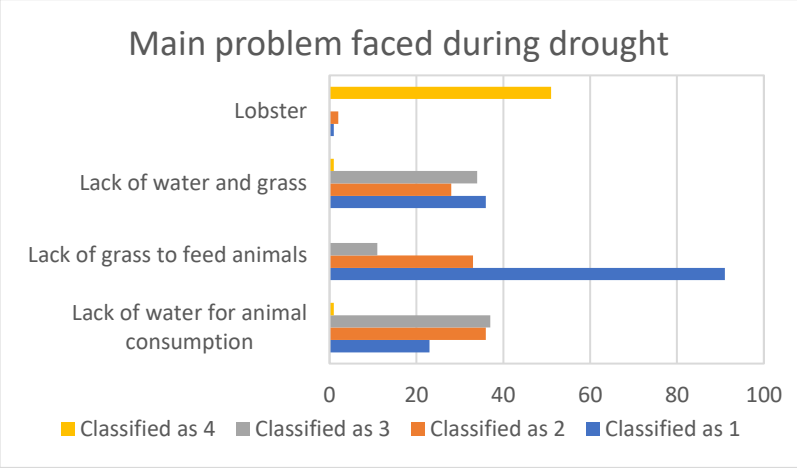


Figure 24. Main problem faced during drought. Source: Autor's own elaboration

Regarding the ***main problems that farmers identify during drought***, lack of grass to feed animals were perceived as the most pressing problem for farmers, followed by the lack of water and grass to maintain animal wellbeing. These results evidence the importance and necessity from a farmer's standpoint of implementing low-cost management techniques recommended by the scientific community, that improve pasture management, allowing to reduce lack of pasture problem during drought episodes.

5.1 Summary of FLF characterization

- Figures and data are shown above, evidencing that most farmers take decisions by themselves and consultation, bonding, shared services and participation in groups or organisations have a low intensity among FLF.
- Most surveyed farmers were men, with an average of 54 years old, and a vast experience on-farm management with the majority being more than twenty years on the farm in which they were surveyed. Among FLF, most farmers have more than 75% of the total productive land used under their property.
- FLF is characterised by having a low educational level where most farmers have primary education as the highest level of formal education achieved, and a low rate of attendance to training evidenced during 2015.
- Most FLF tends to make productive decisions on their own, evidenced by the fact that only 14% of them regularly consult with an agronomist.
- Most farmers (54%) do not have any linkage with farmers organisation, or groups and do not have work-related activities outside the farm.
- Among those that participate as members of a farmer's organisation, they present a low frequency of participation, with the most common activity being attending to a meeting or training courses. Type 3 linkages present a higher frequency of participation in organisation activities than Type 2 linkages (members). Additionally, groups members (Type 3 use groups to access technical assistance, more frequently than organisation members (Type 2).

5.2 High BTI farmers characterization

On the following section, variables that might influence the implemented management techniques are presented in further detail to capture differences among farmers with different BTI index.
Overall results of BTI classification ranges and frequency are detailed in Table 13.

Table 13. BTI classification criteria and frequency

BTI Classification	Value	Freq	%
Very bad	0 - 20	55	26.7
Bad	20 - 40	69	33.5
Regular	40 - 60	62	30.1
Good	60 - 80	19	9.22
Very Good	80 - 100	1	0.49
Total		**206**	**100**

Source: Author's own elaboration based on Paparamborda, (2017)

As reflected on Table 13, ***most FLF (60,2%) achieved a BTI index classified as "Very bad" or "Bad",*** reflecting that techniques recommended by scientific standards are not implemented on most farms. This result is aligned with previous research, where a low level of implementation of techniques among breeding cattle farmers was found (Pereira et al., 2003, Gómez Miller and Saravia Díaz, 2016).

The dependent variable (BTI index) was recoded to represent two groups those farmers that are considered to achieve a an appropriate or high level of implementation of management techniques (high BTI farmers) according to agreed scientific standards and those who are implementing management techniques inadequately or insufficiently (low BTI farmers).
This threshold was elaborated since the highest categories of the BTI index (higher than 40) represent an insufficient number of observations to elaborate a significant analysis. This decision was agreed by the FAGRO research team since it is representative of their experience working with farmers. If the BTI index took a value under 40 it is considered as "Bad" and "Very Bad" and therefore the variable was recoded as a low BTI. If BTI index took a value of 40 or higher it is considered "Regular","Good" and "Very good" BTI, and for the purpose of this research it was classified as a high BTI farmer.

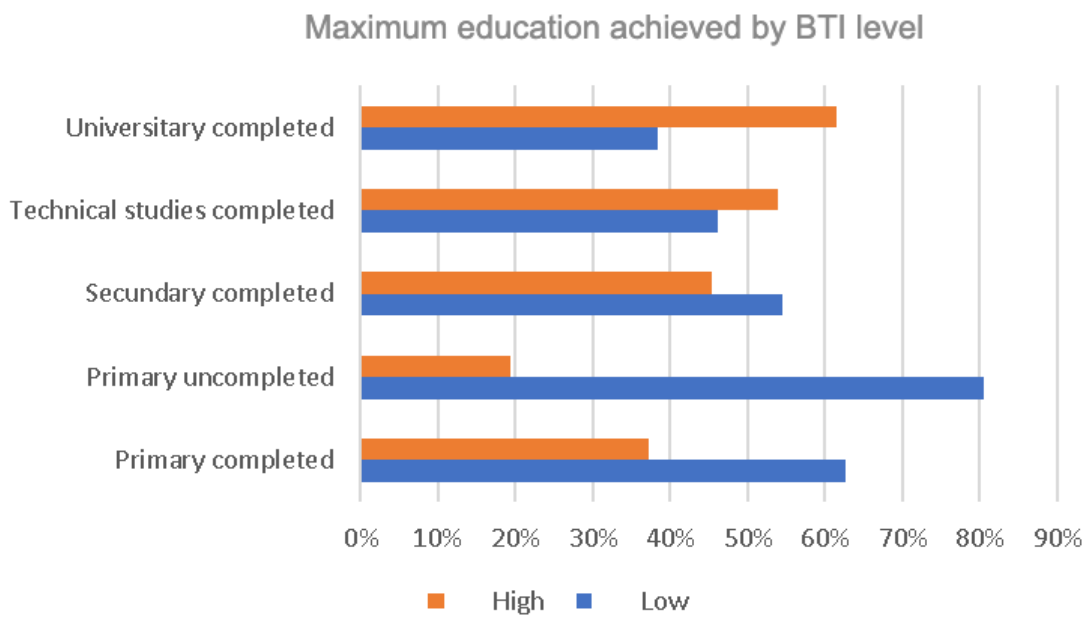


Figure 25. Maximum education level achieved classified by BTI level. Source: Authors elaboration based on MGAP (2017) and Papanamborda (2017)

As presented in Figure 25, among farmers that completed University as the highest level of education achieved, 61% showed a high level of implementations of management techniques (measured by BTI index). While, among farmers that did not complete primary school, only 19% achieved a high BTI. **Therefore, these figures contribute to the conclusion that having a higher level of formal education might impact on achieving a higher level of management techniques.**

Among farmers that implement a low level of management techniques **(Low BTI), 84% declared not counting with any technical assistance regularly** as evidenced in Figure 26. On the other hand, from those who did declare to have technical assistance, 75% of them achieved a high BTI.

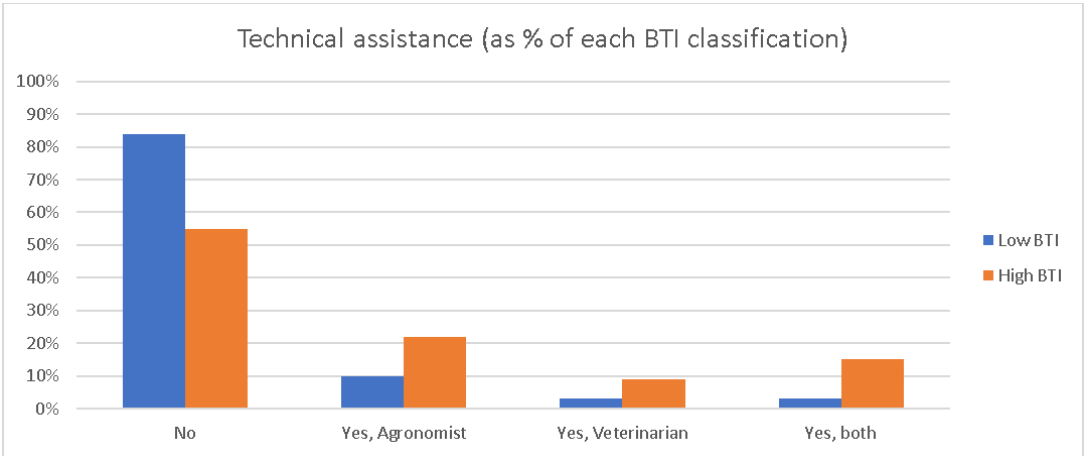


Figure 26. Regular technical assistance. Source: Authors elaboration based on MGAP (2017) and Papanamborda (2017).

Table 14, presents desegregation by professional specialisations from which farmers obtain technical assistance, according to farmers BTI level

Table 14. Technical assistance classified by BTI levels (% of the total on each category).

Usual technical assistance according to specialisation	BTI Levels		
	BTI Low	BTI High	Total
No	84%	55%	72%
Yes, Agronomist	10%	22%	15%
Yes, Veterinarian	3%	9%	5%
Yes, both	3%	15%	8%
Total	100%	100%	100%

Source: Authors elaboration based on MGAP (2017) and Papanamborda (2017).

Linkages with farmers organisations (FO)

The following section presents results regarding BTI level achieved and its relationship with the three types of linkages analysed with FO.

46% of surveyed farmers declared having linkages with an FO (Type 1), 41% declared being members of an FO (Type 2), and 26% were groups members (Type 3), as evidenced on Table 15.

Table 15. Number of observations towards social capital measurements, according to the different types of commitment levels analysed.

Commitment	Type 1	Type 2	Type 3
No	131	12	180
Yes, with more than one organization	12	13	
Yes, with one	101	86	63
No data		133	1
Total	244	244	244

Source: Author's own elaboration.

In the following section, further details regarding the different types of linkages and BTI levels is further detailed.

As evidenced in Table 16 ***most farmers that achieved a low BTI index declare not having linkages with any organisation (63%).*** Meanwhile, among farmers that achieved a high BTI, 37% declared not having linkages with a farmer organisation.

Table 16. Linkages with FO (Type 1), classified by BTI.

Type 1 - Linkages with FO	BTI Levels		
	Low	High	Total
No	63%	37%	52%
Yes, with more than one organisation	2%	7%	4%
Yes, with one	35%	56%	43%
Total	**100%**	**100%**	**100%**

Source: Authors elaboration based on the GFCC survey.

Regarding Type 2 linkages, no significant differences were found on membership level between farmers that achieve a high BTI level in comparison with those that achieve

a low BTI. As showed in Table 17 among both low and high BTI achievers, around 11-12% were not members of any farmers organisation.

Table 17. Members of FO (Type 2) according to BTI level

	BTI Levels		
Type 2 - Membership to FO	BTI Low	BTI High	Total
No	11%	12%	11%
Yes, with one	82%	76%	79%
Yes, with more than one organisation	7%	12%	9%
Total	100%	100%	100%

Source: Authors elaboration based on MGAP and Papanamborda (2017).

Among those Type 3 farmers that showed a low BTI index, 82% did not belong to a farmers group as detailed in Table 18. Therefore, groups might provoque an influence on the level of management techniques implemented.

Table 18. Group member classified by BTI level.

	BTI Levels		
Type 3 – Group member	Low	Low	Total
No	82%	65%	75%
Yes	18%	35%	25%
Total	100%	100%	100%

Source: Authors elaboration based on GFCC survey and Papanamborda, 2017.

Regarding differences on BTI levels according to the size of farms, as evidenced on Figure 27, farmers with **higher smaller productive land showed a higher percentage of farmers that achieved a low BTI level** than farmers with 200 hectares or more. These figures serve as an indicator that having a higher proportion of land could be associated with a higher implementation of management techniques.

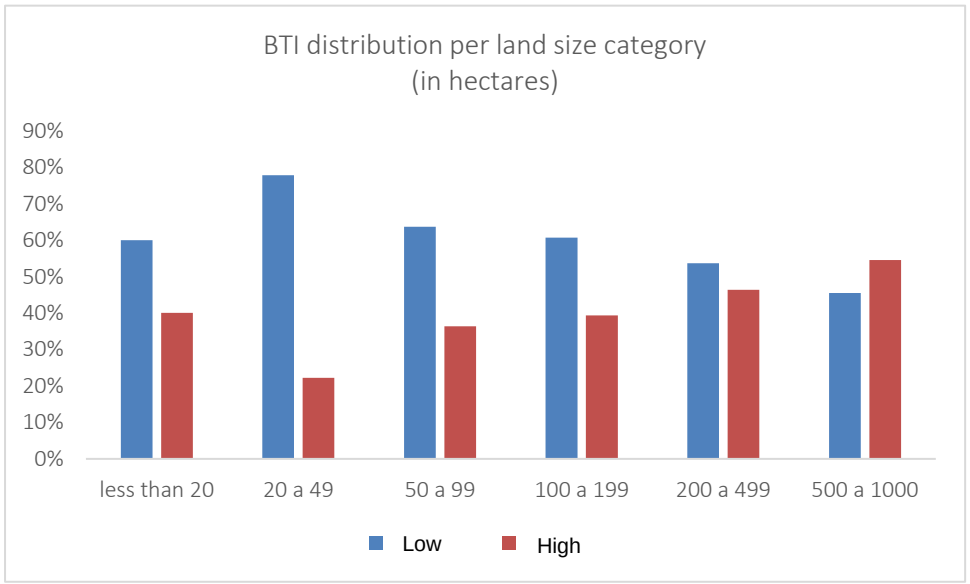


Figure 27. Farms distribution per BTI index and size categories. Source: Authors elaboration based on GFCC survey and Papanamborda (2018).

Regarding previous public policy participation influence, among farmers that presented a high BTI index, 57% declared having participated in a technical assistance programme before, as presented in Table 19.

Table 19. Previous participation on a technical assistance public programme by BTI levels.

	BTI Levels		
Participation in a previous public technical assistance program	Low	High	Total
No	69%	43%	59%
Yes	31%	57%	41%
Total	100%	100%	100%

Source: Authors elaboration based on GFCC (2017) and Papanamborda (2017).

The fact that on the overall result, 59% of the farmers have not participated in any public policy, evidence that public policies of this kind, have not reached their target population entirely.

Levels of work activities outside the farm among FLF classified by BTI index are summarised in Table 20. Most farmers that had a high BTI level (41%) declared having work activities outside the farm. This result contributes to corroborate the hypothesis that those farmers who belong to more diverse social networks have better access to the innovative techniques, sources of information and more resources, therefore, resulting in more management implemented techniques.

Table 20. Farmers that declared working outside the farm.

	BTI Levels		
Work outside the farm	Low	High	Total
No	65%	59%	63%
Yes	35%	41%	37%
Total	100%	100%	100%

Source: Authors elaboration based on GFCC (2017) and Papanamborda (2017).

According to figures presented in Table 21, most farmers that presented a high level of techniques implemented, measured by BTI index, had an experience of farm management of 20 years or longer. This might imply that experience contributes towards achieving a higher implementation of management techniques.

Table 21. Farmers experience on-farm management measured by years by BTI level

Experience on-farm management	Low BTI	High BTI	Total
Over 20 years	57%	64%	60%
Under 20 years	43%	36%	40%
Total	**100%**	**100%**	**100%**

Source: Authors elaboration based on MGAP (2017) and Papanamborda (2017).

As presented on Table 22 from those who showed a high BTI index, 41% were beneficiaries of the GFCC project, whereas, from those who achieved a "Low" index, only 23% had participated on the GFCC project. This result could represent a differential effect of GFCC programme in terms of implementation of techniques, although a more careful analysis should be made.

Table 22. Beneficiaries classified by BTI levels.

	BTI Levels		
	BTI Low	BTI High	Total
Non- GFCC Beneficiary	77%	59%	69%
GFCC Beneficiary	23%	41%	31%
Total	**100%**	**100%**	**100%**

Source: Authors elaboration based on MGAP (2017).

Regarding the relationship between ownership of the land and the level of implementation of management techniques, as shown on Table 23, 43% of farmers with a high BTI own 100% of the land in which their produce. From those farmers who achieved a lower BTI 38%, did not have any land that they produce under ownership. This result could be an indicator that farmers tend to implement more techniques if they own a higher proportion of land.

Table 23. Percentage of land under ownership classified by BTI levels.

	BTI Levels		
Percentage of land owned (%)	Low	High	Total
0	38%	24%	33%
25%	11%	9%	10%
50%	12%	16%	14%
75%	4%	9%	6%
100%	35%	43%	38%
Total	**100%**	**100%**	**100%**

Source: Authors own elaboration based on MGAP (2017)

Characterisation of farmers with a high BTI

- Overall, according to the descriptive analysis elaborated, FLF that have a higher formal education level achieved, achieve a higher BTI index. Also, farmers that present a higher BTI tend to consult regularly to technical assistants (especially agronomist) than those with a low BTI.
- Farmers with a higher BTI index achieved are located on Eastern Sierra region, and on average have farms of higher size and a higher proportion of the land is under their ownership comparing with those farmers that achieved a low BTI.
- Regarding linkages with farmers, those classified as having a high BTI, have shown a higher frequency of linkages with FO (Type 1) and a higher proportion of farmers are associated in groups (Type 3). No significant BTI differences were found among FO members (Type 2).
- Additionally, a higher proportion of farmers with more than 20 years' experience and farmers that work outside the field were found among those that achieved a higher BTI index.
- These figures confirm the necessity to analyse the significance and magnitudes of the relationship between these differential characteristics of farmers and the probability of having a higher BTI. On the following section, the main results from quantitative methods, analyse these relationships further.

5.3 Quantitative model

The quantitative analysis was implemented through a logistic regression model with BTI index as the dependent variable and reclassification of some of the relevant characteristics described above as relevant explanatory variables.
BTI index was grouped in a dichotomic variable that was equal to 1 if BTI equals 40 or higher BTI and 0 if the calculated BTI was under 40 (or classified as "Very Bad" or "Bad"). Significance and interpretations of the logistic model estimations are presented on the following table 24[23].

Table 24.Explanatory variables of logistic regression model. Marginal effects interpretation.

Dependent variable: BTI index higher than 40. VCE Robust. Model with constant			
Explanatory variable	**Marginal effect coefficient**	**Significance**	**Effect**
Linkages with FO (Type 1)	0,1458	0,01	Farmers that declared having linkages with a FO are 14 percentage points more likely to observe a high BTI index in comparison with those farmers that do not have linkages.
Work outside the farm		Non-significant	No significant relationship was found between doing working related activities outside the farm and achieving a higher BTI index.
Older than 50 years old		Non-significant	No significant relationship was found between a farmer are being more than 50 years old and achieving a higher BTI index.
Having regular technical assistance	0,2558	0,00	Having regular assistance from a technician (including vet and agronomist) increases the probability of achieving a high BTI index on 25%, compared with does farmers that do not have regular technical assistance.
Primary as maximum formal education	-0,1458	0,01	Farmers that declared achieving primary education as the maximum formal level achieved, are 14 percentage points less likely to observe a high BTI index in comparison of those farmers that achieved higher levels.
Average coneat index		Non-significant	No significant relationship was found between the average coneat index of a farm and achieving a higher BTI index.
Portion of own land higher than 50%	0,1434	0,018	Farmers that have more than 50% of the portion of land under ownership are 14 percentage points more likely to observe a high BTI index in comparison with farmers that have less than 50%.

