Cross-sectoral planning decision-making platform to foster climate action

Rethink Action

D 6.5 | Reporting of solutions and recommendations at the local level

WP6 – Case studies-local evaluation

Version 1.0 | September 2025

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1	Fundación CARTIF	CARTIF	Spain	
2	University of Valladolid	UVa	Spain	
3	IVL Swedish Environmental Research Institute	IVL	Sweden	
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Abbreviation and Acronyms

Acronym	Description
AWY	(InVEST) Annual Water Yield (model)
CERRA	Copernicus regional reanalysis for Europe
CMIP6	Coupled Model Intercomparison Project 6
CRVA	Climate Risk Vulnerability Assessment (CRVA)
CS	Case Study
CSX	Case Study number X
ECV	Essential Climate Variable
EUC	End-Users Community
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
IC	Impact Chain
ICXY	Impact Chain number Y of Case Study X
ISWC	Initial Soil Water Content
LAMS	Land use-based Adaptation and Mitigation Solutions
MCA	Multi-Criteria Analysis
MCIRVA	Multi-Criteria Impact, Risk and Vulnerabilities Assessment
RCP	Representative Concentration Pathways
RES	Renewable Energy Sources
SD	Systems Dynamics
SSP	Shared Socio-economic Pathway
STO	Scientific and technological objectives
TAW	Total Available Water
TD	Technical Deviation
USDA	United States Department of Agriculture

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Executive Summary

This document is Deliverable 6.5 “Evaluation of local solutions to provide recommendations”, due in M48 (September 2025), which reports the results of Task 6.5 “Evaluation of local solutions to provide recommendations”. The six analysed case studies were: Gotland (Sweden) - Northern case study (CS1), Tarn-et-Garonne (France) - Atlantic case study (CS2), Southern Great Plain (Hungary) - East of EU case study (CS3), Valle D’Aosta (Italy) - Alpine - Mountain (CS4), Almeria (Spain): Mediterranean case study (CS5) and Azores Archipelago (Portugal) - Small Islands case study (CS6).

As such, this report summarizes the development of the local SD models, using the LAMS (packages of solutions), the dialogue with the stakeholders in the workshops and the crop yield simulations using AquaCrop. The results highlight the most relevant and suitable solutions retrieved by assessing the model simulations of policy scenarios and the interactions with the local communities. The policy insights were ranked, outlying the most important ones, and a shared policy statement was developed for each case study, creating a summary of the vulnerabilities, barriers and opportunities to implement the solutions. Finally, the policy recommendations outline the essential strategy for the future, considering the previous analysis, for the main sectors in the local society, and presenting actions to support climate change resilience in each case studies.

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1 Introduction

The objective of this deliverable is the definition of policy recommendations at the local level. Policy recommendations are built upon the results of the local SD model, simulated crop yield by AquaCrop (explained in the Annex III – AquaCrop yields projections) and stakeholders' input. Stakeholders' inputs are based on both online and in-person workshop events from Workshop 5 and the previous workshops. In the last workshop, there are three main outputs from the stakeholders: feedback about the platform, ranking of the policy insights and shared policy statement. Accordingly, with Figure 1.1, we are including the last two as drivers to complement the results of the simulations developed with the local SD model to evaluate different future alternatives. The local SD model was used to develop storylines on the potential future based on an ex-ante evaluation of LAMS coming from the catalogue. The results of this deliverable will be the foundation of D6.6 (Summary results of the case studies). A set of six policy briefs (one per case study) integrating the main outcomes of Work Package 6, are provided in D6.6.

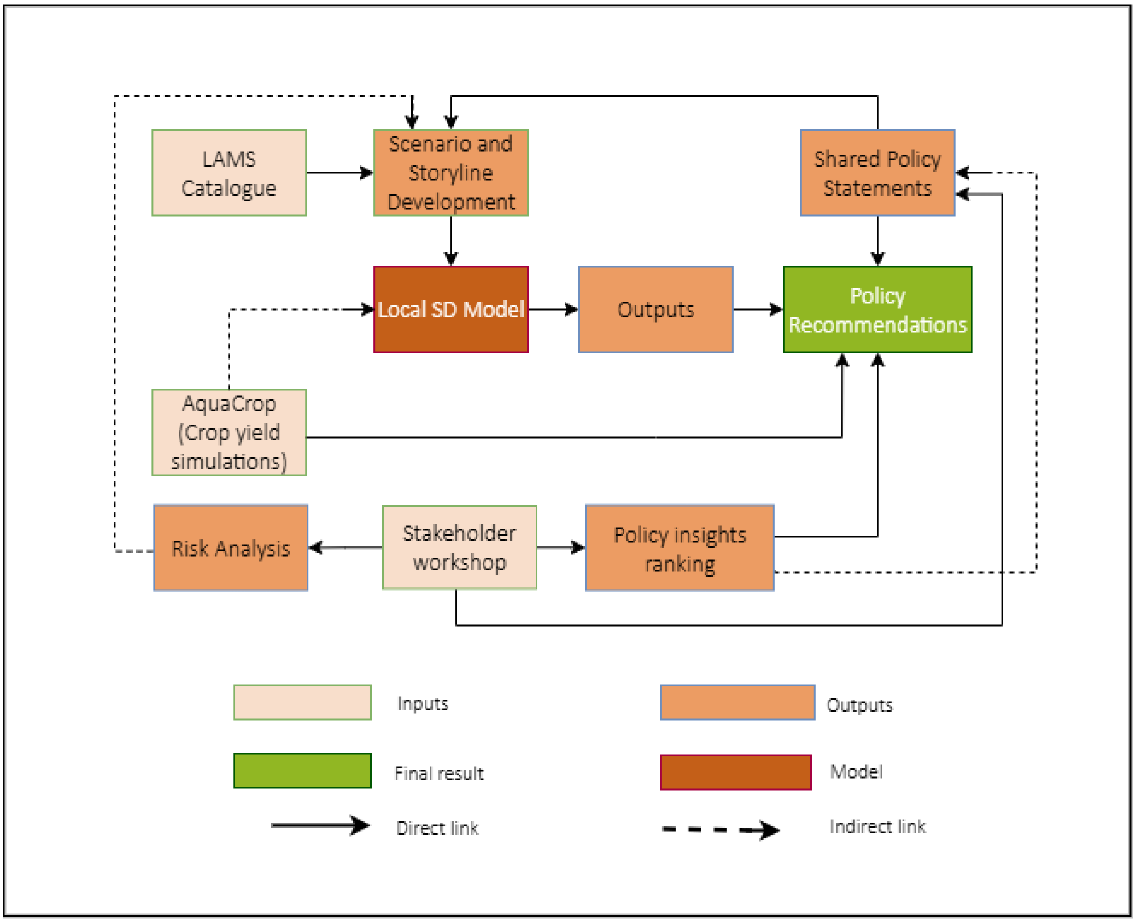

Figure 1.1: Schematic diagram of the flowchart for D6.5.

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2 Methods

The next sections include the methodologies carried out to define policy insights and policy statements for each CS during Workshop 5 and to create storylines and scenarios to simulate in the local SD model (RethinkAction Consortium, 2023. D6.4). Additionally, in the Annex III we present and explain the AquaCrop yields projections. The outcomes of these processes allowed to provide relevant information for the creation of policy recommendations.

2.1 Development of storylines for each CS to test LAMS scenarios with the local SD model

The SD framework was implemented as one model per case study, which in practice translated into using one subscript per case study in VENSIM. The SD model is modular in design and calibrated to local data, including high-resolution land-use maps, water balance accounting, and socio-economic indicators. This modularity ensured consistency across the six European case studies while maintaining the flexibility needed to capture local particularities. Calibration and validation relied on a combination of historical datasets, GIS-derived suitability maps, and, when necessary, downscaled national statistics, ensuring both internal coherence and contextual realism. The outputs of these models were assessed in relation to Key Performance Indicators (KPIs), which provided the quantitative backbone for the recommendations produced. Further details on the system dynamics modelling process can be found in Deliverables D5.3 and D6.4 (RethinkAction Consortium, 2023. D5.3, RethinkAction Consortium, 2023. D6.4).

For the experiment, several simplifications were necessary to make the modelling process tractable, particularly in order to adapt the Land-based Adaptation and Mitigation Solutions - LAMS (Chiriacò et al., 2025) to the dynamic structure of the system dynamics framework. These adjustments were consistent with the methodological framework developed in D6.4 and ensured that the assumptions and data remained aligned with both the technical constraints of the model and the policy relevance of the results. The integration of a suitable package of solutions for each case study was guided by the objectives and priorities identified in T6.3, which were operationalised by combining quantitative modelling with qualitative inputs from stakeholders. This participatory process allowed for the co-design of solution packages that reflected the specific needs and vulnerabilities of each region. In this context, storylines were developed by the Case Study leaders for each case study with inputs from Workshop 5, to provide coherent narratives linking local priorities, external drivers (e.g. climate and socio-economic scenarios), and the policies to be tested (Figure 1.1). These storylines serve both as a means of communication with stakeholders and as a practical tool for translating abstract strategies into testable

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scenarios in the SD model. The model was then run by comparing the baseline scenario with carefully designed solution-oriented scenarios, which represented different configurations of LAMS and their potential interactions. These scenarios are defined as High, Medium and Low, depending on the level of LAMS implementation. The baseline was derived from historical data and existing trends, while the solutions were constructed from both literature-based policy measures and local stakeholder inputs, and were tested dynamically over the simulation horizon.

Finally, in line with the Grant Agreement, multi-criteria decision analysis (MCDA) was employed to evaluate trade-offs across scenarios and to identify the most suitable ones, thereby linking technical results with policy guidance in a transparent and participatory way.

2.2 Development of policy insights at local level

2.2.1 Definition

The main objective of this exercise was to rank which Policy Insights obtained at the European level should be prioritized by the project at the local level. Policy insights at the local level were formulated because of the stakeholders' contrasting inputs, both at the individual and consensus level, for the ranking of objectives and criteria in defining the implementation of the LAMS (packages of solutions) at the case study level in D6.3. Based on the statistical analysis of the ranking of objectives and criteria from the individual and consensus exercises across the case study, it was evident that their understanding of the implementation of different LAMS is strongly influenced by the associated factors at the cross-sectoral level. It was also noticeable that the confusion of the terminology and associated concepts related to the adaptation and mitigation was large. To overcome these issues, eight policy recommendations topics were further presented in D6.3 to enhance the decision-making processes, ensure balanced priorities, and address key challenges in resource management, climate adaptation, and sustainability. Those policy recommendations topics were broken down into 12 Policy Insights and presented to the local stakeholders to rank which of these insights should be studied more and why, in future projects. It is also anticipated that the ranking of the Policy Insights would be an added value for developing the Shared Policy Statement at the cross-sectoral level for each case study, and also for the Policy Brief, activities included in T6.5.

2.2.2 Engagement methods

Stakeholders were first introduced to the list of Policy Insights at the European level. They were divided into groups of sectoral tables, based on the expertise. Necessary materials were provided during the workshop. The moderators explained the methodology to be followed for the ranking of the most

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relevant Policy Insights at local and sectoral levels, by using the materials. When the individual rankings are completed by the stakeholders, then the moderators use the simple arithmetic mean in the consensus column, based on the individual inputs. A discussion was followed with the participants as to reach a consensus about the final ranking. Details of this process have been reported in the Annex II - Guidelines for the 5thWorkshop.

2.2.3 Application of Policy insights

2.2.3.1 Emphasize the importance of climate adaptation, the cost of inaction and maladaptation

Considering the rapidly changing climatic conditions, planning and undertaking adaptation measures to avoid economic damages caused by climate and weather extremes is important, rather than doing nothing (inaction). European Environmental Agency (EEA) states that, despite ongoing mitigation and adaptation efforts, Weather- and climate-related extremes caused economic losses of assets estimated at EUR 738 billion (10^9 €) during 1980 - 2023 in the European Union. Future damages could be avoided by mainstreaming the action plans into national policies to implement adaptation measures. Although the estimation of the cost of inaction is hard to quantify due to associated challenges, but methodological approaches exist to quantify them corresponding to the needs and sector (Valverde et al., 2022) and has been studied quantified in several projects of Joint Research Centre's *Peseta IV* and *COACCH project* (COACCH, 2022). One key example from Peseta IV is that economic losses to the EU+UK from river flooding will grow from around 8 €billion/year to nearly 50 €billion/year by 2100 without mitigation and adaptation actions (JRC, 2022). However, it's also necessary to keep in mind that an intervention intended for a particular location or sector should not increase the likelihood of negative impacts on another location, sector or target group, commonly termed as maladaptation (Noble et al., 2014). EU-funded Regilience project investigates what causes maladaptation at the regional level and aims to develop a tool to avoid such risk in future adaptation plans (Regilience, 2022).

2.2.3.2 Explain how conservation, restoration and sustainable use of ecosystems combined with mitigation (reducing CO2 in the atmosphere)

In EU policy, ecosystem conservation, restoration, and sustainable use are key pillars of climate mitigation. This will be achieved by preserving and enhancing natural carbon sinks, restoring at least 20% of the EU's land and sea areas by 2030 and 20% of the EU's degraded ecosystems by 2030 and all ecosystems in need of restoration by 2050 through legally binding agreements with member states (IUCN, 2024), and supporting a resilient and low-emissions economy. These priorities are embedded in the EU Green Deal, the Biodiversity Strategy 2030, the LULUCF Regulation, the CAP, and the new Nature

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Restoration Law, all of which are designed to work together toward a climate-neutral and nature-positive Europe by 2050.

2.2.3.3 Explain how sustainable consumption of natural resources (used in agriculture and forestry) combines with the conservation of water resources

Sustainable consumption of natural resources in agriculture and forestry is closely linked with the conservation of water resources in EU policies. This has been highlighted in the CAP, where a specific strategic plan, such as the efficient use of water resources in the agricultural field to ensure the sustainable use of water resources and a 50% cut in pesticide use to control the agricultural pollution, protecting groundwater and surface waters has been defined by the commission. Moreover, as part of the EU Biodiversity Strategy 2030 and the new EU forest strategy for 2030, which are a core part of the European Green Deal, the EU recognises the central and multifunctional role of forests, considering the capacity of forests to regulate water cycles, filter pollutants, and protect watersheds.

2.2.3.4 Explore how food security increases by making farms more adapted to climate change

Climate change poses a serious threat to food security by increasing droughts, floods, heat stress, and pests that harm agricultural productivity. Making farms more climate-adapted directly strengthens food security by ensuring that food systems remain productive, stable, and resilient under changing climate conditions. This can be achieved through efficient irrigation system and rainwater harvesting for water management in drought periods, selecting climate-smart crops, integrating mulching, cover crops into the farming system to improve soil fertility and water retention, and providing incentives or generating insurance schemes for farming communities. Moreover, climate-smart infrastructure, forecasting, and access to data for farmers will enable them to make informed decisions. These measures have been integrated into the EU Common Agricultural Policy 2023-27. This modernized policy is a key tool in reaching the ambitions of the *Farm to Fork* and *biodiversity* strategies.

2.2.3.5 Explore how relevant it is to combine individual input with group consensus discussion in decision-making processes

Combining individual input with group consensus discussion in decision-making processes is a highly relevant and increasingly adopted practice in EU policies. This is particularly important for balanced decision-making in complex, collaborative, or high-stakes contexts, often leads to higher-quality decisions because everyone feels heard both as individuals and as part of the group. Furthermore, it helps in risk mitigation and bias reduction by countering individual input with consensus discussion through exposure to alternative perspectives. , EU policies have emphasized these points in different

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climate policies. For instance, EU Missions – Adaptation to Climate Change has adopted a co-creation model where local knowledge from citizens and officials is integrated into research and policy pilots. Moreover, in the European Green Deal (COM, 2019), extensive public consultation and stakeholder engagement were developed, where stakeholders, including citizens, NGOs, businesses, and scientists, submitted feedback via platforms like *Have Your Say* (COM, 2020) during open consultations on the climate law, biodiversity strategy, and Farm to Fork Strategy. It has been institutionalized through group consensus between and among different EU institutions through stakeholder roundtables and Climate Pact Ambassador network.

2.2.3.6 Highlight the importance of ecosystem services to society for adaptation and mitigation

The importance of ecosystem services to society is fundamental for both climate change adaptation and mitigation. Ecosystems offer a natural infrastructure that supports human survival, economic stability, and climate resilience through its different services. Through carbon sequestration by forests, peatland, oceans, and wetland, ecosystems contribute to climate mitigation, regulate methane and carbon emissions from degraded ecosystems and stabilize the carbon cycle within the system. Moreover, coastal wetlands provide regulatory services by absorbing storm energy and reducing flood damage. Similarly, urban green spaces also provide ecosystem services by reducing heat island effects, lowering energy needs and heat stress. In the absence of these spaces, or renewable energy such as wind and ocean current energy, there will be a greater necessity for fossil-fueled energy consumption for the generation of electricity to meet the growing demand of the population. Therefore, in the EU LULUCF regulation, special emphasis has been given on land uses that store carbon. Member states have also been asked to align their national plans according to EU-wide net removals target for 2030. Furthermore, EU Green Deal and Horizon Europe Mission have recognized the nature-based solutions as key to sustainable adaptation.

2.2.3.7 How can decision makers prioritize achieving long-term sustainability over implementation cost?

In the decision-making process of adaptation and mitigation solutions, many times long-term sustainability and implementation costs are opposite to each other. This was also evident in the last workshops across the case studies, where stakeholders prioritized sustainability over costs. This can be dealt with by integrating perspectives from different stakeholders, including local communities, authorities, technicians, decision-makers, elected government officials, academia, all in one table and doing a full assessment of the cost and benefit for the solutions. Moreover, it is also necessary to develop indicators with specific questions concerning environmental, social, and economic factors such

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as long-term benefits, efficiency, effectiveness, coherence and social acceptability and respective costs, as well as measures of flexibility, robustness, and practicality for the solutions.

2.2.3.8 How important is diversity of backgrounds and opinions in decision-making processes?

The diversity of backgrounds and opinions is critical in the formulation of effective, inclusive, and just climate change policies. Climate change affects different regions, sectors, and social groups in varied ways; therefore, decision-making must reflect a broad range of perspectives to ensure that policies are both equitable and effective. This helps in a better understanding of the impacts across society and devising optimum solutions for these impacts. Moreover, more innovative and effective solutions could be derived when stakeholders from different professional and academic backgrounds dialogue with each other from their respective settings and contribute to the identification of real-world vulnerabilities and priorities. Last but not least, for a fair and just climate governance, it is imperative to consider and respect the diverse perspectives in formulating the global and regional climate policies. This is crucial because of the existence of different socio-economic classes within the global society. Therefore, nowadays most European policies, such as the EU Climate Pact & Green Deal, CAP reform, are now formulated based on the bottom-up approach with the integration of the top-level policy makers.

2.2.3.9 How to increase social acceptance for conservation, restoration and sustainable use of ecosystem services?

Society is a crucial component of the entire ecosystem; therefore, the implementation of new climate policies requires effective stakeholder and local community engagement (local authorities, citizens, local businesses, tourism operators, and environmental NGOs) to overcome potential barriers. This can be achieved through their involvement in the decision-making process by clearly communicating the policy's goals, benefits, and trade-offs. Moreover, real examples of the demonstration project from other EU countries that resonate with a similar set of problems might be helpful. For instance, public consultation has been found effective for the relocation of the shoreline road in southwestern France, and retreating private households and businesses with economic compensation from the damage of river flooding next to the Danube River in Austria (Climate-ADAPT, 2016). The former has contributed to the conservation of the aesthetic value and natural habitats provided by the landscape. Another example is the reuse of treated wastewater for agricultural irrigation, industrial processes, and in hotels for swimming pools, flushing toilets, and irrigation of gardens or golf fields in the tourism sector (Climate-ADAPT, 2021). Additionally, building fire resilience using recycled water is also a notable

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application in Spain. Dissemination of knowledge regarding the benefits of such examples might also encourage stakeholders to accept and implement the solutions more easily and participate in them.

2.2.3.10 Increase knowledge about land scarcity to decide on the implementation of different policies

A deeper understanding of land scarcity, its causes, trends, and impacts, provides critical insights for shaping policies that ensure sustainable and equitable land use. By analyzing data on population growth, urbanization, agricultural needs, and environmental pressures, policymakers can identify where interventions (such as urban densification, land protection, or innovative agriculture) are most needed. This knowledge-driven approach helps to design targeted policies that balance economic development, environmental conservation, and social needs while reducing conflicts over land.

