

Final report

# WHEAT LANDRACES IN THE ANDALUSIAN AGRI-FOOD CHAIN

---



---

Guiomar Carranza Gallego, Gloria I. Guzmán Casado and Manuel González de Molina  
Agro-ecosystems History Laboratory (AHL)  
(University Pablo de Olavide, Seville)

Andalucía  
se mueve con Europa





# WHEAT LANDRACES IN THE ANDALUSIAN AGRI-FOOD CHAIN

---

**Guiomar Carranza Gallego, Gloria I. Guzmán Casado and Manuel González de Molina**  
**Agro-ecosystems History Laboratory (AHL) (University Pablo de Olavide, Seville)**

**T**his report presents a review of the project: **Transfer of wheat landraces presenting high value-added niche market potential to the Andalusian agribusiness.** We describe the project's major objectives, challenges, and stages together with its key findings and results.

The project unfolded during the difficult circumstances and restrictions resulting from the COVID-19 pandemic. It was nevertheless possible over the last few months to broaden and consolidate a

network of contacts and to set up a Living Lab of great interest, with the potential to recover wheat landraces. We have launched a process to recover wheat landraces in Andalusia by sharing our concerns, knowledge, objectives and work with producers and food processing companies in the flour-bakery and semolina sectors. Much yet remains to be done, but some key milestones have been reached. The main barriers and actions to implement for a successful outcome in the future have also been put on the table.

Below, we describe the project's agenda of activities. We explain how the project's stages have led atomised actors in the wheat agri-food chain to come together and form a collective in support of the recovery and introduction of wheat landraces into the food chain. In this sense, the project has been a true breeding ground.



## WHAT IS THE GOAL?

The major goal of the project **Transfer of wheat landraces presenting high value-added niche market potential to the Andalusian agribusiness** is to foster the use of wheat landraces in the Andalusian agri-food chain by disseminating their commercial, nutritional, environmental and economic benefits during the production, processing and consumption stages.



## STARTING PREMISE. WHAT VALUE DO WHEAT LANDRACES ADD TO THE AGRI-FOOD CHAIN?

The starting point of this project was the findings of the trials conducted by the [Agroecosystem's History Laboratory](#) (AHL, University Pablo de Olavide, Seville) in farmers' fields over the 2013-2016 period. The field studies established that wheat landraces and their cultivation in Mediterranean rainfed agroecosystems presented notable environmental, socioeconomic and nutritional advantages. These benefits positively affect farmers, food processing

agribusiness as well as consumers. Such positive results prompted the team in charge to present the transfer project included in this report, in order to raise interest and coordinate key players in Andalusia's wheat agri-food chain. The project of re-introducing these cultivars into our food consumption would be unworkable without these key players.

Our proposal was therefore built upon two basic premises: a) the promotion strategy is linked to

the wheat landraces' environmental, socioeconomic and nutritional value; b) the strategy is a win-win situation for all actors in the agri-food chain, because it improves: production capacity, economic profitability, environmental quality, and/or food quality.

The **environmental benefits** associated with the cultivation of wheat landraces in rainfed Mediterranean agroecosystems can be summarised as follow:

- CLIMATE CHANGE MITIGATION**

Wheat landraces contribute to climate change mitigation by producing more phytomass (straw and root biomass) and boosting soil carbon sequestration.
- + FERTILITY OF DEGRADED SOILS**

They improve the fertility of degraded soils, contributing to foster climate change adaptation of rainfed agroecosystems.
- + BIODIVERSITY**

They promote biodiversity and the conservation of endangered species associated with cereal fields (e.g. steppe birds).
- HERBICIDES**

They reduce herbicide usage and the number of weeding machinery passes because they compete better against weeds.
- ↓ CO<sub>2</sub>**

They reduce net greenhouse gas emissions per surface area unit and the carbon footprint per unit of wheat grain produced.

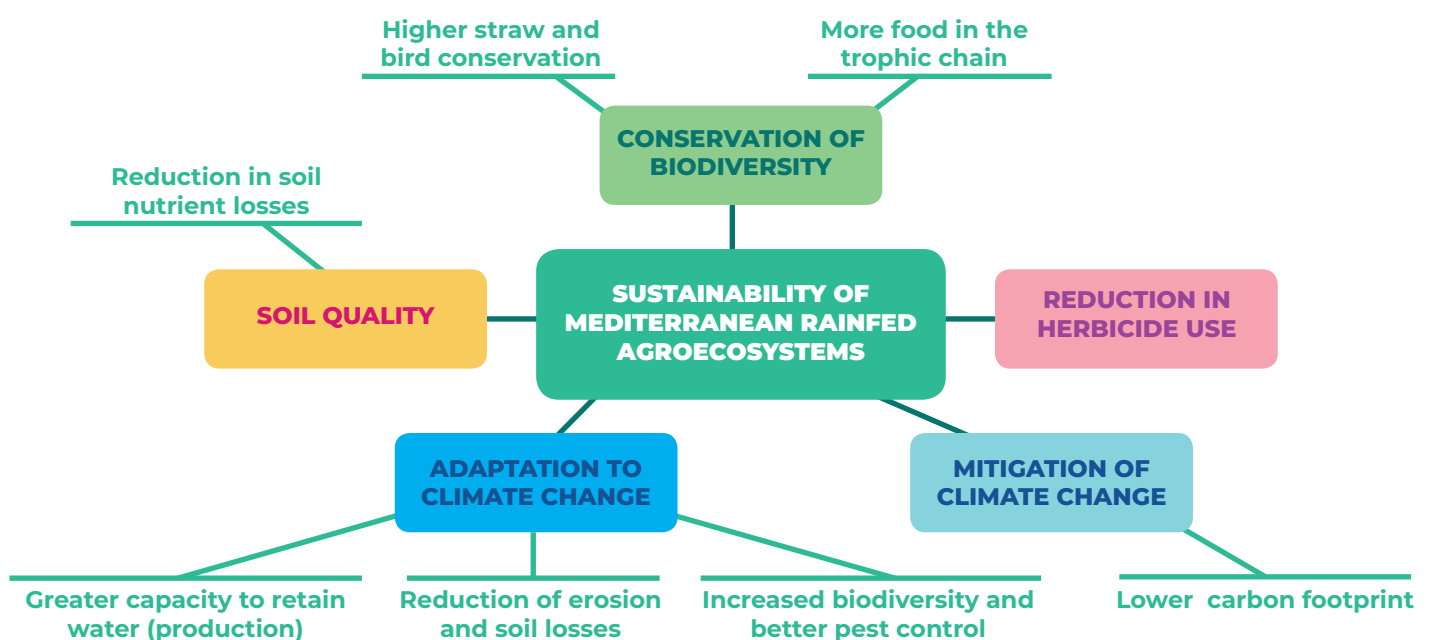


Figure 1. Environmental benefits of growing wheat landraces in Mediterranean rainfed agroecosystems.

The **nutritional benefits** lie in the increased protein content in the grain of wheat landraces, in addition to lesser gluten than that found in modern wheats, an advantage for people sensitive to gluten or who wish to reduce gluten intake. Landraces can thus open significant market niches for businesses involved in the selling and making of breads and pasta. This lower gluten content, however, comes with particularities that must be addressed when making bread and pasta with wheat landraces: new qualities require fresh ways of working.

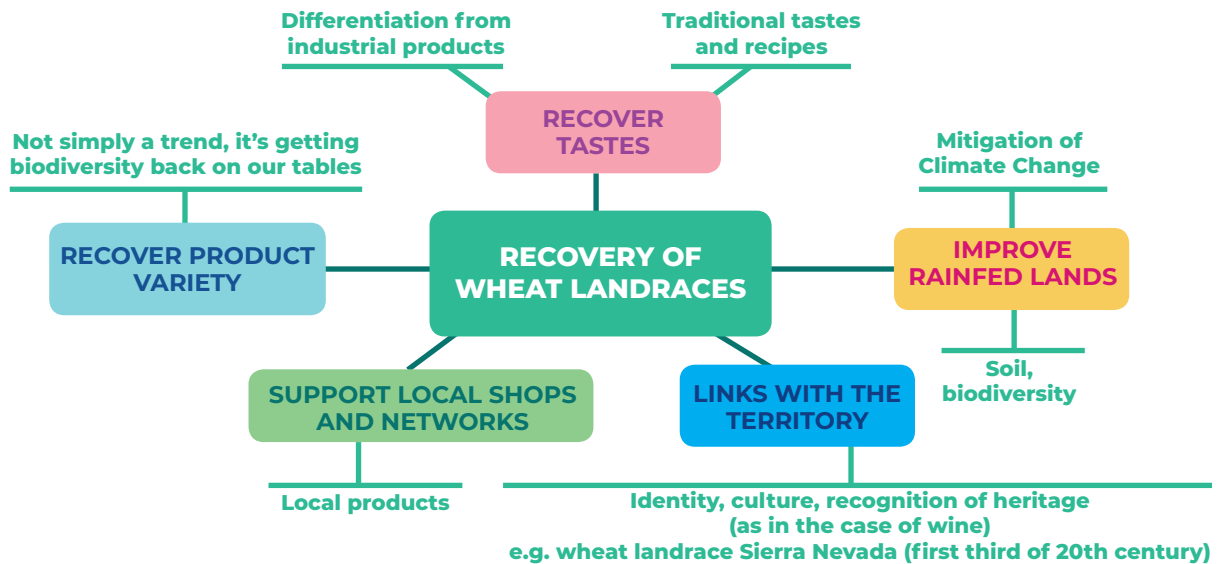


Figure 2. Benefits for the different links in the agri-food chain

The **socioeconomic benefits** of growing wheat landraces are multiple. Wheat landraces produce the same amount of grain as modern varieties in Mediterranean rainfed agroecosystems. But they produce more straw and root phytomass, increasing the organic edaphic matter for farmers cost-free and saving them weeding expenses. Therefore, they produce the same grain, but at lower cost and with the added advantage of improving the soil and future productivity.