Source: Author's own elaboration based on model results.

On the following section, a more detailed analysis of these results is presented, followed by the main findings of the model.:

[23]Detailed data about model specification and results (including full Stata output) is attached on Appendix 3.

Educational level

A dichotomic variable reflecting education level is introduced into the model to analyse whether having primary school only as the highest level of education was influential on the probability of having an acceptable level of implemented measures. The ***coefficient associated with primary education variable was significant to 99% confidence***, and it had a negative sign (-0,14), which can be interpreted as a negative association between achieving primary school as the highest level of education, and a decrease on the probability of presenting a high level of management techniques implementation. Therefore, the importance of the maximum educational level, on the level of management techniques implemented was confirmed. According to the results obtained from the model, hypothesis i is confirmed since a higher level of formal education has a positive impact on the probability of implementing more management technique. Education contributes to better information access and interpretation, enabling broader access and familiarity with knowledge regarding management techniques.

Regular technical assistance

Based on the result of the model, technical assistance is a significant variable to explain the level of implementation of management techniques, with a 99% confidence. The coefficient of the regression has a positive sign, reflecting that an increase on the use of technical assistance can be positively associated with the increase on the probability of reaching a high or acceptable level of implementation of management techniques, measured by BTI index. This significant and positive association between technical assistance and an increase in the techniques implemented confirms hypotheses A of this research, and it constitutes an expected result of this research. Nevertheless, an essential result from this research is the magnitude of the effect caused by technical assistance in comparison with other significant variables. The availability of regular technical assistance is the most relevant variables due to the highest significant impact estimated on the probability of achieving a high BTI index. According to the coefficient obtained in the regression, regularly consulting to a technical assistant is the most relevant variable to increase the probability of reaching a high BTI level, being approximately 50% higher in comparison with a maximum level of formal achieved and having linkages with farmers organisations.

Linkages with FO (Type 1,2 and 3)

This relationship of farmers and their context was tested on the logit model, implemented by considering three different levels of engagement between farmers and organisations. Levels of commitment were tested by introducing a binary explanatory variable on the model that took the value one if each farmer had linkages with an organisation and 0 if it did not have.

A positive and significant effect was identified among having linkages with a farmer's organisation (Type 1) and an increase in the probability of achieving a high BTI index. This result confirms that having linkages with a farmer association is positively

associated with an increase in the probability of implementing more management techniques and therefore achieving a high BTI, confirming, therefore, hypothesis D.

Membership to an FO (Type 2) was also tested with a similar methodology on the regression model, but the non-significant relationship found among being a member of an FO and an increase on BTI index. This result should be carefully analysed since it is influenced by the decrease (from 206 to 96) observations available, limiting the conclusions regarding a deterministic relationship FO members and BTI level. Therefore, no determinant conclusion could be made on this matter due to observation number detorsions.

Type 3 commitment was also tested with a similar methodology on the regression model with an appropriate number of observations, but the non-significant relationship found among being part of a group (Type 3) and the probability of increasing the BTI index.

A possible explanation for the fact that only Type 1 among the three types of linkages analyse is significative is that having linkages with FO (Type 1) would have a more active connotation than being an FO member (Type 2) or belonging to a group (Type 3). FO
Membership or belonging to groups appears to be an insufficient condition to ensure relationships and fluent linkages with FO, limiting the increase of the social capital and the possibilities for farmers to exploit the benefits offered by those institutions.
This implies the existence of a non-linear and complex relationship between farmers and FO, where the membership should not be mistaken by having fluent linkages with FO and groups and therefore accessing to the social capital and opportunities that it might enable. More in-depth analysis to capture the intensity and dynamics of groups and the increase of BTI would offer insight on the topic. Also, extending the database regarding FO members would allow to elaborate a quantitative analysis and conclude further from the relationship between FO members and BTI index.

Own land ratio

Own land ratio was included on the model to check if there was a determinant relationship among the level of techniques implemented. For this purpose, a variable was added in the model that took the value one if farmers own 50% or more of the land in which they produce, and 0 otherwise. According to the results of the model, a positive and significant relationship was found between having more than 50% of the productive land under the ownership and implementing a higher number of techniques, therefore achieving a higher BTI index. The coefficient associated with this effect was 0,14 with 95% of confidence. Therefore, the hypothesis that a higher percentage of land under ownership might cause a higher level of preoccupation and have a positive influence on the level of implemented techniques is verified.
Despite the significant effect of this variable, the magnitude of this impact is lower than the impact caused by technical assistance or educational levels or linkages with FO. Additional variables regarding farm sizes were introduced into the model identifying small farmers according to 50 hectares or 100 hectares, but no significant

relationship was found. This finding supports the hypothesis of this research that ownership might increase awareness for resources status and the state of the ecosystem overall.

Work activities outside the farm

Additionally, to test the hypothesis a variable that took the value one if the farmer worked outside their farm, and cero if the farmer only worked at their farm was created and tested on the logit model. Results from this analysis were that according to estimations non-significant relationship was found between having work activities outside the farm and a change on BTI level. This result constitutes an important finding of this research since it can be interpreted that the sole contact with other realities or social actors does not affect, as it was supposed, the level of implementation of management techniques among FLF. Despite the differences found among BTI level, which were aligned with the hypothesis of this research, the relationship between working outside the field and achieving a high BTI proposed by it was not verified quantitatively. Therefore, the hypothesis was not verified, constituting a relevant finding of this research.

Farmers age

A dichotomic variable was introduced on the model to test whether having 50 years old or older could influence an increase on BTI index, but no significant effects were founded. Therefore, it was found a non-significant relationship between (the main decision taker) farmer age and the level of management technique implementation. This variable was kept on the model for control purposes.

Farm management experience

Additionally, it was introduced on the model a variable that took the value one if the experience was 20 years or more and 0 otherwise, to test the relationship between the length of experience on-farm management and techniques implemented measured by BTI. The estimated coefficients were not significant to explain a relationship between variables. Therefore, there is no significant relationship among farm management experience and an increase in the level of management techniques measured by BTI index. Finally, the variable was excluded from the final model since it did not add explanatory power to the model.

Through this analysis, it was confirmed a positive impact of technical assistance in the level of implementation of management techniques, and that it constitutes the variable with the most significant effect on the level of techniques implemented.

Hypothesis B was also confirmed, finding that a higher level of formal education is positively associated with a higher level of implementation on management techniques, measured by BTI index. Also, a positive relationship was found between having higher linkages with at least one FO (Type 1) and a higher level of management techniques implemented.
Also, hypothesis E was supported by the fact that owning more than 50% of their

productive land, implies an increase in the probability of achieving a higher level of implemented techniques. Regarding hypothesis C, no significant relationship was found between working outside the farm and the implemented management techniques among the studied FLF.

5.4 Case of study: public policy experience - a co-innovation approach

On the next section, the case study is presented and further analysed. Firstly it exposes the co-innovation and an alternative classification for FLF, managers classification that reveals differences in management approaches to the farm. Secondly, farmers management techniques implementation levels were measured by BTI index on two different moments to capture BTI evolution (before and after coinnovation project) and its managers classification evolution. Thirdly, interviews were conducted to capture technician's perception and understanding of this implementation process and extracting lessons towards the design of future public policy aimed to change management techniques implemented among FLF.

The following section is presented according to these items:

a. FAGRO Coinnovation project
b. Managers classification
c. BTI on co innovators
d. Manager classification on coinnovators
e. Interview analysis
f. Lessons learned

Fa) AGRO Coinnovation project [24]

Coinnovation is a project elaborated by an institutional agreement of FAGRO with MGAP and financed on the context of Component 3 of the GFCC project (see Table 5) that aims to increase familiar cattle farmers resilience to face climate change. By increasing resilience, the project expects to increase the ability to absorb the shocks of adverse climatic events (drought) with regards to the productivity level of livestock production systems. The project expects to achieve these results through a higher implementation of cattle management practice, by increasing farmers participation in networks and the usage of agroclimatic information for production decision making.
Coinnovation project considered each familiar farms and identify the system its characteristics, resources, and objectives to define specific farm management that would enable to increase production levels, without increasing the cost significantly. Thus, generating an increase in net income, based on the implementation of management techniques under the ecological intensification approach.

Selected participants (27 FLF) received technical assistance for three years (June 2015-2016 to June 2018 -2019) of qualified technicians that was located in their area[25].
The method implemented by the co-innovation project was to initially propose, after a series of visits to the farm, a redesign of the productive system, defined in conjunction with farmers, considering their objectives, interest, and reality. On the

[24] The most relevant precedent for this type of coinnovation projects among FLF was implemented by INIA from 2012 to 2015 through the project "Coinnovating for the sustainable development of seven familiar livestock systems in Rocha, Uruguay"[24].Participant farmers were selected in agreement with local institutions and organisations with the criteria of representativeness of the diversity of the region. They were analysed by study cases along the three years of work (2012-2015).

[25] Two technicians assigned to Eastern Sierra region and two on Basaltic Slope region.

redesign proposal, the main priorities and lines of action were agreed upon to establish a set of short, middle and long-term goals. Advances concerning the established goals were monitored monthly during technical assistance schedule visits. To ensure a continuous line of work, one technical assistant took responsibility for monitoring a limited number of farms (3 to 7 farms max.), located in nearby areas. The assistant was responsible for elaborating a monthly update of each farm evolution with advances, challenges, difficulties, and goals met.

Figure 28 constitutes an author's interpretation of the co-innovation project functioning to summarise the project.

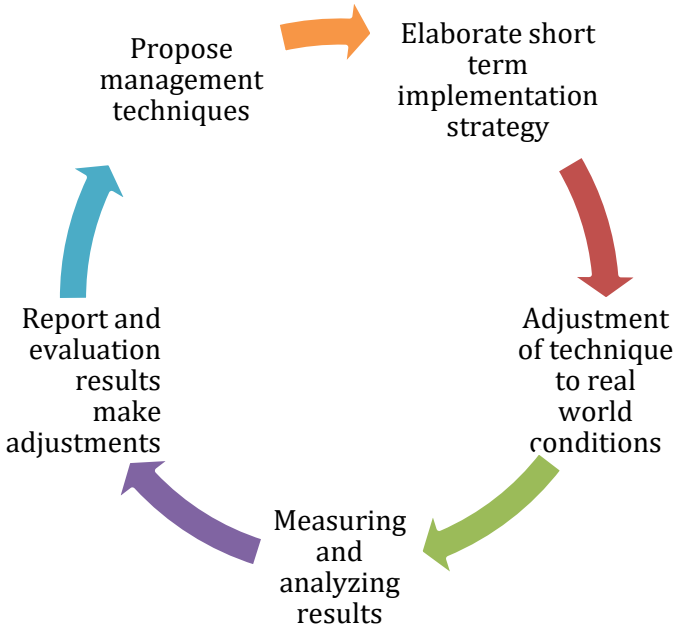


Figure 28.Authors interpretation of Coinnovation project methods. Source: Authors elaboration.

Table 25 summarises relevant variables of Eastern Sierra co-innovation participants to characterize participants from a social standpoint.

Table 25. Main studied variables for analysed co-innovation participants.

ID[26]	Max education achieved	Linkages with farmers organisation	Member of farmers organisation	Group member	Work outside the farm	Age	Technical assistance	Average coneat index	Total land size (2018 - 2019)
1	Secondary uncompleted	Yes	Yes	Yes	No	42	Yes	125	230,9
2	Secondary uncompleted	Yes	Yes	Yes	No	52	Yes	79	316
3	Primary	Yes	Yes	Yes	No	60	Yes	88	293
4	Secondary uncompleted	Yes	Yes	Yes	No	63	Yes	78,9	171,7
5	Primary	Yes	Yes	Yes	No	53	Yes	56	181
6	Primary	Yes	Yes	Yes	No	59	Yes	94	152
7	Secondary uncompleted	Yes	Yes	Yes	Yes	53	Yes	90	222
8	Unknown	Yes	Yes	No	No	50	Yes	70	230
9	Secondary uncompleted	Yes	Yes	Yes	No	53	Yes	59	376
10	Unknown	Yes	Yes	Yes	No	55	Yes	75,5	86
11	Secondary uncompleted	Yes	Yes	No	No	52	Yes	68	829

Source: Author's own elaboration based on data gathered during interviews with technicians and co-innovation reports.

Managers classification

An alternative classification is presented concerning management techniques, is managers classification that measures aspects that refer to a holistic and systemic management of the farm, taking decisions considering the use of space, resources and time according to the state of resources (grass, animals and climate).
According to Papanamborda (2017), this classification organised farmers according to their managerial skills of animal load per hectare, mating, and systemic implementation of a defined pattern of paddock usage according to pasture availability and time.

- Non-managers were farmers that have continuous mating and did not have a pattern of paddock usage.
- Managers are considered those farmers that do a stational mating and they also have a defined a pattern of paddock usage.
- Spatio-temporal managers: seasonal mating and defined paddock usage while keeping animal stocking rate lower than 1,3 UG[27] per hectare.

[26] Each farmer was given an id number to protect their personal identities.
[27] Cattle units or "unidades ganaderas" in Spanish

Other model tested: spatiotemporal managers

Further models were tested to check if BTI explanatory variables might also influence aspects measured on managers classification. Firstly, the same explanatory variables were tested on a model with a dependent variable that was equal to 1 if the farmer was considered a Spatiotemporal manager. This model was tested to analyse if those independent variables that were influential in achieving a high BTI can also explain the probability of being classified as Spatiotemporal manager. This model tested was not significant overall to explain a change on the probability of achieving a spatiotemporal manager status measured that indicated the non-significance of the overall tested model. One influential factor of this result could the low availability of observations for the spatiotemporal managers' classification (69 observations). Due scope of this research, resources were not available to reproduce the calculation of the complete database (244 cases), but it could constitute an interesting further research line to deepen the understanding of determinants that might influence a familiar livestock farmer to implement a spatiotemporal approach to the management farm.

Since the whole model was not significant, every variable that composes managers classification were introduced individually as a dichotomic dependent variable to the logistic model specified to check for relevant relationships between determinants of BTI levels and components of managers level. The model was significant to explain stational mating., but it was not significant to explain the probability of having animal a controlled animal load per hectare or having a pattern of paddock usage.

BTI among co-innovation participants

BTI measurements were estimated (Stage 1) at the baseline of the project (the productive year 2015-2016[28]) and the finalisation period (2018-2019)[29].
Initial BTI index was calculated based on reports elaborated during the redesign proposal, and finalisation data was collected from the same report and complemented with data obtained during interviews conducted to Eastern Sierra technical assistants. BTI was calculated for the farmers that are participants of the co-innovation project on Eastern Sierra region.[30]
For this project, it is assumed that techniques recommended on the co-innovation project are well captured by BTI calculation, even though they constitute classification with different purposes and consequences.[31]

Having the BTI index calculated would enable to test the hypothesis that co-innovation was a successful experience on increasing management techniques implemented on participants farms, measured by BTI.

[28] Agricultural year in Uruguay is measured on a year that goes from June on year x to June on year x+1.
[29] For simplification purposes these years are considered as 2016 and 2019, respectively.
[30] Initially the project selected 12 participants, but one farmer decided during the project, to discontinue participation, therefore the case is not considered on the analysis.
[31] E.g.: According to Papanamborda (2017), spatiotemporal management is significant to explain increase on meat per hectare produced increasing farmers net income, and having a high BTI was not

Main results of BTI calculations for Eastern Sierra co-innovation participants farmers are presented in Table 26, and a detailed disaggregation of calculations is presented in Appendix 5.

Table 26. BTI index and managers classification on co-innovation participants – Main results for Eastern Sierra participants

	BTI 2015-2016		BTI 2018-2019				
ID	BTI 2015-2016	BTI classification 2015-2016	BTI 2018-2019	BTI classification 2018-2019	BTI change in the period	Managers classification (2015-2016)	Managers classification (2018-2019)
1	81,25	Very Good	87,5	Very Good	6,25	Manager	Manager
2	75,25	Good	61,25	Good	-14,00	Manager	Manager
3	76,5	Good	80	Very Good	3,50	Manager	Manager
4	41,25	Regular	66,25	Good	25,00	Non manager	Manager
5	17,5	Very bad	77,5	Good	60,00	Non manager	Spatiotemporal manager
6	61,25	Good	88,75	Very Good	27,50	Manager	Spatiotemporal manager
7	0	Very bad	43,75	Regular	43,75	Non manager	Manager
8	70	Good	80	Very Good	10,00	Manager	Spatiotemporal manager
9	71,25	Good	83	Very Good	11,75	Manager	Spatiotemporal manager
10	40,5	Regular	61,25	Good	20,75	Non manager	Manager
11	3,75	Very bad	62,5	Good	58,75	Non manager	Spatiotemporal manager

Source: Author's own elaboration based on co-innovation reports and primary data and Papanamborda (2017).

Most co-innovation participants farmer (91%) showed an increase in the levels of management techniques implemented on the farm, measured by BTI index after three years of implementation of the co-innovation project. Magnitudes of changes were substantially different among participants, despite there are no differences in the implemented methodology on every participant.

There is a heterogenous baseline evidenced by an initial BTI that varies from 0 to 81,5 among participants farmers of the same Eastern Region. This heterogeneity among participants is representative of the FLF population. Moreover, in this region, the differences on management techniques implementation levels could be partially explained since some farmers, have participated before on a previous co-innovation experience implemented by INIA, from 2012 to 2015, therefore among the highest initial BTI might be associated with this previous project results.
One farmer presented a decrease in the measured BTI, despite maintaining the index "Good BTI index" classification (still higher than 60). This situation could be reflecting a particularly difficult personal situation on the farm that emerged during interviews.

Every participant farmer achieved a BTI classified as “High” after their participation on the co-innovation project, which is considered a successful and relevant result considering that most cattle breeding farmers in the sector showed a low BTI.

Therefore, co-innovation experiences constitute a successful experience of public policy on changing farm management techniques implemented. Furthermore, these results were achieved with a small number of resources, in comparison with the GFCC infrastructure component 1. Other success indexes of the co-innovation project are under construction by the project team, and they have not published yet since the project has finished recently (June 2019). Nevertheless, primary economics results are suspected of showing significant increase improvements among participants farmers, as well as improvements in other areas, such as biodiversity and natural resources conservation.

5.5 Qualitative approach - Interview analysis

Due to the success of the co-innovation experience presented, the co-innovation experts' perception regarding the caveats for public policy in terms of technical assistance and social capital was further analysed. To pursue this aim, interviews (2) were implemented to technical assistants that oversaw the process of implementing a co-innovation approach to change management techniques among FLF farmers in the Eastern Sierra region.
Interviews elaborated are focused on variables where public policy has a higher degree of freedom to design and implement specific programmes such as the relationship of farmers with organisations and groups, and the role of the technical assistance along the process of incorporating management techniques.[32]

The significance and positive impact evidenced associated with having technical assistance regularly at the farm were confirmed and complemented by the perception of technicians collected during interviews. The importance of technical assistance when implementing management techniques was highlighted by both technicians as a fundamental piece on the process. Moreover, they agreed that despite technical assistance is a fundamental condition for the success of management techniques implementation process, it is not sufficient to ensure changes in management techniques implemented.