2.2.3.11 Use rigorous definitions of adaptation and mitigation to formulate policies, their criteria and objectives

In climate policy formulation, certain policy measures are sometimes debated as to whether they should be considered either as mitigation or adaptation. A good example of this is the afforestation activities, which have dual services both as adaptation and mitigation. When the services are related to erosion control or protection of the coastal settlement from extreme events, then afforestation is considered as adaptation. However, afforestation activities also contribute to carbon sequestration for the long-term period, which is considered mitigation. A similar example is peatland conservation, which plays an important role in carbon storage (mitigation) and acts as a natural sponge, regulating water flow and reducing downstream flood risks (adaptation). This type of confusion can be eradicated by clearly defining the contexts and main objectives of the new policy, and subsequently, the precise definition of adaptation and mitigation in that policy. Additionally, when policies are formulated, specific criteria and indicators respective to both adaptation and mitigation should be included in the policy. This can help achieve the overall goal of the policy without contradicting the mitigation or adaptation concept associated with it.

2.2.3.12 What are LAMS high-impact and low-cost solutions for water resources conservation?

LAMS are Land-based Adaptation and Mitigation Solutions to tackle climate change-induced impacts. Under the RethinkAction project, 62 such LAMS were catalogued to identify and characterise land-based solutions applicable across different sectors and to provide valuable references for deriving context-specific solutions to different climate impacts. Within the catalogue, seven LAMS are relevant to water management (Chiriacò et al., 2025). The implementation of any climate solution or LAMS requires

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specific information related to the long-term services provided by the solution itself, along with the implementation cost and acceptance at the local level. Moreover, it requires rigorous assessment in terms of their high impact and cost-effectiveness solutions. Under the *LIFE VIVaCCAdapt* project, a newly developed Decision Support System for Irrigation (DSSI) based on weather forecast, real-time soil moisture content (monitoring data), type of plant and irrigation system was introduced in Slovakia for water management to improve the preparedness for drought together with farmers. This solution has improved the efficiency in water consumption, reduction in energy requirements and CO_2 emissions (Cvejić et al., 2020). Identified water management LAMS within the RethinkAction project are low-cost solutions with broader implications for water resource conservation across various sectors.

2.3 Shared policy statement with the stakeholders

Stakeholders were invited to jointly develop a shared policy statement for their respective regions and sectors. This process drew upon the ranking of policy insights at the case study level, the problem statements defined in Task 5.1 and refined in Task 6.1, as well as the package of LAMS identified in Deliverables 6.1 and 6.3. An initial draft of the shared policy statement was presented to the stakeholders, who were asked for their input and comments. This initial draft was prepared from the problem statement, which was produced for D5.1 and later updated in D6.1, including further information (i.e. project website articles and news) produced by the project. Details of this process have been reported in the Annex II - Guidelines for the 5th Workshop. The resulting policy statement establishes a common strategic direction and provides the foundation for the definition of a significant storyline and subsequent identification of policy measures in each case study.

3 Shared policy statements and storylines at case study level

This section presents the ranking of policy insights, the shared policy statements and the storylines developed and used to create policy scenarios implemented in the local SD model, for each case study.

3.1 Ranking of policy insights per case study

3.1.1 CS1 – Gotland (Sweden)

The overall ranking of policy insights on Gotland reflects the combined preferences of five participants, offering a clear view of which climate-related topics were considered most urgent and impactful. The insights that emerged as top priorities were those addressing the consequences of inaction and the strategic management of land. Specifically, participants gave the highest importance to “emphasizing the cost of inaction and maladaptation in climate adaptation”, and to ”Increase knowledge about land

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scarcity as a basis for political decision making". Closely following were insights that focused on how "decision-makers can prioritize long-term sustainability over short-term implementation costs", and how to "enhance food security by making farms more resilient to climate change". Also considered highly relevant were the "recognition of ecosystem services in supporting both adaptation and mitigation", as well as "Identify low-cost, high-impact LAMS for water resource conservation". Mid-ranked insights centred on ecosystem restoration and sustainable use, such as combining conservation with CO_2 mitigation and managing natural resource consumption in agriculture and forestry to support water conservation. Topics addressing social acceptance and engagement were also viewed as relevant, though not ranked among the most urgent. Overall, the rankings reflect a strong preference for actionable, impact-driven policy areas that directly support climate resilience and land-based strategies, providing clear guidance for where policy development should be focused going forward.

Table 1: Stakeholder ranking of policy insights, based on combined input from five participants of Gotland CS 5th consultation. The table presents the prioritization of twelve policy insights related to climate adaptation, mitigation, and governance. Participants evaluated each insight based on its perceived urgency and relevance for effective implementation of LAMS

ID	Policy Insight to explore	Overall Rank (5 ppl)
1	Emphasize the importance of climate adaptation, the cost of inaction and maladaptation	1
2	Explain how conservation, restoration and sustainable use of ecosystems combines with mitigation (reducing CO2 in the atmosphere)	6
3	Explain how sustainable consumption of natural resources fused in agriculture and forestry) combines with the conservation of water resources	7
4	Explore how food security increases by making farms more adapted to climate change	3
5	Explore how relevant is to combine individual input with group consensus discussion in decision-making processes	11
6	Highlight the importance of ecosystem services to society for adaptation and mitigation	4
7	How can decision makers prioritize achieving long-term sustainability over implementation cost?	2
8	How important is diversity of backgrounds and opinions in decision making processes?	10
9	How to increase social acceptance (education and engagement) for conservation, restoration and sustainable use of ecosystems?	8
10	Increase knowledge about land scarcity to decide about the implementation of different politics	1
11	Use rigorous definition of adaptation and mitigation to formulate policies, their criteria and objectives	12
12	What LAMS pre of high-impact and low-cost solutions for water resources conservation?	5

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3.1.2 CS2 – Tarn-et-Garonne (France)

Here are the policy insights that were the most voted byt the stakeholders:

- Which LAMS solutions (low-cost, high-impact) can effectively conserve water resources?
- Explore how food security can be strengthened by making farms more resilient to climate change.
- Emphasize the importance of climate adaptation, as well as the costs of inaction and maladaptation.
- How can decision-makers prioritize long-term sustainability over implementation costs?

The measure concerning the optimization of water use has remained the most important since the beginning of the project. The second key measure is maintaining food security by ensuring that farms remain resilient to climate shocks (for example, the war in Ukraine affecting the supply of raw materials).

The issue of energy prices was also discussed, since apple storage is energy-intensive and increasingly problematic. Discussions also took place on the potential usefulness of agriPV.

It was also noted that diversity of opinions and backgrounds is important, but consultation should not take too long. The topic of ecosystem services was also mentioned as potentially important, especially for certain stakeholders.

One of the proposals concerning the cost of inaction was also highlighted as important, with several concrete examples given (such as the impact of inaction on soil erosion resulting in actual landslides).

Table 2: Stakeholder ranking of policy insights, based on combined input from five participants of Tarn-et-Garonne CS 5th consultation. The table presents the prioritization of twelve policy insights related to climate adaptation, mitigation, and governance. Participants evaluated each insight based on its perceived urgency and relevance for effective implementation of LAMS.

ID	Policy Insight to explore	Overall Rank (5 ppl)
1	Emphasize the importance of climate adaptation, the cost of inaction and maladaptation	3
2	Explain how conservation, restoration and sustainable use of ecosystems combined with mitigation (reducing CO2 in the atmosphere)	7
3	Explain how sustainable consumption of natural resources fused in agriculture and forestry) combines with the conservation of water resources	5
4	Explore how food security increases by making farms more adapted to climate change	2
5	Explore how relevant is to combine individual input with group consensus discussion in decision-making processes	9

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ID	Policy Insight to explore	Overall Rank (5 ppl)
6	Highlight the importance of ecosystem services to society for adaptation and mitigation	8
7	How can decision makers prioritize achieving long-term sustainability over implementation cost?	3
8	How important is diversity of backgrounds and opinions in decision making processes?	11
9	How to increase social acceptance (education and engagement) for conservation, restoration and sustainable use of ecosystems?	10
10	Increase knowledge about land scarcity to decide about the implementation of different politics	5
11	Use rigorous definition of adaptation and mitigation to formulate policies, their criteria and objectives	12
12	What LAMS pre of high-impact and low-cost solutions for water resources conservation?	1

3.1.3 CS3 – Southern Great Plain (Hungary)

The overall ranking of policy insights reflects the combined preferences of 11 individuals proportionally to the number of participants per table. Based on this method, the top three highest-ranked policy insights to explore were: “What LAMS provide high-impact and low-cost solutions for water resources conservation?” (Rank 1), “How can decision makers prioritize achieving long-term sustainability over implementation cost?” (Rank 2), and “Increase knowledge about land scarcity to decide about the implementation of different politics” (Rank 3). These topics were perceived as the most urgent or impactful across the group. Conversely, the three lowest-ranked insights were: “Use rigorous definitions of adaptation and mitigation to formulate policies, their criteria and objectives” (Rank 11), “Highlight importance of ecosystem services to society for adaptation and mitigation” (Rank 12), and “Emphasize the importance of climate adaptation, the cost of inaction and maladaptation” (Rank 10). These results provide valuable guidance on the policy areas that participants consider most and least pressing for further exploration. The results are visible in Table 3.

Table 3: Stakeholder ranking of policy insights, based on combined input from eleven participants of Southern Great Plain CS 5th consultation. The table presents the prioritization of twelve policy insights related to climate adaptation, mitigation, and governance. Participants evaluated each insight based on its perceived urgency and relevance for effective implementation of LAMS.

ID	Policy Insight to explore	Overall Rank (11 ppl)
1	Emphasize the importance of climate adaptation, the cost of inaction and maladaptation	10
2	Explain how conservation, restoration and sustainable use of ecosystems combined with mitigation (reducing CO2 in the atmosphere)	5

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ID	Policy Insight to explore	Overall Rank (11 ppl)
3	Explain how sustainable consumption of natural resources fused in agriculture and forestry) combines with the conservation of water resources	8
4	Explore how food security increases by making farms more adapted to climate change	9
5	Explore how relevant is to combine individual input with group consensus discussion in decision-making processes	7
6	Highlight the importance of ecosystem services to society for adaptation and mitigation	12
7	How can decision makers prioritize achieving long-term sustainability over implementation cost?	2
8	How important is diversity of backgrounds and opinions in decision making processes?	6
9	How to increase social acceptance (education and engagement) for conservation, restoration and sustainable use of ecosystems?	4
10	Increase knowledge about land scarcity to decide about the implementation of different politics	3
11	Use rigorous definition of adaptation and mitigation to formulate policies, their criteria and objectives	11
12	What LAMS pre of high-impact and low-cost solutions for water resources conservation?	1

3.1.4 CS4 – Valle d'Aosta (Italy)

Table 4 below presents the results of the policy ranking exercise conducted with Valle D'Aosta Stakeholders. Among the policy insights, the highest ranked was "*Explain how conservation, restoration and sustainable use of ecosystems combined with mitigation (reducing CO_2 in the atmosphere)*", which clearly reflects the strong importance attributed to linking ecosystem-based approaches with climate mitigation strategies.

In second place, stakeholders emphasized the need to "*Emphasize the importance of climate adaptation, the cost of inaction and maladaptation*", underscoring that adaptation measures must be prioritized to avoid higher long-term costs associated with inaction or poorly designed responses.

Closely following in third place was "*Highlight importance of ecosystem services to society for adaptation and mitigation*", reinforcing the perception that nature-based solutions not only support mitigation efforts but also play a central role in climate resilience. Other insights that ranked relatively high focused on sustainable consumption of natural resources and on social acceptance and education for conservation measures, both of which highlight the cross-sectoral dimension of the region's challenges.

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By contrast, insights related to decision-making processes, diversity of opinions, and the balance between long-term sustainability and implementation costs were ranked lower, suggesting that stakeholders gave greater priority to concrete ecosystem- and resource-oriented actions rather than governance or procedural aspects. Overall, the results illustrate a clear preference for strategies that integrate ecosystem conservation with climate action, while also signaling awareness of the trade-offs and the risks associated with failing to adapt.

Table 4: Stakeholder ranking of policy insights, based on combined input from three participants of Valle d'Aosta CS 5th consultation. The table presents the prioritization of twelve policy insights related to climate adaptation, mitigation, and governance. Participants evaluated each insight based on its perceived urgency and relevance for effective implementation of LAMS.

ID	Policy Insight to explore	Overall Rank (3 ppl)
1	Emphasize the importance of climate adaptation, the cost of inaction and maladaptation	2
2	Explain how conservation, restoration and sustainable use of ecosystems combined with mitigation (reducing CO2 in the atmosphere)	1
3	Explain how sustainable consumption of natural resources fused in agriculture and forestry) combines with the conservation of water resources	4
4	Explore how food security increases by making farms more adapted to climate change	9
5	Explore how relevant is to combine individual input with group consensus discussion in decision-making processes	12
6	Highlight the importance of ecosystem services to society for adaptation and mitigation	3
7	How can decision makers prioritize achieving long-term sustainability over implementation cost?	11
8	How important is diversity of backgrounds and opinions in decision making processes?	10
9	How to increase social acceptance (education and engagement) for conservation, restoration and sustainable use of ecosystems?	4
10	Increase knowledge about land scarcity to decide about the implementation of different politics	7
11	Use rigorous definition of adaptation and mitigation to formulate policies, their criteria and objectives	6
12	What LAMS pre of high-impact and low-cost solutions for water resources conservation?	8

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3.1.5 CS5 – Almería province (Spain)

Table below presents the results from the policy ranking exercise conducted in Almería during the 5th EUC interaction. Two policy insights were ranked equally as both 2nd and 6th place. The insights ranked in the top 3 all deal with adaptation measures in line with themes such as long-term sustainability, low implementation-cost-solutions, food security and water conservation. For example, the highest ranked insight is '*How can decision makers prioritize achieving long-term sustainability over implementation cost?*' The EUC clearly indicated the importance of future-oriented thinking when it came to sustainable solutions, as opposed to the implementation costs involved. This insight suggests that the EUC feel that the most effective solutions may not always be the easiest to realise, and that the effectiveness of the solution is a more important criteria to consider than ease of implementation.

In joint second place are the policy insights 'Emphasize the importance of climate adaptation, the cost of inaction and maladaptation' and 'What LAMS are of high-impact and low-cost solutions for water resources conservation?'. The first deals with adaptation, in contrast to maladaptation and the cost of inaction. At first glance the meaning is straightforward, but when contextualised by the above explained 1st ranked policy insight, it underscores the need to adapt appropriately regardless of the cost of implementation, as the costs of both maladaptation and inaction are significantly higher. The other 2nd ranked policy insight deals with the balance between water conservation solutions that are high impact, yet relatively low-hanging fruit in terms of their related cost. This insight follows much of the same logic of the previous policy insights in terms of the focus on high-impact solutions and on the cost of implementation (either indicating that it shouldn't be a barrier, or in this case that it makes sense to start with the solutions which are easiest to implement). The novelty though is that the solutions are now specifically about water conservation, which points to the chief risk faced in the province.

The 3rd ranked policy insight is 'Explore how food security increases by making farms more adapted to climate change'. This also relates the findings of the chief risks in the region, as water scarcity is strongly connected to a risk of food insecurity, given the scale and exposure of the agricultural sector in the province. Measures that would make farms better adapted to climate change in the context of this insight would chiefly target the supply and (re)use of water resources, and the minimization of any wastage. As highlighted in previous deliverables, a sustainable supply and efficient (re)use of water resources would not only benefit the agricultural sector and the livelihoods dependent on it, but also the daily water needs of the citizens of the province, as they also need access to water resources. Furthermore, other sectors such as tourism and industry would benefit from such measures, pointing to the fact that such solutions would result in ripples of benefit across the entire province and the sectors therein.

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Table 5: Stakeholder ranking of policy insights, based on combined input from three participants of Almería CS 5th consultation. The table presents the prioritization of twelve policy insights related to climate adaptation, mitigation, and governance. Participants evaluated each insight based on its perceived urgency and relevance for effective implementation of LAMS.

ID	Policy Insight to explore	Overall Rank (3 ppl)
1	Emphasize the importance of climate adaptation, the cost of inaction and maladaptation	2*
2	Explain how conservation, restoration and sustainable use of ecosystems combine with mitigation (reducing CO2 in the atmosphere)	5
3	Explain how sustainable consumption of natural resources (used in agriculture and forestry) combines with the conservation of water resources	4
4	Explore how food security increases by making farms more adapted to climate change	3
5	Explore how relevant it is to combine individual input with group consensus discussion in decision-making processes	8
6	Highlight the importance of ecosystem services to society for adaptation and mitigation	6*
7	How can decision makers prioritize achieving long-term sustainability over implementation cost?	1
8	How important is diversity of backgrounds and opinions in decision-making processes?	9
9	How to increase social acceptance (education and engagement) for conservation, restoration and sustainable use of ecosystems?	6*
10	Increase knowledge about land scarcity to decide about the implementation of different policies	7
11	Use rigorous definitions of adaptation and mitigation to formulate policies, their criteria and objectives	10
12	What LAMS are of high-impact and low-cost solutions for water resources conservation?	2*

** indicates tied ranking.*

In terms of implementation pathways for the above-mentioned policy insights, the highest (1st) ranked can be achieved primarily through a mixture of awareness raising in the province of Almería (including at the policy-maker level) as well as buy-in from the citizenry and most important sectors of the province. The former would build upon and actualise the already significant knowledge of the interrelatedness and severity of the risks faced in the province, while the latter would facilitate pressure (bottom-up) and possible incentives (top-down) towards long-term sustainability solutions. Such an approach can make it possible for decision-makers to focus more on the effectiveness of solutions, over the associated implementation costs. This can also be implemented within the context of the Plan Andaluz de Accion Clima (PAAC) and the Plan Nacional de Adaptación al Cambio Climático 2021-2030 – By doing so, the province can ensure alignment with both regional and national policy in the

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implementation of solutions. The above approach would also satisfy one of the 2nd ranked insights as well as the 3rd, namely '*Emphasize the importance of climate adaptation, the cost of inaction and maladaptation*' and '*Explore how food security increases by making farms more adapted to climate change*', as part of the awareness-raising would also be contextualised by the cost of both maladaptation and inaction, and discussed in relation to the most affected sectors, such as agriculture.

Focusing particularly on making farms better adapted to climate change, it is of note that members of the EUC also suggested that farmers should plant produce that is not only in-line with the climatic conditions of the province, but also in season. Doing so would reduce the water and energy resources consumed in the agricultural sector, but would likely face challenges of acceptability by farmers who are already engaged in current profitable modes of (mass) production. The other policy insight ranked 2nd (*What LAMS are of high-impact and low-cost solutions for water resources conservation?*) can be satisfied primarily through the below listed LAMS:

- Water-use efficiency: improve industrial and domestic water use efficiency (LAMS 34 & 35)
- Increased wastewater treatment and reuse (LAMS 36)
- Water-use efficiency: improve agricultural irrigation efficiency (LAMS 33)

The above LAMS address the source, (re)use and efficiency of water systems and resources, thereby addressing the core risks for the province. Additionally, EUC members also discussed desalinization as a potential solution to expand water sourcing. However, they also pointed to the fact that this solution is also very energy-intensive and would present a challenge in scalability across the entire province. Additionally, they questioned the social-acceptability of this solution, as is seems not to enjoy widespread support within the community. Desalinization is nonetheless a solution that policy makers and actors in the water supply industry are already pursuing in the province.

3.1.6 CS6 – Azores (Portugal)

Table 6 represents the ranking of the policy insights at the cross-sectoral level. Based on the median, it was not possible to rank the insights; therefore, a new ranking formula was used, which produced unique numbers for several insights. For this, participants used the voting method to rank the insights for the repeated numbers. A total of 15 participants voted in the workshop exercise, divided into three groups representing the three primary sectors (Agriculture, Energy, and Tourism) in the Azores. There were four participants in the agriculture sector and the top three insights were: highlight the importance of ecosystem services to society for adaptation and mitigation (rank 1), emphasize the importance of climate adaptation, the cost of inaction and maladaptation (rank 2) and explain how sustainable

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consumption of natural resources (used in agriculture and forestry) combines with the conservation of water resources (rank 3). For the energy sector, the top 3 were policy insight no. 7, How can decision makers prioritize achieving long-term sustainability over implementation cost, followed by emphasizing the importance of climate adaptation, the cost of inaction and maladaptation (rank 2) and what LAMS are of high-impact and low-cost solutions for water resources conservation (rank 3). The top 3 ranked insights from the tourism sector were: emphasize the importance of climate adaptation, the cost of inaction and maladaptation (rank 1), explain how conservation, restoration and sustainable use of ecosystems combined with mitigation (rank 2) and what LAMS are of high-impact and low-cost solutions for water resources conservation (rank 3).

