The Green Link Project

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Summary

Ecosystem services are defined as direct or indirect benefits provided by ecosystems to human communities. According to the MEA (2005), these can be classified in provisioning services. The current state of ecosystems conditions the provision of such services and these, in turn, modify their capacity to support human well-being. In this context, one aim of The LIFE 'The Green Link' project was to assess the social perception of current and potential ecosystem services (ES) in each demonstration area by surveying the different stakeholders before and after the planting process, thus, obtaining a general perception of the capacity of the areas to provide ES, determining preferences, importance and vulnerability in those ES and analyzing the crops that generate the greatest benefits for the well-being of the local communities.

We carried out the same social sampling regarding the ecosystem services provided across six semi-arid sites in the Mediterranean basin: Calabria in Italy, Ptolemais in Greece, and Catalonia, Valencia, Almeria and Gran Canaria for Spain. We found a positive change in ES perceptions and the areas capacity to provide them, being considered agriculture production and erosion control as the most important services and climate regulation and freshwater supply as those services associated with public concern. The crop identified as the most beneficial to locals and their wellbeing, possibly due to its millenary use throughout the arid Mediterranean, was the olive tree (a common variety and endemic to the Canary Islands), followed by the almond tree and the Macedonian oak.

We also found that preferences for particular ecosystem services were influenced by their capacity to support components of human well-being. In general, provisioning services were strongly related to the capacity of obtaining basic materials for life, regulating services to the maintenance of safety and health, and cultural services to good social relations.

We conclude that the application of the socio-cultural assessment of ecosystem services into ecological restoration programs result in a critical step for the success of land management strategies due to it connects with human wellbeing indicators and integrates the views and preferences of both public, land owners and ecosystem services beneficiaries.

Keywords: climate change, stakeholders, social perception, restoration.

1. Introduction

Ecosystem services are defined as direct or indirect benefits provided by ecosystems to human communities. According to the MEA (2005), these can be classified into three categories: provisioning services, which are those direct contributions that we obtain from ecosystems; regulating services, being those indirect benefits resulting from the functions and processes of the natural system; and cultural services as those intangible benefits that humans obtain through interaction with nature. The current state of ecosystems conditions the provision of such services and these, in turn, modify their capacity to support human well-being.

Mediterranean ecosystems are highly susceptible to climate events generated by global change, which makes them vulnerable and prone to the loss of ecosystem services (Quintas-Soriano et al., 2014). Ecological restoration is positioned as a vitally important tool for reducing the vulnerability of these ecosystems so that they can continue to sustain the well-being of local communities (Harris et al., 2006). In this contexts, the main aim of The LIFE 'The Green Link' project is to test an innovative planting method, through seven trials in three Mediterranean countries affected by desertification, based on the use of the Cocoon. Also aims to assess the social perception of current and potential ecosystem services (ES) in each demonstration area by surveying the different stakeholders before and after the planting process, thus, obtaining a general perception of the capacity of the areas to provide ES, determining preferences, importance and vulnerability in those ES and analyzing the crops that generate the greatest benefits for the well-being of the local communities.

2. Study areas

The Green Link project was located in 3 countries: Spain, Italy and Greece. Spain has 5 demonstration areas located in Bruc (Catalonia), Jijona and Tous (Valencia), Sierra Maria-Los Velez (Almeria) and Tifaracás (Gran Canaria); while Italy and Greece have only one study area, located in Calabria and Ptolemais respectively.

El Bruc (Catalonia, Spain)

This area is located in the province of Barcelona, in the municipality of El Bruc. It has a total surface of 700 ha covered by forest or privately-owned crops. Spread over this zone, 6 different sub-areas of plantation were performed.

Jijona and Tous (Valencia, Spain)

In Valencia there are two sites of plantations. The first one is in the municipality of Tous, province of Valencia. It has an area of 5 ha owned by Valencian Government, occupied by Mediterranean forests and pastures. The other planting area is located in the Municipality of Jijona, 25 km north of the city of Alicante. It has an area of 4 ha. This region is well known for the extensive almond tree plantations. However, over time, agricultural lands have been abandoned and degraded.