Considering this difficultness of effective and lasting knowledge building and change in practices[33] interviewed experts highlighted specific characteristics that they had to considerate to help farmer reach a sustainable improvement and autonomous decision-making process, based on their own experience. Regarding the desirable characteristics of a technical assistant when working with FLF, to maximise the efficiency of the dedicated resources are summarised as follows:

Firstly, the technician highlighted the overall importance of having technical assistance available on through a continuous period enough to allow management changes to be implemented and settled. Secondly, technical assistance should assist farmers, not only regarding theoretical aspects of the implemented techniques but also, offer practical recommendations regarding techniques implementation on each specific farm according to resources availability and farm system situation.
As mentioned by Technician 1 during the interview:

[32] Therefore, despite the percentage of land owned by each farmer was significant to determine the level of implemented management techniques in the farm, it was not considered since in Uruguay public policy has little influence on farm land distribution.
[33] Change in behaviour and decision-making process such as changing management techniques that sometimes are being implemented for more than 20 years or by older generations, is a long-haul process, especially in the Uruguayan rural areas where the path dependence can be especially strong.

"is not only taking the technique but also you have to make it work on how to implement it by helping them with practical ideas, so that they realise that is not that hard[34]"(Technician 1).

Also, it was highlighted that technicians should have the flexibility to adapt to the circumstances in which farmers can found themselves on daily reality.

"if the technique cannot be implemented as strictly as it should be, maybe there is an approximation or an alternative idea that helps the farmer to implement the technique" Technician 1.

Furthermore, interpersonal relationships are perceived as essential among familiar companies conformed by FLF since they are complex units affected by trust and familiar relationships, which differ from the traditional company logic. Therefore, it is necessary to build a trusting relationship with farmers to gain legitimacy and to increase acceptance and openness to change.

Interviewed technicians also highlighted the importance of presenting farmers short term objectives towards a successful implementation of the long-term strategy with the effective and durable management change. This implementation is commonly found among the regional development literature, through the suggestion of implementing a long term change/ policy or agreement by the completion of smaller and short-termed milestones to maintain stakeholder engagement throughout the process. (Costamagna, Perez & Spinelli 2013).

As explained by one of the interviewed technicians: *"The first time is when the farmer offers the highest resistance to change, after farmer see the results of the first changes, is encouraged to do more changes, or to repeat the technique next year "*(Technician 1)[35]

Among other relevant factors, the openness of farmers has also evidenced a fundamental aspect key for successful cases regarding the implementation of management techniques. Openness and interests of farmers on the possibility to embrace themselves and their farm on a management change process were highlighted as a fundamental condition for a successful and effective change as evidenced by the co-innovation experience.
Among the mentioned aspects by both technicians, interest in improving, and openness to change, willingness and availability of minimum resources, such as time,

[34] Translated from the Spanish by the author. Original text:*"no es solamente llevar la técnica, sino que también hay que buscarle la vuelta de como implementarla y de repente ayudarlos con ideas más prácticas para que ellos se den cuenta que no es tan difícil" AIS*

[35] Translated from the Spanish by the author. Original text*: "La primera vez es cuando el productor pone más resistencia pone a hacer cambios, después que el productor ve resultados, se anima a ir haciendo más cambios, o a repetir la técnica al año siguiente." AIS*

healthy workforce, and minimum infrastructure were mentioned as necessary conditions to go through the implementation technique process, as well as mental availability (e.g., the absence of conflict or illness on the family), since those aspects were identified as significant obstacles during the implementation process.

Farmers participation on organisations and groups were perceived as necessary by technician 1 since participative farmers are more open to change. As it was argued on the interview: (participation of farmers on FO or groups)*"makes it easier to implement the techniques since they are more open to change in comparison with a more isolated farmer….that still believe that is best to stay in the farm and not to lose time going to a meeting on the local organisation" (Technician 1).*

Finally, about the implementation process, interviewees highlighted the importance of elaborating index and quantifying past results regarding the implemented techniques, on a regular joint activity with farmers. This collaborative elaboration is a valuable learning process, and it was found to increase the acceptance of the proposal for a new technique. Regarding indexes and indicators that are important for farmers to measure progress by themselves, the technician mentioned mostly physical indicators such as the calves birth weight, animal state, weaning rate and pregnancy rate. Financial indicators are not perceived and monitored easily among participants FLF, according to technicians' perceptions (Technician 1 and 2).

Regarding other public policy experiences, technician's perception is that co-innovation experience differentiates from other implemented policies since it offers continuous technical assistance adapted to each farm in comparison with other policies that only offer subsidies, group or occasionally technical assistance.

"*just the money to invest on something that after built, if farmers do not know how to use it, it will not change anything on the system".* (Technician 1)

With respect to the coverage of technical assistance and public policy efficient to cover the targeted population: *"There are many farmers that have never had technical assistance on their life, does not reach even the subsidies policies, for a variety of reasons: because they do not consider it important, for lack of knowledge but overall due to the fact that they do not know that they can change the way in which they produce".* Technician 1

To summarise for a successful implementation of a management technique change process, technical assistance should consider:

- Practical advice
- Flexible to adapt to available resources on the farm
- Personal to gain legitimacy and trust over time
- Professional so that they quantify results in conjunction with farmers.
- Permanent for changes to show results and settle
- Implemented through short term changes to contribute to the long-term goal.

During interviews, suggested techniques (captured by BTI), were classified according to the perceived easiness of implementation or acceptance of farmers, according to technician's perception. Figure 29 exposes the techniques mentioned by farmers during interviews classified by their easiness of implementation on farms.

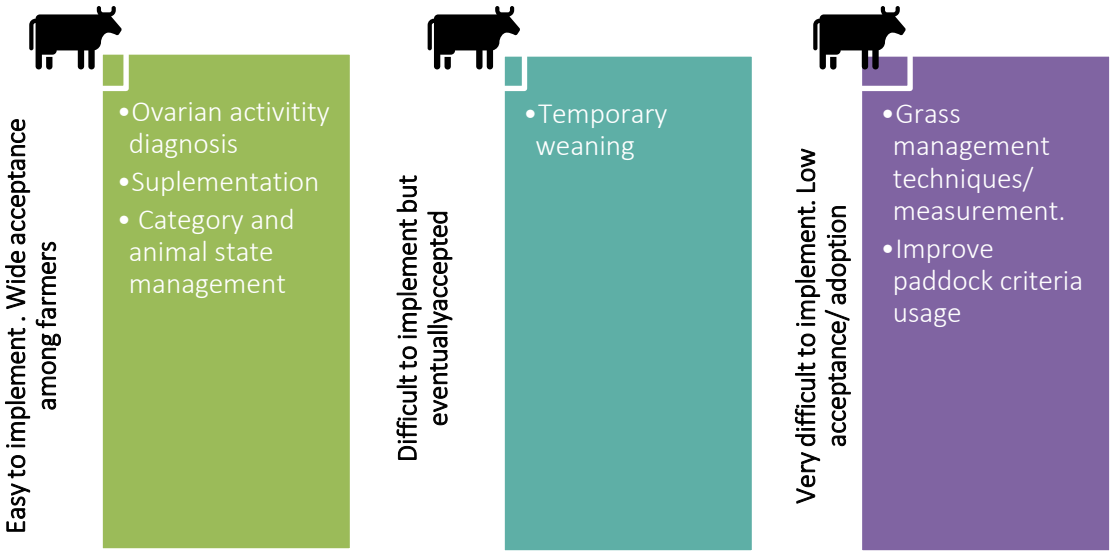


Figure 29. Implemented techniques according to the easiness of implementation. Source: Authors elaboration

Coinnovation project learnt lessons

A co-innovation evaluation report elaborated in September 2019, complements the interview analysis presented. On the co-innovation evaluation report, it is evidenced by the relevance of fluid communication among technical assistance and farmers, since it was highlighted as a strength of the co-innovation project by technicians and farmers. Besides, on the evaluation report, it is also confirmed the critical role that technical assistance has as an interlocutor between the institutions responsible for the project and farmers, even connecting some farmers with other farmers of the region. A personal and trust-based relationship was found between farmers and technician that transcend productive aspects. Contact among them is more frequent than regular institutional scheduled visits to the farm in the context of the project. This communication bond is facilitated by technological media such as mobile phones to reduce distances and increase efficiency on communication.

On the other hand, technicians highlighted communication of farmers with institutions as a weakness of the project, based on the evaluation of farmers. This communication role is highlighted as an essential aspect both by farmers (as reported in the evaluation workshop) and by technicians. This shed light into a factor and role that nowadays is occupied by technicians but could represent a pivotal aspect to enhance levels of techniques implemented. Therefore, it constitutes an aspect that needs further research and that it should be considered as a relevant factor when a public policy to increase management technique implementation level is designed.

This communicational aspects that either are perceived as non-covered (between institutions and farmers) or that are covered and allowed by a technician, which have a double or triple role in the implementation of the co-innovation project, requires a specific role due to the perceived importance among participants and technicians.
A specific stakeholder could have the exclusive role of coordinating and ensuring fluid communication among participant and non-participant institutions, such as education institutions, participant farmers, non-participant farmers in the region as well as other relevant stakeholders. The presence of this communicator or articulator would enable to generate further impacts on the territory and could be efficient to diffuse co-innovation experience and the implemented techniques as well as addressing the detected communication issue between farmers and institutions (such as FAGRO, INIA or MGAP). The presence of articulators is fundamental to enhance management techniques implementation and implement them on a sustainable and efficient manner. Also, it is a crucial factor to achieve a common goal that involves several stakeholders (Costamagna 2013), such as increasing FLF sustainability. Since familiar farmers are key actors of the territories in which they are inserted, the inclusion of the regional development perspective is relevant to address FLF issues.

6. Conclusions

The following section synthesises the main results and conclusions according to the specific objectives of the thesis. Additionally, it introduces recommendations for future public policy design and implementation when addressing the low implementation of management techniques among FLF. Finally, further lines of research are presented.

Specific objective 1: Asses determinants and main characteristics on the implementation of management techniques, among FLF in two climatic vulnerable livestock productive regions in Uruguay.

Regarding this objective, this research has shown that the regular technical assistance to farmers, educational level, having linkages with FO and being the owner of 50% of the land at least have a significant influence on the level of management techniques implemented among FLF.

A significant and positive association between technical assistance (TA), educational level (EL), the linkages with FO(LFO), the proportion of land owned (LO) and the management techniques implemented on a farm was found as a result of this research.

In terms of the magnitude of this influence technical assistance (TA) was identified to cause the most significant change on the level of management techniques implemented, followed by having linkages with a farmer's organisation (LFO) and having more than 50% of the productive land under own property (LO).

No significant relationship was found between working outside the farm, having a higher average CONEAT Index, having a more extensive experience of farm management or a higher farmers age, and the level of management techniques implementation.

Research objective 2: Identify characteristics of technical assistance and social capital dynamics that configures a successful public policy implementation.

Regarding this objective, a more in-depth analysis for technical assistance and social capital (both influential variables to determine the level of management techniques) showed that the sole availability of both resources (TA and LFO) are not enough to ensure a successful implementation of public policy, confirming hypothesis F of this study.

Regarding technical assistance (TA) this should be continued, practical, flexible and adapted to farmers objectives and available resources, personal, and implemented through small milestones ensure engagement of farmers throughout the process.

Regarding hypothesis G, being a member of a FO does enables access to new information and the opportunity to learn from other farmers' experiences, as reflected by the high attendance of farmers to training on FO and by the perception of technicians that evidence that a farmer that member of an FO can be more open to new ideas.

Also, LFO provides the legitimacy and closeness, information and trust that farmers require to implement changes in their daily management techniques. Current low participation both in terms of numbers and frequency among FLF should be

considered as a challenge since it limits the scope of FO and groups as management techniques diffuser.

Although a significant influence of technicians and FO was founded on the probability of achieving a high level of management techniques, currently, most familiar farmers declared making decisions on-farm management by themselves. Since public policy assumes that changes can be implemented collectively, policymakers should include in their theory of change that before thinking in collective strategies, a change in the deep-rooted farmer´s work structure will be needed. Farmer's openness and interests to embrace themselves and their farm on a management change process is a necessary condition for the implementation of a successful public policy. Also, the availability of basic resources, such as time, healthy workforce, overall availability (e.g., the absence of conflicts or illness on the family), and minimum infrastructure are necessary conditions to go through an efficient implementation of changes on management techniques.

In the case analysed a fluent communication has established between experts and farmer, that enable to build the legitimacy and trust needed between technicians and stakeholders required to implement changes in management techniques.
Interpersonal relationships are essential among familiar farmers, which might differ from traditional company logic. Therefore, it is necessary to establish a trusting relationship with farmers to gain legitimacy and to increase acceptance and openness to change.

Daily restrictions and obstacles to the practical implementation of the suggested management techniques, require an individual approach due to the diversity of situations and the specificities of the FLF population. An individual and practical counselling to farmers is highlighted as a core differential aspect for successful public policy implementation.

Technical assistance should be available through enough time to achieve an effective and lasting change in the farmers decision-making process.
Is best to implement the policy by setting and achieving a succession of short-term milestones, monitor and measure results in conjunction with farmers since it might increase the acceptance of a proposal for a new technique.

Research objective 3: Promote a mixed methodology combining quantitative and qualitative methods to contribute to a complex vision of field management, incorporating a high complexity and multidimensional interpretation of problems.

A contribution of this thesis is to implement a quantitative approach to a topic that has been widely studied from a qualitative approach among the Uruguayan FLF. Through quantitative analysis, magnitudes of the impact of explanatory variables on the level of implementation of management techniques were obtained. While, through qualitative analysis, it was possible to identify mechanisms of these explanatory variables and the relationship among different relevant stakeholders, providing information to guide and recommend public policy. Overall this mixed

approach enables to deepen the understanding regarding the relationship among farmers, scientist, technicians and relevant stakeholders towards changes in management techniques implemented.
As a result, experts and farmers groups were identified as crucial for the implementation of a successful public policy since they can promote synergies and a virtuous circle around their context, diffusing techniques and generating an effective downscale of the policy. Public policy should include these stakeholders when designing and implementing projects related to technique implementations. Therefore, hypothesis H has been confirmed, and the interaction between relevant stakeholders that have been fundamental for the adoption of management techniques are presented in Figure 30.

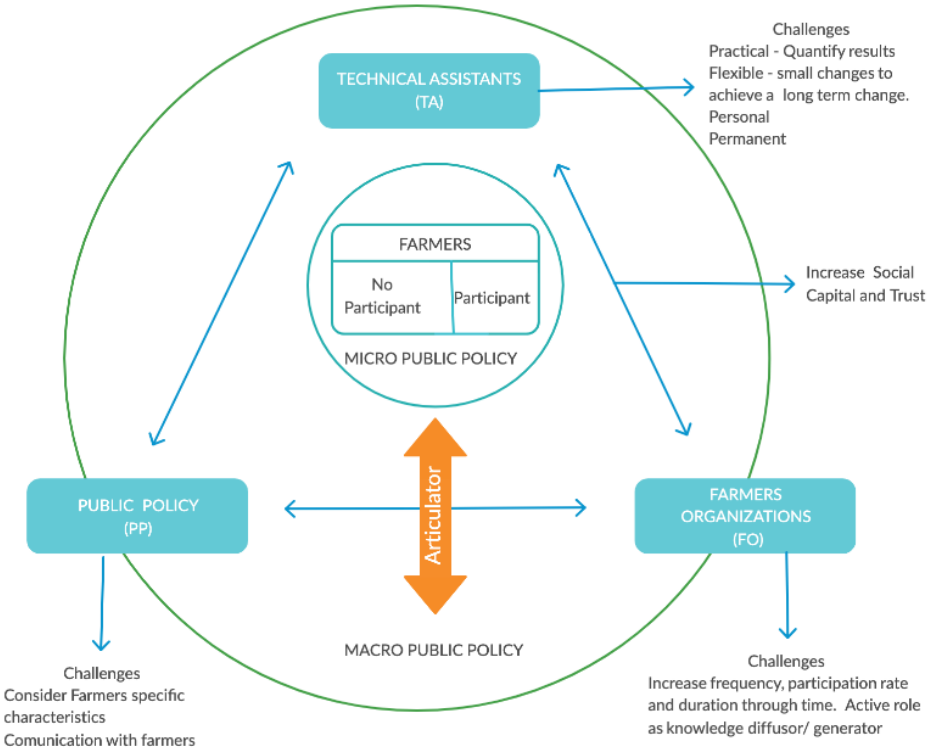


Figure 30. Public policy recommendations and challenges for each stakeholder

Figure 30 represents the vital net of involved stakeholders regarding the implementation of new management techniques on the cattle breeding farmer sector and their challenges and opportunity to improve. Figure 30 also evidence the highest proportions of farmers that do not participate in an organisation or groups, which should be targeted by the micro public policy proposed.

Among conclusions that can be generalised for a different region or countries, is the relevance of identifying the articulator role as a leading role on the process of adoption of innovative techniques, especially among FLF could be highlighted. Furthermore, the technical and technological availability of techniques does not ensure the diffusion and correct implementation. Therefore, it is vital to consider, social dynamics and human interactions when enhancing the efficiency and scope dedicated to implementing innovative techniques. Interpersonal interactions and linkages along

with generating trust and fluent communication among stakeholders are indispensable to bringing closer resources and knowledge to promote and facilitate the implementation of management techniques and other innovative techniques.
This role in Uruguay is covered by technical assistants that have a double role during the implementation of public policy: generating and implementing scientific knowledge while covering the articulation role by generating trust and increasing social capital among farmers, which enables and facilitates the adoption and implementation of management techniques. Regarding other countries, the suitable stakeholder to cover this role will emerge from the idiosyncrasy of the region and sector, but its existence is a keystone for a successful public policy anywhere.

6.1 Public policy implications

This research generates evidence to support the extension and increase of resources dedicated to technical assistance for FLF, for example, through expanding successful experiences such as a co-innovation project.
Public policy should innovate on its design to provoke interacting and reinforcing synergies at a microlevel (or each farmer and the familiar nucleus) as well as macro-level (regarding the institutional structure, and relationship among them and with the farmer).

Furthermore, micro-level policies would be designed to reach FLF that do not participate in FO or groups nowadays, and address problems more precisely, based on each farmer's needs. A more individualised measure for each farmer according to their needs is possible nowadays due to the abundance of data, that could boost the efficiency of public resources destined to increase productivity among FLF on the breeding cattle activity.
An example of a micro-level policy could be to promote association and knowledge exchange among farmers through recognition of existing critical thinking, knowledge and good practices among FLF. Emitting certificates to farmers that are already implementing "good practices" could reinforce the positive approach by generating social and institutional recognition. This micro policy (implemented at individual farms) might have results on a macro level as well, contributing to a more fluent relationships between farmers and institutions while spreading management techniques implementation through the most efficient channel that has been identified by technical assistants: farmers during interviews: mouth to mouth broadcast.
Also, to enhance levels of techniques implemented and widespread the message to the broader farmer community, resources need to be dedicated to an efficient articulation and communication role, as evidenced in this study. Technical assistants covered the role as facilitators have been essential for the success of the policy implementation.

6.2 Further lines of research

Deepen the understanding of groups and its network dynamics and its relationship with public policy.