It is interesting to note that despite being in the same region, the ranking of the insights among the sectors was quite different from each other, except for policy ID 1: emphasizing the importance of climate adaptation, the cost of inaction and maladaptation. Overall, this was the most important policy insight among the sectors. This could be because all sectors are aware of the localized salinity impacts that need to be handled with the adoption of technological solutions, along with proper land management strategies. This was also discussed in the inter-sectoral debate, where they emphasized the technological solutions as well as proper land management strategies while considering the deployment of such solutions.

Table 6: Stakeholder ranking of policy insights at cross-sectoral level, based on combined input from fifteen participants of Azores CS 5th consultation. The table presents the prioritization of twelve policy insights related to climate adaptation, mitigation, and governance. Participants evaluated each insight based on its perceived urgency and relevance for effective implementation of LAMS.

ID	Policy Insight to explore	Agriculture	Energy	Tourism
1	Emphasize the importance of climate adaptation, the cost of inaction and maladaptation	2	2	1
2	Explain how conservation, restoration and sustainable use of ecosystems combined with mitigation (reducing CO2 in the atmosphere)	7	8	2
3	Explain how sustainable consumption of natural resources (used in agriculture and forestry) combines with the conservation of water resources	3	11	5
4	Explore how food security increases by making farms more adapted to climate change	6	12	9
5	Explore how relevant is to combine individual input with group consensus discussion in decision-making processes	11	5	8
6	Highlight the importance of ecosystem services to society for adaptation and mitigation	1	5	7
7	How can decision makers prioritize achieving long-term sustainability over implementation cost?	8	1	12

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ID	Policy Insight to explore	Agriculture	Energy	Tourism
8	How important is diversity of backgrounds and opinions in decision-making processes?	12	8	10
9	How to increase social acceptance (education and engagement) for conservation, restoration and sustainable use of ecosystems?	4	5	6
10	Increase knowledge about land scarcity to decide about the implementation of different policies	9	4	11
11	Use rigorous definitions of adaptation and mitigation to formulate policies, their criteria and objectives	10	10	4
12	What LAMS are of high-impact and low-cost solutions for water resources conservation?	5	3	3

3.2 Shared Policy statements

At the case study level, stakeholders collaborated to define a shared policy statement. This statement reflects a common understanding of the regional challenges and opportunities, building on the problem statements (T5.1, T6.1), the ranking of policy insights, and the package of LAMS identified in Deliverables 6.1 and 6.3. The following sections represent the shared policy statement for each case study.

3.2.1 CS1 – Gotland (Sweden)

Gotland is a Swedish island where agriculture and tourism are central to the local economy, both strongly reliant on vital ecosystem services such as freshwater availability and landscape quality. In the face of climate change, and with increasing risks of drought and freshwater scarcity, climate policy must foster integrated sustainable usage, adaptation and mitigation strategies that ensure positive development for current and future generations.

Agriculture in Gotland is primarily rainfed and vulnerable to decreasing groundwater recharge and increased evapotranspiration. Sector-wide adaptation strategies should include agroecological measures such as cover cropping, crop variation, and rotation with legumes, improved grazing and nutrient management, and precision farming to enhance soil organic carbon, reduce emissions, and improve drought resilience.

Gotland's energy sector is in transition, with rising interest in solar energy systems. To ensure climate and energy resilience, measures such as spatial planning for photovoltaic systems, improved land-use efficiency, and grid-supporting infrastructure must be promoted. These should minimize land-use conflicts while ensuring that renewable energy deployment supports both emission reductions and local energy security.

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Forests on Gotland provide a vital ecosystem, climate policy must include forest protection, sustainable harvesting, and ecosystem restoration. Addressing implementation through local governance, technical capacity and stakeholder engagement is essential for ensuring forest resilience for present and future generations.

Tourism, closely tied to natural and cultural heritage, faces indirect climate risks from water scarcity, landscape degradation, and ecosystem vulnerability. Ecosystem-based adaptation, protection of infiltration zones, restoration of wetlands, and sustainable visitor practices are key to safeguarding the long-term viability of tourism in Gotland.

Cross-sectoral barriers include fragmented governance, limited stakeholder engagement, economical- and technical capacity gaps in water and land-use planning. Enabling conditions must include coordinated land and water policies, enhanced local governance mechanisms, financial and technical support for farmers and municipalities, and public education on water usage.

A climate-resilient Gotland requires an integrated, locally adapted direction to land use-, water-, and energy planning, supported by stakeholder participation, science-based approaches, and aligned policy instruments. Coordinated investment in nature-based solutions, water-smart agriculture, and resilient infrastructure will ensure that Gotland's economy and ecosystems thrive in a changing climate.

3.2.2 CS2 – Tarn-et-Garonne (France)

Tarn-et-Garonne is a dynamic agricultural department in South-West France, where farming is the backbone of the economy. Agriculture covers more than 70% of land use, with cereals, orchards, and vineyards as the main productions. Many farms depend on irrigation, making the sector highly vulnerable to recurrent droughts, heatwaves, and water scarcity. Climate change directly threatens crop yields, livestock systems, and farmers' livelihoods. Adaptation options include crop diversification, cover crops, improved soil organic matter, the use of adapted varieties, efficient irrigation, and conservation agriculture.

Water management is a critical issue, as competing uses increasingly generate social tensions. Solutions include the restoration of buffer zones (wetlands, hedgerows), sustainable water storage, and the promotion of irrigation efficiency at both farm and basin levels.

Rural tourism and local energy systems are also exposed to climate pressures. Tourism depends on landscape quality and water availability, while the energy transition requires investment in solar and biomass, infrastructure upgrades, and capacity-building for technicians to ensure autonomy and resilience.

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The main barriers to implementation are fragmented policies, regulatory complexity, and social tensions over water use. Conversely, levers include territorial coordination, financial incentives, local innovation, capacity-building, and citizen participation.

Resilient and sustainable development in Tarn-et-Garonne requires an integrated long-term strategy linking agriculture, water management, biodiversity, and social cohesion under a shared vision of climate resilience.

3.2.3 CS3 – Southern Great Plain (Hungary)

The Southern Great Plain region of Hungary is increasingly vulnerable to water scarcity, driven by rising temperatures, uneven and declining precipitation, and intensifying drought conditions during the summer months. These climatic pressures are compounded by the region's strong dependence on agriculture, which is particularly sensitive to water stress and declining groundwater levels. The agricultural sector, a cornerstone of the local economy, is already experiencing reduced crop yields and heightened uncertainty, threatening the livelihoods of local producers and the long-term viability of food production.

The region's water infrastructure is outdated and poorly maintained, resulting in significant water loss both in distribution systems and on agricultural fields. This inefficiency, coupled with institutional fragmentation and limited stakeholder coordination, exacerbates the challenges of climate adaptation. Social distrust, financial insecurity, and misaligned land use practices further hinder the implementation of effective solutions.

To avoid severe environmental, social, and economic consequences, a proactive and integrated approach to land and water management is essential. Climate change is expected to intensify these challenges, increasing water need and an intensive adaptation of cropping systems and land management. A combination of strategies is needed to safeguard long-term water security and agricultural resilience.

Key measures should include improving water use efficiency through modernised water allocation system, reducing infrastructure-related water losses, and promoting precision agriculture to optimize resource use. In parallel, the adoption of regenerative agricultural practices—such as soil restoration, legume crop rotation, and the protection and expansion of grasslands—can strengthen ecosystem services, improve soil water retention, and reduce vulnerability to drought. These actions should be complemented by systemic reforms in water governance, fostering multi-level coordination and stakeholder engagement to ensure coherent land, water, and agricultural policies.

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However, these solutions come with barriers and trade-offs. Upgrading infrastructure and implementing advanced farming technologies require significant financial investment and technical capacity, while social acceptance of new practices may be limited by entrenched norms and uncertainty in markets and policies. Addressing these challenges will require targeted financial support, knowledge-sharing platforms, and incentives for innovation, leveraging EU funding and local partnerships.

Finally, integrating these measures into regional climate adaptation plans and establishing a dedicated coordination body to monitor progress will be critical. By aligning local priorities with EU climate targets, the Southern Great Plain can transition toward a more resilient, sustainable future—one that secures water resources, sustains agricultural productivity, and protects the well-being of its communities.

3.2.4 CS4 – Valle d'Aosta (Italy)

The Valle d'Aosta is a mountain region defined by a delicate balance between economic development, natural heritage, and territorial identity. Its economy relies strongly on hydropower and tourism, but also on agriculture and livestock farming, which together sustain the fabric of local communities and preserve cultural traditions deeply rooted in the Alpine landscape.

The energy sector, predominantly based on hydropower, faces growing risks from prolonged droughts and rising temperatures, which reduce water availability and threaten production continuity. Addressing these challenges requires adaptive measures to improve water management, integrate new renewable sources, and enhance storage capacity and grid flexibility.

Tourism, closely tied to winter sports and outdoor activities such as trekking and mountaineering, is increasingly exposed to extreme climate events, ranging from heatwaves to strong winds, that compromise its attractiveness. The sector must evolve towards more sustainable and diversified models, building resilience through low-impact experiences, cultural valorization, and adaptive infrastructure.

Agriculture and livestock farming are essential pillars of resilience in Valle d'Aosta. Beyond their economic contribution, they safeguard landscapes, biodiversity, and the region's carbon absorption capacity. Maintaining a viable agricultural and livestock system is critical for climate adaptation and mitigation, ensuring that the territory continues to act as a natural carbon sink. To achieve this, policies must support sustainable farming practices, fair remuneration for farmers and breeders, and the integration of scientific knowledge and transparent data into decision-making.

The territory as a whole remains fragile, highly interconnected, and vulnerable to soil erosion, floods, and land degradation. Integrated territorial policies are therefore essential, ensuring coherent

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management of land, water, forests, and human settlements. Strengthening the right of people to "remain" in the region, through support for local families, farmers, and communities, must be a central objective of sustainable territorial governance.

A resilient and inclusive future for Valle d'Aosta depends on coherent and integrated climate policies, based on transparency, scientific rigor, and active stakeholder engagement. This requires adaptive planning tools, targeted incentives, and strong cross-sector collaboration, ensuring that ecosystem protection, technological innovation, and community well-being advance together towards a sustainable and shared future.

3.2.5 CS5 – Almería province (Spain)

The following policy statement is aligned with the storyline for Almería presented in section 4.3.5, but adapted to include the insights from EUC members in a coherent manner

The province of Almería is characterized by a semi-arid climate, making it especially vulnerable to severe water scarcity. This challenge is further intensified by the province's strong economic reliance on agriculture, which depends heavily on irrigation to offset the effects of its extremely dry conditions and historical over exploitation of aquifers. Horticultural production in particular, is widespread across the region and contributes significantly to the high demand for water. Agriculture's heavy reliance on groundwater extraction further aggravates the fragile hydrological system of the region. Furthermore, Almería lacks perennial rivers and depends primarily on aquifers and external sources like desalination or transboundary water to meet its water needs. However, overexploitation of aquifers increases the risk of saltwater intrusion from the sea, which can make the water unsuitable for irrigation and permanently compromise freshwater resources (Caparrós-Martínez et al., 2020). Another less-pressing risk facing the province is the increasing frequency and severity of heatwaves that affect the local population and the tourism sector, which can be at least partially mitigated by addressing some of the constituting factors of the risk of water scarcity.

To avoid severe environmental, social and economic consequences associated with further degradation of water availability, proactive measures must be taken. This is especially urgent as climate change intensifies and brings higher temperatures and reduced rainfall, which will likely increase the demand for irrigation and push water use beyond sustainable limits. A combination of strategies is needed to safeguard long-term water security. These include the expansion of desalination capacity, the treatment and reuse of wastewater, and improvements in irrigation efficiency. These measures can reduce dependence on groundwater and shift water sourcing toward more sustainable alternatives. However, desalinization and reuse of wastewater both pose challenges of social acceptability by the local

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population and those involved in agriculture. Farmers can be prone to be distrusting of treated wastewater for their crops, while citizens will question the energy required for desalinization as well as how to deal with the resultant salt residues from the process.

These solutions also have barriers and trade-offs that need to be evaluated before implementation. Both desalination and wastewater treatment are energy-intensive processes, leading to increased energy demand and potentially, higher greenhouse gas emissions, especially if the energy mix remains dependent on fossil fuels (Garcia-Caparros et al., 2017). However, this impact can be mitigated through a parallel increase in the share of renewable energy sources in the local energy system.

Finally, the integration of expanded irrigated cropland policy with improved water use efficiency, increased desalination, and enhanced wastewater reuse can support agricultural productivity while improving water management and ensuring water security. Policy makers and the agricultural sector should also consider adapting to the higher temperatures and lower precipitation rates by planting produce that is in season, as opposed to the propagation of a widespread intensification of agriculture through more irrigation, especially for produce that is not in season. This may however prove challenging for stakeholders in the agricultural sector, as this would necessitate a change in their business model, and might have an effect on food consumption and potentially food security.

3.2.6 CS6 – Azores (Portugal)

The Azores archipelago is an outermost European region where agriculture and tourism are key sectors of the economy. Both sectors depend on ecosystem services, particularly the availability of water resources and appealing natural landscapes. In the context of the current energy transition, today's climate policies must ensure balanced development for present and future generations.

Agriculture is primarily based on cattle farming to produce milk and meat. This activity makes a significant contribution to exports and is important to the economy and to those whose livelihoods depend on it. Climate change directly and indirectly threatens agricultural and livestock productivity. Adaptation solutions for the agricultural sector include practices such as crop rotation, intercropping, sustainable management of livestock and land to improve soil health, enhanced water storage and distribution, and investment in precision farming.

Energy is a critical component for all sectors and faces a dual challenge: the shift to low-carbon sources and the impacts of climate risks. With this transition, the energy system tackles broader challenges related to stability, reliability, and resilience. Adaptation and mitigation solutions should include the expansion and diversification of renewable energy through repowering of wind energy, the introduction

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of solar power, increased electricity storage capacity, and the promotion of electric mobility, in order to reduce reliance on external energy sources and lower carbon emissions.

Tourism and other co-dependent sectors face climate risks that may affect the destination's attraction. These risks include reduced water availability, weather conditions unfavourable to tourism activity, increased presence of invasive species, increase of coastal erosion, and ecosystem degradation. Adaptation solutions should include assessing the visitor's capacity of tourism sites, ecosystem restoration, expansion of protected areas, safeguarding water infiltration zones, and raising awareness among visitors and residents about environmental and resource impacts.

The main barrier to implementing solutions originates from the region's geographical situation. Specifically, the territory's isolation, dispersion, and insularity result in higher investment and maintenance costs for solutions; difficulties in acquiring critical mass; and challenges in the sustained growth of specialised labour. To facilitate implementation of solutions, transport efficiency and resilience must be improved, local knowledge and technical capacity enhanced, and the tax structure modified to be more appropriate. Measures to facilitate implementation of these solutions include increased financial transfers to the region; improved governance procedures; better conditions for retaining specialised labour; increased public awareness of climate issues; and more coherent policies.

The ecologically sustainable and economically viable development of the Azores requires an integrated approach aligned with sectoral strategies under a shared vision of climate resilience.

3.3 Storylines and scenarios to test LAMS with the Local SD model

This section reports the storylines created by each case study. They are based on the feedbacks provided by the stakeholders during the 5th consultation and in general on the most vulnerable sectors in their region. Based on the storyline, policy scenarios were built which are also included in this section for each case study. These scenarios were implemented in the local SD model and the results are reported in section 4.

3.3.1 CS1 – Gotland (Sweden): Navigating water scarcity: climate risks, land use and competing demands

The following topics were covered for storylines and scenarios definition:

Current situation and consequence of inaction

Gotland is Sweden's largest island, located in the middle of the Baltic Sea, with a land area of approximately 3,200 km². It is one of Sweden's less densely populated regions, although its population

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fluctuates greatly due to tourism. Each year, mainly during the summer, the island hosts around 1,4 million guest nights, making tourism, along with agriculture and the food industry, central to Gotland's economy. Gotland has a temperate climate, characterized by mild winters and warm summers, with most precipitation during the autumn and least during spring and early summer. This seasonal distribution does not align with peak water demand in summer, creating a mismatch between water availability and consumption. Long dry periods and increasingly frequent droughts, likely intensified by climate change, are putting further pressure on the island's already burdened water system. The island's geological history has shaped its present environmental challenges. Gotland is the remnant of ancient calcerous corals and sediment from the siluran period, and its bedrock is primarily composed of porous limestone and sandstone. The island has a rather subdued relief, with thin soil layers across much of the island, limited abilities to retain groundwater, as well as brackish groundwater along the coastlines. Therefore, Gotland is one of Sweden's most water-scarce regions, natural aquifers are shallow and easily depleted, especially during the dry summer months when water demand peaks due to tourism and irrigation needs. Agriculture covers about 31% of Gotland's land area, primarily used for livestock grazing and crop production. Forests occupy another 40%, much of which is managed by small-scale, independent foresters. While these sectors are vital to the island's rural economy, they also place a significant burden on water resources. Livestock farming, and crop irrigation have increasing water needs, especially during dry summers that is predicted to become dryer and hotter.

Proposed actions

To prevent escalating social, environmental, and economic consequences from worsening water scarcity, Gotland must adopt a combination of proactive and integrated measures. As climate change intensifies, longer dry periods, reduced summer rainfall, and increased evapotranspiration will heighten demand for irrigation and place further pressure on already limited groundwater resources. Ensuring long-term water security will require both technical and behavioural solutions. Key strategies include the development of rainwater harvesting systems, storage infrastructure such as irrigation dams, and the reuse of greywater and treated wastewater. While precision irrigation and water-saving technologies offer significant benefits, their high capital and technical demands may pose challenges for smaller farmers and municipalities. Additionally, increasing water retention in the landscape through nature-based solutions must be carefully planned to avoid land-use conflicts with agriculture and development. These measures must be supported by local renewable energy to offset the added energy demand from water infrastructure. Recognizing water as a shared and finite resource will be essential to reduce sectoral conflicts and promote collective resilience.

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Drivers and Barriers

The proposed solutions for Gotland also face implementation barriers and trade-offs that must be addressed. Rainwater harvesting and greywater reuse require upfront investment, technical capacity, and long-term maintenance, which can be challenging for small landowners and rural municipalities. In addition, while irrigation dams and water reuse infrastructure can reduce pressure on aquifers, they may alter land availability and raise concerns around landscape impact or water quality. These challenges can be mitigated through supportive policy frameworks, funding mechanisms, and stakeholder engagement.

Furthermore, combining targeted irrigation expansion with improved water use efficiency, nature-based solutions like wetland restoration, and the protection of recharge zones offers a path to climate-resilient agriculture. If paired with renewable energy development—such as rooftop solar or bioenergy—these measures can enhance water security, reduce emissions, and support Gotland's broader transition to sustainable land and resource management.

Policy scenarios

Table 7 outlines the range of policies simulated within the local System Dynamics modelling for Gotland, tested under different implementation intensities—low, medium, and high—according to the values indicated. All policy scenarios were modelled under three climate futures: SSP1 (RCP 2.6), SSP2 (RCP 4.5), and SSP5 (RCP 8.5). The selected policies target key water-related challenges identified by local stakeholders, particularly in the context of seasonal water scarcity and increasing drought risks. Two of the policies focus on improving water-use efficiency, both in domestic and agricultural contexts, while a third explores the increased use of treated wastewater across all sectors under high-intensity scenarios. These policy levers are designed to reduce pressure on Gotland's shallow aquifers and enhance long-term water resilience. The outcomes of the SD model simulations based on these policy combinations and climate pathways inform the results reported in Section 4.1.1 and serve as input for integrated adaptation planning on the island.

Table 7: Policies and respective values changes, in percentage, comparing with the present level, for Low, Medium and High scenarios, in Gotland.

Policy	Low	Medium	High
Water use efficiency in domestic uses	30%	50%	50%
Water use efficiency in agriculture	30%	50%	50%
Increased use of treated waste water	0	0	50% (type 3- all uses)

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Policy	Low	Medium	High
Climate assumption	SSP1-2.6 SSP2-4.5 SSP5-8.5	SSP1-2.6 SSP2-4.5 SSP5-8.5	SSP1-2.6 SSP2-4.5 SSP5-8.5

Key outputs in Gotland to be analysed

Thanks to the simulation of scenarios using the local SD model, the following variables could be analysed and discussed in order to understand how the selected policies could modify their future trends:

- Water demand.
- Water supply.
- Water security.
- Yearly water flowing to sea.
- Groundwater resources.
- Wastewater treatment energy demand.