Sierra Maria-Los Velez (Almeria, Spain)

The fourth planting area is located in the province of Almeria. The restoration site is located on a private plot located on a ravine within Sierra Maria - Los Velez Natural Park, in the municipality of Chirivel. It occupies an area of 10 ha and the challenges of this trial were to improve the connectivity between the green surfaces of the neighbour areas, to introduce different ecological almonds trees.

Tifaracás (Gran Canaria, Spain)

The plantation area is located is shared by two Environmental Protected Areas, the Rural Park "Parque Rural El Nublo " and a Natura Park "Parque Natural de Tamadaba", sites included in the Gran Canaria Biosphere Reserve and the european Natura 2000 network. The plantation covers area surface of 12 ha owned by the Cabildo de Gran Canaria.

San Marco Argentano (Calabria, Italy)

San Marco Argentano is a municipality in the province of Cosenza, located in the Italian region of Calabria. In this rural region, agriculture stand for the basis of the economy. Because of the frequent droughts and floods, and the growing negative human influence on the territory, the area has suffered abandonment of farmland, causing soil degradation. In addition, high rainfall have caused water erosion to catalyse a desertification process.

Ptolemais (Macedonia, Greece)

The last planting area is in Greece, in Ptolemaida area, which is part of the Municipality of Eordaia. It has a surface area of 10 ha owned by Public Power Corporation, the largest electricity company in Greece partially controlled by the government. This area was a lignite mine, currently abandoned after the cessation of coal extraction.

3. Methods

Stakeholders identification

For each study area, different groups of stakeholders were identified, according to the restoration objectives and the scope of the project. these stakeholders were classified into two categories, primary and secondary.

Social sampling

In each of the study areas, face-to-face surveys were conducted before and after the restoration. A minimum number of 20 surveys per area and per phase were established. The pre-plantation surveys were conducted during the months of July-September 2017 and post-plantation surveys were conducted during the months of July-November 2019 (Castro et al., 2011).

Questionnaire design

The questionnaire is composed of four main sections. The section A named "ecosystem services free listing", in which the different actors determined the capacity of the study area to provide benefits, they freely described different types of ecosystem benefits or services and identified wellbeing components associated with those benefits. In Section B "contributions/benefits panel", through a panel sought they determine the preference,

importance, and vulnerability of 15 previously established ecosystem services. In section C "species cultivated perception", respondents determine their perceptions and preferences about traditional crops in the area. Finally, in section D, socio-economic information was collected that would help explain the perceptions and preferences of the respondents (Castro et al., 2016).

Survey analysis

Qualitative and quantitative analyses of survey results were conducted for each of the areas. Differences in perceptions and preferences about ecosystem services and crop species before and after the restoration process were determined, and results from all areas were compared.

4. Results

The results obtained for each area are shown below, starting with an analysis of the change in social perception of the capacity of the study areas to provide benefits. The following compares the ecosystem services identified before and after planting. Thirdly, an analysis of the importance and vulnerability of ecosystem services and finally a synthesis of the most important crop species for the stakeholders:

Sierra Maria-Los Velez (Almeria, Spain)

In the second consultation phase, stakeholders perceived an increase in the area's capacity to provide benefits or ecosystem services to people, about 95% of respondents identified the site as beneficial or very beneficial, while in the first phase only 45% of respondents did so. Concerning the benefits described by locals freely converting to ecosystem services, agriculture was the service most often identified. However, in the post-planting phase, a greater variety of services were perceived that did not appear in the previous phase, such as aesthetic appreciation, air purification, and climate regulation.
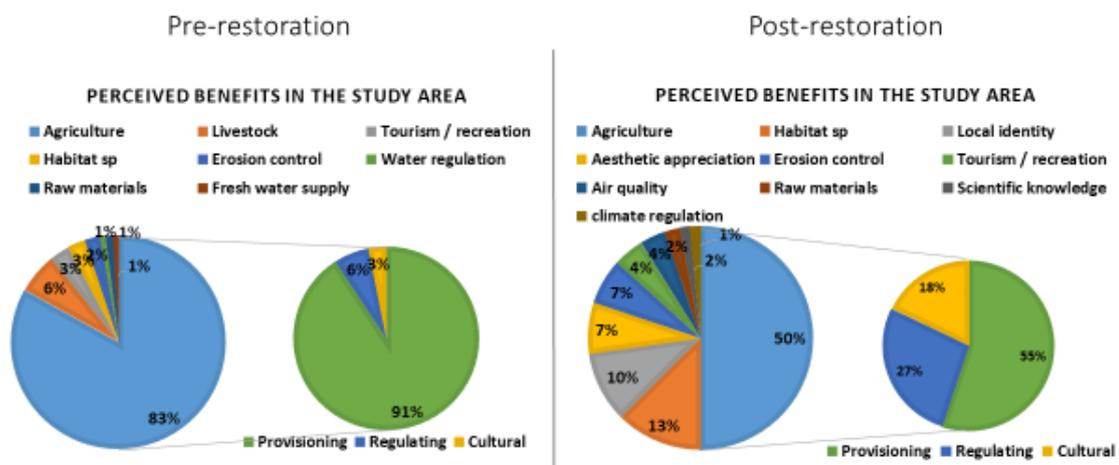