A panel data study would enable to follow farmers trajectories through the adoption of management techniques, providing insights on the characteristics and decisions of prosperous farmers, and provide insight on how new ideas and techniques gain legitimacy among farmers and spread in the sector. Also, this would enable to identify virtuous and vicious cycles, associated with specific institutions and stakeholders on the sector.

Also, analysing the efficiency of public policies experience that is implemented through groups formation is still pending among the public policy sector, and would provide valuable information, especially on how to promote more lasting and participative groups and organisations.

Promote further research on understanding the complex decision-making process behind management techniques adoption among farmers, especially paddock and pasture management, would provide interesting complementary analysis to this research.

Additional research would be to expand available data on spatiotemporal managers classification so that it enables to elaborate a quantitative analysis, to support the promising presented qualitative data, towards the possibility of elaborating generalisation to a broader population and promote the use of this management techniques.

The role of the articulator or implementor of management changes on the Uruguayan livestock sector context also constitutes an aspect that would provide interesting insight regarding the communication among stakeholders. A complementary study on the articulation between policies and tools on a macro and micro level would supply insight on how to achieve an efficient communication, among stakeholders to promote knowledge generation process and sustainable adoption of management.

A complementary approach to the analysis elaborated on this thesis would be a behavioural experiment to understand priorities, belief and influential cognitive process to design public policies that diffuse knowledge regarding management techniques aligned with the methods by which FLF learn. This approach has been widely implemented at a worldwide level but is incipient in Uruguay and Latin America, especially on public policies dedicated to the agricultural farmers, and might offer relevant insight into the decision-making process.

Finally, findings of this research, intend to contribute to the design of more effective public policy, improving actions towards increasing livestock farmers productivity, wellbeing and their resilience to the impacts of climate change. Also, this research highlighted the importance of combining quantitative and qualitative methods to understand complex realities. Furthermore, triangulation allows researchers to provide insights towards the design of more effective policies to transform the reality of a community with diverse characteristics.

Appendix 1: Climate change variables estimations (FAO and ONU)

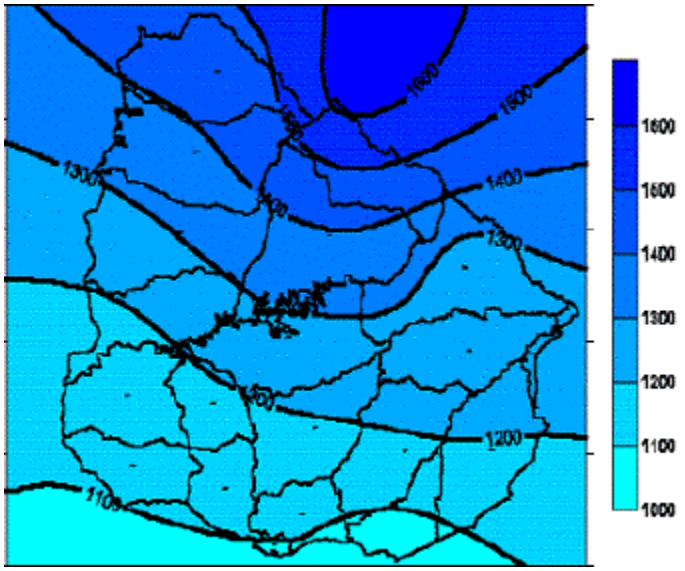


Figure 31.Historical average annual rainfall in mm (1961-1990) Source: INUMET (2019) taken from (Bentancur et al. 2019).

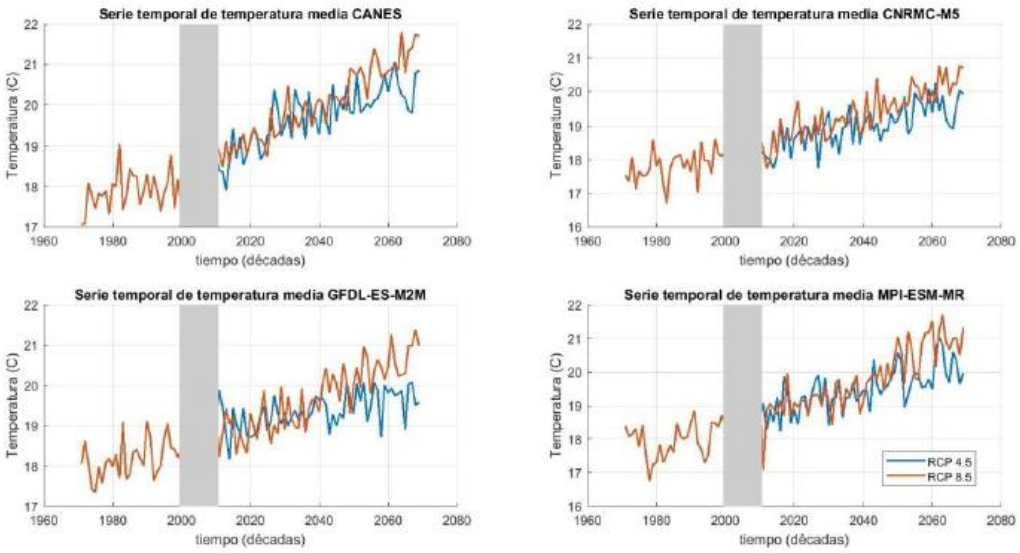


Figure 32. Average medium temperature modelled through different estimation methods. Source: (Bentancur et al. 2019)

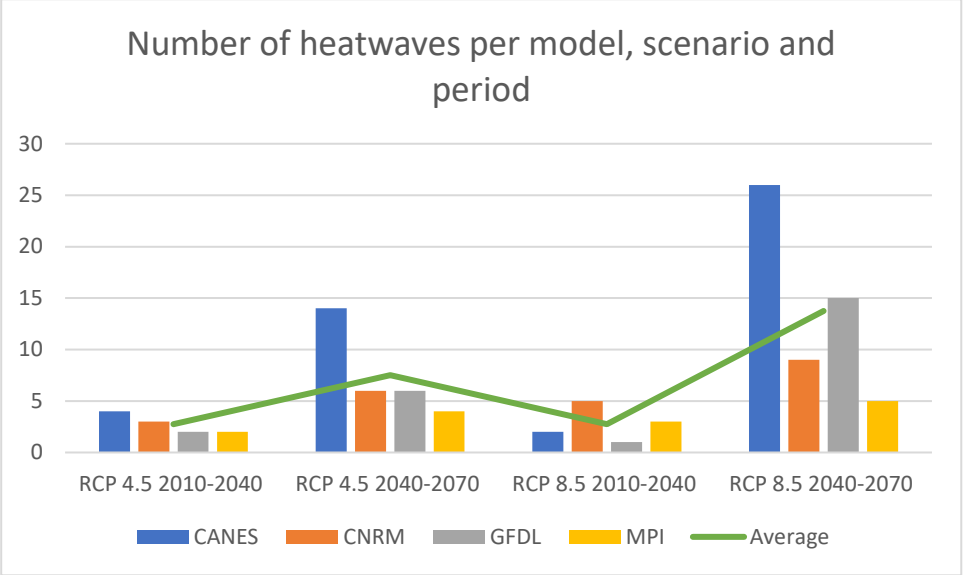


Figure 33. Heatwaves per mode (number)l, scenario and period. Source: Authors elaboration based on Bentancur et al., (2019)

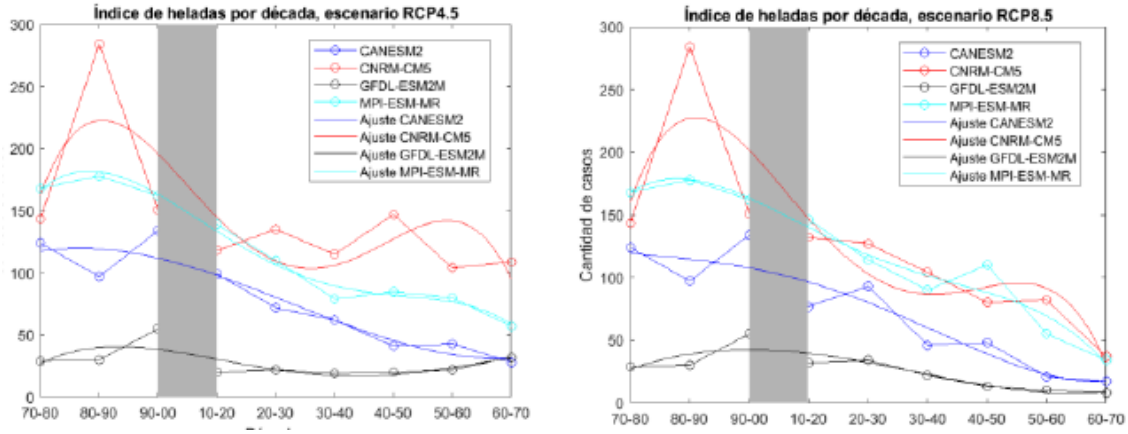


Figure 34.Reduction of frost (number), per decade in different RCP scenarios. Source: Bentancur et al. (2019)

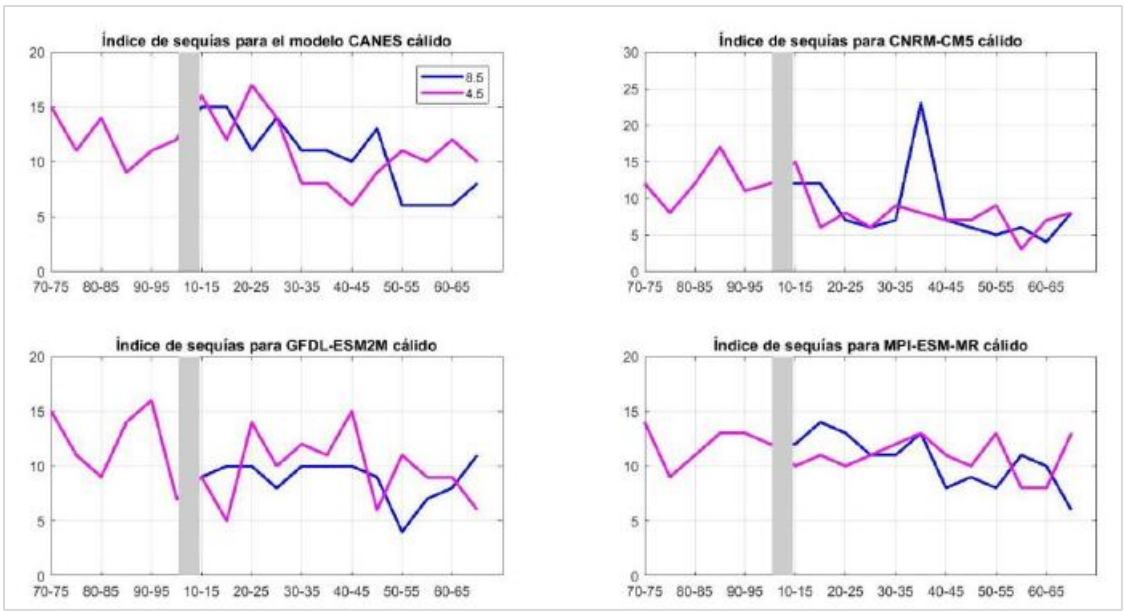


Figure 35.Drought index by the model during the warm season. Source: Bentancur et al. (2019)

Appendix 2: Model specification details

The decision of implementing a certain level of recommended techniques, based on an economic analysis of benefit maximisation, will be determined by farmers perception of perceiving that they might obtain a benefit from the application of those set of management measures (expected benefits). This could represent economic benefit as well as another type of benefits, such as a reduction in working journals, or effort, among other factors, and it can be classified as a latent variable since it is not directly observable.
In this context if farmers expected benefits are higher than zero, farmers will implement the techniques and achieve a high BTI index level that can be classified as "Regular", "Good" or "Very good". Otherwise, farmers will not choose to implement managements techniques, reaching a BTI that can be classified as "Low" or "Very Low". This approach determine that (BTI), as a dependent variable can be analysed as a binary variable that would be equal to one, if the index collected in the survey can be considered as "acceptable", "good", or" very good", according to the classification elaborated by Paparamborda, (2017). BTI will be equal to 0 if the index is considered "low" or "very low", according to the scientific standard on the previous literature.

Explanatory or independents variables for consideration in the model were chosen from a total of 85 variables that were collected on the GFCC survey, according to background studies, data availability, and the objective of this research.
Before analysis, a dataset was consolidated, classified, prepared and filtered, checking for missing values, outliers and grouping or recoding variables according to the analysis requirements.

The independent variables include household characteristics (e.g., farming experience of household head, household head's education, size of household, proportion of renting and landholding), institutional factors (e.g., access to credit, market information, weather forecasting information, and dummies for areas or productive unit that they are located (UP).

Model building process was implemented according to the methods suggested by Heeringa et al. (2017), to implement a systematic and scientific process for building a logistic regression model. These involves:
1) Model specification
2) Estimation of model parameters and their standard errors
3) Model evaluation and diagnosis
4) Interpretation of results and inference based on the final model.
The mentioned four stages that are identified were repeated throughout the model building process several times to refine and test the model.

Stage 1: Model Specification
This stage was implemented following the stages recommended by (Hosmer Jr, Lemeshow, and Sturdivant 2013):

1- Perform initial bivariate analysis of the relationship of y to individual predictor variable candidate.
2- Select the predictors that have a bivariate association with y at the significance of p<0,25 as candidates for main effects in a multiple logistic regression model
3 - Evaluate the contribution of each predictor to the model using the Wald test.
4 - Check the linearity assumption for continuous predictors
5 - Check the scientifically justifies interactions among predictors

Explanatory variables candidates are presented in Table 27, along with the source that was considerate to include them on the analysis.

Table 27. Explanatory variables candidates

Variable	Interpretation
Beneficiaries	One of the farmers is beneficiary of the GFCC project and 0 if it doesn't
Member or Linkages	One if farmer belongs or participates on a farmers group, 0 if it doesn't
Internet Access	One if the farmer declares to have internet access, 0 otherwise
Porcentage of land under ownership	1 if farmer had more than 50% of the land under ownership. 0 otherwise.
North or East	One if the farm is located on Basaltic Slope 0 if it is located on Eastern Sierra
Capacitation	1 if farmer attended any course or capacitation on a wide variety of topics, 0 otherwise
Droughts	1 if farmer declares to have suffered the effects on the last two droughts or at least one of them, 0 otherwise
Metrologic consultation Medium-term	1 if the farmer declares to consult meteorologic information when making decisions for the medium term,0 otherwise.
Metrologic consultation Long term	1 if farmer declares to consult meteorologic information when making decisions for the long term, 0 otherwise.
Investment	1 if farmer declares to have invested on infrastructure on their farm during 2011 - 2015, 0 otherwise
Education	1 if farmer declared to have Primary education as the highest education level achieved, 0 otherwise
Technical assistance	1 if the farmer declares to regularly have technical assistance, from an agronomist, a veterinarian, or both.
Cattle Breeding	1 if the farm is considered specialised on Cattle breeding, 0 otherwise (complete cycle or wintering cows)
Mixed production	1 if the productive farm specialisation is mixed (cattle and ovine together), 0 otherwise
Changes after capacitation	1 if farmer declared to have implemented changes on the farm after attending to capacitation, 0 otherwise.

Source: Author's own elaboration

Description and selection of dependent and explanatory variables

To elaborate on the multiple analysis, firstly, the association between the dependent variable (BTI) and the possible explicative variables were analysed. For this purpose, a bivariate analysis was implemented to test the existence of the association (Chi-squared test (Cochran 1952) implemented between pairs of variables.) Using different combinations and functional forms several explanatory variables were tested, to achieve the model with the best goodness of fit criteria possible, according to what is suggested by statistical literature

Regarding goodness of fit test, Robust White estimation of the matrix variance and covariances was implemented, probability of success in a positive or negative event was checked, and ROC area. For a more detailed analysis of Goodness of fit tests see Appendix 8.

Marginal effects and partial elasticities

A summary of the interpretation techniques used on this multiple logistical model, are summarised on Table 28.

Table 28. Methods to interpret logistic models results.

Marginal effects		Partial elasticities	
Definition	Interpretation	Definition	Interpretation
Describe the effect of a unit change in the explanatory variable on the probability of a dependent variable.	A positive coefficient β shows that an independent variable Xk increases the likelihood that Yij = 1 (which is the implementation of a set of management techniques in our case).	Measure the percentual change in probability of the dependent variable (implementation techniques index - BTI) due to a 1 % increase in the explanatory variable.	Partial elasticity of the logit model calculated at mean as is the responsiveness of the dependent variable in percentage given a percentage change in the independent variable.

Source: Authors adaptation from (Abid et al. 2015)

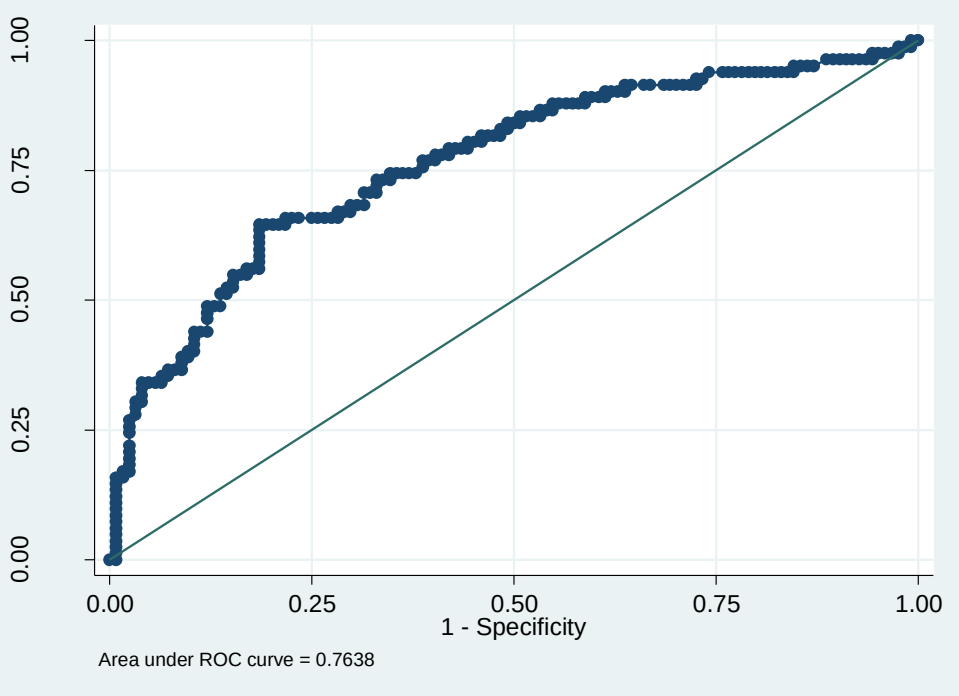
Appendix 3: Logistic model

Dependent variable: BTI higher than 40.
Independent variables:
Having linkages with at least one farmer's organisation
Having worked related activities outside the farm
Age of farmers respondents: more than 50 years old
Having technical assistance for regular decision making
Having primary education as the highest level of formal education achieved.
Owning more than50% of the productive land.