3.3.2 CS2 – Tarn-et-Garonne (France): Towards a sustainable future from saving water for irrigation to greening the energy sector

The following topics were covered for storylines and scenarios definition:

Current situation and consequence of inaction

The Tarn-et-Garonne, located in the Occitanie region in southwestern France, is an inland department known for its diverse landscapes, ranging from the Quercy hills to the Garonne valley. The territory is characterized by a temperate oceanic climate with Mediterranean influences, marked by warm summers, mild winters, and occasional drought periods in summer and early autumn. Annual precipitation averages between 600 and 900 mm, with higher rainfall in the hills and plateaus, especially in spring and autumn.

Agriculture is a key economic sector in the department, both in terms of land use and employment. A significant share of the population is engaged in farming, with activities focused on fruit production (notably apples, plums, and kiwis), market gardening, and cereal crops such as maize and sunflower. The vegetable and fruit sector in particular plays a vital role in local and national food supply chains and contributes substantially to the department's agricultural output. While tourism is less dominant than in coastal or mountainous regions, it still contributes to the economy through rural tourism, heritage sites, and gastronomy.

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As highlighted in the impact chains of D6.1, stakeholders in Tarn-et-Garonne are increasingly worried that rising temperatures, combined with more frequent heatwaves and erratic rainfall patterns, will amplify local vulnerabilities.

Agricultural sector: Hotter conditions and frequent summer droughts could severely reduce market garden and forage maize yields, while thermal stress will intensify for livestock like bovines. This threatens both productivity and economic viability for farms already struggling with rising input costs. Water resources: Historically periodic, water scarcity could become chronic, with groundwater recharge diminished and river flows dropping more sharply in summer. Salinisation risk may spread from agricultural areas to drinking water supplies, leading to higher extraction costs, increased reliance on treated sources, and tensions over water allocation between farming, households, and ecosystems.

Tourism and rural attractiveness: Tarn-et-Garonne's appeal for rural tourism, including gastronomy, river-based leisure, and heritage visits, may be undermined by water restrictions and unfavourable weather (heatwaves, lower river levels, intense rainfall events). Invasive species, soil erosion on riverbanks, and loss of biodiversity could further degrade the very landscapes that draw visitors.

Natural hazards and land management: Although drier summers reduce some flooding risk, heavy rainfall events—now more intense and unpredictable—could trigger flash floods, soil erosion, and even landslides in hilly Quercy areas, especially where slopes are poorly vegetated or mismanaged.

Energy systems: Higher ambient temperatures reduce the efficiency of hydro and thermal power operations, while increasing demand for cooling in summer. Greater variability in water availability and solar radiation patterns will challenge the reliability of the renewable energy mix (hydro, solar, wind), necessitating infrastructure adaptation and grid balancing. Inaction therefore risks exacerbating food security, water equity, landscape conservation, and energy resilience—all central pillars of sustainable development for Tarn-et-Garonne.

Proposed actions

To prevent these impacts, solutions need to be implemented, starting with increasing water use efficiency in agriculture (especially in orchards and irrigated crops), domestic use, and the economic sectors (industry, services). Complementary actions such as treated wastewater use for irrigation, particularly during summer droughts, can reduce pressure on freshwater sources. The change of irrigated crops to less water-intensive species and the deployment of regenerative agriculture practices can also mitigate water scarcity while improving soil health.

To preserve the landscape and prevent degradation, the protection of grasslands, especially in the Causses and Quercy areas, should be prioritized, together with soil management in grasslands through

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regenerative grazing. Afforestation and forest plantations on marginal or erosion-prone land can further enhance water retention and carbon sequestration. The protection of primary and managed forests is key to maintaining local climate regulation and biodiversity. In cropland areas, precision agriculture combined with a change of rainfed crops adapted to climate conditions can improve yields and input efficiency. Protection of croplands from urban sprawl is also necessary to secure food production in the long term.

On the energy side, rooftop photovoltaics and increased ground-mounted photovoltaics should be deployed with care to avoid land-use conflicts, particularly on already artificialized land. Where suitable, floatovoltaics deployment on irrigation reservoirs can provide co-benefits for evaporation reduction and energy generation. Repowering PV energy production plants and wind farms deployment (in low-conflict zones) contribute to decarbonization targets. Finally, biomass extraction for energy use should be balanced with forest conservation and soil protection needs.

Drivers and barriers

Enablers / Drivers:

- Strong territorial coordination.
- Local innovation and capacity-building of advisors.
- Citizen engagement.
- Growing public awareness of ecological and climate issues.

Barriers:

- Fragmented policies.
- Heavy administrative procedures.
- Complex technical knowledge requirements.
- Limited financial support; social tensions around water allocation.

Policy scenarios

Table 8 outlines the range of policies simulated within the local System Dynamics modelling, under different implementation intensities ranging from *low* to *high* according to the respective values indicated. Additionally, all implementation intensities were modelled under climate assumptions SSP 1 (RCP 2.6), SSP 2 (RCP 4.5) and SSP 5 (RCP 8.5). The policies considered for the creation of scenarios

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belongs to the most relevant sectors for Tarn-et-Garonne as specified in the storyline. These sectors are water management, agriculture, forestry and energy.

Table 8: Policies and respective values changes, in percentage, comparing with the present level, for Low, Medium and High scenarios, in Tarn-et-Garonne.

Policy	Low	Medium	High
Improved water use efficiency [domestic, industrial, agriculture]	25%	50%	75%
Increase use of treated wastewater	0	0	60% (type 3- all uses)
Deployment of regenerative agriculture	10%	30%	50%
Precision agriculture	10%	30%	50%
Regenerative grazing	30%	60%	100%
Afforestation	10%	20%	30%
Protection of primary and managed forests, grassland	30%	60%	100%
Rooftop photovoltaics	1500MW	1500MW	1500MW
increased ground-mounted photovoltaics	0	50	100MW
Photovoltaics deployment	100MW	100MW	100MW
Repowering PV energy production plants	0	0	60%
Wind farms deployment	100MW	500W	1000MW

Key outputs in Tarn-et-Garonne to be analysed

Thanks to the simulation of scenarios using the local SD model, the following variables could be analysed and discussed in order to understand how the selected policies could modify their future trends:

- Water demand and supply.
- Agriculture crop area.
- Percentage of agriculture in transition (regenerative and precision agriculture).
- Energy demand and generation.
- Wood extraction and carbon capture.

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3.3.3 CS3 – Southern Great Plain (Hungary): Adapting to drought environments: challenges and opportunities in agriculture

The following topics were covered for storylines and scenarios definition:

Current situation and consequence of inaction

The increasing water stress - due to the decreasing trend of precipitation in the summer months and its uneven temporal distribution, and the increase of temperature (average and the number of hot days) during the growing season, combined with the increasing water demand of all sectors poses the threat of water scarcity in the case study region during the summer term especially. The water resource deficit is expected to increase by 30-50% in the second half of the century.

Effects of climate change intensify the effects of drought in the region particularly in the summer periods, having significant impacts on the local ecosystem services. It increases climate sensitivity of every element of the water resource system, in the soils and land consequently. This leads to direct and indirect effects on multiple sectors, of which agriculture is the most relevant and exposed one. The view of local stakeholders and the research community points out that the most serious realisation of climate change effects is the decrease of crop yields, making it one of the most important climate risks, considering its local and national weight. It means that local actors depending on this sector are already experiencing great damage, and see their future livelihoods rather uncertain and at high risk.

Adaptation strategies, though rational, appear to stay on the level of mitigation in most cases and do not necessarily address fundamental causes, routed in systemic management, cooperation issues and finance. These affect further (and affected by) the social norms and strategies of the local stakeholders regarding resource allocation and lifestyle, increasing financial insecurity, distrust, and lowering social capacity.

Proposed actions

The Southern Great Plain region would benefit from targeted policies such as the systemic and effective support of *regenerative agriculture*. By transitioning to such production approach, local producers could fight and overcome the climate change effects and risk in the agri sector with more success. Regenerative approaches could help developing a more resilient system of production with decreased climate vulnerability and decreased sensitivity to water stress and drought. In combination with the *protection of grasslands* they could be effective for a more optimal water management system. Protection of grassland should mean not only the preserve of grass areas in the context of CS3, but also the support of its increase within the territory, typically beyond the riparian zones, allowing temporal

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inundation and better infiltration. Giving space for such activities is important for the support of keeping water in the region.

Policies targeting *water use efficiency* in agriculture together with *precision agriculture* could yield in significant benefit for the region. Precision-based practices and solutions could help increase resource efficiency, which could yield in significant benefit for the region. Supporting policies regarding water use efficiency in agriculture need to focus not only on the utilisation side but also on the provision as well. Regional water loss due to the condition of infrastructure elements is extremely high due to the poor quality and lack of maintenance. Effective water use would mean decreasing water loss at the infrastructure stage, and also on the fields. The more effective use of water by the farmers would also yield in more optimal quantities of water stocks and support a more responsible management.

Drivers and barriers

Mechanisms and important characteristics of the region on multiple levels have been identied as barriers of adaptation – blocking implementation of adaptive measures, directly or indirectly. Such include the centralised and top-down approach of the local governance system, the lack of effective stakeholder participation in policy formation; the fragmented institutional system around land management-remated sectors and lack of coherent comminucations. The inefficient financial support scheme in the agrarian sector that locks unadaptive management practices, and the landuse management system that is frequently not in line with local biophysical/climatic characteristics. On the social dimension, lack of trust in general, and uncertainty regarding market conditions and coherent policies.

Policy scenarios

Table 9 outlines the range of policies simulated within the local System Dynamics modelling, under different implementation intensities ranging from *low* to *high* according to the respective values indicated. Additionally, all implementation intensities were modelled under climate assumptions SSP 1 (RCP 2.6), SSP 2 (RCP 4.5) and SSP 5 (RCP 8.5). The policies concern water management and agriculture. The output of the local SD model based upon the policies below under different intensities will form the basis for the results reported below in Section 4.1.3, if they are indeed significant for Southern Great Plain.

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Table 9: Policies and respective values changes, in percentage, comparing with the present level, for Low, Medium and High scenarios, in Southern Great Plains.

Policy	Low	Medium	High
Regenerative agriculture	10%	35%	50%
Water use efficiency in agriculture	40%	60%	80%
Precision agriculture	10%	35%	50%

Key outputs in Southern Great Plain to be analysed

Thanks to the simulation of scenarios using the local SD model, the following variables could be analysed and discussed in order to understand how the selected policies could modify their future trends:

- Water demand – total and in agriculture.
- Water supply.
- Fertiliser demand.
- Carbon emission.
- Nitrogen emission.
- Yields from rainfed and irrigated land.

3.3.4 CS4 – Valle d'Aosta (Italy): Navigating climate and resource pressures: water, energy and land use

The following topics were covered for storylines and scenarios definition:

Current situation and consequence of inaction

Valle d'Aosta, located in north-western Italy, is the country's smallest and least densely populated region, with a land area of just over 3,200 km². Despite its size, it plays a crucial role in Italy's alpine system, with an economy strongly dependent on tourism, hydropower, agriculture, and livestock. Tourism peaks both in summer, when visitors are attracted to hiking and alpine landscapes, and in winter, when ski resorts dominate the economy. Agriculture, while covering only a limited share of land due to the mountainous terrain, is deeply rooted in traditional livestock grazing and specialized crops, supported by irrigation channels dating back centuries. These multiple land uses compete for scarce natural resources in an environment increasingly stressed by climate change.

The region's climate is highly variable, ranging from continental conditions in valley floors to alpine and tundra climates at higher altitudes. Precipitation is unevenly distributed, with internal valleys lying in rain shadows that create semi-arid conditions, and snowmelt and glacier-fed springs serving as crucial

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water sources. However, glaciers are retreating rapidly, reducing long-term water availability, while seasonal demand continues to rise. Summer droughts and hotter conditions increase irrigation needs for grasslands and crops, while winter tourism depends on artificial snow production that requires large amounts of water. At the same time, hydropower, which has historically provided both local energy security and a major share of the region's income, faces growing uncertainty as river flows fluctuate.

These pressures are compounded by land-use tensions. Agriculture, livestock, and forestry are vital to maintaining rural communities and cultural landscapes, but they must now coexist with expanding renewable energy infrastructure. Regional policies promote the repowering of photovoltaic plants, installation of rooftop photovoltaics on residential, agricultural, and tourism buildings, and selective deployment of ground-mounted PV and wind farms. Hydropower modernization is another central pillar, aiming to maintain production levels while reducing ecological impacts. Yet these developments risk clashing with the protection of natural land, as nearly a third of the region is covered by Natura 2000 sites and national or regional parks such as Gran Paradiso and Mont Avic.

Soil management in grasslands is emerging as a key challenge, since maintaining healthy alpine pastures can improve infiltration, reduce erosion, and enhance water retention, but requires consistent practices and support for farmers who often resist reducing irrigation or altering traditional methods. Precision agriculture, grey-water reuse, and wetland restoration could ease seasonal stress, yet they demand financial investment and technical skills that small-scale farms struggle to mobilize. Similarly, enhancing water storage and reuse systems could help reconcile the mismatch between winter precipitation and summer demand, but new infrastructure often competes for land and raises concerns about visual and ecological impacts in a landscape strongly tied to identity and tourism.

Energy-water interactions also pose trade-offs. Repowering PV, expanding rooftop solar, and developing wind farms can support climate-neutral energy, but water pumping, treatment, and storage may increase electricity demand during droughts, precisely when hydropower output declines. Coordinating renewable expansion with water management is therefore critical. Aligning photovoltaic deployment with existing built surfaces, integrating solar into ski and tourism infrastructure, and combining pumped-storage hydro with renewable capacity are possible strategies to stabilize both water and energy systems.

Future resilience in Valle d'Aosta will depend on the ability to reconcile these competing pressures through cross-sectoral collaboration. Tourism, agriculture, hydropower and environmental conservation must recognize water as a limited and shared resource, while regional policies will need to balance ambitious renewable energy targets with the protection of fragile alpine ecosystems. Changes in behaviour, improved soil and grassland management, and investment in innovative water-

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saving technologies will be as important as infrastructural upgrades. The success of this transition lies in finding equilibrium: protecting the natural heritage that draws millions of visitors each year, while enabling a green energy transition and ensuring long-term water security for communities, farms, and ecosystems across the valley.

Proposed actions

To strengthen climate resilience in Valle d'Aosta, proposed actions should focus on integrated land, water, and energy management. Priority should be given to sustainable grassland practices, soil conservation and precision agriculture, combined with wetland restoration to reduce irrigation pressure. Expanding rooftop photovoltaics and modernizing hydropower plants are "no-regret" options, while the selective deployment of ground-mounted PV and wind projects must be carefully aligned with ecological constraints.

In the tourism sector, adaptation strategies must promote diversification away from snow-reliant models, enhancing summer eco-tourism, cultural tourism, and low-impact activities. At governance level, cross-sectoral collaboration and participatory planning should ensure that energy transition, water security, and ecosystem protection advance together.

Drivers and barriers

Several drivers can support the implementation of these actions: Valle d'Aosta's strong tradition of community-based water management (e.g., the historic Rûs canals), the region's dependence on hydropower as a clean energy source, and the presence of Natura 2000 sites and national parks that provide a strong regulatory and ecological framework. The attractiveness of the region as a tourism destination also creates opportunities to integrate sustainability into visitor experiences. However, barriers remain significant: fragmented governance structures, limited financial and technical capacity for small farms, and potential conflicts between renewable energy expansion and the protection of fragile alpine ecosystems. Resistance to change among local actors, particularly regarding irrigation practices and land management traditions, also poses challenges. Balancing competing land uses, while ensuring fair remuneration for farmers and community acceptance of new infrastructure, will be decisive for the long-term success of climate adaptation and mitigation policies.

Policy scenarios

Table 10 outlines the range of policies simulated within the local System Dynamics modelling, under different implementation intensities ranging from *low* to *high* according to the respective values indicated. Additionally, all implementation intensities were modelled under climate assumptions SSP 1 (RCP 2.6), SSP 2 (RCP 4.5) and SSP 5 (RCP 8.5). In the Valle d'Aosta, selected policy options reflect the

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need to reconcile energy transition with ecosystem protection and land management. The expansion of photovoltaics, both through rooftop installations and carefully sited ground-mounted plants, together with the repowering of existing PV facilities, can strengthen renewable production with limited land pressure. The deployment of wind farms and the modernization of hydropower plants remain key for energy security, though they must be planned in line with ecological constraints and fluctuating water availability. On the environmental side, the protection of primary and managed forests is essential to preserve biodiversity, carbon storage, and landscape quality, while improved soil management in alpine grasslands will enhance water retention, reduce erosion, and support traditional livestock systems. Together, these measures can balance economic vitality, resource security, and ecosystem resilience in a fragile alpine setting.

Table 10: Policies and respective values changes, in percentage, comparing with the present level, for Low, Medium and High scenarios, in Valle D'Aosta.

Policy	Low	Medium	High
Increase of Photovoltaics on land (ground mounted)	0%	100MW	100MW
Rooftop photovoltaics	50MW	50MW	50MW
Repowering PV energy production plants	0%	0%	50%
Wind farms deployment	20MW	50 MW	100MW
Hydropower deployment	222MW (20%)	555 MW(50%)	1110MW (maximum limit)
Protection of primary forests, managed forests and natural land	0%	0%	100%
Soil management in grassland	20%	50%	100%

Key outputs in Valle d'Aosta to be analysed

Thanks to the simulation of scenarios using the local SD model, the following variables could be analysed and discussed in order to understand how the selected policies could modify their future trends:

- Solar PV installed
- Total energy generation
- Energy emissions avoided due to solar PV productions
- Share of grasslands under regenerative grasslands
- Soil carbon stock change grassland

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3.3.5 CS5 – Almería province (Spain): Optimizing water management strategies

The following topics were covered for storylines and scenarios definition:

Current situation and consequence of inaction

The province of Almería is characterized by a semi-arid climate, making it especially vulnerable to severe water scarcity. As noted in D6.1, this challenge is further intensified by the province's strong reliance on agriculture, which depends heavily on irrigation to offset the effects of its extremely dry conditions. Horticultural production, in particular, is widespread across the region and contributes significantly to the high demand for water. Agriculture’s heavy reliance on groundwater extraction further aggravates the fragile hydrological system of the region. Almería lacks perennial rivers and depends primarily on aquifers and external sources like desalination or transboundary water to meet its water needs. Overexploitation of aquifers increases the risk of saltwater intrusion from the sea, which can make the water unsuitable for irrigation and permanently compromise freshwater resources (Caparrós-Martínez et al., 2020).

Proposed actions

To avoid severe environmental, social and economic consequences associated with further degradation of water availability, proactive measures must be taken. This is especially urgent as climate change intensifies, bringing higher temperatures and reduced rainfall, which will likely increase the demand for irrigation and push water use beyond sustainable limits. A combination of strategies is needed to safeguard long-term water security. These include the expansion of desalination capacity, the treatment and reuse of wastewater, and improvements in irrigation efficiency. These measures can reduce dependence on groundwater and shift water sourcing toward more sustainable alternatives.

Drivers and barriers

However, these solutions have barriers and trade-offs that need to be evaluated before implementation. Both desalination and wastewater treatment are energy-intensive processes, leading to increase energy demand and potentially, higher greenhouse gas emissions, especially if the energy mix remains dependent on fossil fuels (Garcia-Caparros et al., 2017). However, this impact can be mitigated through a parallel increase in the share of renewable energy sources in the local energy system.

Finally, the integration of expanded irrigated cropland policy with improved water use efficiency, increased desalination, and enhanced wastewater reuse can support agricultural productivity while improving water management and ensuring water security.

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Policy scenarios

Table 11 outlines the range of policies simulated within the local System Dynamics modelling, under different implementation intensities ranging from *low* to *high* according to the respective values indicated. Additionally, all implementation intensities were modelled under climate assumptions SSP 1 (RCP 2.6), SSP 2 (RCP 4.5) and SSP 5 (RCP 8.5). Three out of the four policies are aligned with the water management sector, touching not only on water sourcing, but also use efficiency for both domestic and industrial (agriculture) use. The final policy is aligned towards the agriculture industry specifically, highlighting the policy suggestion to incentivise and facilitate a transition towards irrigated crops instead of rainfed produce. The output of the local SD model based upon the policies below under different intensities will form the basis for the results reported below in section 4.1.5, if they are indeed significant for the province of Almería.