On the agribusiness side, flours and semolina made from wheat landraces are better adapted to small-scale or artisan processing, which predominate in the organic sector. Due to their rheological characteristics and low gluten content, wheat landraces are processed differently from the grain of modern varieties used in bread and pasta making, which are more adapted to industrial processing. Small organic agribusiness cannot compete with the large conventional industry unless they resort to market differentiation. To do so, they must offer products that present no comparative advantages for big industry, generating an opportunity to increase the profitability and economic viability of small projects that are usually part of short marketing chains. It is thus worth noting that the use of modern varieties with a higher gluten content may not be the only reason for the rise in cases of coeliac disease or gluten sensitivity. Another explanation may be the mechanisation of agriculture and the increase in the use of industrial fertilizers. The latter may have favoured the content of aller-

genic proteins in wheat, leading to gluten-related disorders increase (Peñuelas et al. 2020). In addition, shorter fermentation processes in bread making could also be responsible for increasing the amount of gluten in end products (Gobbetti et al. 2007). We thus consider that wheat landraces represent an opportunity for organic and artisan agribusiness.

Moreover, the growing environmental and health concerns of citizens has boosted the consumption of locally produced certified organic food, leading to the development of territorialised agri-food systems. From an economic and development perspective, the consumption of local products strengthens local commerce and local networks. The latter play a key role, because it is local businesses that makes it possible, in turn, to recover local varieties.

Finally, wheat landraces can also be an advantage for other economic sectors, such as catering. Restaurants can offer flavours thought to be lost, thus helping to differentiate wheat landraces products from industrial products and increase diet diversity.

In short, wheat landraces could strengthen the bonds between the wheat agri-food chain and the territory: each region's specific cultivars could be recognised, generating a win-win strategy for all the stakeholders in these territorialised agri-food systems. Why is this bond so widespread and suited to the wine industry and its vineyard appellations of origin, and yet does not apply to bread? Efforts should be made in this regard, especially when one considers that wheat provides us with a significant amount of daily protein and energy.

To conclude, **all the environmental, nutritional, and socioeconomic benefits of using wheat landraces would contribute to increasing the end product's added value.** And this added value could have a positive impact on economic projects linked to the cereal. The cereal is often found in rural areas in decline that require sustainable projects, both from an environmental and socioeconomic perspective.

This information constituted the premise of the transfer project and, once we transmitted the project to the actors in the agri-food chain, we encouraged the formation of a common project.

Peñuelas, J., Gargallo-Garriga, A., Janssens, I. A., Ciais, P., Obersteiner, M., Klem, K., Urban, O., Zhu, Y-G., Sardans, J. 2020. Could global intensification of nitrogen fertilisation increase immunogenic proteins and favour the spread of Coeliac pathology? *Foods*, 9(11), 1602

Gobbetti M, Giuseppe Rizzello C, Di Cagno R, De Angelis M. 2007. Sourdough lactobacilli and celiac disease. *Food Microbiol*, 24: 187-196



## WHOM HAVE WE WORKED WITH?

Throughout the project, we contacted, conducted activities and planned future actions with the following entities:

Andalusian companies dedicated to the production of wheat flour, with or without organic certification.

Companies in the region producing end products from wheat flour: organically certified bakeries and pastry shops.

An enterprise that manufactures organic durum wheat semolina and artisan pasta. This company is unique in Andalusia and Spain.

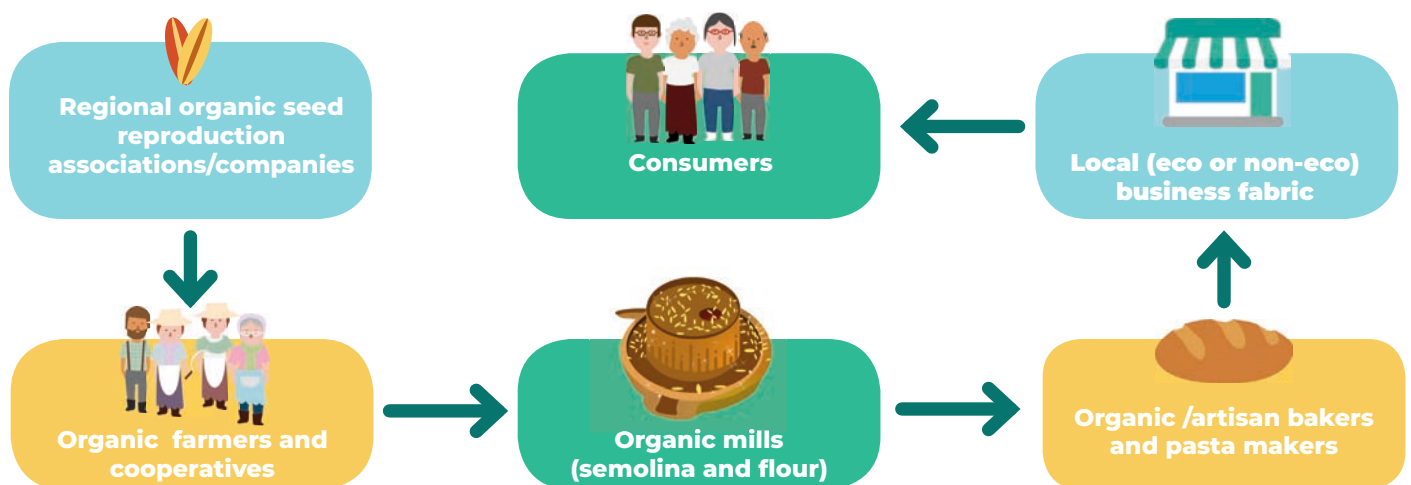
Organised producers experienced in recovering wheat landraces and actively leading projects for the recovery of these varieties: the *Grupo de Acción Compartida (Shared Action Group)*.

A company dedicated to the production of organic crops interested in producing crops of wheat landraces.

Producers interested in recovering wheat landraces.

Regional and nationwide social organisations within the field of organic agriculture: *Ecovalia* and the *Red Andaluza de Semillas*.

### Introduction of wheat landraces into Agroecological Local Agrifood Systems (ALAS) in Andalusia



Introducing wheat landraces in the Andalusian agri-food chain by promoting their nutritional, environmental and economic benefits throughout the agri-food chain

Figure 3. Actors involved in the wheat agrifood chain.



## COOPERATION AND DISSEMINATION IN THE SECTOR

Action	Actors involved	Addressees	Outcome
Surveys	AHL	Food processing companies part of Andalusia's wheat agri-food chain: flour mills, artisan semolina and bakeries.	<ul style="list-style-type: none"> <li>- Report including knowledge levels, criteria for choosing varieties and sector prejudices regarding wheat landraces.</li> <li>- Identification of barriers to the upscaling.</li> </ul>
Online dissemination events	AHL, Ecovalia, Red Andaluza de Semillas, Spiga Negra, Horno María Diezma, La Artesa, Grupo de Acción Compartida	Food processing companies, producers, associations for the preservation of cultivated biodiversity, etc.	<ul style="list-style-type: none"> <li>- Disclosure of the results of previous AHL trials.</li> <li>- Sharing of the advantages and disadvantages of wheat landraces for processing and cultivation.</li> <li>- Identification of barriers to upscaling.</li> <li>- <a href="https://lha.es/es/PUBLICACIONES/">https://lha.es/es/PUBLICACIONES/</a></li> </ul>
Meetings	AHL, Ecovalia, Red Andaluza de Semillas, Spiga Negra.		<ul style="list-style-type: none"> <li>- Coordination of work on this project.</li> <li>- Connections for collaborating in future projects.</li> <li>- Identification of barriers to upscaling.</li> <li>- Search for funding of future projects.</li> </ul>

## ELABORATION OF DISSEMINATION MATERIALS

Action	Actors involved	Addressees	Outcome
National and international congress	AHL	<ul style="list-style-type: none"> <li>- Researchers, associations, etc.,</li> <li>- Congress attendees.</li> </ul>	<ul style="list-style-type: none"> <li>- Internationalisation of the project and its results</li> <li>- Article in Congress proceedings: <a href="https://www.researchgate.net/publication/344775155_INSERTION_EN_LOS_SISTEMAS_AGROALIMENTARIOS_LOCALES_DE_BASE_AGROECOLOGICA_SALBA_DE_CULTIVARES_TRADICIONALES_DE_TRIGO_EN_ANDALUCIA">https://www.researchgate.net/publication/344775155_INSERTION_EN_LOS_SISTEMAS_AGROALIMENTARIOS_LOCALES_DE_BASE_AGROECOLOGICA_SALBA_DE_CULTIVARES_TRADICIONALES_DE_TRIGO_EN_ANDALUCIA</a>.</li> </ul>