Figure 1. Perceived awareness of Almeria study area ecosystem services pre and post restoration

When comparing these results with the ecosystem service panel (section B), agriculture continues to be the most important service during the two phases, presenting a low vulnerability in terms of being perceived as a service that has increased in the last 10

years. Another interesting service in the area is erosion control, which is perceived as important for the locals and its vulnerability decreases during the second phase, going from being considered a decreasing service to a service that has increased with the development of the project. Thirdly, the fresh water supply service continues to be a concern for the region, which is considered the most vulnerable by the different actors.

Finally, in terms of the perception of the crops, the almond tree is the most important crop and the one that generates the greatest contribution to the well-being of the locals, which shows a specific preference for the cultivation of ecological varieties of almond trees.

El Bruc (Catalonia, Spain)

In the Bruc area, the overall perception of the area's capacity to provide benefits to people increased positively. It went from 71% of respondents who identified it as a beneficial or very beneficial region to 91% in the second phase. Concerning the benefits described by locals freely and categorized as ecosystem services, aesthetic appreciation was the most identified service.
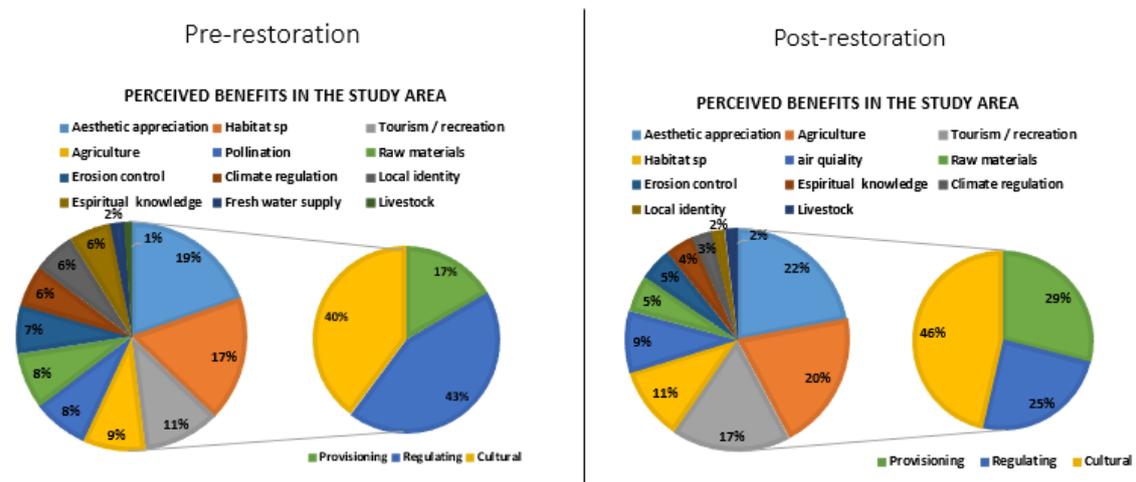

Figure 2. Perceived awareness of Catalonia study area ecosystem services pre and post restoration

In general, a wide variety of services were identified during the two phases, most of them being cultural (aesthetic appreciation) and regulating (species habitat) for the first phase, and in the second phase, provisioning services take on a greater role with agriculture, but it is still the cultural ones that are mostly perceived.