Table 11: Policies and respective values changes, in percentage, comparing with the present level, for Low, Medium and High scenarios, in Almería.

Policy	Low	Medium	High
Improved water uses efficiencies (agriculture, domestic and economy)	30%	60%	100%
Expansion of desalination capacity	50 Hm^3/year	100 Hm^3/year	200 Hm^3/year
Increase wastewater treatment and reuse	25%	50%	90%
Increment of cropland irrigated demanded	25%	50%	90%

Key outputs in Almería to be analysed

Thanks to the simulation of scenarios using the local SD model, the following variables could be analysed and discussed in order to understand how the selected policies could modify their future trends:

- Request from groundwater extraction.
- Land distribution (increase of irrigated cropland).
- Water security.
- Energy demand related with desalination and water treatment.
- Emissions related with energy.

3.3.6 CS6 – Azores (Portugal): Tackling cross sectoral challenges in isolated islands

The following topics were covered for storylines and scenarios definition:

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Current situation and consequences of inaction

The Azores, a 9-island archipelago in the North Atlantic Ocean, is a Portuguese Autonomous Region and an *European Outmost Region* which is isolated from the mainland by approximately 1500 km. The islands themselves are very heterogeneous with unique geophysical characteristics. The climate is characterized by a temperate moist climate, with temperate summers and no marked dry season and a wet winter (Carvalho et.al, 2022).

The agriculture and tourism industries are the main economic drivers for the archipelago (SREA, 2023). A lot of people (8% of the labour force) depend on agricultural activities which are mostly concentrated to bovine cattle (for meat and milk production) and the forage maize, used for cattle feed. This economic activity significantly contributes to the region's exports.

As noted in the impact chains of D6.1, local stakeholders are concerned with future higher temperatures combined with high humidity resulting in different impacts. Such is the case of reduced forage maize production and thermal stress to bovines for the agriculture sector and loss of tourism destination attractiveness. Moreover, future climate may make the currently localized water scarcity and groundwater salinisation problems (REAA, 2019) more frequent and widespread, which may result in high water costs for agriculture and human consumption (especially in the summer months). Tourism may also suffer and contribute to water scarcity, unfavourable weather conditions for tourism activities, increase of invasive species, coastal erosion and ecosystems degradation, on which this sector depends on. Excessive precipitation events may become worse and more frequent, leading to more erosion and landslides, which are aggravated by unsuitable land use options. The increase of temperature will also affect the efficiency of energy production and distribution (Encarnação-Coelho et.al, 2017), as well as affecting energy demand. Variability of renewable energy resources like solar, hydro and wind may increase the burden of energy quality.

Proposed actions

To prevent these impacts, solutions need to be implemented, starting with water use efficiency increase in agriculture (PEPAC, 2023-2027), tourism and domestic sectors together with protection of grasslands for the cattle and their production. Intercropping and precision agriculture is considered necessary. Adequate soil management with protection of primary forest and afforestation will improve the water retention and prevent landslides or erosion. Increase water availability can prevent water storage in future drought and hot periods, together with the higher use of treated wastewater, both focused on agriculture and tourism sectors. Because the tourism sector needs to limit the load factor, the protection of natural land should be included. The energy sector is already aiming to implement

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repowering wind production plants (EDA,2025) as to avoid unnecessary environmental impacts and land use issues. Deploying more photovoltaic energy (EDA,2025) should be accomplished along with the implementation of more energy storage which is important in the context of islands, namely increase system resilience and decrease the dependency to external energy sources.

Drivers and barriers

The main barrier of the implementation of solutions in Azores is the isolation and dispersion of the territory and the challenges that come with this. There are high investment and maintenance costs, aggravated with a lack of qualified personnel, which is associated with difficulties in obtaining critical mass of people and capital. This is further aggravated by difficulties related to governance. Social acceptance is a critical factor to implement solutions which change business models and life standards across different sectors. Enablers include better governance agility and efficiency, more intersectoral coherence of policies, fiscal regimes favourable to green practices, local knowledge and technical capacity improvement and retention, increased funds for financing and increase of people climate awareness (DMO, 2021).

Policy scenarios

Table 12 outlines the range of policies simulated within the local System Dynamics modelling, under different implementation intensities ranging from *low* to *high* according to the respective values indicated. Additionally, all implementation intensities were modelled under climate assumptions SSP 1 (RCP 2.6), SSP 2 (RCP 4.5) and SSP 5 (RCP 8.5). The designated policies for Azores cover important sectors as for example, tourism and water, with the protection of primary forest, natural land and afforestation. For agriculture and energy sectors the selected policies are precision agriculture and photovoltaic energy on land. The level of implementation influences the values in future, from, for example, 25% increase of protection of grasslands and cropland, in the Low scenario, to 75% increase, in High scenario. The output of the local SD model based upon the policies below under different intensities will form the basis for the results reported below in section 3.1.5, if they are indeed significant for the province of Almería.

Table 12: Policies and respective values changes, in percentage, comparing with the present level, for Low, Medium and High scenarios, in Azores.

Policy	Low	Medium	High
Protection of primary forest + natural land	30%	60%	100%
Protection of grasslands + protection of cropland	25%	50%	75%

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Policy	Low	Medium	High
Afforestation	30%	60%	100%
Precision agriculture	30%	60%	100%
Photovoltaic energy on land	100 MW	300 MW	500 MW

Key outputs in Azores to be analysed

Thanks to the simulation of scenarios using the local SD model, the following variables could be analysed and discussed in order to understand how the selected policies could modify their future trends:

- Agricultural production
- Meat production
- Gross Value Added per sector
- Energy production
- Renewable energy share
- Fossil fuels saved
- Water consumption/use
- Greenhouse gases emissions
- Terrestrial protected land area
- Forest and semi-natural areas
- Available water capacity in the soil

4 Analysis of scenario results for each storyline in each case study

This section presents and analyses the main results of the simulation of different policy implementation scenarios. To analyse these changes, it is important to note that our baseline can be established according to three future socioeconomic scenarios: SSP1-2.6, SSP2-4.5, and SSP5-8.5. These serve as the initial assumptions of the simulation with the model and, as such, define the behaviour of all other variables within it. It should be emphasized that SSP2-4.5 is used as the Business as Usual (BAU) scenario, in which population and climate trends follow the projections derived from historical data.

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4.1.1 CS1 – Gotland (Sweden)

The scenario analysis for Gotland demonstrates that predicted precipitation levels will remain sufficient to meet increasing water demands, even under the extreme climate scenario SSP5-8.5. This scenario includes significant population growth and rising temperatures, which typically lead to higher water consumption. These findings suggest that the central challenge for Gotland is not the quantity of precipitation, but rather the capacity to retain and manage freshwater resources, particularly in groundwater aquifers and surface water bodies.

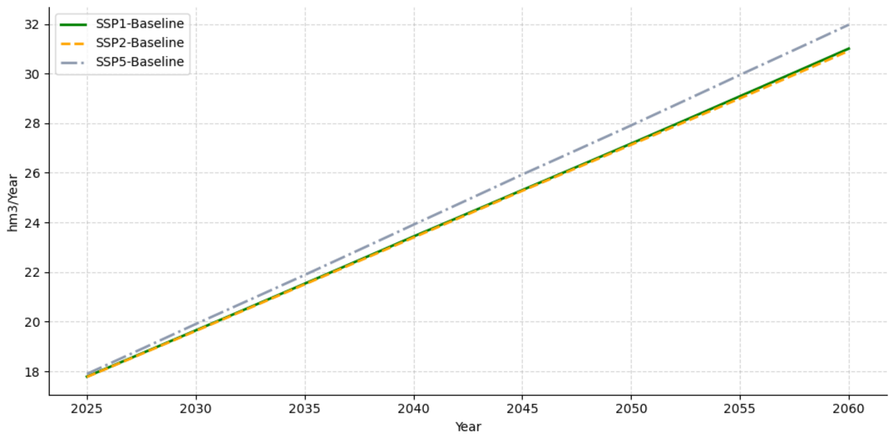

Figure 4.1: Total water demand for 3 climate scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5) with no policies applied (baseline) in Gotland.

Total water demand, as projected across three climate scenarios with no additional policy interventions, rises significantly under SSP5. This is particularly evident in the high-development scenario where demographic and economic pressures are most intense. Despite this, the corresponding water supply figures indicate that natural hydrological inputs, principally precipitation, remain sufficient to meet demand, assuming that the underlying ecological and hydrological systems are preserved and not overexploited. While annual water balance seems secure across the SSP scenarios, seasonal distribution of both precipitation and demand is likely to be uneven. Gotland, like many northern European regions, is expected to face longer dry spells in spring and summer, when both agricultural and tourism-related water demand peaks. The current analysis focuses on yearly aggregates, which obscures critical seasonal mismatches that stresses the system.

The scenario results clearly show that precipitation is not the limiting factor for water availability on Gotland. Instead, challenges lie in the effective capture, storage, and reuse of water resources, along with the sustainability of groundwater systems. To improve long-term resilience and sustainability, water management strategies should focus on new systems for collecting, storing, and reusing water, as well as land-use reforms, improved water use efficiency and awareness of the issue.

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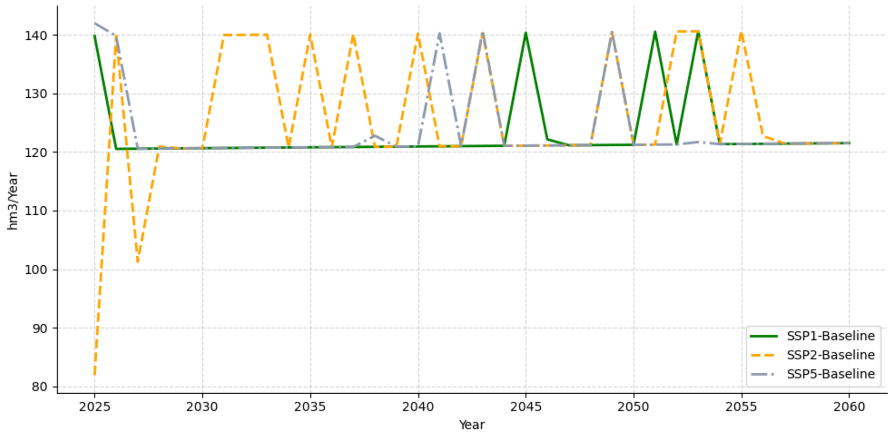

Figure 4.2: Yearly water supply for 3 climate scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5) with no policies applied (baseline) in Gotland.

The figure below indicates substantial surface water runoff to the sea and reduced groundwater recharge, suggesting limited infiltration capacity. Gotland's limestone geology and shallow soils naturally limit percolation, but this is exacerbated by land-use changes, including urbanisation, compaction from agriculture, and drainage modifications. These processes reduce the land's sponge function, decreasing the effectiveness of natural aquifer recharge.

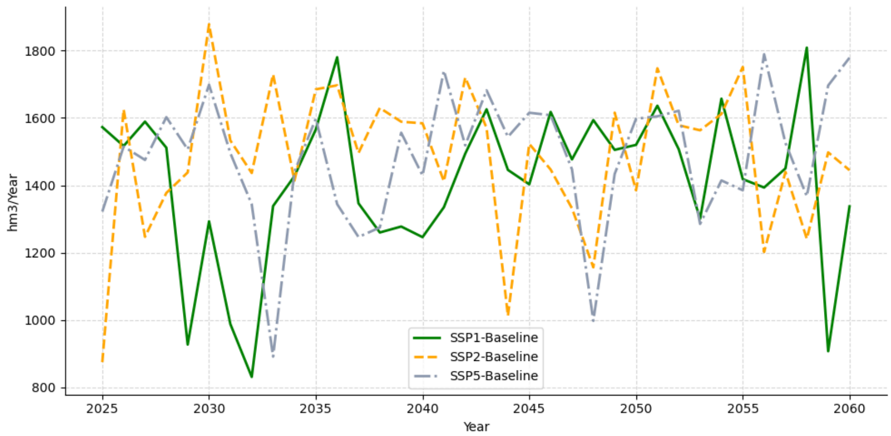

Figure 4.3: Yearly water flowing to sea for 3 climate scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5) with no policies applied (baseline) in Gotland.

The figures indicate substantial surface water runoff to the sea and reduced groundwater recharge, suggesting limited infiltration capacity. Gotland's limestone geology and shallow soils naturally limit percolation, but this is exacerbated by land-use changes, including urbanisation, compaction from agriculture, and drainage modifications. These processes reduce the land's water retention function, decreasing the effectiveness of natural aquifer recharge.

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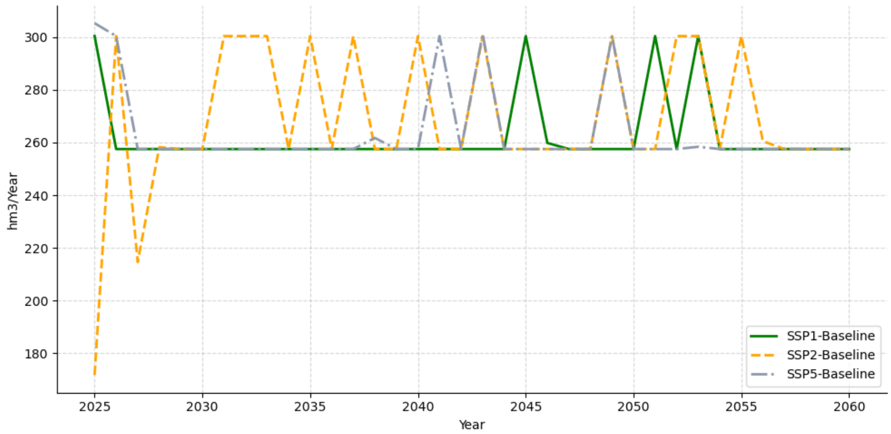

Figure 4.4: Yearly water infiltrating to aquifer for 3 climate scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5) with no policies applied (baseline) in Gotland.

Figure 4.5 show the modelling results using the most extreme climate scenario (SSP5) for the policy scenarios with Low, Medium and High implementation of policies to reduce water scarcity.

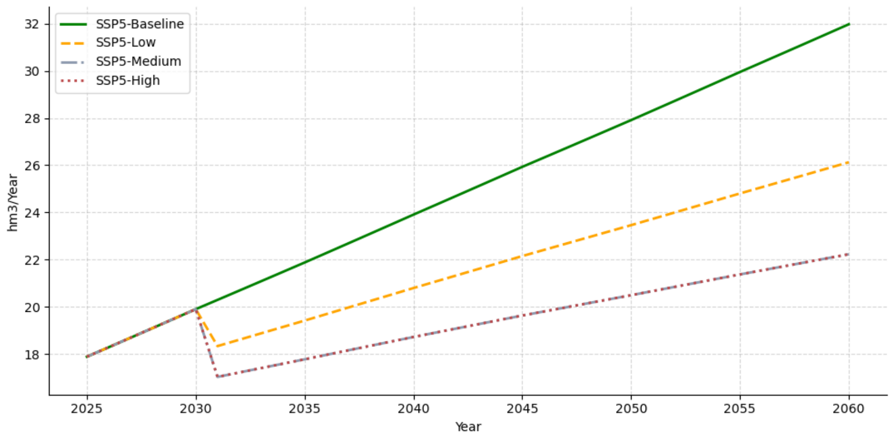

Figure 4.5: Total water demand for climate scenario SSP5-8.5 considering Baseline, Low, Medium and High level of policy application in Gotland.

Figures below showing groundwater dynamics reveal a concerning trend: reduced groundwater resources under SSP5, which may reflect altered infiltration conditions due to climate change and land-use pressures. Additionally, significant volumes of water continue to run off into the sea, representing a loss of potentially usable freshwater. These outflows underline the importance of investing in retention infrastructure and nature-based solutions such as wetlands and managed aquifer recharge systems.

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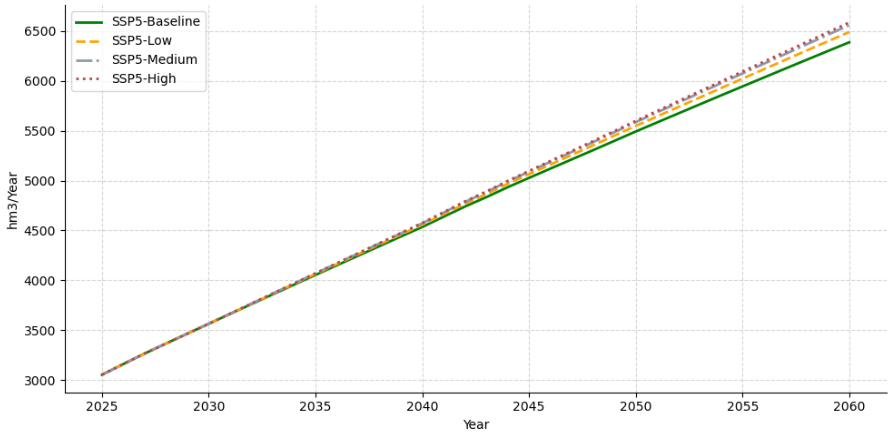

Figure 4.6: Groundwater resources for climate scenario SSP5-8.5 considering Baseline, Low, Medium and High level of policy application in Gotland.

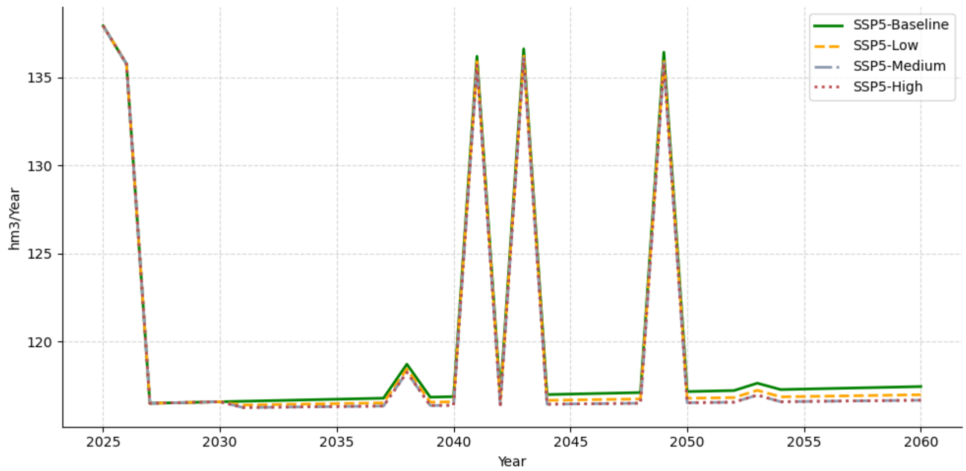

Figure 4.7: Groundwater input for climate scenario SSP5-8.5 considering Baseline, Low, Medium and High level of policy application in Gotland.

Domestic water demand is expected to rise in line with population growth, figure below, contributing to increased pressure on water treatment infrastructure. Furthermore, energy demand for wastewater treatment also grows, particularly under SSP5, due to the larger volumes of water requiring processing. These trends point to the need for integrated planning across the water and energy sectors, especially in insular and resource-sensitive regions such as Gotland.

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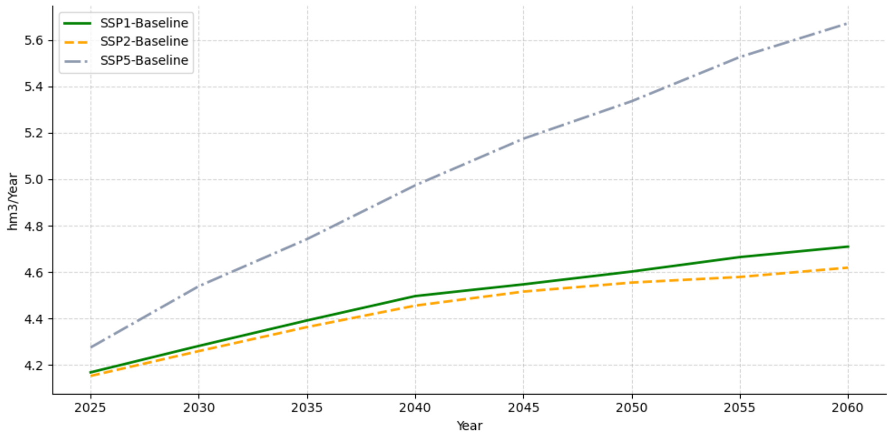

Figure 4.8: Water demand from domestic use for 3 climate scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5) with no policies applied (baseline) in Gotland.