## ELABORATION OF DISSEMINATION MATERIALS

Action	Actors involved	Addressees	Outcome
Article	AHL	Researchers	Article supporting wheat landraces, their benefits and the environmental services associated with them.
Fact sheets	- AHL, Ecovalia, Red Andaluza de Semillas	Producers, food processors and associations for the preservation of cultivated biodiversity.	- <a href="https://lha.es/es/DESCARGA/">https://lha.es/es/DESCARGA/</a> - <a href="https://redandaluzadesemillas.org/noticias/publicadas-fichas-de-6-variedades-locales-de-trigo">https://redandaluzadesemillas.org/noticias/publicadas-fichas-de-6-variedades-locales-de-trigo</a> - <a href="https://www.ecovalia.org/index.php/component/content/article/25-proyectos/408-cultivares-tradicionales-de-trigo?Itemid=216">https://www.ecovalia.org/index.php/component/content/article/25-proyectos/408-cultivares-tradicionales-de-trigo?Itemid=216</a>
Dissemination poster	AHL	Consumers of organic consumption entities.	Graphical materials for general public retail outlets.
Animated video	- AHL, Ecovalia, Red Andaluza de Semillas, Spiga Negra, La Artesa.	Consumers, processing companies, producers and other actors linked to crop diversity, as well as the general public.	<a href="https://lha.es/es/NOTICIA/#video-sobre-las-variedades-tradicionales-de-trigo">https://lha.es/es/NOTICIA/#video-sobre-las-variedades-tradicionales-de-trigo</a>
Documentary video	AHL, Horno La Artesa, Panadería Buenas Migas y Horno María Diezma.	Consumidores, empresas de transformación, productores y otros actores relacionados con la diversidad cultivada, así como público en general.	<a href="https://lha.es/es/NOTICIA/#video-con-las-manos-en-la-masa">https://lha.es/es/NOTICIA/#video-con-las-manos-en-la-masa</a>
Vídeos de apoyo a la transformación	LHA, Spiga Negra, Semillas Silvestres	Consumers, processing companies, producers and other actors related to crop diversity, as well as the general public.	- <a href="https://lha.es/es/NOTICIA/#spiga-negra">https://lha.es/es/NOTICIA/#spiga-negra</a> - <a href="https://lha.es/es/NOTICIA/#semillas-silvestres">https://lha.es/es/NOTICIA/#semillas-silvestres</a>
Alimentta News	AHL	Researchers and the public interested in sustainable food.	- <a href="https://alimentta.com/sabias-que-trigo-enfrentarnos-cambio-climatico/">https://alimentta.com/sabias-que-trigo-enfrentarnos-cambio-climatico/</a> - <a href="https://alimentta.com/sabias-que-trigo-disminuir-gluten/">https://alimentta.com/sabias-que-trigo-disminuir-gluten/</a>
Final report	AHL	National and international researchers.	Dissemination document that includes the main actions and findings of the transfer project. Initial document that serves as a basis for regional, state, international project calls, etc.

**Table 1.** Actions conducted during the project **Transfer of wheat landraces presenting high value-added niche market potential to the Andalusian agribusiness**, as well as the actors involved in its execution, its addressees and its most relevant outcomes.

The first steps were to disseminate the results of the trials that had previously been conducted by the AHL over the 2013-2016 period. In this way, we started with a solid rationale supporting the recovery of wheat landraces in Andalusian rainfed agricultural lands. The priority recipients of this information were farmers and those responsible for the transformation of grains into flour and semolina. Given the situation generated by COVID-19, the results were disseminated mainly through online dissemination events.

But first we conducted **telephone surveys**, in order to determine the extent of the interest of food processing companies. This allowed us to: a) collect information on whether these companies knew about wheat landraces and were currently using them; and b), gather their opinions on their potential success within the sector. The telephone surveys were also an opportunity to divulge the online dissemination events that would take place in the months following the surveys. The survey analysis led us to relevant conclusions on

how to move forward with the other project activities. Indeed, it shed light on certain barriers together with a lack of knowledge and/or experience that the project needed to take into account. The results and conclusions drawn from telephone surveys are briefly discussed further down.

Two editions of the **online dissemination events** were held, some in collaboration with *Ecovalia* and others with the *Red Andaluza de Semillas*. *Ecovalia* is the largest state-level organic sector association. Its participation ensured that the project would have a broad scope and impact, since it brings together a large mass of organic producers and food processing businesses, all potential future beneficiaries

of the project's outcomes. The organisation *Red Andaluza de Semillas* "Cultivating Biodiversity" (RAS) seeks to contribute to the recovery of local varieties and promote the collective management of cultivated biodiversity, as well as the promotion of agroecological food systems.

**JORNADAS online**  
24 sep 2020, 18h  
Inscripciones: <https://forms.gle/opadh6WKN4twBP8>

Andalucía se mueve con Europa

INVESTIGACIÓN  
+  
RECUPERACIÓN  
+  
TRANSFORMACIÓN  
+  
PERSPECTIVAS

**Investigando y recuperando conocimientos y experiencias de variedades tradicionales de trigo**

- Presentación: ¿Por qué son necesarias estas jornadas? *Ecovalia*
- Resultados de ensayos de variedades tradicionales andaluzas en agricultura ecológica: producción y calidad de grano *Investigadoras Universidad Pablo de Olavide*
- Experiencia en recuperación de variedades tradicionales *Red Andaluza de Semillas*
- Elaboración de pan y pasta con variedades tradicionales de trigo *La Artesa y Spiga Negra*

Financian:    *Consejería de Economía, Conocimiento, Empresas y Universidad*  *Red Andaluza de Semillas*

**15/10/2020**  
18h

JORNADAS online dentro de la **XVII FERIA ANDALUZA DE LA BIODIVERSIDAD AGRÍCOLA** Edición virtual

Inscripciones online: <https://forms.gle/Nq2ikaXgnWshd5F47>

Andalucía se mueve con Europa

**Variedades tradicionales de trigo, recuperando calidad en el campo y en la mesa**

- ¿Por qué es necesario el trabajo de recuperación de trigos locales? *Red Andaluza de Semillas*
- Resultados de ensayos de variedades tradicionales de Andalucía: producción y calidad de grano *Investigadoras Universidad Pablo de Olavide*
- Experiencia en recuperación de variedades tradicionales *Red Andaluza de Semillas*
- Elaboración de pan y pasta con variedades tradicionales de trigo *Horno María Diezma y Spiga Negra*

Financian:    *Consejería de Economía, Conocimiento, Empresas y Universidad*  *Red Andaluza de Semillas*

Figure 4. Posters of the online dissemination events carried out in collaboration with Ecovalia (left) and the Red Andaluza de Semillas (right).

The events were structured in three stages:

- 1) Results of the studies conducted by AHL.
- 2) The experiences of bakers and pasta makers with wheat landraces.
- 3) The farmers' work to recover wheat landraces in the field.

The objective of the conferences was to shape a common discourse based on the different perspectives. In this way, it would be possible to enhance and promote the use of wheat landraces by disseminating their benefits and the experiences of the participating food processing companies and producers. *Spiga Negra*, a semolina grinding mill and pasta factory, together with *La Artesa* and *Horno María Diezma*, pioneering organic bakeries in the use of wheat landraces, were responsible for presenting their agro-industrial processing experience with these varieties. The *Grupo de Acción Compartida* is a group of producers with extensive experience in Andalusia in the recovery of traditional herbaceous varieties and participatory crop improvement. This Group was responsible for transmitting their experience with wheat landraces in the field to the attendees. For their part, the attendees represented a broad spectrum of the wheat agri-food chain, including interested producers, bakers, members of organic agriculture and crop recovery groups and even staff from public institutions linked to agriculture (such as the Basque Institute for Agricultural Research or Spain's National Centre for Phytogenetic Resources).

In order to publicise the major agronomic performance descriptors and the varieties' flour-bakery qualities, **descriptive data sheets** were elaborated and made available to the interested public on different websites (see Table 1).

Throughout the project, a number of meetings were held with several objectives: to organise the online dissemination days; to establish common starting points to generate new project ideas; to determine the main barriers to the upscaling of wheat landra-

ces, etc. These meetings were held with social organisations such as *Ecovalia* or the *Red Andaluza de Semillas*; collaborating companies such as *Spiga Negra*, *Semillas Silvestres*, etc. and producers tasked with multiplying the traditional crop varieties.

To adapt the project's dissemination activity to new digital formats, we have produced several videos to further disseminate the project results. An [animated video](#) (Video 1) that describes the main benefits of wheat landraces, broadcast on different networks and digital channels (see Table 1).



**Video 1.** Variedades tradicionales de trigo. Recuperando la calidad y sostenibilidad para los secanos mediterráneos.



**Video 2.** Con las manos en la masa. Recuperando variedades antiguas andaluzas



**Video 3.** Spiga Negra. Pasta artesana y ecológica y el valor de las variedades tradicionales de trigo

To finish, we realised two videos in support of **two unique projects in the region** that address food processing ([Spiga Negra, Video 3](#)) and crop reproduction ([Semillas Silvestres, Video 4](#)).