The following section the complete Stata outcome of the regression model is presented:

```
logit     regulargood_bti     linkages_organisationwork_outside_farm     older_than_50
technical_assitance     max_educ_primary     average_coneat_index     own_land_higher_5,
vce(robust)

Iteration 0:   log pseudolikelihood = -138.4766
Iteration 1:   log pseudolikelihood = -116.26408
Iteration 2:   log pseudolikelihood = -116.1244
Iteration 3:   log pseudolikelihood = -116.12433
Iteration 4:   log pseudolikelihood = -116.12433

Logistic regression                                     Number of obs     =        206
                                                        Wald chi2(7)      =      33.54
                                                        Prob > chi2       =     0.0000
Log pseudolikelihood = -116.12433                       Pseudo R2         =     0.1614

------------------------------------------------------------------------------
                    |               Robust
      regulargood_bti |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------------+---------------------------------------------------------------
linkages_organization|   .7720956   .3331272     2.32   0.020     .1191783    1.425013
    work_outside_farm |   .4127961   .3553666     1.16   0.245    -.2837097    1.109302
        older_than_50 |    .452546   .3571422     1.27   0.205    -.2474399    1.152532
  technical_assitance |   1.345392   .3529563     3.81   0.000     .6536109    2.037174
     max_educ_primary | -.7670058   .3229338    -2.38   0.018    -1.399944    -.134067
 average_coneat_index |   .0085156   .0062769     1.36   0.175    -.0037869    .0208181
    own_land_higher_5 |   .7539411   .3367734     2.24   0.025     .0938775    1.414005
                _cons | -2.317238   .6174557    -3.75   0.000    -3.527429   -1.107047
------------------------------------------------------------------------------

. estat classification

Logistic model for regulargood_bti

              -------- True --------
Classified |         D            ~D |      Total
-----------+--------------------------+-----------
     +     |        46            21 |         67
     -     |        36           103 |        139
-----------+--------------------------+-----------
   Total   |        82           124 |        206

Classified + if predicted Pr(D) >= .5
True D defined as regulargood_BTI != 0
--------------------------------------------------
Sensitivity                     Pr( +| D)   56.10%
Specificity                     Pr( -|~D)   83.06%
Positive predictive value       Pr( D| +)   68.66%
Negative predictive value       Pr(~D| -)   74.10%
--------------------------------------------------
False + rate for true ~D        Pr( +|~D)   16.94%
False - rate for true D         Pr( -| D)   43.90%
False + rate for classified +   Pr(~D| +)   31.34%
False - rate for classified -   Pr( D| -)   25.90%
--------------------------------------------------
Correctly classified                        72.33%
--------------------------------------------------
```

```
. margins, dydx(*)

Average marginal effects                        Number of obs     =        206
Model VCE: Robust

Expression   : Pr(regulargood_BTI), predict()
dy/dx     w.r.t.     :     linkages_organisationwork_outside_farm     older_than_50
technical_assitance max_educ_primary average_coneat_index
               own_land_higher_5

------------------------------------------------------------------------------
--
                     |            Delta-method
                     |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
--
linkages_organisation|   .1468557   .0595288     2.47   0.014     .0301814    .2635301
    work_outside_farm |   .0785155   .0663799     1.18   0.237    -.0515867    .2086177
        older_than_50 |   .0860761   .0669259     1.29   0.198    -.0450964    .2172485
  technical_assitance |   .2558991   .0586199     4.37   0.000     .1410062    .3707921
     max_educ_primary | -.1458876   .0580417    -2.51   0.012    -.2596473    -.032128
 average_coneat_index |   .0016197   .0011781     1.37   0.169    -.0006894    .0039288
    own_land_higher_5 |   .1434027   .0605984     2.37   0.018     .0246319    .2621734
------------------------------------------------------------------------------
--

. estat gof

Logistic model for regulargood_BTI, goodness-of-fit test

       number of observations =       206
 number of covariate patterns =       193
            Pearson chi2(185) =       198.27
                  Prob > chi2 =         0.2393

. estat gof, group(10)

Logistic model for regulargood_BTI, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)

       number of observations =       206
             number of groups =        10
     Hosmer-Lemeshow chi2(8) =         3.97
                  Prob > chi2 =         0.8597

. lroc regulargood_BTI

Logistic model for regulargood_BTI

number of observations =      206
area under ROC curve   =   0.7638

.
end of do-file
```



.

Figure 36.Higher Receiver Operating Characteristic (ROC) of our model. Source: Authors elaboration based on data provided by MGAP (2017).

The area under the ROC curve is plotting sensitivity and specificity with the aim to measure how accurate the specified model discriminates the success event using different cut points (0,25, 0,50, etc), being desirable a higher ROC curve. Our model has an area under the ROC curve of 0,76 which is a reasonably adequate predictive power.

Appendix 4: Logistic model goodness of fit tests.

Checking for outliers and residuals behaviour

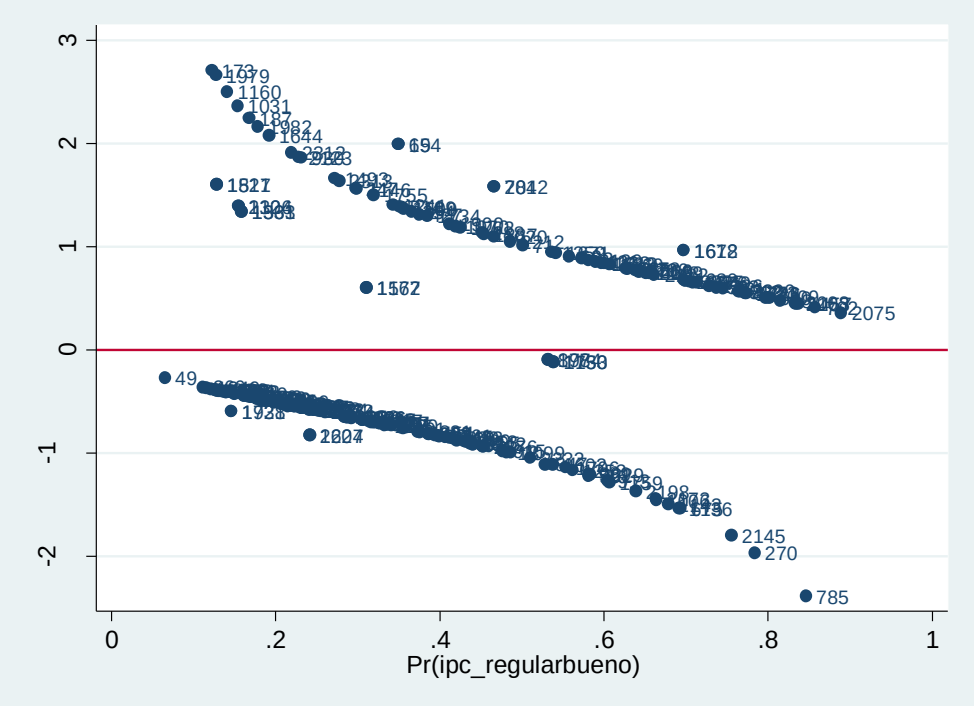


Figure 37. Standardized Pearson residuals of the model. Source: Authors elaboration

Figure 38.Standarized Pearson residuals by farmers id. Source: Authors elaboration

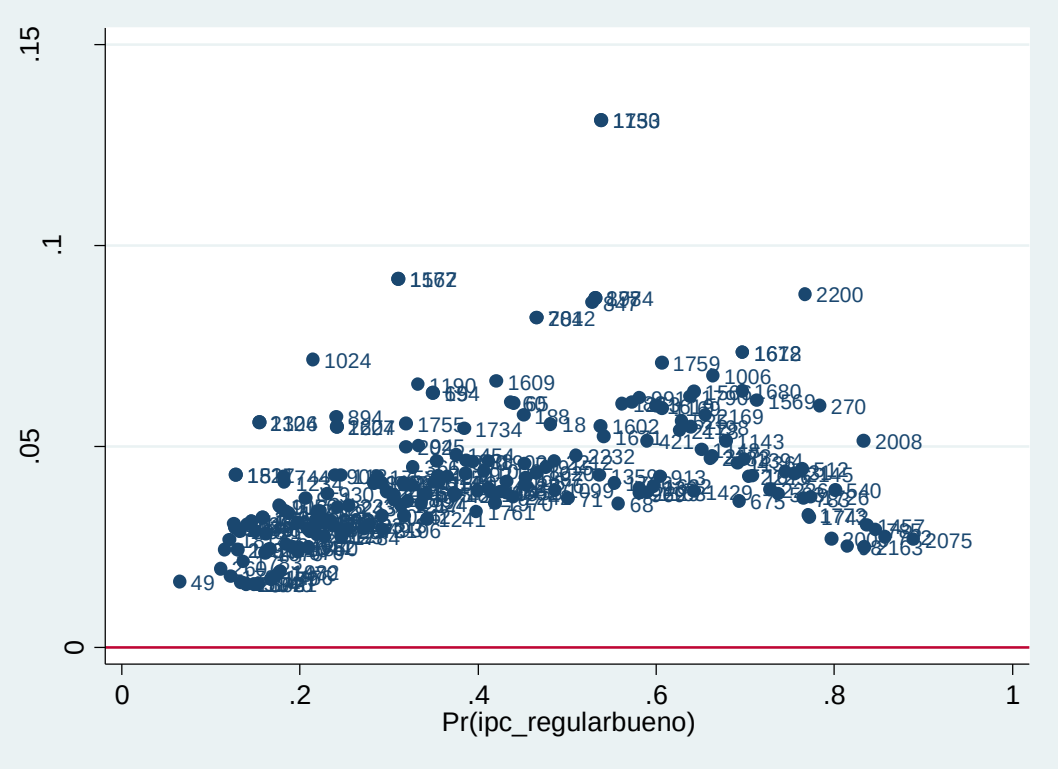


Figure 39. Leverage of the model. Source: Authors elaboration

Appendix 5: BTI Detailed calculation: co-innovation project Eastern Sierra participants-.

Baseline (2015-2016)

BTI index calculation - Eastern Sierra participants - Baseline (2015-2016)															
	Atributte	Modality	Absolute value	Weighted value	Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Farmer 6	Farmer 7	Farmer 8	Farmer 9	Farmer 10	Farmer 11
Strategic	Mating	Continuous	0*	0,00					0,00		0,00				0,00
		Two seasons	50,00	5,00											
		Summer (December to February)	100,00	10,00	10,00	10,00	10,00	10,00		10,00		10,00	10,00	10,00	
	Differential management adults	1 batch Natural Grazing with sheeps	0,00	0,00				0,00	0,00		0,00				0,00
		1 batch Natural Grazing without sheeps	25,00	3,75		3,75								3,75	
		1 batch on improvements	50,00	7,50											
		2 batches adults in general	0,00	0,00											
		2 batches failed or other	75,00	11,25	11,25		11,25			11,25		11,25	11,25		
		2 batches 2º mating or worst animal state	100,00	15,00											
	Differential heifer management	Not done	0,00	0,00							0,00			0,00	0,00
		Done without sheep	50,00	5,00				5,00							
		Done others	50,00	5,00					5,00						
		Done in best pasture	75,00	7,50	7,50	7,50						7,50	7,50		
		Done in improvements	100,00	10,00			10,00			10,00					
	Autumn Paddock Reserve	Do not reserve	0,00	0,00					0,00	0,00	0,00			0,00	0,00
		Reserve	100,00	10,00	10,00	10,00	10,00	10,00				10,00	10,00		
	Definitive weaning month	March	100,00	15,00		15,00				15,00					
		April	75,00	11,25	11,25		11,25					11,25		11,25	
		May	50,00	7,50				7,50					7,50		
		June	25,00	3,75											3,75
		Other	0,00	0,00					0,00		0,00				

Figure 40.Detailed BTI calculation (2015-2016) for Strategic decisions component. Source: Authors elaboration based on Coinnovation projects reports. Verified by technicians during interviews and Papanamborda (2017).

Decision making support	Animal Condition Clasification	Does not classify	0,00	0,00				0,00	0,00		0,00			0,00	0,00
		Classify without scale for pasture allocation	75,00	7,50								7,50			
		Classify without scale for weaning	25,00	2,50											
		Classify without scale others	0,00	0,00						0,00					
		Classify with scale for pasture allocation	100,00	10,00	10,00	10,00	10,00						10,00		
		Classify with scale for weaning	50,00	5,00											
		Classify with scale others	0,00	0,00											
	Ovarian activity diagnosis	Not done	0,00	0,00				0,00	0,00	0,00	0,00		0,00	0,00	0,00
		Done for other reasons	50,00	2,50		2,50									
		Done for breastfeeding control	100,00	5,00	5,00		5,00					5,00			
	Pregnancy diagnosis	Not done	0,00	0,00							0,00				0,00
		Done on less than 30 % bellies	50,00	2,50											
		Done between 30 % and 60 % bellies	75,00	3,75				3,75							
		Done in more than 60 % bellies	100,00	5,00	5,00	5,00	5,00		5,00	5,00		5,00	5,00	5,00	
	Bull Review	Does not check	0,00	0,00		0,00	0,00	0,00			0,00				0,00
		Checked by farmer	50,00	2,50	2,50				2,50			2,50	2,50	2,50	
		Checked by other	50,00	2,50											
		Checked by technician	75,00	3,75											
		Checked by veterinarian	100,00	5,00						5,00					

Figure 41. Detailed BTI calculation (2015-2016) for Decision Making support component. Source: Authors elaboration based on Coinnovation projects reports. Verified by technicians during interviews and Papanamborda (2017).

Tactics	Breastfeeding control	Does not implement techniques	0,00	0,00			0,00				0,00	0,00			0,00
		Early weaning only	50,00	5,00					5,00				5,00		
		Temporary without flushing	50,00	5,00				5,00		5,00					
		Temporary with flushing	75,00	7,50	7,50	7,50									
		Temporary without flushing and early weaning	80,00	8,00										8,00	
		Temporary with flushing and early weaning	100,00	10,00											
	Suplementation	Does not suplement	0,00	0,00				0,00	0,00	0,00	0,00	0,00		0,00	0,00
		Supplement only cows without salts	25,00	1,25	1,25										
		Supplement only cows with salts	50,00	2,50											
		Supplement heifers without salts	50,00	2,50									2,50		
		Supplement heifers with salts	75,00	3,75											
		Supplement cows and heifers without salts	80,00	4,00		4,00	4,00								
		Supplement cows and heifers with salts	100,00	5,00											
		BTI INDEX		100	81,25	75,25	76,50	41,25	17,50	61,25	0,00	70,0	71,25	40,50	3,75

Figure 42. Detailed BTI calculation (2015-2016) for Tactical component. Source: Authors elaboration based on Coinnovation projects reports. Verified by technicians during interviews and Papanamborda (2017).

BTI Calculation Final (2018-2019)

BTI index calculation - Eastern Sierra participants - Final (2018-2019)															
	Atributte	Modality	Absolute value	Weighted value	Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Farmer 6	Farmer 7	Farmer 8	Farmer 9	Farmer 10	Farmer 11
Strategic	Mating	Continuous	0*	0,00											
		Two seasons	50,00	5,00											
		Summer (December to February)	100,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00
	Differential management adults	1 batch Natural Grazing with sheeps	0,00	0,00											
		1 batch Natural Grazing without sheeps	25,00	3,75		3,75									
		1 batch on improvements	50,00	7,50											
		2 batches adults in general	0,00	0,00							0,00				
		2 batches failed or other	75,00	11,25			11,25	11,25	11,25	11,25		11,25	11,25	11,25	11,25
		2 batches 2º mating or worst animal state	100,00	15,00	15,00										
	Differential heifer management	Not done	0,00	0,00							0,00				
		Done without sheep	50,00	5,00				5,00							
		Done others	50,00	5,00										5,00	5,00
		Done in best pasture	75,00	7,50		7,50			7,50			7,50	7,50		
		Done in improvements	100,00	10,00	10,00		10,00			10,00					
	Autumn Paddock Reserve	Do not reserve	0,00	0,00										0,00	0,00
		Reserve	100,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00	10,00		
	Definitive weaning month	March	100,00	15,00	15,00	15,00		15,00		15,00				15,00	
		April	75,00	11,25			11,25		11,25		11,25	11,25	11,25		
		May	50,00	7,50											7,50
		June	25,00	3,75											
		Other	0,00	0,00											

Figure 43. Detailed BTI calculation (2018-2019) for Strategic decisions component. Source: Authors elaboration based on Coinnovation projects reports. Verified by technicians during interviews and Papanamborda (2017).

Decision making support	Animal Condition Clasificatio n	Does not classify	0,00	0,00		0,00		0,00			0,00			0,00	
		Classify without scale for pasture allocation	75,00	7,50								7,50			
		Classify without scale for weaning	25,00	2,50											
		Classify without scale others	0,00	0,00											
		Classify with scale for pasture allocation	100,00	10,00	10,00		10,00		10,00	10,00			10,00		10,00
		Classify with scale for weaning	50,00	5,00											
		Classify with scale others	0,00	0,00											
	Ovarian activity diagnosis	Not done	0,00	0,00											
		Done for other reasons	50,00	2,50	2,50	2,50		2,50	2,50	2,50	2,50				
		Done for breastfeeding control	100,00	5,00			5,00					5,00	5,00	5,00	5,00
	Pregnancy diagnosis	Not done	0,00	0,00											
		Done on less than 30 % bellies	50,00	2,50											
		Done between 30 % and 60 % bellies	75,00	3,75											3,75
		Done in more than 60 % bellies	100,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	5,00	
	Bull Review	Does not check	0,00	0,00		0,00	0,00	0,00			0,00				
		Checked by farmer	50,00	2,50	2,50				2,50			2,50	2,50	2,50	2,50
		Checked by other	50,00	2,50											
		Checked by technician	75,00	3,75											
		Checked by veterinarian	100,00	5,00						5,00					

Figure 44. Detailed BTI calculation (2018-2019) for Decision Making support component. Source: Authors elaboration based on Coinnovation projects reports. Verified by technicians during interviews and Papanamborda (2017).

Tactics	Breastfeeding control	Does not implement techniques	0,00	0,00											
		Early weaning only	50,00	5,00											
		Temporary without flushing	50,00	5,00		5,00			5,00		5,00	5,00		5,00	5,00
		Temporary with flushing	75,00	7,50	7,50		7,50	7,50		7,50					
		Temporary without flushing and early weaning	80,00	8,00									8,00		
		Temporary with flushing and early weaning	100,00	10,00											
	Suplementation	Does not suplement	0,00	0,00	0,00		0,00	0,00			0,00				0,00
		Supplement only cows without salts	25,00	1,25											
		Supplement only cows with salts	50,00	2,50		2,50			2,50	2,50				2,50	
		Supplement heifers without salts	50,00	2,50									2,50		2,50
		Supplement heifers with salts	75,00	3,75											
		Supplement cows and heifers without salts	80,00	4,00											
		Supplement cows and heifers with salts	100,00	5,00								5,00			
		BTI INDEX		100	87,50	61,25	80,00	66,25	77,50	88,75	43,75	80,00	83,00	61,25	62,50

Figure 45. Detailed BTI calculation (2018-2019) for Tactical component. Source: Authors elaboration based on Coinnovation projects reports. Verified by technicians during interviews and Papanamborda (2017).

Appendix 6: Interview form

Regarding internal farm variables

1. Which management techniques have been implemented in your area?
2. What do you consider to be the component with the highest impact on the process of implementing improvements on the management techniques in each farm? Do farmers share this view?
3. Which are the relevant aspect to consider when working with farmers towards the implementation of management techniques, to achieve an increase in the management techniques implemented?
4. What aspects do you consider most influential on farmers at the decision-making time?
5. Which techniques have a higher receptivity or acceptance among farmers?
6. Which are the main difficulties or barriers that do you perceive among farmers when implementing the suggested management techniques?
7. How was the perception of the suggested management techniques in terms of easiness of implementation and productive results that could be achieved by the recommended techniques?
8. Which indicators do farmers considerate to define a management technique as successful?