By relating these results to the ecosystem services panel (section B), agriculture and climate regulation become the most important services during the two phases. However, while agriculture decreases its vulnerability, becoming a growing state, climate regulation increases it, being perceived as a decreasing service during the last 10 years. Another interesting service in the area is pollination, which is perceived as important for locals, but its vulnerability is high during both phases, indicating a concern in the region about the state of this service in recent years.

Finally, in terms of the perception of the crops, the olive grove is the most important crop and the one that generates the greatest contribution to the well-being of the locals, especially in terms of job opportunities.

Ptolemais (Macedonia, Greece)

For the Ptolemais area, the perception of the area's capacity to provide ecosystem services also presented a positive change. In the second phase, about 75% of the respondents identified the site as beneficial or very beneficial, while in the first phase only 26% of the respondents did so. In general, regulation services were the most identified during the two phases, especially the climate regulation service. Another important service is agriculture, which loses importance during the post-crop period, being replaced by services such as species habitat and aesthetic appreciation.
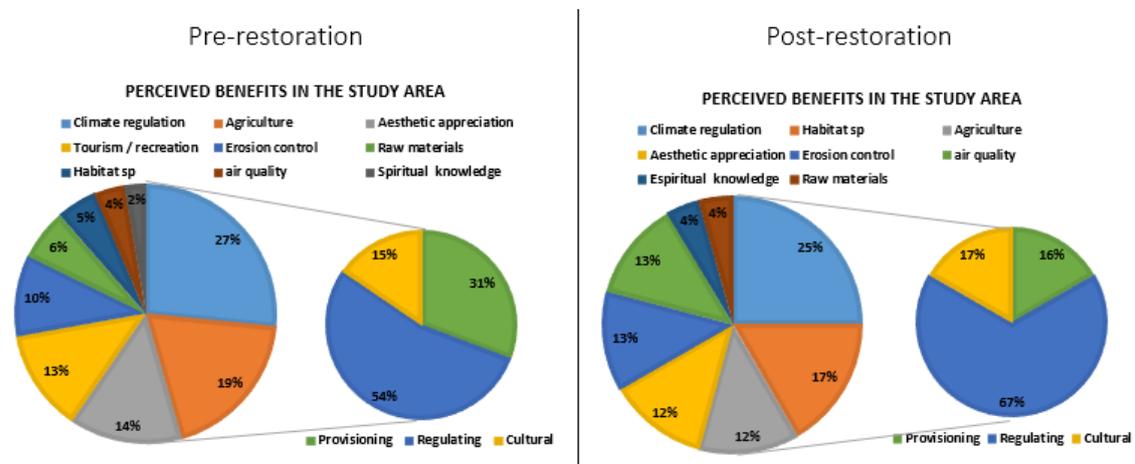

 Figure 3. Perceived awareness of Greece study area ecosystem services pre and post restoration

Comparing these results with the service panel (section B), air purification becomes the most important service during the two phases, leaving climate regulation in second place. For air purification vulnerability decreases from being perceived as decreasing to stable, for climate regulation in both phases it is perceived as stable.   Another interesting service in the area is the fresh water supply, which increases its importance in the final phase and is considered stable. Finally, as regards the perception of the crops, the Macedonian oak presents the greatest preference and importance, generating contributions to the well-being of the locals.

Jijona and Tous (Valencia, Spain)

As this partner has two areas of study, its results were analysed separately:

In Jijona, stakeholders perceived an increase in the area's capacity to provide benefits or ecosystem services to people, about 87% of respondents identified the site as beneficial or very beneficial, while in the first phase only 53% of respondents did so. With respect to the benefits described by locals and categorized under ecosystem services, agriculture was the most often identified service. However, in the post-planting phase, a greater variety of services was perceived, such as species habitat, erosion control, and landscape appreciation.
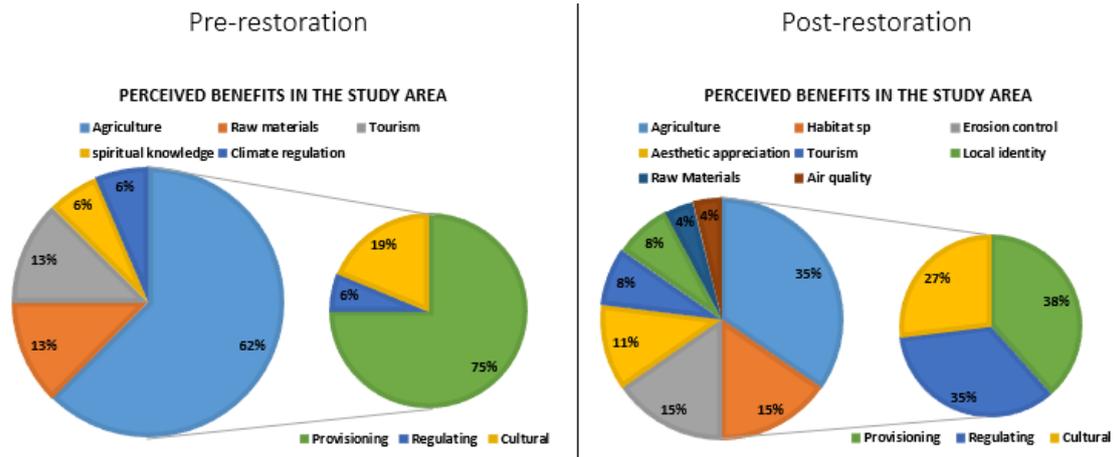
Figure 4. Perceived awareness of Jijona study area ecosystem services pre and post restoration

Relating these results to the ecosystem service panel (section B), agriculture remains one of the most important and vulnerable services during both phases. Another interesting service in the area is tourism, which increases its importance during the second phase and presents a low vulnerability. Finally, in terms of the perception of the crops, olive growing is the most important crop and generates the greatest contribution to the well-being of the locals.

In the Tous area, there was a perceived increase in the capacity of the area to provide benefits or ecosystem services to people, about 93% of the respondents identified the site as beneficial or very beneficial, while in the first phase only 47% of the respondents did so. With respect to the benefits described by locals and categorized in ecosystem services, as in Jijona, agriculture was the service most often identified and in the post-planting phase, a higher percentage was perceived to be cultural services (aesthetic appreciation).
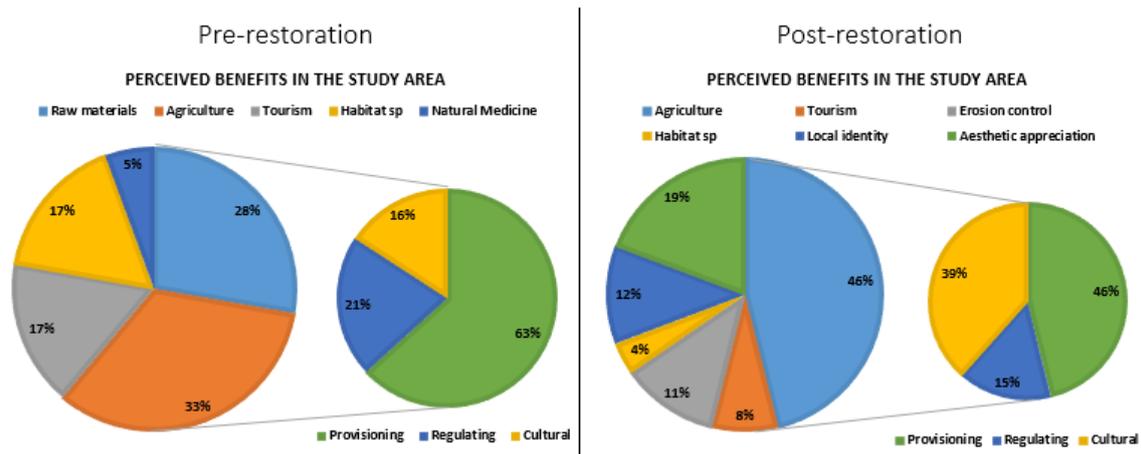

Figure 5. Perceived awareness of Tous study area ecosystem services pre and post restoration

 When relating these results to the services panel (section B), the situation changes since in the pre-plantation phase local ecological knowledge is positioned as the most important service, but for the post-plantation, erosion control is positioned as the most important service, both services are perceived as vulnerable. Another interesting service in the area is climate regulation, which increases its importance during the second

phase, but remains a concern for the local population (high vulnerability). Finally, in terms of crop perception, olive growing is the most important crop and generates the greatest contribution to the well-being of the local people.