Secondly, we produced a [video documentary](#) (Video 2) in collaboration with three Andalusian artisan bakeries experienced in the use traditional flour varieties (Horno La Artesa, in Arcos de la Frontera, Cádiz; Panadería Buenas Migas in Nigüelas, Granada; and Horno María Diezma in Benalúa de Guadix, Granada). The purpose was to publicise the socio-economic advantages and the main differentiating characteristics of wheat landraces compared to modern varieties, and thus contribute to divulging their value. To do this, it was essential to include master bakers with a long-standing experience in these varieties and who could convey their opinions, concerns and experiences. (Video 2).



**Video 4.** Semillas Silvestres. Conservando variedades autóctonas y tradicionales

The objective is to publicise the experiences and shared vision of the two major actors in the Andalusian food chain regarding the wheat landraces. Thanks to its audiovisual format, this material was

widely disseminated on websites (see Table 1) and social networks. It was also included in the teaching materials of 3 official master's degrees related to the agri-food system.



Figure 5. Informative poster with the main environmental and socioeconomic benefits of consuming wheat landraces.

Some materials were designed to have a direct impact on consumers. The work performed with bakeries interested in wheat landraces led to an **informative poster** that laid out the main environmental and socioeconomic benefits (Figure 5) of consuming wheat landraces that could be distributed to the different retail outlets. This way, we made it possible to transmit this information directly to consumers who were already appreciably informed.

Furthermore, we were able to collaborate with the newly created think tank for sustainable food, *Alimentta*, by editing the main findings and benefits

of wheat landraces in **news** format on its [website](#). In collaboration with this multidisciplinary group, whose objective is to promote sustainable food in Spain, we were able to reach a greater number of consumers and researchers, in a context of heightened awareness of the need to introduce sustainable and healthy products into the Spanish diet.

Regarding the **academic dissemination** of the results of the transfer project, we participated in the Eighth International Congress of Agroecology organised by the University of Vigo (1, 2 and 3 July 2020) and the VIII Congress of Agroecology of Montevi-

deo (Uruguay), set up by the Latin American Scientific Society of Agroecology (SOCLA) from 26-27 November 2020. In parallel, a **scientific paper** has been drawn up with detailed information on wheat landraces, their agronomic performance and benefits in the processing and elaboration for publication in JCR journals. It is currently in the draft phase.



## WHAT IS THE POTENTIAL OF INTRODUCING WHEAT LANDRACES FOR ANDALUSIAN AGRIBUSINESS?

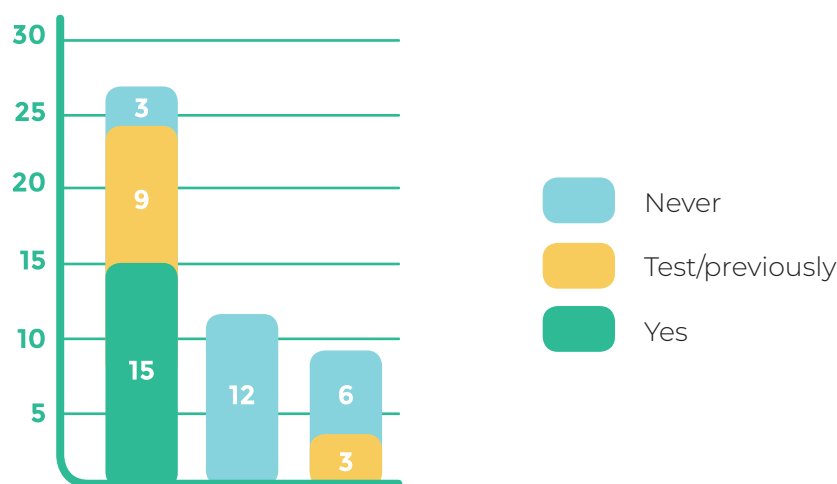
In this section, we describe the main conclusions of the telephone surveys conducted with managers in the Andalusian flour-bakery agribusiness, whether of companies with organic certification (companies registered in the SI-PEA –Information System of Andalusia’s Organic Production-) and without (com-

panies belonging to the AFHSE –Association of Flour and Semolina Manufacturers of Spain). They were briefly informed of the results obtained in the field experimentation carried out by the AHL on wheat landraces and the benefits related to their cultivation and consumption. They were then asked about their prior knowledge

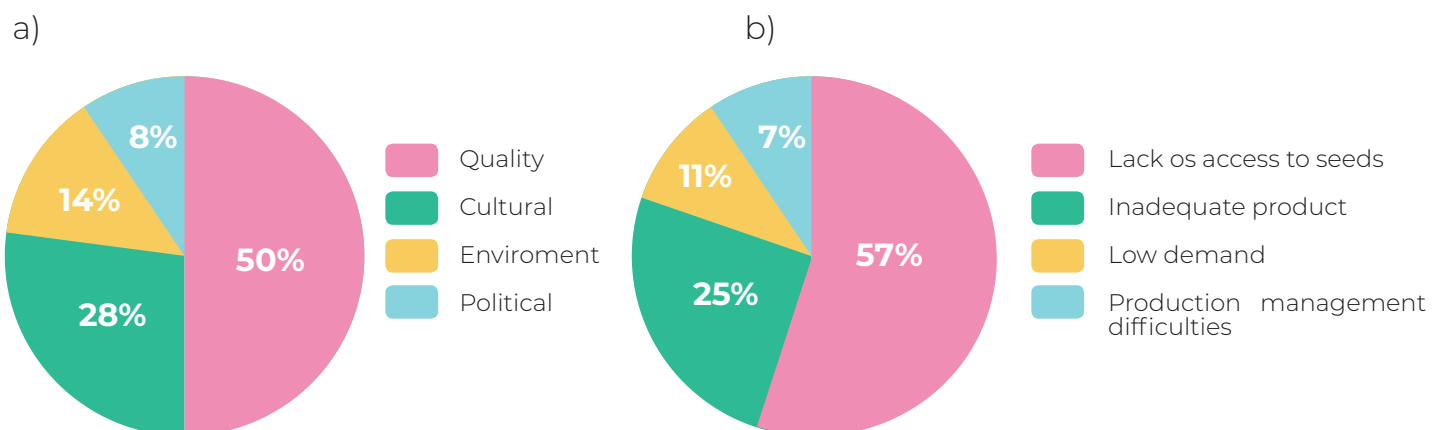


of these varieties, whether they used them, and their interest in incorporating them into their production chain. Based on these contacts with a large number of agribusiness companies, we were able to detect the knowledge, criteria and prejudices underlying the decisions of these agents around the use or non-use of wheat landraces.

There is generally a remarkable potential within agribusiness to recover wheat landraces, although we also identified significant barriers to an upscaling in the use of these varieties which means they are kept in the fringes of production. The processing and consumption of these varieties are also extremely scarce. A total of 48 companies answered the questionnaire, of which 27 knew what wheat landraces were, 12 did not know what we were referring to by wheat landraces, and 9 had some idea of what they were but still had some uncertainties. It was only within the group of people who said they knew what wheat landraces were, that we found a group of people who were currently using them (Figure 6).



**Figure 6.** Number of respondents who said they knew or did not know about the wheat landraces, showing the number of people currently using wheat landraces (in green), who never used them (in blue) or who tested or used them previously (in ocher).



**Figure 7.** Reasons for currently using or for having used them in the past (a) and reasons for not currently using the wheat landraces or for having stopped using them (b).

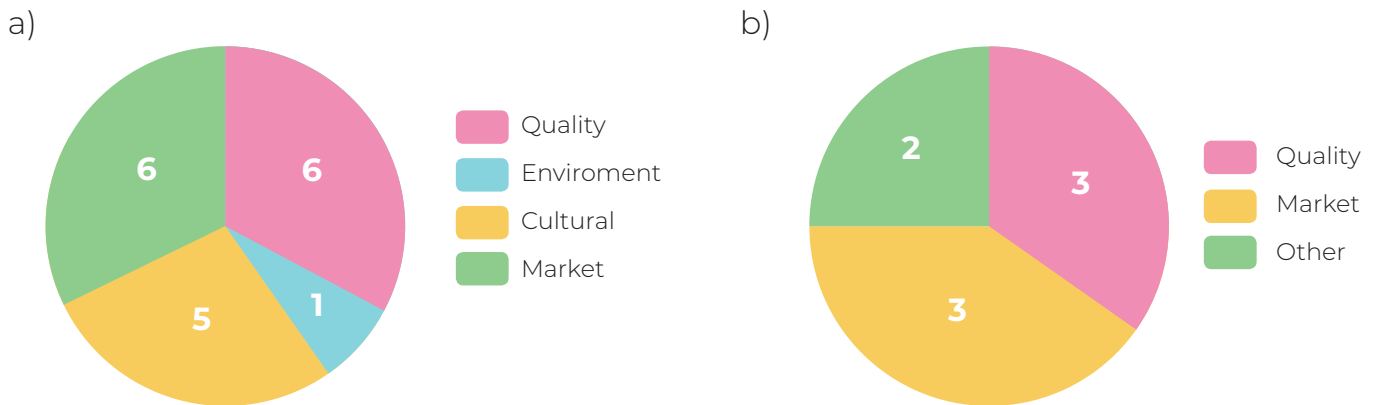
In total, 27 people said they used or had used wheat landraces. The reasons for using or having used them fell into 4 categories (Figure 7a):

- 1) **Quality**: the high quality of the flour or protein content of these varieties, organoleptic characteristics of the resulting bread, nutritional quality and health, etc. This criterion also included reasons for differentiating bread from traditional industrial bread varieties;
- 2) **Environmental**: concern for the recovery of lost crops, conservation of cultivated biodiversity, environmental concerns, local adaptation of crops, etc.
- 3) **Cultural**: local or indigenous varieties, the “memory” of bread consumed in the past, curiosity to work with another raw material, etc.
- 4) **Politicians**: non-transgenic varieties, food sovereignty, etc.