Contextual variables

9. How do you consider that the perception of non-participant farmers in the area concerns the implemented management techniques?
10. Do you consider that having linkages with any farmers organisation, might influence the implementation of management techniques? How do you think farmers consider this influence?
11. Do you consider that farmers might be influenced when having technical assistance available? How? Do you consider this a uniform effect among neighbours and other farmers in the region?
12. What characteristics do you find fundamental on a technical assistant to implement a successful change in the management techniques implemented?
13. Do you consider that farm management experience might influence management techniques implemented by farmers? What about the educational level?
14. Do you consider that farmers are influenced by participating in previous participation on a public policy that offers technical assistance? How?

Coinnovation project

15. Do you consider this co-innovation experience different than other public policies that offer technical assistance? How?

Appendix 7: Interview full transcript

Interview implemented in person with Technician 1[36], referent of four participants farmers on Eastern Sierra region, held in Montevideo, Uruguay.

- *Con respecto al proceso a la interna del predio cuales son las técnicas que más se han implementado en tu zona.*

En la zona eso el cambio en el entore, pasar de entore continuo a entore estacional, el hacer el diagnostico de actividad ovárica que no se hacía en varios de los predios no se hacía. Si se hacia el diagnostico final pero no el diagnostico de actividad ovárica que te permite a mediados del entore poder tomar alguna medida para mejorar los resultados y no esperar a que termine el entore para recién enterarte de cómo va. Mas en los predios que son criadores, que el determinante es ese, la producción de terneros la preñez. Eso y ta un poco el manejo de la pastura y eso de entrar y salir de los potreros.

- *¿Cuál consideras que ha sido el componente diferencial o de mayor impacto dentro de este proceso de mejoras de manejo del predio?*

El componente diferencial y ese manejo de los animales en función de la disponibilidad de la pastura, eso es lo que ha sido determinante en varios de los resultados.

- *¿Te parece que esta visión es compartida por los productores?*

Si yo creo que sí, porque ellos mismos te dicen que al trabajar con más pasto, al saber cómo asignar, ellos mismos te dicen - no porque a mí me parece mejor mover esto para acá o estos animales para el otro potrero. Entonces creo que eso ha sido como lo más relevante, que ellos han aprendido como a ver como esta de pasto y cuáles son los que está mejor y que animales necesitan más o menos y a irle asignando ellos mismos.

- *¿Cuáles son los aspectos relevantes por considerar en el trabajo con los productores para lograr un aumento en la implementación de técnicas y la obtención de buenos resultados en el predio?*

A ver, hay como varias cosas. Primero es que llevar la técnico como tal no te dice nada porque también hay que ver la disponibilidad que tiene el productor, ya sea de instalaciones para hacer las cosas, de tiempo, de que si una productora tiene dos fracciones y tiene que moverse de una a otra, eso es determinante de cómo va a ser la aplicación de las técnicas, la mano de obra que dispone, si es una persona sola, si son varios en la familia, si lo pueden hacer cualquier día de la semana o tienen que esperar porque fulanito viene el domingo, entonces lo hacemos el domingo, o la edad de los productores también, hay muchos que dicen si bueno yo lo hago, pero realmente están cansados y de repente no lo hacen y si viene el hijo, están esperando que venga el hijo para decir bueno ta lo hacemos tal día y eso. También las situaciones emocionales, a mí me paso con un productor que yo le decía que para mí estaba bueno hacer un manejo diferente con los ovinos y ta, siempre le insistía, pero claro yo nunca

[36] Name are not disclosed for privacy reasons.

había estado en los corrales que la tenía para trabajar con los ovinos. Entonces en ese intermedio se le enferma la hija, y ta la hija tenía cáncer, entonces claro el tipo no estaba con la cabeza en el predio, estaba en otra cosa. Después que paso todo lo de la hija, nos sentamos a conversar, y me dice sí, pero yo para darle toma a las ovejas, las siento, les pongo un casillero en la panza para que no se muevan y le doy toma de a una. Entonces claro, el tipo nunca va a tener ganas de traer las ovejas a darle toma porque sabe que cuando las vaya a traer es un sacrificio, lo que va a hacer.
Entonces esas cosas a veces, no es solamente llevar la técnica, sino que también hay que buscarle la vuelta de como implementarla y de repente ayudarlos con ideas más prácticas para que ellos se den cuenta que no es tan difícil.
Porque por ejemplo nos pasó recorriendo otro predio que el productor tenia, como había hecho el Diagnostico de Actividad Ovárica tenía varios lotes repartidos, entonces él quería mejorarle la comida a las vacas que necesitaban mejoras, pero no sabía cómo hacer para que no se le entreveraran porque eran de campos distintos. A mí tampoco se me ocurrió como solucionarlo en ese momento y a la siguiente visita seguía con lo mismo, que no sabía cómo íbamos a mover las vacas y le dijo - y si le pones una cinta de color - Entonces con una cinta de color identifico las que eran de un lado, las que eran del otro y ta con eso lo pudo hacer, pudo hacer el cambio y le facilito una cosa que era difícil, porque era entendible que él no quería entreverar a los animales, yo hubiera hecho ta uno los entrevera y después los separa que se yo, pero ta eran cosas más fáciles, más prácticas de repente que a veces hay que facilitarle eso.
Bueno está bien si no lo podés hacer estrictamente, así como se debe hacer, bueno pero capaz que hay alguna aproximación y tirar alguna idea también te ayuda a que el productor lleve adelante la práctica.

-¿Claro, y capaz que igual puede mejorar el resultado?
Claro, a pesar de no hacer estrictamente bien hecho, pero ta lo puede hacer. Por eso también te digo, lo del otro productor que tenía la hija enferma y que ta también, entonces como que las dos cosas a veces son importantes.

- Cuales son las técnicas que cuentan con más receptividad, aceptación o visto bueno de los productores?
Capaz que las técnicas más fáciles de implementar fueron por ejemplo el diagnostico de actividad ovárica, la suplementación en el invierno sobre todo a las categorías chicas. En la mayoría la tablilla está bien aceptada. Después hubo algunos que hubo que pelear para que pusieran la tablilla porque decían que los terneros perdían peso, entonces hay que cuantificar que la pérdida de peso no va a ser tal que no se pueda poner la tablilla, o sea no vas a perder más por poner una tablilla que lo que vas a perder si no la pones. Porque en realidad, con la tablilla pierde unos kilos, pero los va a recompensar con toda la preñez que tienes después, entonces eso hubo que pelearlo bastante.
Y después lo más difícil capaz bueno cuando está bajo el campo y cuando esta alto (el pasto), y la interpretación de las alturas y como cuantificar eso es lo más difícil. Pero las más fáciles esas: el diagnostico, la suplementación, el manejo por categorías y por estado, también fue fácil de implementar.

- *Cuáles son las principales dificultades/barreras/ obstáculos que percibe en los productores al momento de implementar técnicas sugeridas?*

A veces las edades, la ganas que tengan de hacer las cosas, capaz que más que emocional o no sé cómo llamarlo, pero a veces ta, capaz que son cosas fáciles de hacer y si el productor no tiene ganas no las hace. Bueno eso si la apertura es importante porque ta hay predios donde tú te das cuenta de que vas y estas siempre discutiendo con el productor y el productor hace lo que quiere y no llegas nunca a un acuerdo. La infraestructura también a veces es más difícil si no tiene buena infraestructura. Muchas veces no lo ven como algo importante porque en ese caso por ejemplo surgió decir bueno, pero porque entonces no nos dedicamos a arreglar eso, porque si te da tanto trabajo, eso es lo que tiene que mejorar, no puedes estar pasando trabajo o produciendo mal porque no tienes un corral para encerrar las ovejas, como tendría que tener, entonces quieras o no eso te está limitando.
Después otros que por ejemplo se cae el alambre y bueno si, pero ta no lo voy a levantar. Si bueno ta, no lo vas a levantar, pero te limita el manejo que tú haces del predio si no lo levantas, porque si el alambre está sano los bichos no se van a ir y sabes que los podés meter ahí, pero si el alambre esta caída, no podés usar esa parte del campo porque se te van a ir los animales y eso ya te condiciona la productividad.
Así que la infraestructura si es importante, y las ganas, la apertura del productor.

- *¿Como ha sido la percepción de las medidas planteadas en términos de facilidad de implementación y resultados productivos de las técnicas recomendadas?*

Yo creo que en realidad la primera vez es cuando el productor pone más resistencia poner a hacer cambios, después que el productor ve resultados, se anima a ir haciendo más cambios, o a repetir la técnica al año siguiente. Porque de repente la primera vez te lleva más horas de discusión de porque poner la tablilla, cuanto pierde si no pones la tablilla, porque mover las vacas para un potrero y no para otro, porque esperar al potrero aquel que en unos días más o porque poner las vaquillonas allí y no las vacas y ta eso la primera vez te lleva más tiempo de discutirlo de verlo y si el productor lo hace y se convence de lo que hizo y le da un buen resultado, a la siguiente vez la hace como más fácil. El cambio de lo que vienes haciendo ya implica resistencia, algunos tienen más resistencia y otros menos y eso también depende de la apertura que tenga o a veces de la educación, porque a veces alguien que tiene un poco más de formación de repente te discute hasta un poco más la medida que le estas planteando que alguien que desconoce un poco más por ahí no te discute y lo hace o no lo hace pero no te discute tanto. Por lo menos eso es lo que me ha pasado a mí.
Me paso con un chiquilín de pasar toda la mañana y un día en la tarde discutiendo porque no quería poner tablilla, bueno ta explicarle mostrarle y decirle que bueno está bien, no quiere hacerlo, no lo hagas, pero vamos a hacerlo, vamos a probar y después vemos los resultados. Y ta, lo mismo que el diagnostico de actividad ovárica que lo voy a hacer si no tengo que darle después. Bueno, vamos a hacerlo, vamos a ver como estas y si necesitas o no y después buscamos las alternativas para mejorar, si necesitamos mejorar la comida a un grupo de vacas, bueno ta, pero vamos a hacerlo porque si no lo hacemos tenemos que esperar a marzo que tengamos el diagnóstico definitivo y ahí ya no podemos hacer nada. Podemos hacer algo ahora, antes. Eso a veces te lleva mucho tiempo de discutir y de tratar de convencerlos para que lo hagan.

De repente, tuviste esa discusión, te dio trabajo, lo convenciste lo hicieron, anduvo bien y de repente vas a hacer una propuesta de otra cosa distinta y ya te es hasta más fácil la discusión. Una vez que se convenció de una te facilita las otras, eso también está interesante. Eso después te vas dando cuenta con el tiempo como te facilita o no una cosa.
Igual que un productor que se le propuso algo y no se convenció, lo hizo, pero no estaba convencido y después te sigue diciendo no porque yo hice tal cosa y a mí no me convencía y te sigue discutiendo y después cada cosa que le propones te sigue discutiendo.

- *¿Cuáles son los indicadores que los productores consideran para definir qué medidas como exitosas?*

Yo creo que cuando uno se sienta después con los números con ellos y le explicas más o menos los números , porque viste que nosotros hacemos la presentación general para todos y ta capaz que ellos van escuchan, pero no lo ven. Después cuando tú te sientas y les muestras sus números personalmente y ven como esta respecto al inicio o al año anterior, ellos ven el estado de los animales, el peso de los terneros, sobremodo ellos que son criadores que es un indicador claro si hicieron las cosas bien o no y después le porcentaje de preñez también. Esos son como los dos indicadores que ellos rápidamente pueden darse cuenta si anduvieron bien o no.
Después todo lo que es económico, les cuesta un poco más porque en realidad si bien es por plata, no lo tienen tan fino digamos, entonces ta, aparte porque muchas veces son modos de vida entonces no están midiendo que tan rentable es la actividad que están haciendo sino porque bueno eso ya lo tienen y viene de una generación a otra y es lo que saben hacer y lo siguen haciendo. A veces ta, vas más allá de lo económico, me parece, pero ta ellos también pueden darse cuenta cuando tú les muestras mira produjiste tanto, hiciste tanta plata y ellos te pueden decir si realmente se dan cuenta si hicieron más plata si les quedo más plata o no.
Pero los indicadores físicos son los que ellos más se dan cuenta de cómo han evolucionado y si mejoran o no.

- *¿Cómo considera que es la percepción de los productores de la zona (no participantes) con respecto a las técnicas implementadas?*

Ha habido poca participación extra de afuera, pero en realidad, la gente más cercana así que uno le puede transmitir lo que se está haciendo y que han visto tienen una buena percepción, incluso hay gente que está interesada en el proceso que se ha hecho.
Yo creo que igual falta más difusión de esto para que el resto de la gente, porque las jornadas que hemos hecho abiertas no ha ido mucha gente. La gente que ha ido es porque por algún lado le ha llegado y se ha mostrado interesada en ver que es lo que han hecho y está bueno.

- *Considera que pertenecer a un grupo de productores/ Sociedad Fomento u otra organización, incide en la implementación de ciertas técnicas de manejo?*

Yo creo que si porque cuanta más relación, no sé si es lineal la relación , pero yo creo que cuanta más vinculación tengan y más comunicación es más fácil de que implementen las técnicas y que estén más abiertos a los cambios, que si tu agarras un

productor que está más dado. Desde el momento que el productor está vinculado con otros productores, ya tiene una apertura que no tiene el que no se vincula, entonces por eso me parece que es más fácil que ese productor adapte mejor las tecnologías y las ponga en práctica, me parece que tiene más facilidad de hacerlo que alguien que no tiene vinculación o que no participa de las reuniones o de las charlas, porque ese tipo de productor sigue pensando que es mejor quedarse en el campo y no ir a perder tiempo a una reunión a la sociedad de fomento por ejemplo. Pero no sabe que esa charla justo era importante para su sistema de producción y que capaz que, si iba, podía ver otras experiencias que le aporte.
Entonces ya desde ese momento, es más difícil que ese productor adopte la tecnología.

- *¿Como considera que es la influencia en los productores cuando cuentan con la presciencia de asistencia técnica?*

Capaz que ayuda un poco más que si el productor se encuentra solo frente a la técnica porque así la técnica puede ser una cosa muy simple como poner una tablilla, pero hay productores que no saben en qué momento, si es mejor antes o después, o a qué edad. Porque suena increíble, pero todavía hay gente que no sabe.
Después hacerlo más práctico, por ejemplo, como separar una vaca que está mejor de una que está peor, como hago si tengo un solo potrero y quiero dividir. No sé, me parece que esas cosas, además, que el productor está metido de cabeza dentro del predio, entonces la asistencia técnica, viene como un extra, como de afuera y tú tienes una visión más fría de las cosas. Entonces uno ve cosas que el productor que esta todo el día ahí adentro, no las ve. Mas allá del conocimiento que uno pueda tener para facilitar el trabajo, pero también la visión que puedes traer de afuera. O mismo porque el productor te llama y te dice - ta yo no sé si moverlos para acá o para allá - y capaz que uno va, el productor ya tiene como la idea, pero uno lo ayuda a terminar de definir la idea. Me parece que eso es importante.

- *¿Considera que este efecto es uniforme entre los vecinos y otros productores de la región?*

En estos productores está el que te llama y te pregunta cuando venís y que le pasa, y está el que si no vas ni te llama. No es de la misma manera. A mí me ha pasado que en general yo tengo buen vínculo con todos y hasta para un dato de un esquilador, te llaman y te preguntan. Pero creo que no todos hacen uso (de la asistencia técnica) de la misma manera, mismo en la visita. De repente tú vas y un productor está más interesado en que tus vayas y veas tal cosa porque quiero hacer tal y tal cosa o quiero mover estos animales para acá o quiero tirar fertilizante o quiero juntar los animales tal día y quiero que vayas porque así vemos tal cosa. Y esta el otro que vas y bueno que quieres hacer, que quieres ver y te dicen nono, lo que tú quieras hacemos ,lo que quieras ver. No, pero yo te pregunto, ¿qué quieres ver tu como productor, que dudas tienes? Nono lo que tu digas.
Eso es determinante, o aprovechan o no aprovechan tanto la jornada que en realidad es para ellos, para que ellos saquen todas las dudas o para que hagan todos los planteos que tengan.

- *¿Qué características considera fundamentales en el asistente técnico para poder lograr un manejo que modifique las prácticas en el predio?*

Un determinante es entender de que hay una diferencia entre la técnica y la práctica. Que son sistemas que están influidos por muchos factores, no es uno solo y generalmente el productor está ahí y si bien lo hace por plata y es su principal ingreso, capaz que al productor no es la plata lo único que le interesa, porque le interesa mantener el sistema funcionando, compartirlo con los hijos porque a los hijos también les interesa, o no. No es solamente económico, sino que hay muchos factores, no es solamente el mercado, no solamente el clima. Hay un montón de factores que juegan entonces no es tan sencillo como ir a decir bueno hay que hacer esto y ta, y de repente eso que me paso con el productor y las ovejas, pero hay que entender también que el productor en ese momento no estaba con la cabeza en el predio, entonces ibas a ir cinco meses a decirle que hiciera algo y el tipo no lo iba a hacer porque su prioridad era su familia y tenía una hija enferma. El predio lo iba a ir llevando porque ta, lo tenía que ir llevando, pero capaz que no tenía ni ganas de hacer nada. Uno también tiene que entender esa cosa y entender cómo funcionan que no es que tu digas mañana hay que sembrar una pastura y el productor mañana no tiene la plata para hacerlo mañana, y no lo va a hacer mañana. Capaz que lo hace la semana que viene, pero ta, que no es una cosa tan automática como otro tipo de emprendimiento u otro tipo de empresa agropecuaria que hay que hacer esto y se hace. Las cosas se hacen, pero de repente no tan perfectamente como seria en otro entorno.

Hay que ser más flexible o entender, pero flexibilidad no en el sentido de no importa si no lo haces, sino que hay que hacerlo, pero bueno vamos a buscar la manera de que se haga lo mejor posible, porque quizás no se pueda hacer tan perfecto como debería ser.

Hay que entender cómo funciona el sistema y como ese montón de factores te juegan a favor o en contra. pero no es un sistema que está cerrado y no tiene ninguna influencia de afuera. y tú tienes que tratar de liderar con todos los factores.

- Como considera que influye en los productores la experiencia de manejo en el predio y el nivel educativo ?

- La experiencia a veces ayuda a que ellos conozcan mejor los predios, como funcionan, pero a veces de mucho tiempo hace que estén como las ligados o agarrados de algo que productores con menos experiencia o que son más nuevos en el rubro. Es más fácil cambiar a los que son más nuevos, que a los que tienen más años de trabajo. porque la experiencia que ellos tienen es de hacer las cosas como se hacían antes y capaz que antes la realidad era diferente y hoy te tienes que ir cambiando, no te puedes agarrar tanto.

El nivel educativo genera estas instancias de discusión porque la otra persona tiene capacidad para discutirte o plantearte sus inquietudes que capaz que alguien que no, te lo puede plantear por experiencia, pero no te lo discute tanto porque tú eres el técnico y eres el que sabe. Capaz que no es así porque a veces la experiencia en eso también pesa, de hacer ciertas cosas o de saber que lugares son más adecuados para una cosa o para otra y uno eso lo tiene que ir aprendiendo trabajando en el predio. Uno también tiene que incorporar eso, es el conocimiento más la experiencia de ellos. Solo el conocimiento nuestro no es suficiente para lograr los cambios.