One often overlooked component in the modelling is the rising energy demand for wastewater treatment under high-consumption scenarios. The expansion of domestic and agricultural water use leads directly to increased loads on treatment infrastructure. This growth in energy consumption can undermine climate mitigation efforts if fossil-based energy is used.

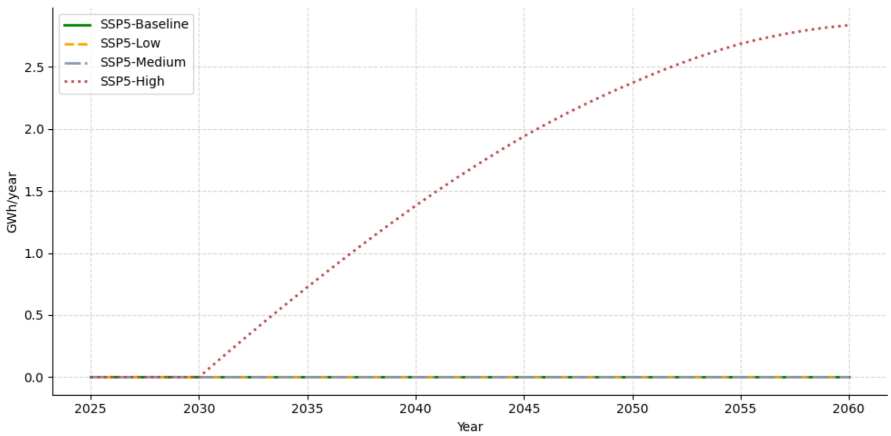

Figure 4.9: Wastewater treatment energy demand for climate scenario SSP5-8.5 considering Baseline, Low, Medium and High level of policy application in Gotland.

4.1.2 CS2 – Tarn-et-Garonne (France)

The Tarn-et-Garonne case study focuses on water, agriculture, energy, and forestry under the climate scenario SSP1-2.6, which best reflects the regional storyline (see Section 4.3.2). Overall, water supply is projected to remain relatively stable, with only slight decreases in extreme years and particularly during summer. However, implementation of land-based adaptation and mitigation solutions (LAMS) improves water efficiency and reduces demand across sectors, especially through regenerative and precision agriculture that enhance irrigated crop yields.

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Figures show limited changes in irrigated and rainfed crop areas, since measures are applied mainly to existing cropping systems. Yet, the transition toward regenerative and precision agriculture becomes visible in the high policy scenario, with up to 4% of the crop share adopting precision practices by 2060.

Energy demand is expected to rise by around 30% by 2060 due to demographic growth. Nevertheless, the expansion of renewable energy, particularly photovoltaic rooftops, can offset emissions and avoid up to 122 tCO_2eq. Forestry dynamics also contribute to climate mitigation, with forest cover increasing by up to 15%, wood extraction by 10%, and carbon stocks in regenerative grasslands by up to 16 tC.

Overall, the Tarn-et-Garonne results highlight that stability in water availability must be complemented by efficiency gains, renewable energy development, and land-use diversification to ensure long-term resilience.

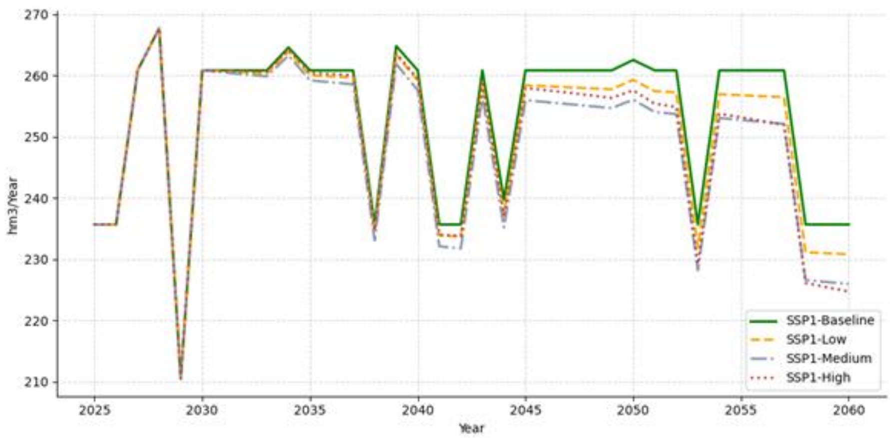

Figure 4.10: Yearly water supply for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne.

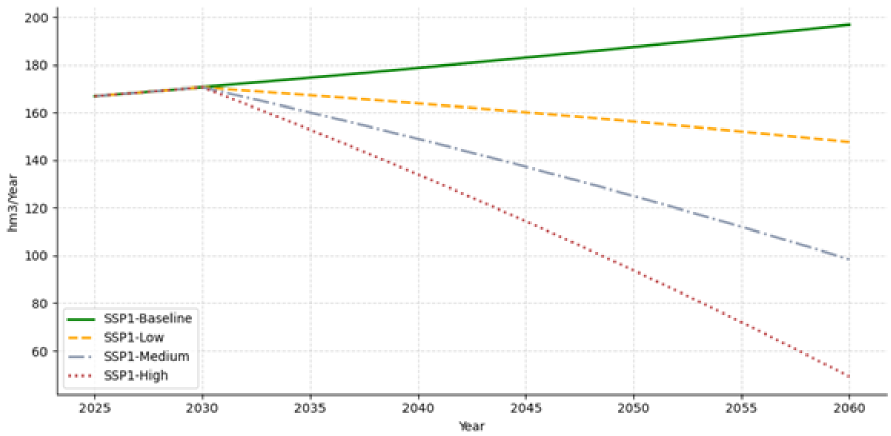

Figure 4.11: Yearly water demand for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne.

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No drastic changes appear as well for rainfed and irrigated crops areas either despite the use of regenerative agriculture and precision agriculture (Figure 4.12 and Figure 4.13). This is mainly due to the implementation of measures on the same crops.

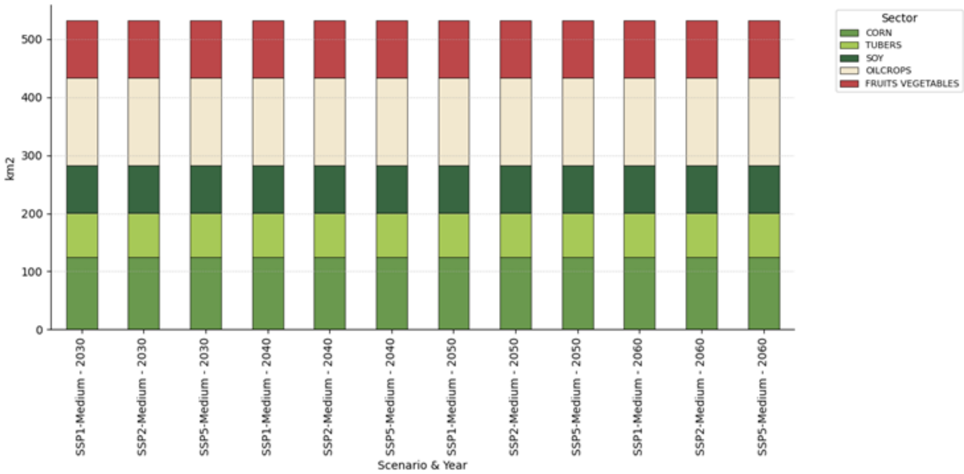

Figure 4.12: Yearly irrigated crop area for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne from 2030 to 2060.

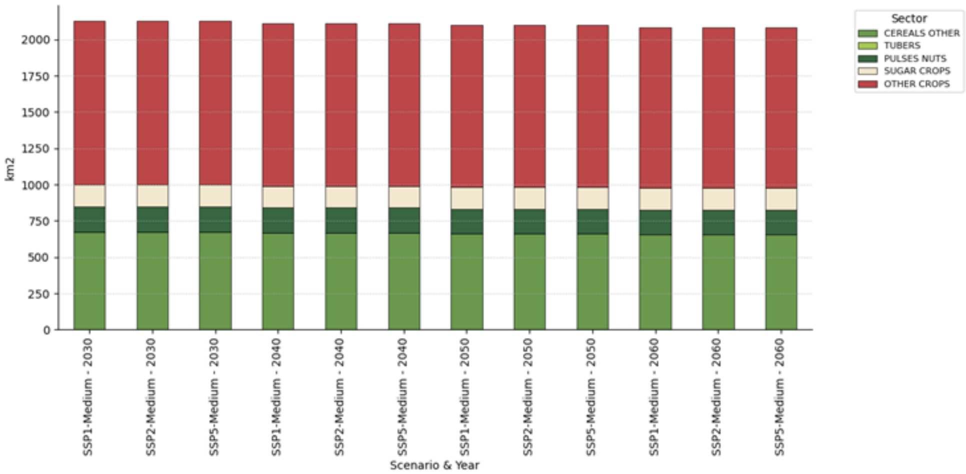

Figure 4.13: Yearly rainfed crop area for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne from 2030 to 2060.

As described in the storyline, we can see in Figure 4.14 and Figure 4.15, that the implementation of regenerative and precision agriculture is effective especially for the 'high' scenario with up to 4% of crop share under precision agriculture by 2060.

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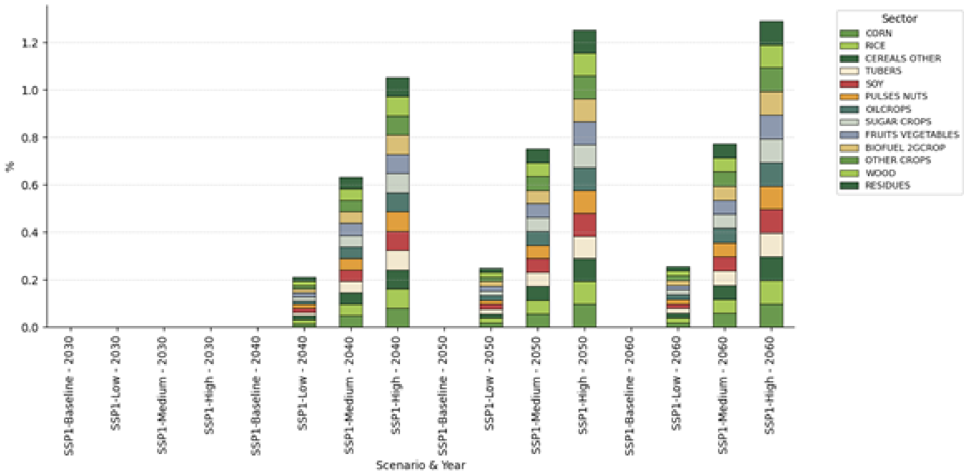

Figure 4.14: Share of agriculture in transition for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne from 2030 to 2060.

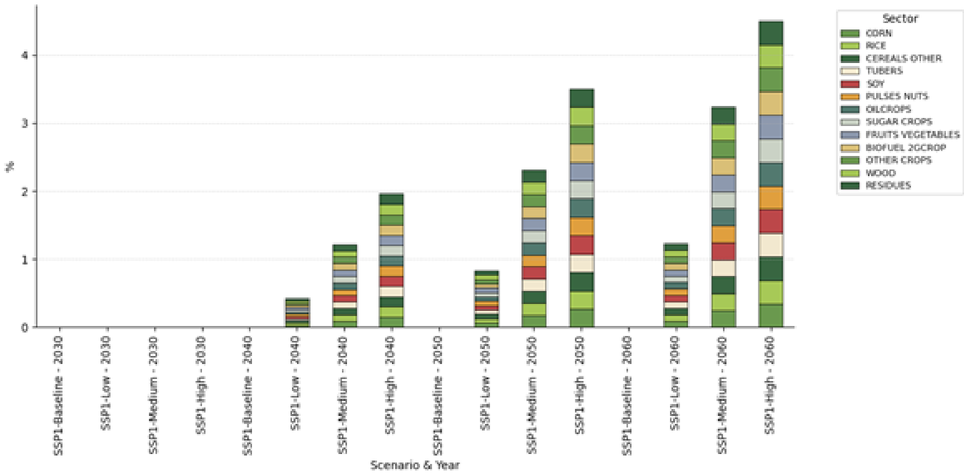

Figure 4.15: Share of precision agriculture for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne from 2030 to 2060.

Due to a growing population, the energy demand is planned to raise to 2060 by about 30% (Figure 23). However, thanks to the implementation of green energy especially photovoltaic rooftops, the energy emission can be reduced by up to 122 tCO2eq by 2060 (Figure 4.16 and Figure 4.17).

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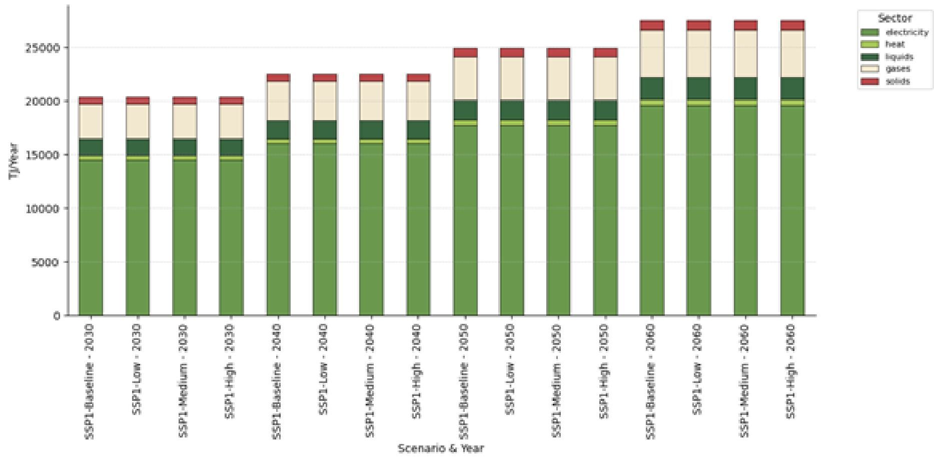

Figure 4.16: Yearly energy demand for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne between 2030 and 2060.

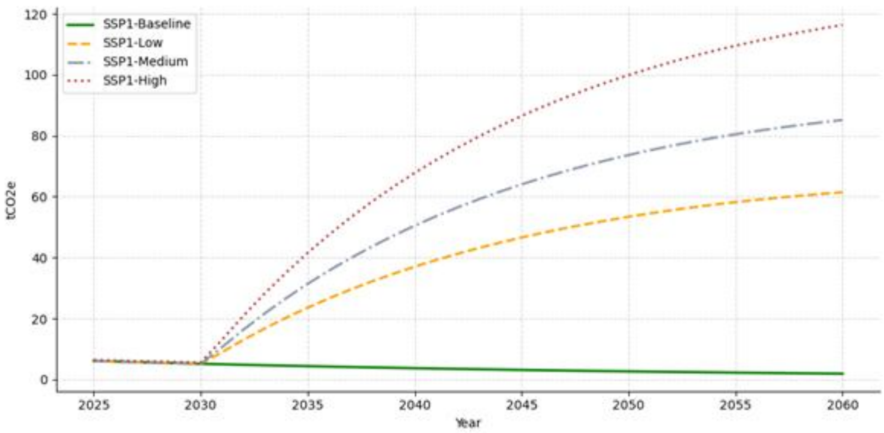

Figure 4.17: Yearly energy emissions avoided to the production of local electricity for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne between 2030 and 2060.

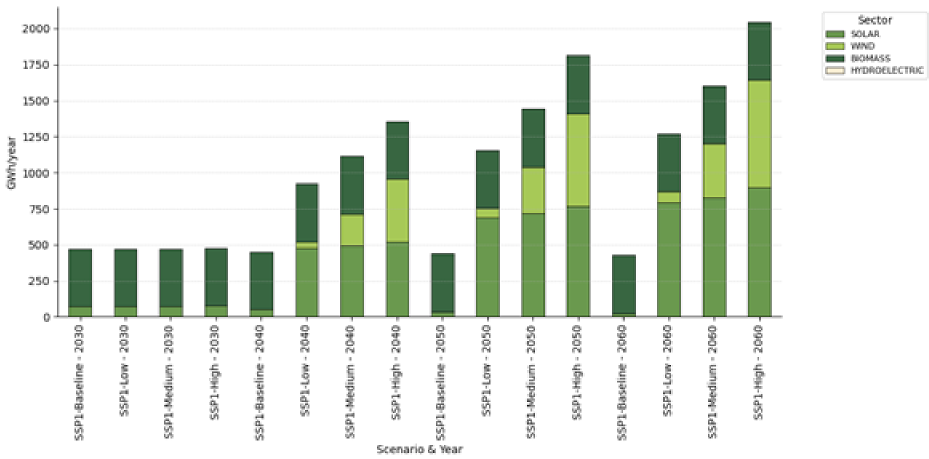

Figure 4.18: Yearly energy generation by primary type for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne between 2030 and 2060.

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Finally, the implementation of LAMs show that forested area might increase up to 15% and will contribute to wood extraction (up to 10%) and to an increase in carbon stocks up to 16 tC, due to the implementation of regenerative grasslands (Figure 4.19, Figure 4.20 and Figure 4.21).

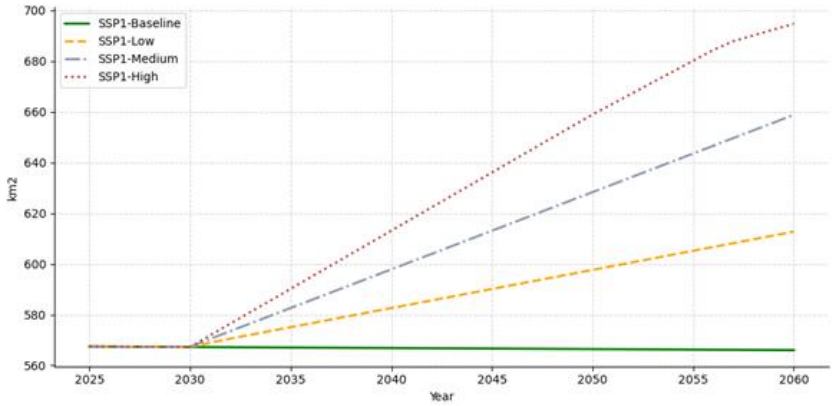

Figure 4.19: Yearly forested area for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne between 2030 and 2060.

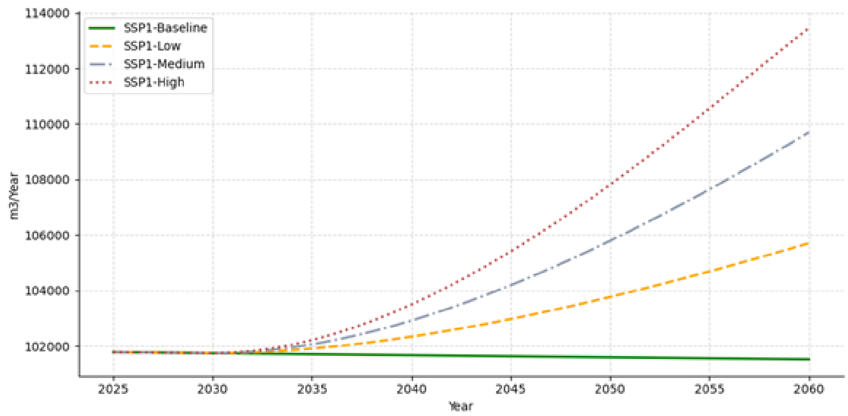

Figure 4.20: Yearly wood extraction for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne between 2030 and 2060.

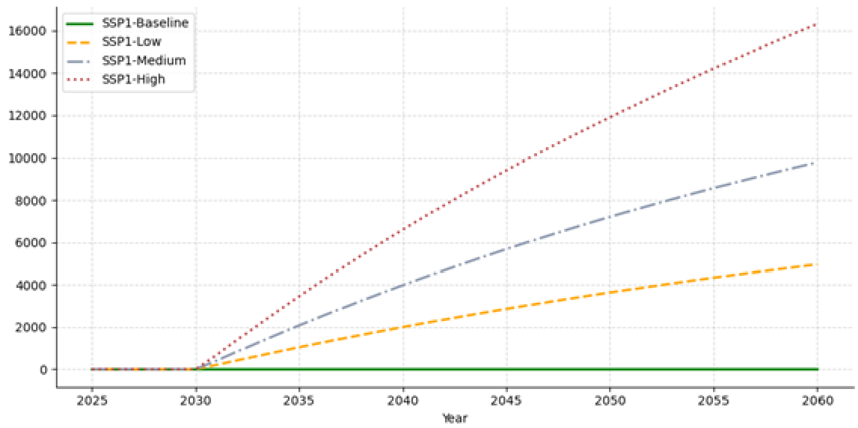

Figure 4.21: Yearly carbon capture (in tC) due to change to regenerative grasslands for climate scenario SSP1-2.6 considering Baseline, Low, Medium and High level of policy application in Tarn-et-Garonne between 2030 and 2060.