Conversely, the reasons for which companies never used them or had ceased to use them (Figure 7b), notably included:

- 1) **Crop inaccessibility**: unavailability of crops, small and unstable productions, higher price compared to other cultivars, lack of organic certification.
- 2) **Product inadequacy**: difficulty of working with the flours; lower quality of organic flours or poor quality of flours because they are a mixture of different varieties, due to the difficulty of harvesting traditional crops; unusual appearance of bread made with wheat landraces; or lack of difference with other flours that came from good raw materials.
- 3) **Lack of market demand** for wheat (due to the cereal’s poor reputation) generally, and lack of baker and consumer demand for these particular varieties.
- 4) **Difficulties in managing production**: Increasing the number of varieties in the production process leads to production management difficulties.

The survey also asked them for the reasons underlying their interest or lack of interest in using wheat landraces (Figure 8). The main positive motivations for using wheat landraces were as follow (Figure 8a):



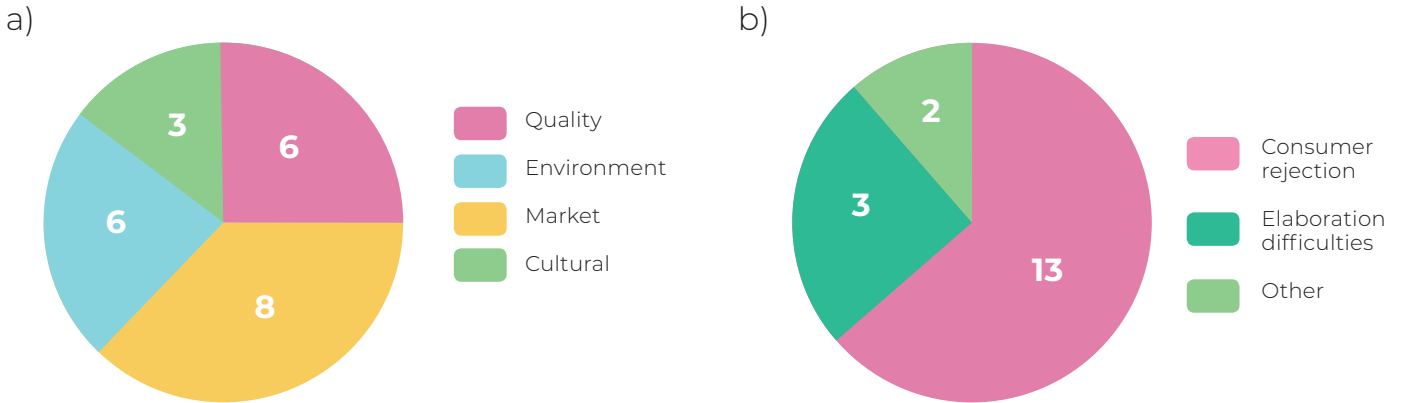
**Figure 8.** Reasons for being interested (a) or not (b) in using the wheat landraces.

- 1) **Quality:** Positive reactions included the quality of the resulting flour or protein, the taste of the bread, or health-related issues.
- 2) **Environment:** One person was interested in contributing to the recovery of wheat landraces.
- 3) **Cultural:** Cultural reasons ranged from the recovery of local products to personal or professional curiosity.
- 4) **Market:** Several people showed interest for reasons relating to the market: because tradition is fashionable, for the added value of these products, or advancing the condition of the acceptance of these wheat landraces.

The reasons for not being interested in using wheat landraces (Figure 8b) included:

- 1) **Quality:** Difficulties obtaining homogeneous flour and baking difficulties.
- 2) **Market:** Due to being more expensive and today's bad reputation of wheat products.
- 3) **Other:** Due to company closures or the making of gluten-free products.

Additional reasons respondents could not state with certainty whether they were interested or not included: a lack of awareness of the properties of wheat landraces and resulting products (3 people); the higher price (1); production complications due to diversification (1); or testing requirements (1).



**Figure 9.** Reasons for the success (a) or lack of success (b) of the wheat landraces, according to respondents' perceptions.

The motives underlying respondents' perceptions as to whether wheat landraces would be successful or not could be similarly categorised (Figure 9).

All the reasons for believing in their success were linked to market trends favourable to wheat landraces, whether due to their tangible, intangible or symbolic attributes. The motives could be grouped in the following way (Figure 9a):

- 1) **Quality:** Better quality and healthier products.
- 2) **Environment:** Reasons that appealed to consumers who were environmentally awareness.
- 3) **Market:** Success depends on good marketing strategies and the new product's differentiation in the market. The increase in the consumption of bread as a fashionable product or the growth of native product consumption were also mentioned in parallel.
- 4) **Cultural:** Some respondents valued this as a traditional product reminiscent of bread of the past.

The reasons for which respondents felt that wheat landraces would not succeed were as follow (Figure 9b):

- 2) **Low consumer acceptance:** different appearance or taste, more expensive, lack of knowledge of variety, presumed poor demand or low success of wheat in recent years, etc.
- 2) **Production problems:** lack of knowledge and experience in working with wheat landraces, priority given to the search for quality flours regardless of variety, etc.
- 3) **Others:** For example, two people were not sure of their stance regarding the potential success of the varieties.



## BEGINNINGS OF THE *TRIGO-LAB INNOVA* LIVING LABORATORY. GENERATING KEY NETWORKS FOR THE INTRODUCTION OF WHEAT LANDRACES INTO THE AGRI-FOOD CHAIN

A living lab can be defined as a form of multidisciplinary research based on participation, innovation and development. Participants are co-creators of innovation. Experiments in real-world scenarios, cocreation of knowledge, new technologies and concepts of sustainability, the circular economy and bottom-up approaches play a major role. A living lab or living laboratory can be understood as a research ecosystem where agents collaborate to find innovative solutions to different challenges or needs based on the cocreation of knowledge.

lar economy and new technologies. Based on the organisation and implementation of the first actions taken, links were established with other actors in the agri-food chain, as well as with associations related to the sector, which proved to be the starting point of the creation of this Living Laboratory. The main objective of *Trigo-Lab Innova* is to continue this project's work (the incorporation of wheat landraces into the wheat agri-food chain in Andalusia) via the cooperation of different actors. Each actor is involved in one phase or another of the wheat agri-food chain and is committed to the recovery of wheat landraces.

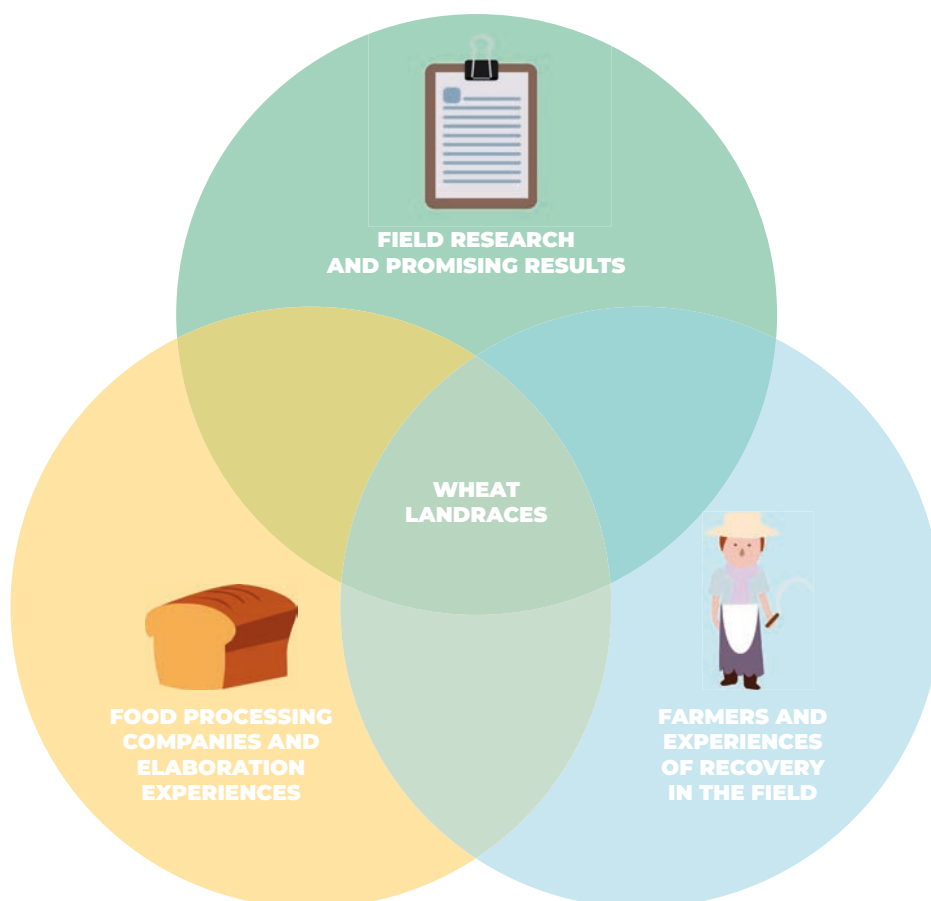
A Living Laboratory called *Trigo-Lab Innova* was gradually formed as the project unfolded on the basis of this new paradigm: co-creation, experimentation, innovation, use of local resources, sustainability, circu-