- *¿Como considera que influye en los productores la participación en algún programa público de asistencia técnica?*

Quizás los que venían del connotando eran más fáciles de trabajar que los que eran nuevos, pero a su vez eran más desafiantes porque ellos ya venían con un proceso de mejora que había que mejorar todavía, porque en los nuevos estaba todo por hacer. Los que ya venían con el antecedente, había muchas limitantes que ya las habían levantado. Eran más desafiantes porque ya estaban a otro nivel, pero más fáciles que los que no habían aplicado nunca una técnica o la habían aplicado, pero de otra manera.

- *¿En que considera que se diferencia esta experiencia de innovación con otros programas públicos de asistencia técnica en cuanto a la implementación de las técnicas?*

Los otros programas no aportan asistencia técnica, lo que yo conozco, te dan un subsidio para hacer alguna practica de manejo o alguna mejora de infraestructura, pero no aporta asistencia técnica o aporta alguna capacitación que es como lo más cercano a la implementación de las técnicas, pero creo que la asistencia técnica es lo más importante. Ayudarte a decidir qué técnicas aplicar o cuando o como eso es determinante.

Solamente una plata para hacer una cosa, si tu después no sabes como la vas a manejar, no te va a cambiar en nada el sistema. Que yo conozca no hay otros programas de asistencia técnica, por eso cuando hicieron el llamado me llamo la atención que al fin se dieron cuenta que había que hacer otra cosa. Porque hace muchos años ya se había hecho y después nunca más, después los proyectos son de financiación de un corral, mejoramientos, pozos de agua, cosas puntuales que están buenas, pero que no te cambian en nada si tú no sabes por ejemplo si tú haces un mejoramiento y no sabes cómo manejarlo, no te va a cambiar en nada la producción de tu sistema. Si produces poco, vas a seguir produciendo poco, porque no tiene una continuidad en eso en el asesoramiento técnico, que creo que siendo un país productivo tendríamos que tener más asistencia técnica en el campo que lo que tenemos hoy en día.

Después esta la discusión de que, si el productor puede o no puede pagarla, pero yo creo que, dentro de la política pública, tendría que haber algo que mejorara la ayuda para la asistencia técnica. No necesitas un técnico por predio, pero capaz que se puede instrumentar de alguna otra manera, pero siendo que da tanto valor, habría que buscar alguna política que mejorara eso que la asistencia técnica estuviera a disposición para mejorar la producción de todos los sistemas. Tienes que ir mas al campo, salir más, mirar lo que está pasando, porque de adentro de la oficina no vas a lograr nunca un cambio y si nos basamos en nuestra producción agropecuaria tendrías que tratar de mejorarlo.

Hay gente que nunca en su vida ha tenido asistencia técnica, hay gente que no llega ni siquiera a los proyectos de subsidios, no llega por muchas cosas, por desconocimiento, porque no le da importancia, pero sobre todo creo que es por desconocimiento de que puedes cambiar de manera de producir. Es todo el circulo, de vuelta vuelves a que muchos productores son productores porque les toco, y es lo que conocen y lo siguen haciendo como lo hacían antes, y eso les permite subsistir, pero no mejorar. El proyecto ha sido bueno, era necesario que saliera este tipo de iniciativa para poder

mejorar lo que es de todos, porque la producción es el principal ingreso del país. Entonces si queremos seguir creciendo tenemos que mejorar por ahí.

Interview with technical assistant 2 elaborated in person in the city of Montevideo, Uruguay.

1. *¿Cuáles son las técnicas de manejo que más se han implementado en su zona?*

Las técnicas que más se implementaron fueron rodeo de cría, destete temporario, suplementación de terneras en invierno, la fecha de destete tratar de hacerla más temprano de lo que la hacían, la idea era hacerlo en abril, o marzo no todos lo lograron, pero era la idea. Estacionalizar más los entores, algunos venían con entore continuo, acotar el período de entore.

2. *¿Cuál considera que ha sido el componente diferencial o de mayor impacto dentro de este proceso de mejoras del manejo del predio?*

Lo que hizo la diferencia me parece que fue, (aunque me pierdo porque no estuve en todo el proceso), pero me parece que es por lo que veo de mis 4 casos, es la actitud de los productores. Porque los 4 que tengo yo, más o menos, con diferentes maneras, pero más o menos el otro (Joaquín, técnico previo de la zona) les propone a todos las mismas cosas y no tuvieron los mismos resultados. Cuando yo miro hay algunos que están más comprometidos que agarran más, vos vas y te dicen que hacemos y te escuchan y hay otros que están más como bueno si me dijiste esto, lo pienso, convénceme, entonces me parece que va más por el lado de los productores de cuales se comprometen más o están más abiertos a esa metodología de innovación.

Viendo yo con mi caso que hay dos técnicos, yo agarre lo que seguía de otro, no sé exactamente, pero a grandes rasgos las propuestas iban en el mismo sentido, pero los resultados no fueron los mismos. Cuando miro hay algunos que están más comprometidos que otros y se dio los resultados con esos.

¿Te parece que hubo diferencia en la respuesta que ellos tenían al técnico anterior y la respuesta que tuvieron contigo?

No, no se eso. Yo veo la respuesta que ellos tienen hacia mí, supongo que la respuesta de ellos hacia el otro técnico debería ser la misma. Bueno en realidad no todos, hay algunos que sí, que hacia mi tienen otra actitud, porque por eso lo sacaron al otro, porque se llevaba mal con algunos predios. Algunos yo sé que hoy en día tienen otra actitud, pero igual creo que la predisposición de ellos es lo más importante.

3. *¿Cuáles son los aspectos relevantes por considerar en el trabajo con los productores para lograr un aumento en la implementación de técnicas y la obtención de buenos resultados en el predio?*

De trato ni que hablar, la forma de llegarle a cada uno es toda distinta. Para mí es el hecho de ir con números y cosas concretas. Que el productor vea que haces otra cosa que lo que hace él, porque ir y hablar de bueno esto puede ser mejor, o los animales están lindos o están feos, ellos hablan así todo el tiempo, - ah no, lo vendo el mes que viene que tengo más precio- esas cosas así medias generales, a veces bolazos.

Entonces vos tenes que marcar una diferencia tener el dato por ejemplo, bueno esto es más lindo, pero porque es más lindo, porque pesa tanto, no pesa tanto, acá entran más animales, porque hay x kilos, no hay y. Ir con eso de cuantificar y datos concretos, o hacerle los cálculos, que ellos no lo hacen, es lógico, y uno tiene que llegar y bueno

te propongo esto pero mira la idea sería esto y tener los cálculos hechos. Pero ese lenguaje de cuantificar y procesar los datos.

4. ¿Qué aspectos considera que son los más influyentes en los productores a la hora de tomar decisiones de manejo?

Darte cuenta del trato de cada productor. Vos podés decirle cualquier cosa con un dato objetivo, pero en parte tienes que contemplar a cada uno el sistema que tiene sería como llevarte bien. Entonces, entendiendo el sistema que cada uno tiene, no sería ir y decirles lo mismo a todos, sino que a cada uno lo que precisaría su predio. De acuerdo con la idea que ellos tienen. Por ejemplo, tengo una productora que tiene el esquema del pastoreo rotacional y tiene todo empotrado. A mí no me gusta, pero ta, si a ella le gusta y yo entiendo que en parte le ha hecho bien, que lo haga, cuando me parece que le va a hacer mal o no estoy de acuerdo le digo, la vez pasada ella tenía todos los animales juntos en un potrero, empezaron a parir y se le venían abajo los animales ahí era un penal seguir con todos los animales juntos. Entonces ahí desarmamos. Fuimos recorrimos todo el campo, medimos, les hice los números, de cuanto había, cuanto estarían comiendo más o menos con ella, los hicimos ahí, que esas son las cosas que el productor no hace, el productor tiene los datos todo, pero no hacen el cálculo. Entonces hicimos todo el cálculo y terminamos armando tres lotes de animales pasamos de uno a tres, ojo yo con el verso de que esto es por veinte días, y le arme una rotación, ella tenía toda una rotación armada. Y yo le arme una rotación que era uno de ese grupo lo mandamos a tal parcela específica, Ella tenía una rotación armada que por ejemplo iban a la cuatro a la tres a la cinco y a la siete entonces yo le dije parte de esos animales lo mandamos a la siete, parte a la tres que iba después, y los otros los dejamos acá, y estos que iban a la tres después van a la cinco y después van a llegar a la siete y esos se van a juntar con los otros, entonces como que le arme con el sistema de ella, en realidad le cambie su sistema pero con el sistema de ella. Y ella quedó contenta porque ya era por veinte días las vacas estaban feas y era por veinte días y en veinte días las vacas ya volvían a tener todo su lote junto de vuelta entonces ta ahí le contemplas su manejo cuando te parece que no lo tratas de cambiarlo, pero ya eran veinte días el resto del año lo manejo como esa quiso, desde que yo fui creo que era la primera vez que rompíamos el lote. entonces ta va por ahí en tratar de contemplar a cada uno en las ideas que tiene.

Bueno yo lo que pasa que en el momento que entre lo mío fue a corto plazo y específico porque esto en realidad arrancó con el armado del rediseño, una caracterización del sistema un diagnóstico y en base a ese diagnóstico plantear un rediseño. Y ahí seria como el momento para plantearte para ver el largo plazo. Yo arranque y ya estaba terminando el proyecto le quedaban seis meses y ta había que seguir ejecutando y ta en realidad no me tocó ver cosas a largo plazo.

5. ¿Cuáles son las técnicas de manejo que te aparecen que cuentan con más receptividad, visto bueno o aceptación de por parte de los productores?

La suplementación, es en la cabeza porque le estas dando comida animal entonces te quedan contentos. L suplementación es la primera y después el destete precoz en parte, aunque no es parte de la propuesta que nosotros le hacemos, pero enganchados con lo mismo como eso tiene en parte suplementación ellos se quedan tranquilo de que bueno ta.

Bueno si la estacionalidad de entore sí, yo creo que Ana no tenía ninguno, pero yo tenía uno que tenía entore y ese lo adoptó casi totalmente. Y después el manejo ahí depende el productor y el esquema que tenga en la cabeza, pero el manejo de los potreros un poco en función de la cantidad de pasto que hay, eso no es de lo más pero no es tampoco digamos no son, como que eso les parece bien no sé si lo agarran del todo el porqué , pero cuando lo empiezan a hacer eso es una propuesta de las que , después hay algunas por ejemplo el entore temporario es muy efectiva y la aplican pero no es tan aceptada porque le estas poniendo una tarilla al ternero y no lo estas dejando mamar entonces hay se me va a morir de hambre el ternero y no voy a vender nada. Lo hacen, pero ta, porque es muy buena y tiene resultados muy buenos, pero no es aceptada, si la pueden zafar la zafan, tengo uno que la hace diez días y la técnica dice que es entre once y catorce y él la hace diez y no entiendes por qué. Entonces después ha tenido unos resultados regulares y decís déjalo un día más y vez, y no tienen miedo por el ternero y ese tipo de cosas viste.

6. ¿Cuáles son las principales dificultades, barreras u obstáculos que percibes en los productores al momento de implementar las técnicas sugeridas?

Ese tipo de cosas, el preconcepto que muchas veces tienen de diferentes técnicas, la prensa negativa corre mucho más rápido que la prensa positiva entonces si una técnica uno la hizo en la zona y le fue mal. Que capas que la hizo mal pero no importa, de aquella hizo y le fue mal entonces eso es como que se difunde mucho y genera preconceptos que son mucho más fáciles de adquirir que los buenos resultados de la técnica.

no claro, pero no, no se suplementar a las terneras en invierno, hoy lo hacen todos y es una técnica aceptada como es suplemento. pero igual dicen no, pero eso lo hizo aquel y no le sirvió para nada y de repente lo hizo mal, pero a él le pareció que estaba bien y terminó el invierno y el tipo dice no a mí me fue horrible y ya está, todo el barrio dice no eso no sirve para nada. Y eso se corre mucho más que los buenos resultados.

Sí total y si el vecino lo aplico y le fue bien, te van a decir a si por el año, le llovió no se cualquier cosa, pero no. Cuando le va mal no sirve, pero cuando le va bien no sirve eso es así tal cual. Tenes que demostrarle y ahí está el tema de que quien se abre a bueno vamos a probar y demostrar. Y algunos que ni siquiera te dicen vamos a probar y ese es dificilísimo entrar. Entonces si uno lo hace bien a fue por el año y si uno lo hace mal a eso no sirve para nada. Entonces es dificilísimo que agarren buena prensa digamos ese tipo de prácticas. y hay prácticas de estas que no tienen marketing, una tablilla nadie va a hacer plata vendiendo una tablilla entonces nadie lo fomenta, te hacen marketing del destete precoz porque vendes un montón de ración con eso, pero el destete temporario nadie te hace, vendes una tablilla que te dura años porque son de plástico y no sé qué te valdrá un dólar una tablilla. Entonces nadie va a hacer plata con eso entonces no tienen prensa.

Además, la difusión por parte de la facultad INIA y demás tienen unos problemas bárbaros.

No sé qué problemas tienen, pero la forma de llegar a los productores o el alcance que tienen no es alto.

- *¿Es por la radio o por dónde?*

No a los productores le corre mucho más el boca a boca y las cosas que veníamos hablando que, o la facultad INIA no se sabe expresar o le erran en la forma de

expresión, hay no se bien, pero es poca la difusión que tienen. Si claro es que la mejor prensa que pude tener son los mismos productores, esa es la mejor prensa que pueden tener este tipo de proyectos. Ellos agarrando al vecino, al que sea y, eso es mucho más que.

7. ¿Como ha sido la percepción de las medidas planteadas en términos de facilidad en términos de implementación y los resultados productivos de las técnicas que recomiendan?

A no eso es dificilísimo una vez que vos te vas ellos toman en función de eso, igual lo que yo veo como yo tengo tres que arrancaron ahora, otro que hace tres años y hay uno que viene del proyecto anterior de INIA ósea que hace 6 años que está, y en realidad lo que yo veo que ese ya lo tienen más incorporado, hay veces que yo voy y ese ya me está esperando diciéndome lo que hay que hacer y no dista mucho de lo que le puedo decir yo. a veces no se cambiamos algo una parte de la que él dice o algún ajuste y hay vece que si hace eso ta entonces como que ya le va agarrando la mano. Y los otros lo adoptan, digamos ellos les parecen fáciles lo que no quiere decir que las hagan bien después.

¿Y qué te parece que es lo que influye ahí entre que les parece fácil pero no lo hagan bien?

No lo que pasa que vos ahí justo me pusiste el ejemplo del manejo de los potreros y ese es como lo más bravo porque ellos te cambian después de un potrero a otro porque les pareció que había más pasto y cosas así y ta ahí hay que ver. Esa es la parte más, capas las decisiones más complicadas para tomar ellos sin tener capas un ojo más fino de cuánto pasto hay o sin medir. Porque ellos no pero el resto de las técnicas propuestas las han adoptado sin problema. Las han hecho y las hacen solo sin problema.

¿Y cuál ha sido la más difícil, la que más te ha costado transmitir?

Eso, el manejo del pastoreo, si eso. Ellos miran y a su criterio miran cual tiene más o menos pasto. pero a su criterio si este es el mejor potrero que tengo le meten más animales. y de repente no tiene pasto, pero ese es el mejor potrero y le siguen metiendo animales porque siempre fue el mejor potrero. o este es el mejoramiento porque en una época le eche fertilizante y le meten animales y en realidad no tiene pasto. Ta bien que vos le pusiste fertilizante y semilla, pero no tiene pasto. El otro que está al lado no tienen nada, pero tiene mucho más pasto. Pero el mejoramiento es este y siguen metiendo animales.

Ellos no manejan la diversidad de pastos, te diría que no se maneja mucho en el proyecto. Se maneja tipo este potrero tiene más pajonal, menos pajonal, hay más paja menos paja y ta hasta ahí. Diversidad no. ni toman decisión en base a eso.

8. ¿Cuáles son los indicadores que los productores consideran para definir qué medidas son exitosas y cuáles no?

El resultado final, el porcentaje de destete, por ejemplo. el porcentaje de destete es uno de los primeros. El peso de los terneros otro también. Esas cosas son de las principales que los toman.

9. ¿Cómo considera que es la percepción de los productores de la zona ósea los que no participan con respecto a estas técnicas implementadas?

En realidad, la zona en la que yo me muevo, yo creo que la visión de la vuelta es buena. Pero es una zona en la que hay muchos productores que se manejan en grupos y

entonces usan muchas de estas técnicas a veces no sé cómo las usan ese es otro tema; pero sé que las técnicas en la zona están instaladas por el manejo en grupos que tienen ellos y hay mucho pariente en la zona, una a la que voy son todos rodríguez, por un lado siempre es primo o es sobrino o es no sé qué, entonces tienen contacto y yo sé que manejan ósea que debe ser bueno.

10. ¿Considera que pertenecer a un grupo de productores o sociedad de fomento puede influir en la implementación de más técnicas?

Si sin lugar a duda, si porque siempre hay alguno que le va bien y la difusión que te decía.

11. ¿Cómo considera que es la influencia de los productores cuando cuentan con asistencia técnica?

Fua relativa, no se ahí creo que va a depender un poco de la zona, si agarran uno de la zona esta que te digo que tienen trabajo en grupo que tienen un poco de ese funcionamiento yo creo que los técnicos son bien vistos, pero si agarras a alguien en una zona más alejada que no estén con este sistema de trabajo, lo ven como un loco capas.

12. ¿Consideras que este efecto asistente técnico no es uniforme entre tus productores?

No, yo creo que sí que es generalizado de que todos lo consideran bien. Después yo creo que ellos adoptan de distinta forma la propuesta, pero creo que ahí creo que puede haber habido un tema en el proceso de trabajo desde que arrancó con ellos, porque acá tienen que haber hecho un rediseño desde el principio, ese rediseño parte de la base que tienen que ser en conjunto el técnico con los productores entonces, armamos esto para ir hacia allá y yo lo que entiendo es que el productor debería adueñarse de eso. y yo lo que vi es que no están todos iguales, pero después también lo que veo es que en realidad no sé si este rediseño se hizo en conjunto o ese rediseño lo hizo el técnico para cumplir, porque acá en el proyecto pedían hacer un rediseño. Lo hizo el técnico para cumplir entregó el rediseño, porque cuando yo voy les hablo del rediseño y muchos no tienen ni idea, y digo, ¡¡¡¡pero para!!! al principio quedaba medio descolocado, pero como esto no, yo leí esto cuando arranqué porque pensé que íbamos hacia acá, no tenían ni idea los productores. Entonces creo que ahí hubo un poco de, por eso digo que algunos como que adaptaron más y menos. Pero la visión del técnico es generalizada por todos de que es buena.

13. ¿Qué características consideras fundamentales en el técnico para poder lograr un manejo que modifique las prácticas en el predio?

Para mí un poco de lo que te decía hoy del tema de cuantificar, llevar registros y usarlos, hacer los cálculos y plantear las cosas con números. Salir de ese lenguaje de los productores de un poquito más un poquito menos. Cuanto más cuanto nos va a dar, cuanto menos. Ahí es cuando creo que el productor te empieza a creer en lo que le estas diciendo porque, vos le vas con algo concreto, bueno vos mediste y ahí dice tanto, ahí cambias el lenguaje de ellos ahí cambias y haces un lenguaje más técnico digamos, yo creo que eso sería uno de los primeros, uno de los principales.