Tifaracás (Gran Canaria, Spain)

In Artenara region, Gran Canaria, the general perception of the area's capacity to provide benefits to people, had a slight positive increase. It went from 13% of respondents who identified it as a beneficial or very beneficial region to 40% in the second phase.

With respect to the benefits described by the locals freely and categorized as ecosystem services, it is interesting to see how before the planting, about 42% of the respondents were unable to identify any benefits, a situation that changes after the planting, where everyone identifies some benefit, especially from agriculture.
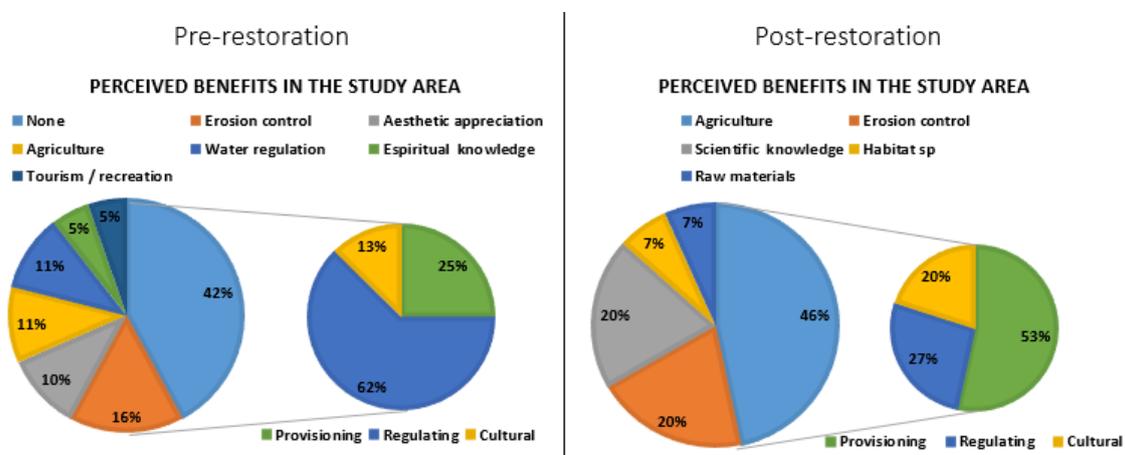

Figure 6. Perceived awareness of Gran Canaria study area ecosystem services pre and post restoration

By relating these results to the service panel (section B), agriculture remains one of the most important and vulnerable services during both phases. Another interesting service in the area is spiritual knowledge, which increases its level of importance for the locals and decreases their vulnerability in the second phase of surveys. Thirdly, the fresh water supply service which improves its level of importance, but remains vulnerable, being a concern for the local population. Finally, in terms of the perception of the crops, the endemic olive (*Olea europaea ssp. Guanchica*) is the species perceived as most important and which makes the greatest contribution to the well-being of the locals.

San Marco Argentano (Calabria, Italy)

In the study area located in the region of Calabria, there is a particular situation, since it is the only area, where a decrease in the area's capacity to provide ecosystem services is perceived. So much so that before the planting, 86% of the respondents perceived the region as beneficial or very beneficial, but in the final phase 75% of the respondents perceived it as little or not at all beneficial.

This first result is in line with the following ones since the locals identified few benefits, mainly agriculture. As for section B, before planting, agriculture was perceived as important and increasing, but in the post-planting phase, its importance decreased and

its vulnerability increased. Services such as climate regulation and air purification were strengthened, increasing its importance and decreasing its vulnerability.
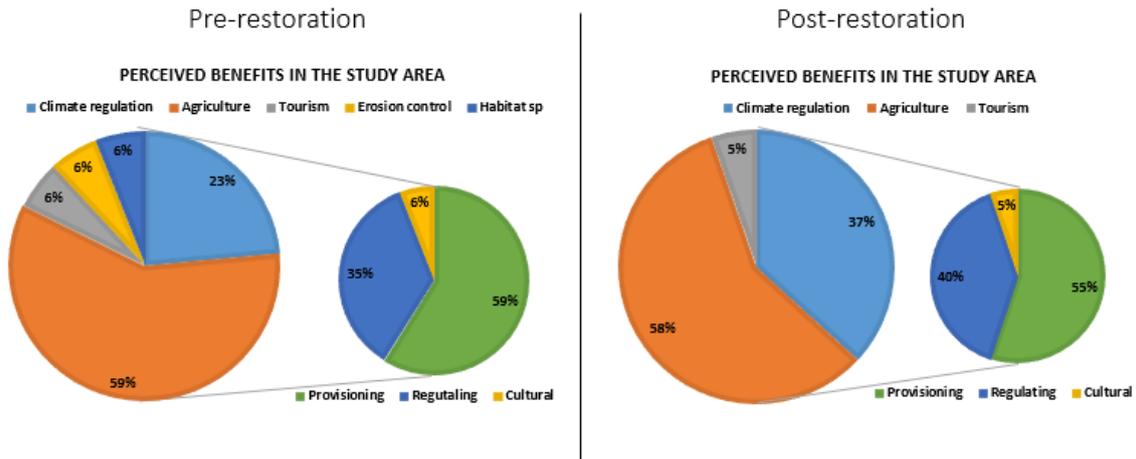