## How did Trigo Lab Innova start?

As mentioned above, the telephone surveys revealed that a number of companies were interested in wheat landraces and were thus motivated to attend the dissemination events. A notable outcome of the surveys was the importance of a prior connection between organic farming associations, and producers and/or food processing companies. Specifically, the *Red Andaluza de Semillas* showed that it had raised awareness among several

protagonists of the agri-food wheat chain, whether producers, food processing companies or consumers of these varieties. These connections made it easier for these actors to deepen their knowledge of these varieties, as well as to obtain small seed samples for cultivation and use in the making of their products. However, to upscale and consolidate the inclusion of wheat landraces, it was necessary to generate broader networks and

meeting points to share information about these varieties and their relevance. The ultimate goal being to achieve a greater number of bakers, flour makers and farmers interested in recovering wheat landraces. And it is in this spirit that we have been building the Living Laboratory, one step at a time.



**Figure 10.** The integrative approach of the dissemination events was the first step towards the consolidation of the Living Lab.

It was during the initial transfer project activities that the relationships between the entities in the Living Laboratory began to take root. We adopted a bottom-up approach i.e. we allowed the problems and their possible solutions to emerge from the different actors involved. This way, despite the difficulties of virtual communications, we found a common point from which to start with other actors in the agri-food chain: the benefits of wheat landraces should encourage working with them, regardless of any barriers relating to the scale of their cultivation and consumption.

The online events were a key step forward in approaching producers and agribusiness. The bottom-up rationale and the contacts and debates generated during the online activities were decisive in the creation of the *Trigo-Lab Innova* Living Lab. Using the platforms for open debate and reflection put at their disposal, farmers and food manufacturers set out their shared interests, as well as the potential to initiate collabora-

tions pursuing the same goals as those of the transfer project: reintroducing wheat landraces into the Andalusian agri-food chain.

During the meetings to organise the events, we consolidated our connection with *Ecovalia*, an association with which we already collaborated to teach the Master's Degree in Organic Agriculture and Livestock, directed by the AHL. Together with *Ecovalia*, we incorporated more entities interested in the *Trigo-Lab Innova* Living Lab. For example, this link made it possible to incorporate the company *La Espelta y La Sal*, a partner company of *Ecovalia*. *La Espelta y La Sal* undertakes the stages of cereal production and processing. It disposes of an extensive network of short marketing channels through which they can reach a large number of consumers.

## First developments of *Trigo-Lab Innova*.

The first phase to be covered in *Trigo-Lab Innova* was the **multiplication of seeds of the wheat landraces** of the project and to increase their availability for the following years. Two farmers who attended the conferences and were interested in planting old cereals (Ana Gavilán and Ángela Portero) eventually undertook the task of reproducing wheat landraces. Both offered pieces of their lands to plant the seeds. Their responsibility within the group involves

the sowing, monitoring and the harvest of wheat landraces.

Similarly, *Alqata*, a company dedicated to organic agriculture consulting, attended the events and expressed interest in supporting one of the plots with its technical follow-up. It was during this phase of seed multiplication and grain cleaning and quality process that *Semillas Silvestres* (a producer of organic seeds) was incorporated

into the group due to its previous relationship with *Spiga Negra*.

The online events also gave rise to the **incorporation into the Living Laboratory of companies dedicated to agro-industrial wheat processing**. Both *Spiga Negra* and *Horno María Diezma* had taken part as speakers in the conferences but decided to participate in the Living Laboratory and to contribute their long-standing experience

in testing and using wheat landraces. In addition, as in the case of *Ecovalia*, both entities had previously collaborated with AHL in teaching the Master degrees led by the group. The *Povedano y Ruiz* flour mill had already showed intense interest in fieldwork with the AHL wheat landraces during the telephone survey and was therefore among the companies that attended the online conferences. Their extensive interest and prior links to *Alqata* led

to their collaboration with *Trigo-Lab Innova*, sharing their milling experience in the grinding of wheat landraces grain. In short, the inclusion of these three entities in *Trigo-Lab Innova* (along with the presence of the *La Espelta y la Sal* mentioned above) made it possible to encompass both flour-bakery and semolina processing, as well as subsequent pasta making.

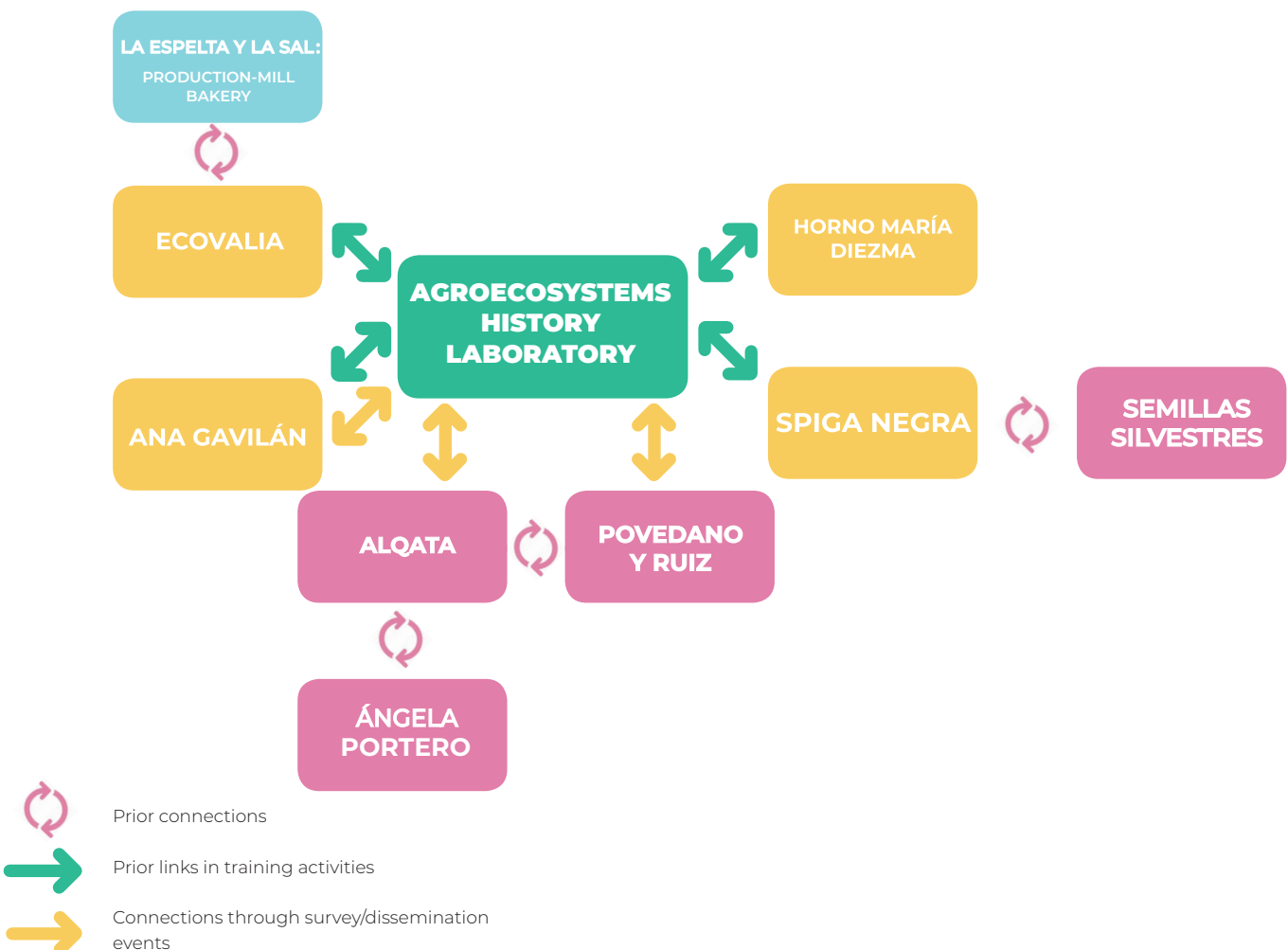


Figure 11. Diagram of the connections between the different entities that make up the operating group.



Thanks to the collaboration of the *Grupo de Acción Compartida* in the conferences, we were able to jointly edit a [recipe book](#). The bread recipes came from Andalusian bakers who had tested traditional flour varieties. Some of the recipe book's contributors are bakeries with ties to the *Grupo de Acción Compartida*, while the bakeries *Panadería Buenas Migas*, *Horno María Diezma*, and *La Artesa* had prior links with AHL projects.