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4.1.3 CS3 – Southern Great Plain (Hungary)

This section aims to provide interpretations of the modelled results for the Southern Great Plain in case of the selected policy scenarios applied. The polices selected and introduced in Section 3.3.3 were modelled in order to see their possible longer-term effects in the region, described through multiple biophysical variables. The policy scenarios applied included 'Precision agricultural practices', 'Regenerative agriculture', and 'Water use efficiency in the agricultural sector', modelled under SSP1, SSP3, and SSP5 global scenarios (revisit Table 9). The recommended policy scenario 'Protection of grassland' was not included in the results as its application showed insignificant changes in the model.

Effect of policy implementation shows potential decrease in water demand in the agricultural sector for the coming decades in the region (Figure 4.22), but difference is not shown across the global scenarios. The trend can be reasoned by the potential effects of the implementation of water use efficiency- and precision agriculture policies. On the other hand, the identicality of trends in the different global scenarios is not that obvious, reasoning would require further studying. Comparing agricultural water demand to the overall demand, which predicts steady increase for the future terms (compared to the baseline), a logical explanation can be that agriculture, under the applied policies, is taking up only minor part of the general water demand in the region (the ratio of irrigated land is less than 3% of all arable land).

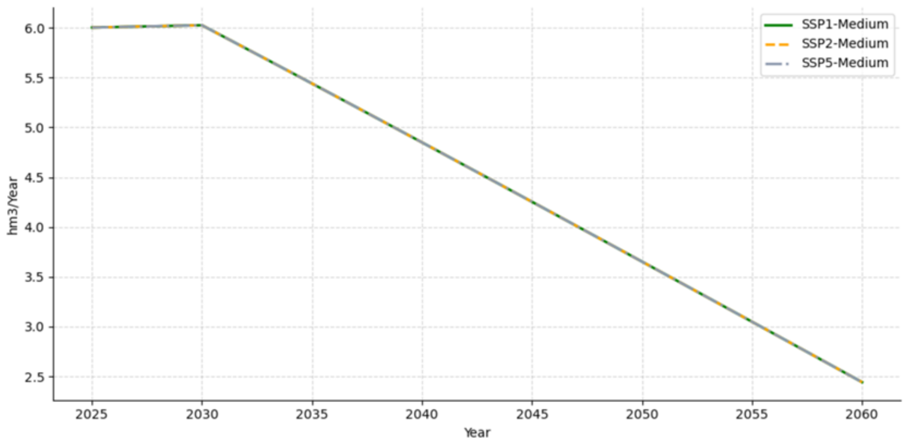

Figure 4.22: Water demand of the agricultural sector, policy scenarios applied, for 3 climate scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5) in the Southern Great Plain.

Comparing model insights to the current understanding of drought effects in the region (both ecosystem- and agricultural related), several points of interest came up but could not be fully answered. Model results suggest that water supply in the region is, and will be for the projected term, firmly exceeding overall water demand (Figure 4.23). Water supply, in the model, is characterised based on water inflow values, hence its distribution, and precipitation and its patterns are not reflected in this

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variable. It is safe to assume that the core problem behind drought is not the lack of water supplied to the region but rather its fast "running-through" the region, and its allocation and management.

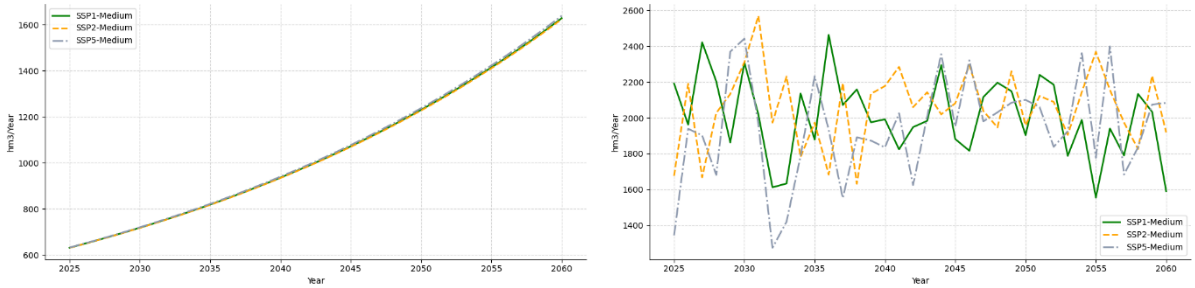

Figure 4.23: Overall water demand and water supply, baseline and SSP policy scenarios under a medium intensity of policy application in the Southern Great Plain.

The implementation of policies shows a significant decrease in fertiliser demand, C emissions and N_2O emissions, in case of all global scenarios. These results are explained by the potential implication of regenerative and precision agriculture. Differences though, regarding the global scenarios were not projected by the model, where reasoning is rather uncertain (Figure 4.24).

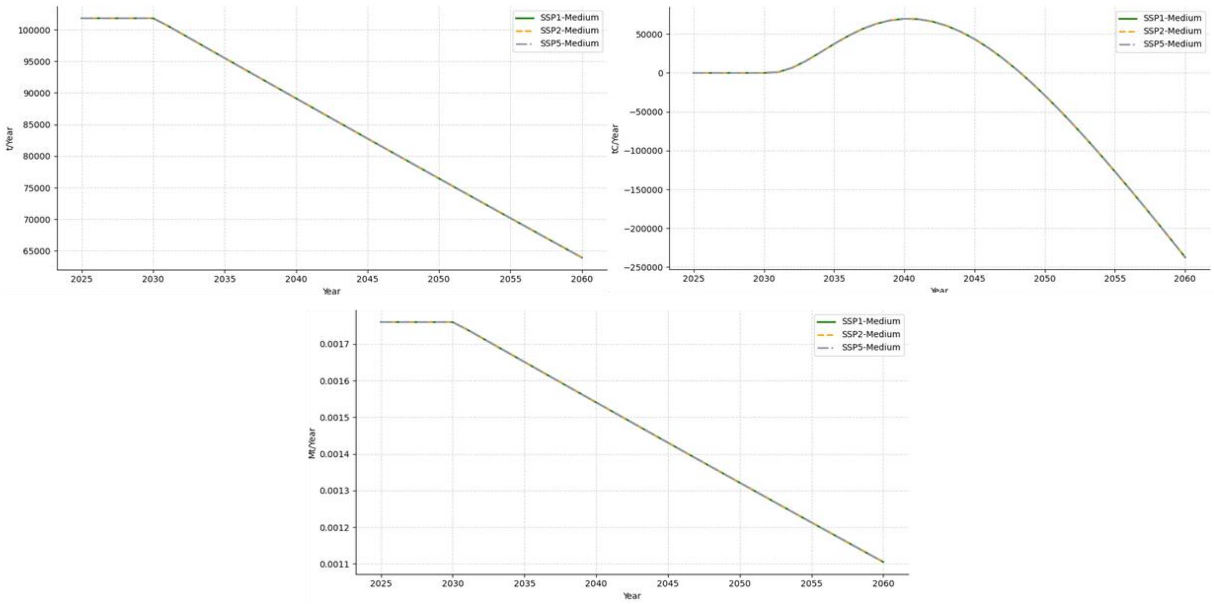

Figure 4.24: Fertilizer demand (upper left), total carbon emission (upper right), and N_2O emission (lower) with global scenarios applied.

It is also worth mentioning that no detectable change is visible in yields (from both irrigated and rainfed fields) across the scenarios, based on the model. Regardless of the application efficiency of the selected scenarios, the amounts stay nearly the same till 2060. Reasoning this output is rather difficult, as probably numerous different dynamics can act and counteract affecting the yields. Local models from Hungary have been projecting yield losses in the region for the upcoming decades with the current

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climate trends and agricultural practices, hence the baseline was expected to show similar decrease. In general, the lack of decrease in yields projected under the application of the selected policy scenarios could be affiliated with their positive effect, but the stubborn stagnation of the amounts and ratios in the yield graphs across time projected and the scenarios reflect probably else (Figure 4.25 and Figure 4.26).

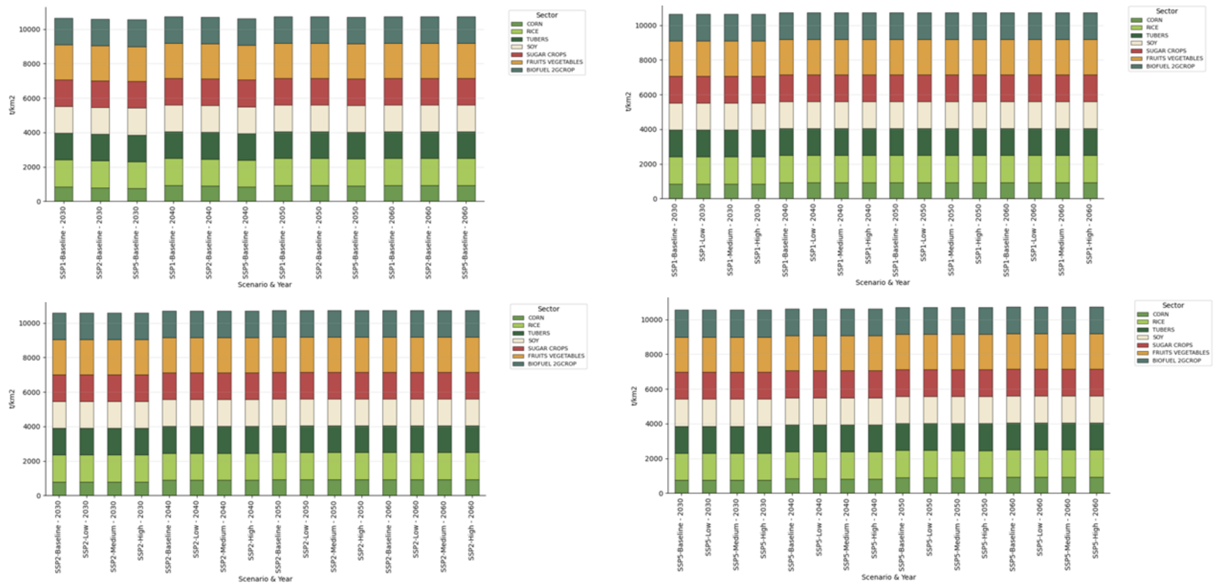

Figure 4.25: Yields from irrigated land; baseline (upper left), SSP-1 (upper right), SSP-2 (lower left), and SSP-5 (lower right) scenarios applied.

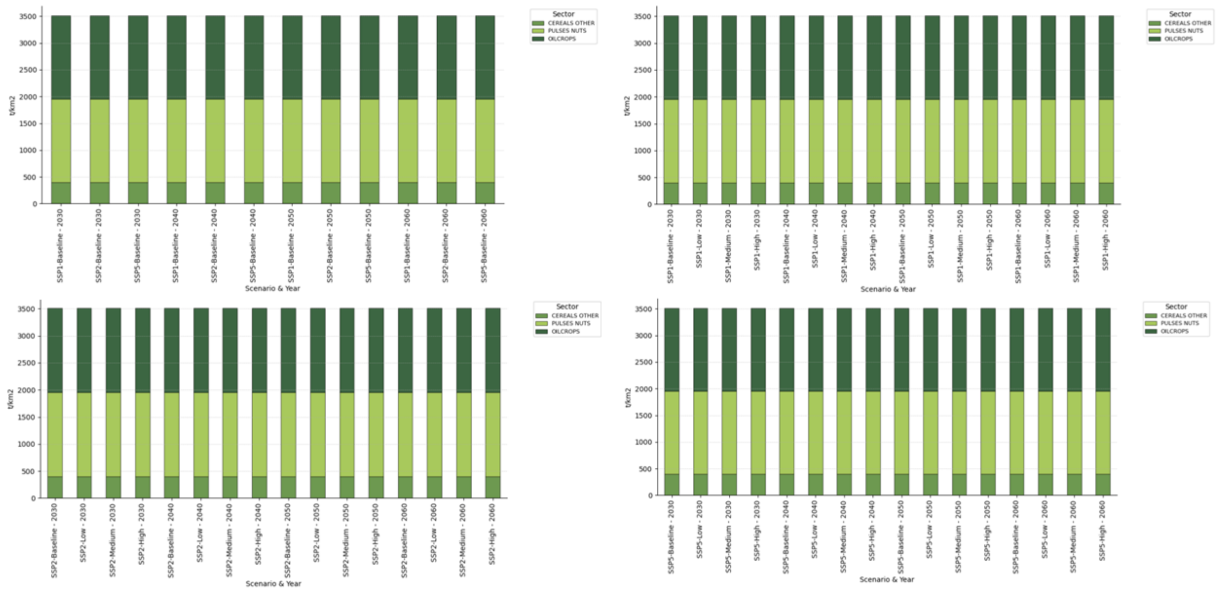

Figure 4.26: Yields from rainfed land; baseline (upper left), SSP-1 (upper right), SSP-2 (lower left), and SSP-5 (lower right) scenarios applied.

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4.1.4 CS4 – Valle d'Aosta (Italy)

The table below highlights the difference in installed PV power according to different policy intensities. It should be noted that showing the difference between the SSP1, SSP2, and SSP5 scenarios is irrelevant, since installed PV power benefits only from the implementation of policies and not from climate scenarios. Both medium- and high-intensity policies target an increase of 100 MW for ground-mounted PV and 50 MW for rooftop PV. The only difference is that the high-intensity policy also includes a 50% repowering of PV energy (whereas the medium-intensity policy corresponds to 0 MW).

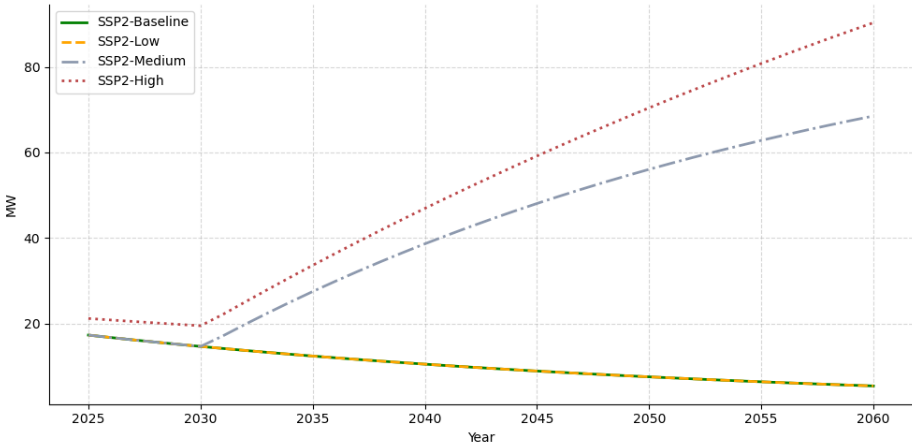

Figure 4.27: Solar PV power Installed for climate scenario SSP2-4.5 considering Baseline, Low, Medium and High level of policy application in Valle d'Aosta.

The policy outlined above, in synergy with the policies aimed at the deployment of wind farms and hydroelectric plants, enables an increase in energy production in the region, as shown in the figure below.

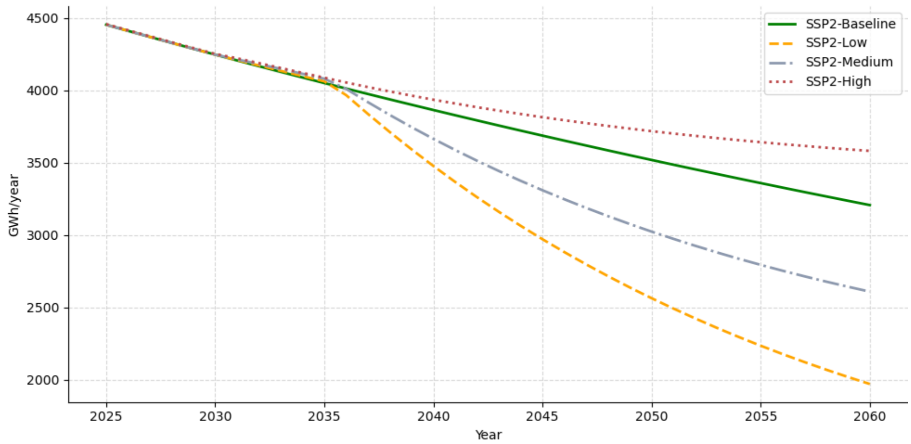

Figure 4.28: Total energy generation (GWh/year) for climate scenario SSP2-4.5 considering Baseline, Low, Medium and High level of policy application in Valle d'Aosta.

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In addition to increasing renewable capacity, solar PV contributes directly to climate mitigation by reducing reliance on fossil fuels. The Figure 4.29 compares avoided greenhouse gas emissions under the SSP2 scenario across different policy intensities. While the baseline scenario achieves less than 5 tCO_2e of avoided emissions until 2060, the low-intensity pathway shows a slow increase, reaching around 10 tCO_2e by 2060. The medium-intensity pathway delivers more significant results with about 30 tCO_2e avoided, while the high-intensity policy option surpasses 35 tCO_2e by the same year.

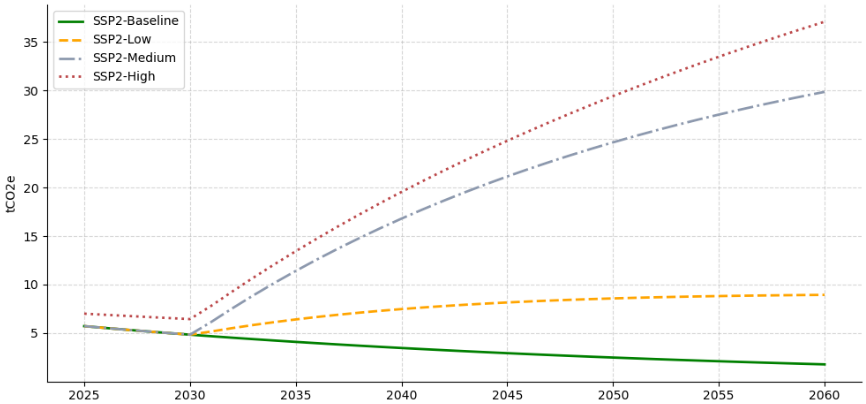

Figure 4.29: Energy emissions avoided due to solar PV productions for climate scenario SSP2-4.5 considering Baseline, Low, Medium and High level of policy application in Valle d'Aosta.

Beyond the energy sector, land-based measures play a critical role in building resilience and reducing climate risks. The Figure 4.30 below illustrates the projected share of grasslands managed under regenerative practices, comparing low, medium, and high policy intensities. Under the low-intensity option, regenerative grasslands would cover only 20% of the total area by 2060, while the medium pathway achieves 50% by the same year. The high-intensity policy is more ambitious, targeting full adoption by 2060, but it also reaches the 50% threshold as early as 2045, around 15 years earlier than the medium pathway, underlining the acceleration potential of stronger interventions.

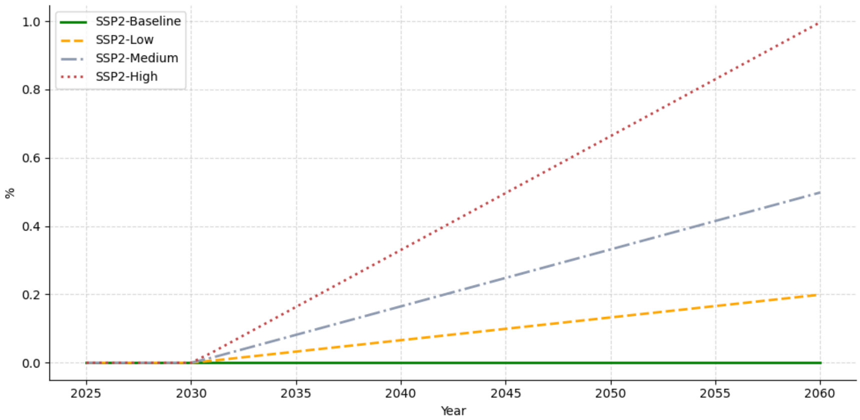

Figure 4.30: Share of grasslands under regenerative grasslands for climate scenario SSP2-4.5 considering Baseline, Low, Medium and High level of policy application in Valle d'Aosta.