14. ¿Cómo consideras que influye la experiencia de los productores en el manejo del predio?

Creo que los nuevos son más proclive a la adopción de técnicas, me parece, pero en realidad no lo sé. Me parece que un productor nuevo que no estuviera muy metido va a ser más factible que adopte técnicas que uno que toda la vida trabajo, que el papa lo hacía así, esos son más bravos.

15. ¿Considera que el nivel educativo puede influir en la implementación de técnicas?

El nivel educativo yo calculo que influye positivamente a mayor nivel educativo es más factible que adopten técnicas. En mi caso creo que no hay mucha diferencia de nivel educativo, terminaron a mitad de camino en el liceo y hay una productora que no sé. ***¿Cómo percibes que ven estas dos cosas la experiencia y la educación los productores?*** *L*a experiencia la ven positiva, si uno arrancó ayer no importa nada ya no sabe nada, la experiencia la ven positiva. No sé cómo lo ven, lo que sí sé que decirte que ven más importante la experiencia que el nivel de educación eso sí. El nivel de educación yo creo que hoy en día le dan un poco más de importancia, pero no es determinante.

16. ¿Como consideran que influyen la participación en algún programa previo de asistencia técnica, en poder implementar más o mejor las técnicas o no?

Yo creo que es positiva, pensando en lo mío yo creo que es positiva, no sé si, pero ninguno ha tenido una experiencia negativa de participación anterior. Pero en los que yo conozco influye de manera positiva la participación anterior. Creo que piensan que al haber participado les puede sumar más porque ellos parten de que, por ejemplo, hay uno de los que tengo que te dice que él siempre trabajó con técnicos desde hace algunos años y quiere seguir porque dice Tenes otra persona pensando por vos para tu predio. Y a veces te podrá decir más cosas y a veces menos, pero es alguien que viene y piensa contigo y uno acá esta solo y tiene que tomar un montón de decisiones y ta, entonces él siempre lo ve positivo.

17. ¿En qué consideras que se diferencia la experiencia de coinnovation con otros programas públicos que puedan ofrecer asistencia técnica?

La diferencia con los que están arrancando ahora, es la seriedad y la dedicación que se les da el uno a otro. El ministerio largo unos planos que tienen que tener asistencia técnica, porque vieron los resultados de esto y son buenísimos, hay que meter asistencia técnica, entonces tal metemos este proyecto que te damos plata para que te compres no sé qué y Tenes que tener asistencia técnica, entonces ahí se desvirtúa y nadie entiende nada y el productor termina aceptando que un técnico vaya a la casa porque le van a dar plata para que ponga un molino para sacar agua, igual técnico y no sé qué y tienen el periodo para hacer la caracterización y el diagnóstico, porque supuestamente iba a ser esta metodología, su especialización y diagnóstico era un mes creo y con eso no haces ,haces una chanchada nomás y entonces me parece que la diferencia va por la dedicación, no sé si tomarlo más de enserio o no pero si sea envase a estos resultados se ha masificado dentro de los planes del ministerio pero ta otra implementación y vamos a ver cómo les va.

Glossary

CIRCVC-UDELAR: Interdisciplinary Centre to Response to Climatic change and variability.
FLF: Familiar Livestock Farmer. It refers to the farmer in charge of the decision making on each farm. On this research, FLF also refers to the respondents of the GFCC survey.
FLS: Familiar Livestock System
GFCC project: a public policy experience that was implemented to increase farmers resilience to climate change through the implementation of 3 components: infrastructure aid, working with FO and research on the topic.
UDELAR: University of the Republic in Uruguay.

References

Abid, M, Scheffran, J, Schneider, UA & Ashfaq, M 2015, 'Farmers perceptions of and adaptation strategies to climate change and their determinants: the case of Punjab province, Pakistan', Earth System Dynamics, vol. 6, no. 1, pp. 225–243, <https://www.earth-syst-dynam.net/6/225/2015/>

AGEV-OPP & Dirección de Gestión y Evaluación 2017, 'Ganaderos Familiares y Cambio Climático (GFCC)', retrieved from, <https://transparenciapresupuestaria.opp.gub.uy/sites/default/files/evaluacion/Ganaderos%20Familiares%20y%20Cambio%20Clim%C3%A1tico.pdf>.

Bartaburu, D, Dieguez, H, Molina, M, Astigarraga, L, Picasso, V, Montes, C, Cruz, G, Modernel, P, Mondelli, M, Terra, R, Taks, J, Cobas, P, De Torres, F, Lizarralde, F & Quiñones, A 2013, 'Sensibilidad y capacidad adaptativa de la ganadería frente al cambio climático'. Volumen III de: Clima de cambios: nuevos desafíos de adaptación en Uruguay, <http://www.fao.org/3/a-au192s.pdf>

Bentancur, V, Molinari, M, Jones, C & Oyhantçabal, W 2019, 'Proyecciones climáticas mediante reduccion estadistica de escala para Uruguay', <http://www.mgap.gub.uy/sites/default/files/proyecciones_climaticas_mediante_reduccion_estadistica_de_escala_para_uruguay_1.pdf>

Bryman, A, Bresnen, M, Beardsworth, A, & Keil, T 1988, 'Qualitative research and the study of leadership', Human relations, 41(1), 13-29, <https://journals.sagepub.com/doi/abs/10.1177/001872678804100102>

Checkland, P 2000, 'Soft systems methodology: a thirty year retrospective', Systems Research and Behavioral Science, vol. 17, no. S1, pp. S11–S58, <https://onlinelibrary.wiley.com/doi/abs/10.1002/1099-1743(200011)17:1%2B<::AID-SRES374>3.0.CO;2-O>

Checkland, P 1989, 'Soft Systems Methodology', Human Systems Management, vol. 8, no. 4, pp. 273–289, <https://content.iospress.com/articles/human-systems-management/hsm8-4-05>

Chhetri, N, Easterling, W, Terando, A & Mearns, L 2010, 'Modeling path dependence in agricultural adaptation to climate variability and change', Annals of the Association of American Geographers, 100(4), pp.894-907, <https://www.tandfonline.com/doi/abs/10.1080/00045608.2010.500547>

Cochran, W 1952, 'The χ2 Test of Goodness of Fit', The Annals of Mathematical Statistics, vol. 23, no. 3, pp. 315–345, <https://www.jstor.org/stable/2236678>

Costamagna, P 2013, 'Facilitas del desarrollo territorial', Programa Regional de Formación en Desarrollo Económico Local con Inclusión Social en América Latina y El Caribe, <http://www.conectadel.org/wp-

content/uploads/downloads/2014/01/Anexo-I-Documento_Antecedentes-Facilitadores-en-DT.pdf>.

Cros, M, Duru, M, Garcia, F & Martin-Clouaire, R 2004, 'Simulating management strategies: the rotational grazing example', Agricultural Systems, vol. 80, no. 1, pp. 23–42, <http://www.sciencedirect.com/science/article/pii/S0308521X03000933>

Dankhe, O 1986, 'La comunicación humana: ciencia social', México, DF.

DGDR 2014, 'Estado de situación de la producción familiar agropecuaria y los agricultores familiares en base al CGA y RPFA', retrieved from <http://www.mgap.gub.uy/sites/default/files/multimedia/pptpafregistros2015.pdf>

DIEA, M 2019, 'Anuario 2019', retrieved September 13, 2019, <https://descargas.mgap.gub.uy/DIEA/Anuarios/Anuario2019/Anuario2019.pdf>.

DIEA,M 2018,'Anuario 2018',retrieved September 13, 2019, <https://descargas.mgap.gub.uy/DIEA/Anuarios/Anuario2018/Anuario_2018.pdf>

DIEA, M 2015, 'Regiones agropecuarias del Uruguay', retrieved from <http://www2.mgap.gub.uy/DieaAnterior/regiones/Regiones2015.pdf>.

Dogliotti, S, García, M, Peluffo, S, Dieste, J, Pedemonte, A, Bacigalupe, G, Scarlato, M, Alliaume, F, Alvarez, J, Chiappe, M & Rossing, W 2014, 'Co-innovation of family farm systems: A systems approach to sustainable agriculture', Agricultural Systems, vol. 126, pp. 76–86, <http://www.sciencedirect.com/science/article/pii/S0308521X13000280>

Doré, T, Makowski, D, Malézieux, E, Munier-Jolain, N, Tchamitchian, M & Tittonell, P 2011, 'Enfrentando el paradigma de la intensificación ecológica en agronomía: revisitando métodos, conceptos y conocimientos', European journal of agronomy , 34 (4), 197-210, <https://www.sciencedirect.com/science/article/abs/pii/S1161030111000220>

FAO, T 2014, 'The state of food and agriculture: Innovation in family farming', retrieved October 28, 2019, from <https://scholar.google.com/scholar_lookup?title=The%20state%20of%20food%20and%20agriculture%202014%3A%20Innovation%20in%20family%20farming&publication_year=2014&author=FAO>.

Figari, M, Rossi, V, & Nougué, M 2002, 'Impacto de una metodología de asesoramiento técnica alternativo en sistemas de producción lechera familiar', Agrociencia, 6(2), 61-74, < http://www.fagro.edu.uy/agrociencia/VOL6/2/p61-74.pdf>

Frugoni, R 2008, 'La inclusión del desarrollo rural en las políticas públicas agropecuarias. Un proceso imprescindible en marcha', Anuario Estadístico

2008,<http://www.mgap.gub.uy/sites/default/files/multimedia/1200_R_Frugoni_y_varios_La_inclusic3b3n_de_desarrollo_rural_en_polc3adticas_pc3bablicas.pdf>

Garavaglia, S., & Sharma, A. (1998, October). A smart guide to dummy variables: Four applications and a macro. In Proceedings of the Northeast SAS Users Group Conference (p. 43).

García, M and Méndez, P, 2004, 'Los Sistemas Productivos Regionales desde la perspectiva del Análisis de Redes', REDES. Revista hispana para el análisis de redes sociales, 6(2),<https://www.researchgate.net/publication/26444429_Los_Sistemas_Productivos_Regionales_desde_la_perspectiva_del_Analisis_de_Redes>

GFCC (2015) Complete Survey Database. Non published material. MGAP- FAGRO

Gómez, R & Saravia, H 2016, 'Tecnología en sistemas ganaderos criadores de Sierras del Este: oferta disponible y toma de decisiones tecnológicas en el predio', Agrociencia - Uruguay, vol. 20, no. 1, pp. 113-122–122, <http://www.fagro.edu.uy/agrociencia/index.php/directorio/article/view/1221>

Graeub, B, Chappell, M, Wittman, H, Ledermann, S, Kerr, R & Gemmill-Herren, B 2016, 'The State of Family Farms in the World', World Development, vol. 87, pp. 1–15, <http://www.sciencedirect.com/science/article/pii/S0305750X15001217>

Gutierrez, R, Molina, C, Garcia, R, Picos, G, Santos, C, Modernel, P & Tommasino, H 2008, 'DINÁMICAS ECONÓMICO-PRODUCTIVAS DE LA PRODUCCIÓN FAMILIAR CRIADORA', retrieved from <http://www.mgap.gub.uy/sites/default/files/multimedia/1170_Determinantes_de_sustentabilidad_de_los_productores_familiares_criadores._Una_aproximacic3b3n_interdisciplinaria_con_metodologc3adas_mc3baltiples_2011.pdf>.

Heeringa, S, West, B, Berglund, P 2017, 'Applied Survey Data Analysis', Chapman and Hall/CRC, <https://doi.org/10.1201/9781315153278>

Hosmer Jr, D, Lemeshow, S & Sturdivant, R 2013, 'Applied logistic regression', *John Wiley & Sons,* <https://epdf.pub/applied-logistic-regression-wiley-series-in-probability-and-statistics.html>

Howley 2015, extracted from Producer Incentives in Livestock Disease Management, <https://books.google.com.uy/books?id=J7Q0DwAAQBAJ&pg=PA50&dq=farmer+decision+making+process+that+farmers+seek+to+balance+economic,+social+and+lifestyle+goals&hl=es&sa=X&ved=0ahUKEwje5L21gevlAhVVHbkGHTW4CJoQ6AEIJzAA#v=onepage&q=farmer%20decision%20making%20process%20that%20farmers%20seek%20to%20balance%20economic%2C%20social%20and%20lifestyle%20goals&f=false>

IPCC 2019, 'Food security - IPCC', retrieved September 23, 2019, from <https://www.ipcc.ch/site/assets/uploads/2019/08/2f.-Chapter-5_FINAL.pdf>.

Kilpatrick, S 2000, 'Education and training: Impacts on farm management practice', *The Journal of Agricultural Education and Extension, vol. 7, no. 2, pp. 105–116*, <https://doi.org/10.1080/13892240008438811>

Klerkx, L, Van Mierlo, B, & Leeuwis, C 2012, 'Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions', *In Farming Systems Research into the 21st century: The new dynamic (pp. 457-483). Springer, Dordrecht*,< https://link.springer.com/chapter/10.1007/978-94-007-4503-2_20>

Klerkx, L, Hall, A, & Leeuwis, C 2009, 'Strengthening agricultural innovation capacity: are innovation brokers the answer?', <https://cris.maastrichtuniversity.nl/portal/files/1101498/guid-050652d4-d0db-4cb5-a852-dede8c8fba03-ASSET1.0>

Kristensen, E & Jakobsen, EB 2011, 'Challenging the myth of the irrational dairy farmer; understanding decision-making related to herd health', *New Zealand Veterinary Journal, vol. 59, no. 1, pp. 1–7*, <https://www.tandfonline.com/doi/abs/10.1080/00480169.2011.547162>

Long, B 2013, 'Understanding farmer decision making and adoption behaviour', *Grains Research and Development Corporation*, retrieved August 1, 2019, from <https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2013/02/grdc-updatepaper-long2013-decisionmakingandadoption>.

MGAP 2019, 'Plan Nacional de Adaptación al Cambio y la Variabilidad Climática (PNA-Agro)', retrieved September 22, 2019, from <http://www.mgap.gub.uy/unidad-organizativa/oficina-de-programacion-y-politica-agropecuaria/estadisticas-y-documentos/PNA-Agro>.

MGAP 2017, 'Línea de Base para la evaluación de impacto del proyecto GFCC.', retrieved from <http://www.mgap.gub.uy/sites/default/files/presentacion_area_evalaucion_de_politicas._seminario_gfcc_24-10-17.pdf>.

ODS - UN 2018, 'Informe Nacional Voluntario Uruguay', retrieved November 6, 2019, from,<https://sustainabledevelopment.un.org/content/documents/19436Uruguay_VNR_URUGUAY_2018.pdf>.

'OEC - Uruguay (URY) Exports, Imports, and Trade Partners', retrieved October 31, 2019, from <https://oec.world/en/profile/country/ury/>.

Oyhantcabal, W, & Mori, E 2003, 'Encuesta de actitudes y comportamiento tecnológico de los ganaderos uruguayos', Montevideo, INIA,<http://www.inia.uy/Publicaciones/Paginas/publicacion-770.aspx>

Paparamborda, I. 2017, '¿Qué nos dicen las prácticas de gestión del pastoreo en los predios ganaderos familiares sobre su funcionamiento y resultado productivo?'.

Peng, C-YJ, Lee, K & Ingersoll, G 2002, 'An Introduction to Logistic Regression Analysis and Reporting', *The Journal of Educational Research, vol. 96, no. 1, pp. 3–14*, <https://doi.org/10.1080/00220670209598786>

Pereira, G, Rincón, F, Tommasino, H & Grasso, A 2003, 'La ganadería en Uruguay. Una contribución a su conocimiento', *Montevideo, MGAP. DIEA*,<http://www2.mgap.gub.uy/portal/afiledownload.aspx?2,5,99,O,S,0,170%3BS%3B9%3B40,.>

Piñeiro, D 1994, 'Caracterizacion de la Produccion Familiar', <http://mail.upc.edu.uy/produccion-familiar?download=80:pineiro>

República Oriental del Uruguay 2017, 'Primera Contribución Determinada a nivel Nacional de Uruguay al Acuerdo de París. Decreto n.° 310/017.', retrieved from <http://bit.ly/2Y8OVTf>.

Ruggia, A, Scarlato, S, Cardozo, G, Aguerre, V, Dogliotti, S, Rossing, W & Tittonell, P 2015, 'Managing pasture-herd interactions in livestock family farm systems based on natural grasslands in Uruguay', p. 2, <https://library.wur.nl/WebQuery/wurpubs/fulltext/371773>

Schmidheiny, K 2013, 'Short Guides to Microeconometrics Fall', <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.563.2208&rep=rep1&type=pdf>

Searchinger, T, Hanson, C, Ranganathan, J, Lipinski, B, Waite, R, Winterbottom, R, Dinshaw, A, Heimlich, R, Boval, M & Chemineau, P 2014, 'Creating a sustainable food future. A menu of solutions to sustainably feed more than 9 billion people by 2050. World resources report 2013-14: interim findings', *World Resources Institute (2014)*.<https://www.undp.org/content/dam/undp/library/Sustainable%20Development/Creating-a-sustainable-food-future.pdf>

Soca, P, Carriquiry, M, & Do Carmo, M 2013, 'Forage allowance and cow genotype, tools to increase animal production in native pastures. *Proc. 22nd Int. Grass Congr. Sydney, Australia, 599-600.*

Stebbins, R 2001, Exploratory research in the social sciences (Vol. 48),< https://books.google.com.uy/books?hl=es&lr=&id=hDE13_a_oEsC&oi=fnd&pg=PR5&dq=stebbins+2001+explorati+researchers&ots=NlWH11GBqK&sig=OLgFUQlMYWMWf_QlXsbTGDgTe9o&redir_esc=y#v=onepage&q=stebbins%202001%20explorati%20researchers&f=false>

Stimson, R (Ed.) 2014, 'Handbook of research methods and applications in spatially integrated social science', Edward Elgar Publishing<

https://books.google.com.uy/books?hl=es&lr=&id=mEYjBAAAQBAJ&oi=fnd&pg=PR1&dq=Handbook+of+Research+Methods+and+Applications+in+Spatially+Integrated+Social+Science&ots=FzrrYlkEU7&sig=_x7EICOWv_mVhI1aiuhg1R8WXkA&redir_esc=y#v=onepage&q=Handbook%20of%20Research%20Methods%20and%20Applications%20in%20Spatially%20Integrated%20Social%20Science&f=false>

Terra, I 2009, 'Cual es la importancia real del sector agropecuario en Uruguay', retrieved from <http://www.mgap.gub.uy/sites/default/files/multimedia/cual_es_la_importancia_real_del_sector_agropecuario_2009_fao_terra_y_otros.pdf>.

Tittonell, P, Klerkx, L, Baudron, F, Félix, GF, Ruggia, A, van Apeldoorn, D, Dogliotti, S, Mapfumo, P & Rossing, WAH 2016, 'Ecological Intensification: Local Innovation to Address Global Challenges', *in E Lichtfouse (ed), Sustainable Agriculture Reviews: Volume 19, Sustainable Agriculture Reviews, Springer International Publishing, Cham, pp. 1–34, retrieved August 23, 2019*, from <https://doi.org/10.1007/978-3-319-26777-7_1>.