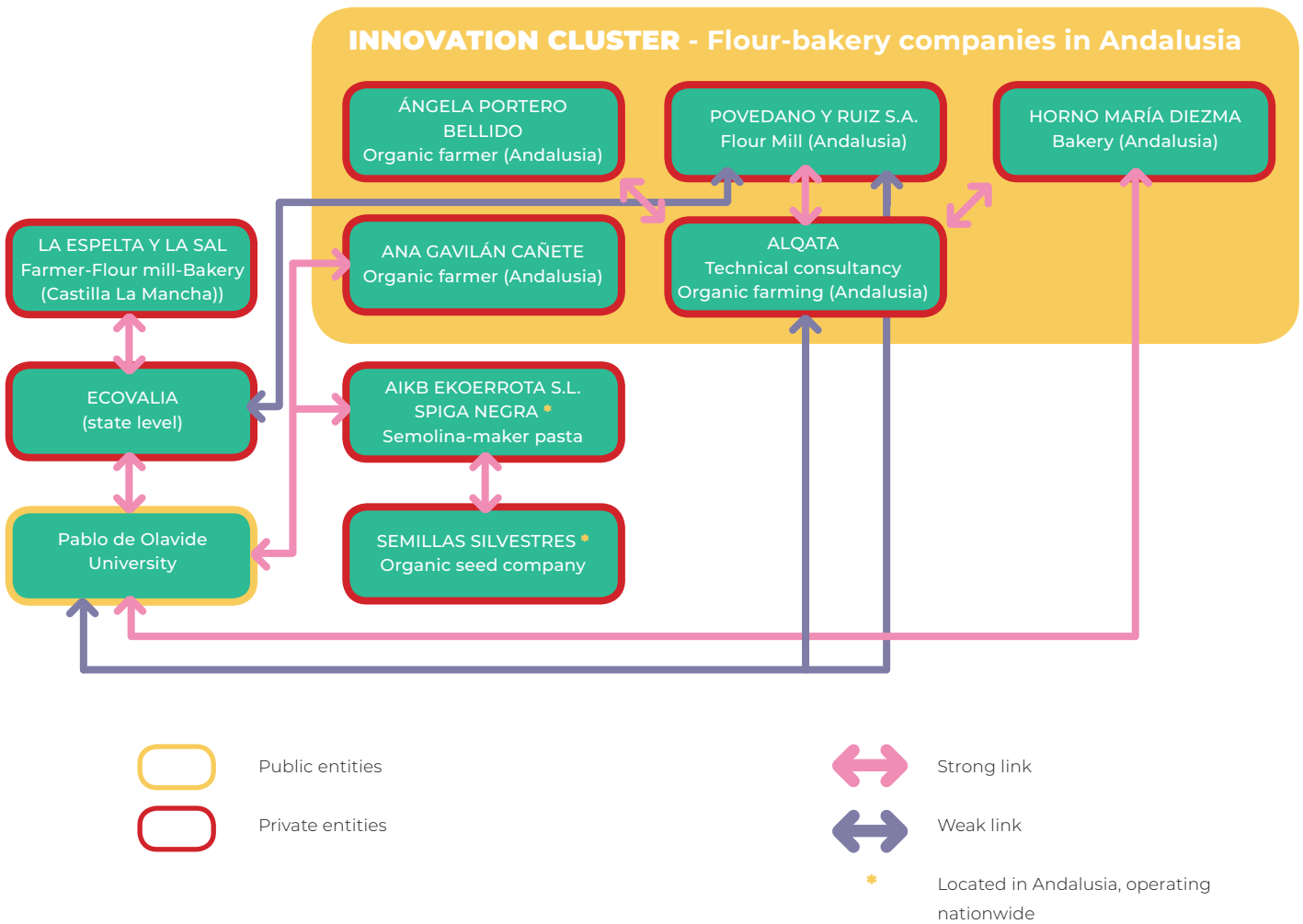
To conclude, the conferences triggered the grouping of entities with a common objective and thanks to the events, a major collective research and work group began to be consolidated.

## What are the respective roles of the Living Laboratory's participants?

Living Laboratories involve the collaboration of public and private actors to co-create knowledge and lead initiatives (business, regulatory actions, etc.) that drive environmental, sociocultural and economic improvements in the community. Living Labs are about doing Citizen Science in order to solve problems that affect all stakeholders and in the present case: from seed to table. The participants of *Trigo-Lab Innova* cover all stages in the agri-food chain, from the multiplying of wheat seeds to the selling to consumers through short food distribution channels (ordinates axis, Figure 12). In this way, innovations taking place along the chain (regarding genetic material, production and processing of grain into flour and semolina, and the elaboration of the end product) are evaluated by all actors: from the company that reproduces and cleans

the seeds, to the farmers who replicate the grain, to the flour and semolina manufacturers, bread and pasta makers, and, lastly, to the consumers via surveys and product tests.

Finally, to ensure the coordination within the Living Laboratory and to strengthen training and its capacity for methodological and technological innovation, the AHL, *Ecovalia* and *Alqata* company all support the process by sharing their organisational, research and training experience with all the members (Figure 12).



**Figure 12.** Diagram of the links and functions of the different members of the Living Laboratory.

## What obstacles prevent the upscaling of wheat landraces?

An outcome of the knowledge cocreation led by *Trigo-Lab Innova* was the identification of the main barriers to the upscaling of wheat landraces and to their growth within our diet. The barriers were determined as follow:

### • In production

- A major obstacle to the use of wheat landraces is **the difficulty faced by agribusinesses to acquire them**. This factor is in turn closely linked to the **unavailability of seeds** for the farmers who are interested in them or even to the lack of certification of the few that are available. In both cases, both the Spanish legislation governing the certification and registration of new plant varieties -which penalise landraces via the registration criteria- and the legislation applicable to organic agriculture -which makes the use of registered varieties compulsory- prevent and hinder the use and recovery of this genetic heritage. Solving this problem is essential in order to enhance the value of landraces.

- **Lack of specialised agricultural machinery** for planting and harvesting plots that are smaller than the large areas of land normally used for cereal cultivation. In the case of harvesting, for example, the lack of adapted machinery may cause the collected crop to be mixed with other

crops, which can lead to lower and/or variable flour quality.

- **Lack of companies specialised in the recovery of traditional seeds**, providing services of grain quality control and cleaning, responsible for ensuring the conservation of genetic material and avoiding the contamination and mixing with other varieties.

- **Annual production instability**, having not ensured a minimum of traditional grain crop surface area. To some extent, this prevents the elaboration of products based on these traditional flours, since it is impossible to guarantee a constant supply to meet retail demands.

## • In processing

- There is a **certain lack of knowledge around the wheat landraces within Andalusia's bakery and flour industry**, coupled with extensive confusion. Although many people could identify characteristics of landraces, they were often associated with ancestral wheats. This leads us to prioritise the dissemination of basic information about these cultivars (such as the results obtained in our field research), and their differentiation from the products that have recently spread on the market, such as "old wheats" or "ancestral wheats". This need is even more pressing when one considers the influence of highly marketed registered products (such as kamut). Indeed, they are regarded in the sector as traditional, presenting all the characteristics associated with "traditional", even though their origin or age are not entirely clear. And they are not local either. They are not required to be adapted to Mediterranean agri-environmental conditions, nor, therefore, to present adaptive advantages in this context. The differentiation and value of wheat landraces should take into account the existence and growth of these products in recent years in order to ensure their differentiation and success in the market. In addition, the reasons for rejecting these varieties and believing in their hypothetical lack of success on the market included factors that seemed largely due to prejudice. This makes it even more necessary to disseminate the bene-

fits and positive aspects of these varieties, helping agribusiness to manage adequate and accurate information regarding wheat landraces.

- The **lower gluten content** of wheat landraces means that the kneading process differs from the widespread work generally performed today with conventional flour doughs. These new features highlight **the need to experiment and research the products developed from these wheat landraces**, as well as the lack of adequacy of the quality criteria and thresholds dictated by industry when characterising these flour varieties. The required processing modifications mentioned by the major actors throughout the project include: increasing fermentation times; greater fermentation control (both in terms of temperature and dough rising) or the use of softer kneading.

- A great difficulty at this stage is **the need for large quantities of flour to perform tests** so as to optimise the processing and the end product. This implies that the small amounts of grain obtained from field trials are insufficient to introduce the variety into the production chain of the companies concerned. Ultimately, this means that large investments are required from the very beginning.

- The constant reduction in the number of flour mills in recent decades and the **sector's concentration** in large companies that take over the market, make it difficult for small and medium-sized enterprises to start up. In addition, concentration favours long-distance trading and speculation in necessity goods markets. In short, small and medium-sized initiatives are negatively affected, but these entities are precisely the ones that tend to maintain an interest in innovation, the recovery of wheat landraces and artisanal or traditional ways of working the end product.

## • In consumption

- Generally, **the decline in demand** for wheat-based products results from their poorer reputation in recent years, due to increases in gluten intolerance and sensitivity in the population.

- The **high price** of the end product, which derives from the difficulties in the previous stages of the chain, lowers the appeal of products based on these varieties.

- **Lack of knowledge** of the existence of a specific genetic heritage or the role of consumption in their preservation prevents consumers from recognising the intangible value of buying products made from wheat landraces.