Figure 7. Perceived awareness of Italy study area ecosystem services pre and post restoration

In general terms, this is the area where the least variety of services and benefits are perceived. Finally, in terms of the perception of crops, olive groves are the most important crop and the one that generates the greatest contributions to the well-being of the local people.

5. Discussion

In general, for most areas the perception of their capacity to provide benefits or ecosystem services improved in the post-plantation phase (16-50% improvement), indicating a positive influence of the project. Except for Calabria (Italy) where the social perception had a negative change (50% decrease) possibly caused by the different situations that have occurred in this area.

With respect to perceived importance and vulnerability, it is necessary to highlight services that before the plantation was perceived as vulnerable by the locals, but in the final phase their perception improved and their vulnerability decreased. In other words, services that went from being perceived as being decreasing to being a growing service. In Almeria and Tous, the perception of erosion control was improved, in Jijona tourism, in Bruc agriculture, in Italy fresh water supply, in Greece air purification, and in the Canary Islands spiritual knowledge.

Similarly, there are services that are of great importance, but currently continue to be perceived as vulnerable or of concern to locals in each of the study areas. That is, services where the population perceives a decline in their provision over the last 10 years. For the areas of Valencia and Catalonia, the service of greatest concern is climate regulation, in Almeria and the Canary Islands, it is fresh water supply and for the areas of Italy and Greece, it is agriculture.

Finally, respondents from the areas of Catalonia, Valencia and Calabria (Italy) perceived the olive crop (*Olea europea*) as the most beneficial. As for the Canary Islands, a variety of olive tree was selected that is endemic to the Canary Archipelago

(*Olea europaea spp guanchica*), for Almeria the almond tree (*Prunus dulcis*) is the most beneficial and common crop in the area, and finally in Greece there was a preference for Macedonian oak (*Quercus trojana*) (figure 4).

6. Conclusions

Within the context of the Green Link project, we carried out the same social sampling regarding the ecosystem services provided across six semi-arid sites in the Mediterranean basin: Calabria in Italy, Ptolemais in Greece, and Catalonia, Valencia, Almeria and Gran Canaria for Spain. The social survey aimed to understand how the social perception of ecosystem services changed among sites and before and after the restoration process, identifying the most important services, their vulnerability. We overall found out a positive change in ES perceptions, being considered agriculture production as the most important service and climate regulation and freshwater supply as those services associated with public concern. The crop identified as most beneficial to locals and their wellbeing, possibly due to its millenary use throughout the arid Mediterranean, was the olive tree (a common variety and endemic to the Canary Islands), followed by the almond tree and the Macedonian oak.

Despite increasing attention to the ecosystem services framework in the EU context, the number of studies applying a socio-cultural perspective in restoration programmes is limited. Although we are aware that the sample size between sites was not homogeneous, which could affect the perception of ecosystem services, we believe that our research results are well aligned with the objectives of the UN Decade on Ecosystem Restoration (which seek to improve the productivity and capacity of ecosystems to meet society's needs), and should be incorporated into the restoration process so that the needs of all stakeholders can be unified.

We conclude that the application of the socio-cultural assessment of ecosystem services into ecological restoration programs result in a critical step for the success of land management strategies due to it connects with human wellbeing indicators and integrates the views and preferences of both public, land owners and ecosystem services beneficiaries.

7. Bibliography

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