- As mentioned above, the proliferation of highly marketed and **publicised products described as “made with old wheats”** contributes to consumers confusing them with varieties traditionally grown in the region. This is a major obstacle to growth in the traditional variety market, as old wheats ultimately grab consumers' attention. They cannot differentiate them from wheat landraces without being suitably informed.

- Succeeding in making **consumers understand the benefits** of wheat landraces for the upscaling of these varieties is a major challenge. Indeed, the advantages constitute a key and unique value, allowing to differentiate old varieties from

the varieties currently on the market. The surveys conducted with agribusinesses revealed the positive reception of the idea of added value and improving the product's market position through differentiation. Attributes such as product quality, nutritional and health benefits and local origin were also worthy of note.

In short, it is necessary to influence all levels of the wheat agri-food chain to recover wheat landraces. In addition, the major actors in the food chain must dispose of substantiated and clear information about the products they are growing and consuming to decide which ones they should support and which not. This information should concern environmental, human health and economic factors.

Finally, we concluded that **institutional support, via public policies**, for the recovery of wheat landraces during the food processing should focus on the following: regulations or schemes that facilitate the registration and availability of seeds; support for research on the baking process; or the dissemination of the benefits (both environmental and for human health) of the products made with these varieties.

## Technological innovation at the service of wheat landraces

Many barriers to the upscaling make it essential to innovate within the flour and semolina sector to include wheat landraces. Technological innovation must take place both at the production stage—with machinery adapted to the planting and harvesting, adequate knowledge and ensured access to the seeds—and in the later processing stages. First, (both soft wheat and durum wheat) milling companies must be able to make all the necessary adaptations to the machinery so that they may, above all, adapt to smaller

quantities of grain to mill and the novel characteristics of the old grain varieties. Secondly, bread and pasta workers must also dispose of the machinery adapted to the rheological characteristics of the doughs resulting from the grinding of wheat landraces.

Support and research regarding this technological innovation should be a priority, both for public research entities and for the various state institutions with responsibilities in the recovery.



## TRIGO-LAB INNOVA BECOMES AN OPERATIONAL GROUP

A major step of the Living Laboratory was its establishment as an Operational Group. This was done to respond to the October 2020 call for subsidies for the implementation of innovative projects of general interest by the European innovation Partnership for agricultural productivity and Sustainability (AEI-Agri) of the Ministry of Agriculture, Fisheries and Food. The diversity of the entities in the Operational Group offers the opportunity to bring together different fields, experiences and formats and to introduce wheat landraces, together with their associated genetic material diversity, into the organic agri-food chain. The goal is to make improvements regarding: the environment (carbon sequestration and promotion of wild biodiversity); agronomics (soil improvement and more efficient use of water in rainfed agricultural lands); economy (a higher income for farmers and increased added value in the agri-food chain); society (greater production resilience against climate change); health (lower gluten contents); and culture (fostering gastronomy with differentiated and local foods).

We list below the Living Laboratory entities that form the Operational Group, together with their respective functions and main contributions within the group.

### • In formal research

The Agroecosystems History Laboratory Research Group represents a research pillar of a formal nature, conducted at the university. It has extensive experience in research projects related to agricultural sustainability from a historical perspective. The group members manage two official Master's Degrees (Official Master's Degree in Organic Agriculture and Livestock and Official Master's Degree in Agroecology: an Approach to Rural Sustainability) and the connections made through them with certain companies and organisations could be used and strengthened via the

establishment of the Living Laboratory. The AHL researchers who requested this Transfer Project were joined by [Jacob van Etten](#) of Bioersity International. Van Etten is a [member of the AHL](#) and facilitated the incorporation of new information technologies into the evaluation of landraces "from field to table" in the Operational Group (see the section "A commitment to Citizen Science").

## • In production

This phase included farmers who sow wheat landraces and are monitoring cultivated land. *Alqata*, a company that gives advice on organic agriculture and monitors one of the plots, and *Semillas Silvestres*, responsible for crop multiplication and quality control, are the two companies part of the Living Laboratory who are fulfilling this task in this phase.



**Figure 13.** Pictures of the plots located in Montilla, Cordoba.





**Figure 14.** Pictures and location of the plots located in Villanueva de Córdoba.

Concretely, [Semillas Silvestres](#) is an organic certified company that centres on the reproduction of local species and varieties. Its participation is essential as it offers the

specific technology needed for the collection, cleaning, selection and analysis of small batches of native/local seeds. This enterprise is among the few Spanish companies

that ensures the reproduction of clean seeds following high quality standards.



**Figure 15.** Wheat landraces planted in plots of lands of Semillas Silvestres in Santa Cruz, Córdoba.

## • In processing

At this stage, the major players are the companies dedicated to agro-industrial processing.

[\*Spiga Negra\*](#) represents the manufacturing phase of durum wheat semolina and the production of organic pasta as an end product. Its contribution thus stands out in the intermediate and final food processing phase. *Spiga Negra* is a pioneer in the organic cereal sector: it is the only business project in Spain that produces pasta from semolina that it manufactures itself. The company's participation in this grouping is thus essential and irreplaceable. In addition, it has long-standing experience working with organic producers to obtain grain from wheat landraces and to introduce their derived products into their product lines.

[\*Horno María Diezma\*](#) addresses technological innovation at the stage of bakery flour processing. This partner is in turn

part of numerous alternative commercial organic food channels in Andalusia, which facilitate access to organic consumers and the dissemination of the benefits of wheat landraces.

[\*La Espelta y la Sal\*](#) is a highly innovative company in Castilla-La Mancha. It covers all the stages of production, offering services of grain production, flour manufacturing, baker product elaboration and final sale to consumers. This partner also has a long history of collaborating in research projects with notable institutions, such as CSIC. This member thus has extensive experience both with the connections between research and business innovation (cocreation of knowledge) and in the field of organic production and processing. Like the *Horno María de Diezma*, it takes part in short organic food sale channels, which facilitates the dissemination of the resulting products among consumers.

The flour company *Povedano y Ruiz* has many years of experience in the milling of soft wheat. Its role within the group is to receive and clean the grain, and to grind it using a stone mill. During these years, the company has innovated its facilities and products. The company has consistently kept up with the latest developments or market trends. It has previously worked with wheat landraces and is in contact with the producers involved in the project

in Andalusia. Locally, the company is notably among the few flour mills left in Andalusia, making it a regional pioneer in the processing of traditional flour varieties.

### • In the group’s cohesion and coordination

*Ecovalia* has extensive experience in the management and execution of nationwide and international projects, as well as a long history in the generation of technical reports and dissemination material specialised in the sector. In addition, the Operational Group foresees the establishment of a Network of Experimental Farmers in wheat landraces formed by partner cereal farmers of *Ecovalia*, who would be responsible for evaluating 9 wheat landraces based on various crop banks through the digital platform *ClimMob* (see section below). *Ecovalia*'s participation gives the project a broad scope and impact, by coordinating a large mass of organic producers and food processing companies as potential future beneficiaries of the project’s results.



Figure 16. Profiles and stage at which the different entities that make up the Operating Group come into play.

## A commitment to Citizen Science

In order to complete the group's multidisciplinary profile and to thus respond to the ministerial call for grants to Operational Groups, one of the collaborating members of the AHL, Jacob van Etten, designer of the digital citizen science platform (<https://climmob.net>) joined the Living Laboratory. Thanks to this incorporation, a key pillar of Trigo-Lab Innova was the active participation of consumers and producers in the selection of the most suitable end products and varieties, respectively. The ClimMob digital tool allows to evaluate different products and processes through a mobile application, thus strengthening the model

of active participation in knowledge generation within the Living Laboratory and ensuring statistical and empirical robustness (thanks to a wide range of environments). The proposal was based on the participatory evaluation through ClimMob of:

- 1) The agronomic performance of wheat landraces taken from the INIA germplasm bank (National Institute of Agrarian Research) by a network of producers, partners of *Ecovalia* (Experimental Farm Network).
- 2) the organoleptic quality of products made with wheat landraces obtained from the AHL trials in the processing entities of the

Living Laboratory. The assessment of the organoleptic quality is made by a consumer network and contacts with these consumers would be facilitated by the participation of the Living Laboratory's processing companies in short marketing channels.

This innovative approach made a major methodological and technological contribution to the Operational Group's proposal, enhancing the cocreation of knowledge and incorporating ICTs into experimental design and evaluation in such a way that farmers and consumers massively participate in the innovation process.

## What is the next step?

We were not granted the funding despite obtaining a good rating in the call's results and despite the approval of the Operational Group's submitted project. The structure and links of the Living Laboratory are consolidated, so our future steps depend on receiving the necessary funding to pursue the processes currently underway and to strengthen the presence of these cultivars in the Andalusian agri-food chain.



**UNIÓN EUROPEA**  
Fondo Europeo de Desarrollo Regional

Este informe ha sido realizado con financiación de la Consejería de Economía, Conocimiento, Empresas y Universidad de la Junta de Andalucía con cargo al Programa Operativo FEDER de Andalucía 2014-2020, dentro del Objetivo Específico 1.2.2. «Transferencia de conocimiento y cooperación entre empresas y centros de investigación» y de la programación financiera de la medida A1122062E0 «Transferencia de tecnología y cooperación entre universidades y empresas, principalmente en beneficio de las PYME». El porcentaje de ayuda aportada por dicho fondo es de un 80%.