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The implications of these trajectories become even clearer when linked to soil carbon dynamics. The figure below shows the projected change in soil carbon stocks under the same policy intensities. With the low-intensity pathway, corresponding to 20% of grasslands under regenerative practices by 2060, soil carbon stocks increase modestly, reaching around 2,000 tC/ha by 2060. The medium-intensity option, aligned with 50% adoption, achieves approximately 6,000 tC/ha, while the high-intensity pathway doubles this impact, reaching 12,000 tC/ha. Notably, the high-intensity policy matches the medium's long-term outcome of 6,000 tC/ha already by 2045, highlighting how ambitious adoption of regenerative practices can accelerate soil carbon sequestration and deliver earlier climate benefits.

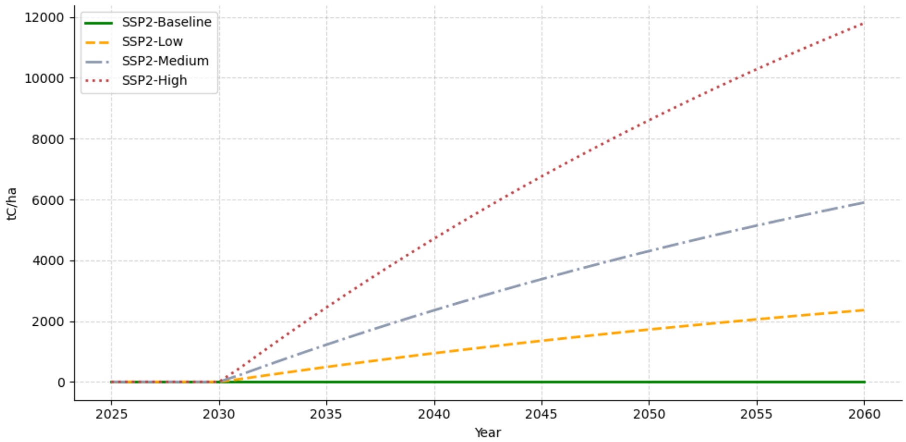

Figure 4.31: Soil carbon stock change grassland for climate scenario SSP2-4.5 considering Baseline, Low, Medium and High level of policy application in Valle d'Aosta.

4.1.5 CS5 – Almería province (Spain)

In the case of Almería, the results are discussed by comparing scenarios without policy implementation (baselines under the different population and climate assumptions) against scenarios with moderate-intensity in policy implementation, as well as scenarios with low, medium, and high level of policy intensity under the scenario SSP2-4.5 that represents a continuation of current trends.

The results show that rising temperatures and decreasing precipitation reduce the availability of surface water resources, thereby increasing the demand for groundwater extraction in the medium and long term (Figure 4.32 graph a). However, if policies are implemented to improve water-use efficiency in the agricultural, domestic, and economic sectors by 60%, combined with an increase in desalination capacity (100 hm^3/year) and the reuse of treated water up to 50%, groundwater extraction and thus its overexploitation can be reduced by more than 50% compared to current levels by 2050, even when the irrigated crop area increases up to 50% (Figure 4.32 graph b). Finally, the third graph (c) in Figure 4.32 illustrates how varying the intensity of policy application demonstrates that, under a BAU scenario, at

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least medium-intensity measures are required to avoid the continuous overexploitation of aquifers considering the increase iin irrigated crops included by the selected policies.

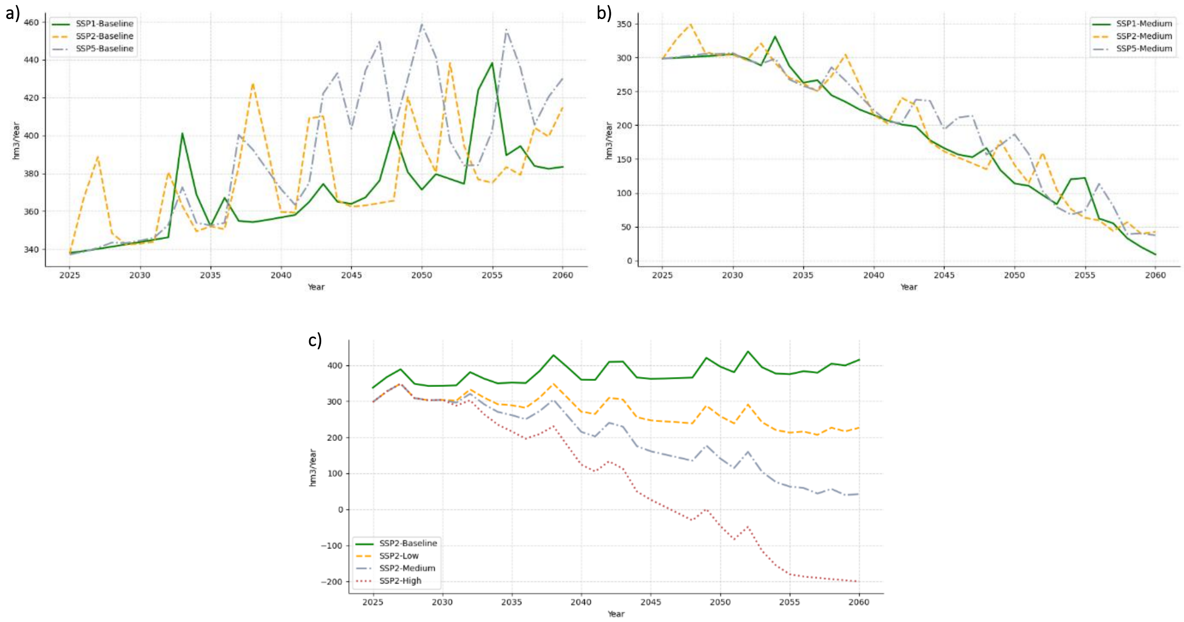

Figure 4.32: Water request from groundwater to cover the demands. a) Without policies; b) Medium intensity in policy application under different baseline scenarios and c) Different policy intensities under SSP2-4.5 scenario.

As shown in Figure 4.33(graph a), water demand increases considerably in scenarios without policy implementation, exceeding 480 hm^3/year. Improving water-use efficiency in agriculture, domestic consumption, and economic activities by 60% reduces demand to values below 250 hm^3/year (Figure 4.33, graph b). The combined effect of the policies demonstrates that, despite higher population growth in the SSP2 and SSP5 scenarios, water demands converge to very similar levels across the three simulated scenarios when medium-intensity policy implementation is applied. When policy intensities are varied with low, medium and high values (Figure 4.33, graph c), it can be observed that even under a low-intensity scenario, efficiency improvements in water use significantly reduce water demand, even when considering an expansion of irrigated crop areas.

Figure 4.34 shows the evolution of water security across the different simulated scenarios. A value of one indicates that sufficient water is available to meet demand without depleting the aquifer, thus preserving its viability to support economic activities in the case study area. A value of zero, in contrast, indicates that water availability is insufficient and water security is therefore compromised. Without policy implementation, only a few years show uncompromised water security, which correspond to years of unusually high precipitation (an infrequent occurrence in Almería due to its dry climate). However, the combined effect of policies promoting desalination, the reuse of treated water, and efficiency improvements in water use, helps guarantee water security throughout the evaluated time

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series. These policies, however, generate an increase in energy demand (Figure 4.35), as water treatment requires energy, with a direct effect on electricity consumption. This increase becomes particularly visible by 2060, exceeding baseline values in 2030 by more than 15,000 TJ/year.

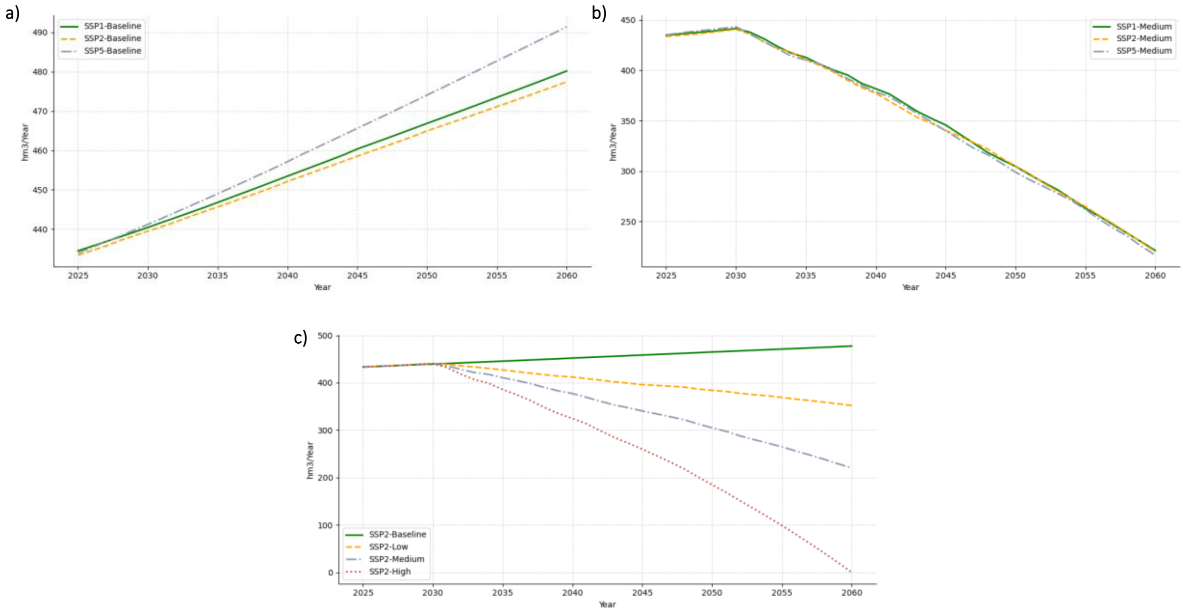

Figure 4.33: Water demand. a) Without policies; b) Medium intensity in policy application under different baseline scenarios and c) Different policy intensities under SSP2-4.5 scenario.

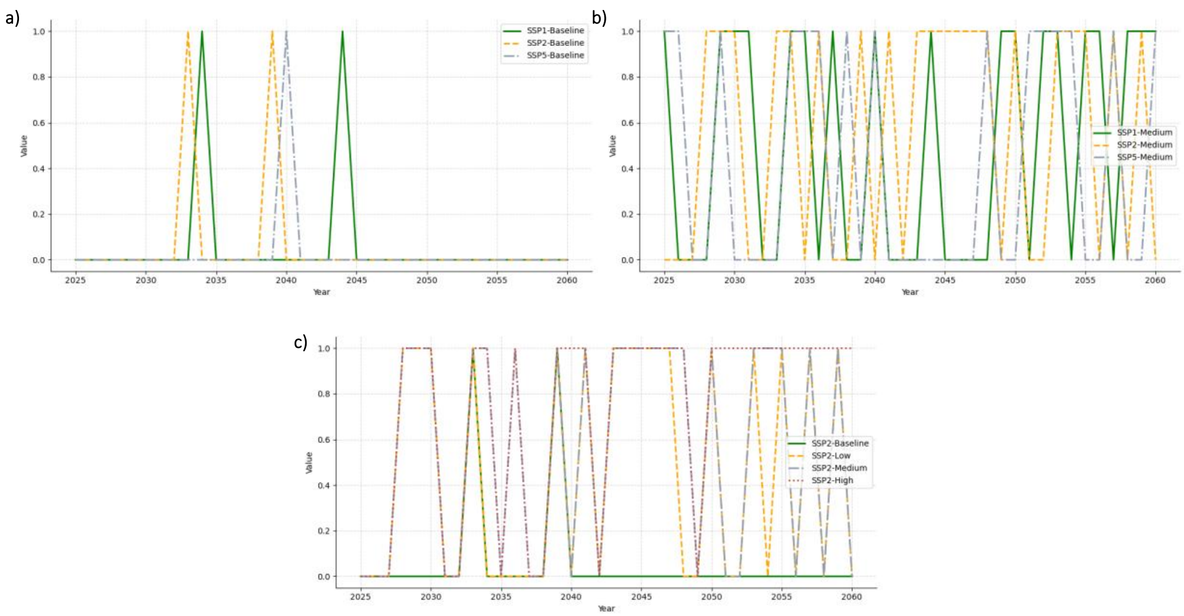

Figure 4.34: Water security. a) Without policies; b) Medium intensity in policy application under different baseline scenarios and c) Different policy intensities under SSP2-4.5 scenario.

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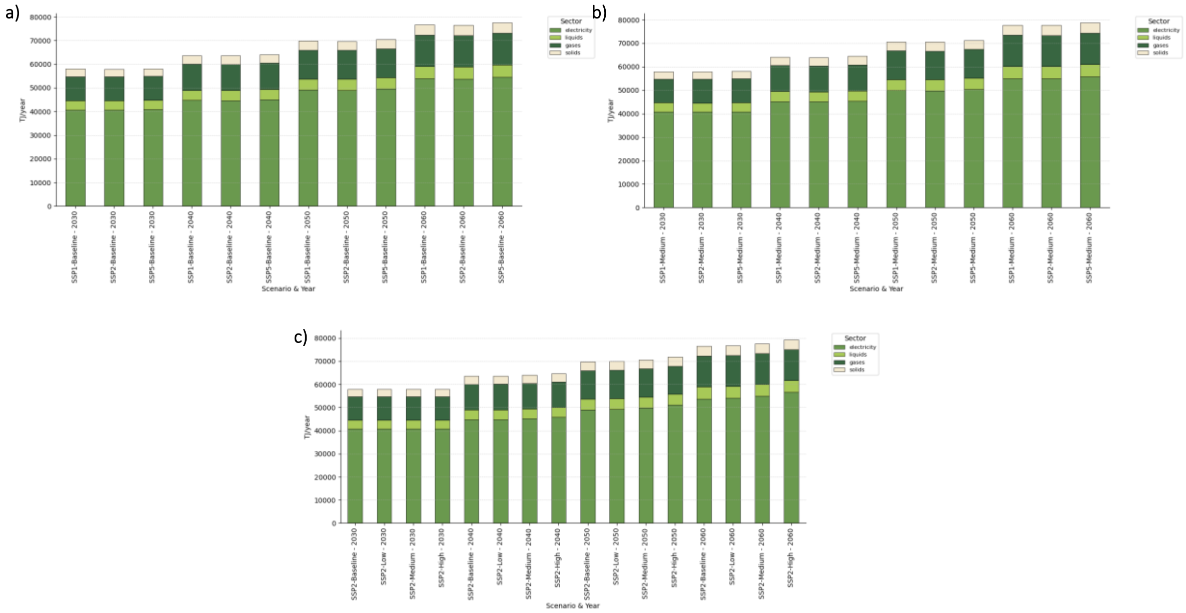

Figure 4.35: Energy demand including water treatment. a) Without policies; b) Medium intensity in policy application under different baseline scenarios and c) Different policy intensities under SSP2-4.5 scenario.

Finally, the representation of land-use distribution across the different analysed scenarios is included (Figure 4.36). Land-use changes are driven by policies that promote the conversion of rainfed crops into irrigated ones. This policy was adopted to adapt agriculture to climate change, which will make it increasingly difficult to maintain with reasonable yields without irrigation. The most visible changes occur in the long-term (2060) and under high-intensity land-use change policy implementation. However, it is important to emphasize that despite this change in land use, the new water demands can be met through the combined effect of policies aimed at improving water-use efficiency, increasing desalination capacity, and promoting the reuse of treated water.

The obtained results demonstrate that without policy intervention, rising temperatures and declining precipitation will increase water demand and propagate unsustainable groundwater extraction, thereby compromising long-term water security. Medium- to high-intensity policy implementation is essential to mitigate this risk identified for the groundwater sustainability. To this end, an improvement in water-use efficiency, combined with desalination and reuse of treated water (with a medium-intensity policy implementation), can cut aquifer overexploitation by more than 50% by 2050, even with a 50% increase in irrigated areas. These measures can secure water availability, but come with an increase in the energy demand, highlighting trade-offs that must be managed.

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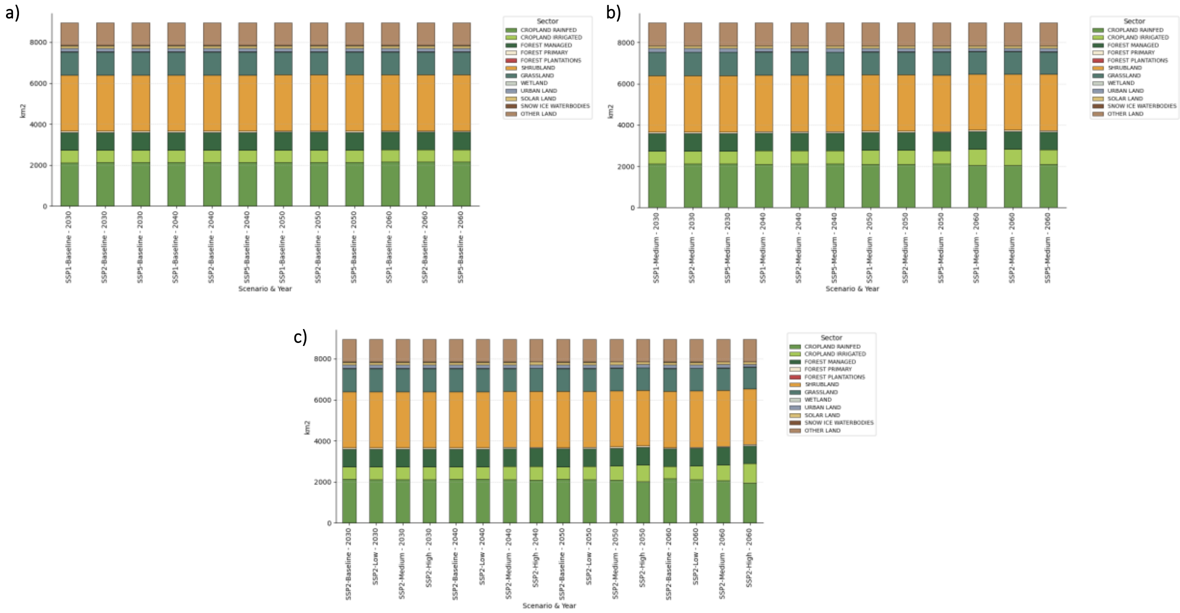

Figure 4.36: Land use distribution. a) Without policies; b) Medium intensity in policy application under different baseline scenarios and c) Different policy intensities under SSP2-4.5 scenario.

4.1.6 CS6 – Azores (Portugal)

In the Azores, baseline simulations give us the following values for water demand and supply (Figure 4.37 and Figure 4.38). Water demand is projected to increase in Azores, depending on the scenario, to around 91hm3 for the SSP1 and SSP2 baseline, and to 96hm3 for the SSP5 baseline, in 2060 (Figure 4.37). Water supply is, for each year, always much higher than water demand in Azores, with yearly differences due to respective precipitation amounts (Figure 4.38). Consequently, water security is always assured yearly in Azores. Azorean stakeholders referred seasonal and localized water shortages in some islands, but that can't be assessed in the current version of the model.

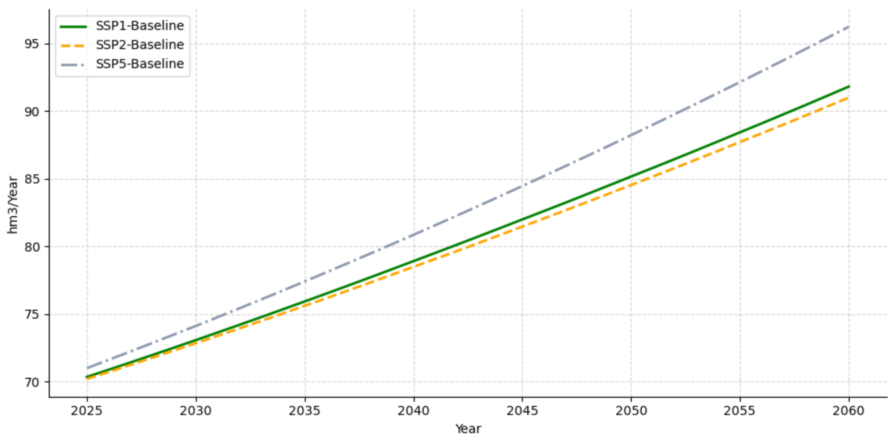

Figure 4.37: Water demand in Azores, for SSP1, SSP2 and SSP5, baseline scenarios.

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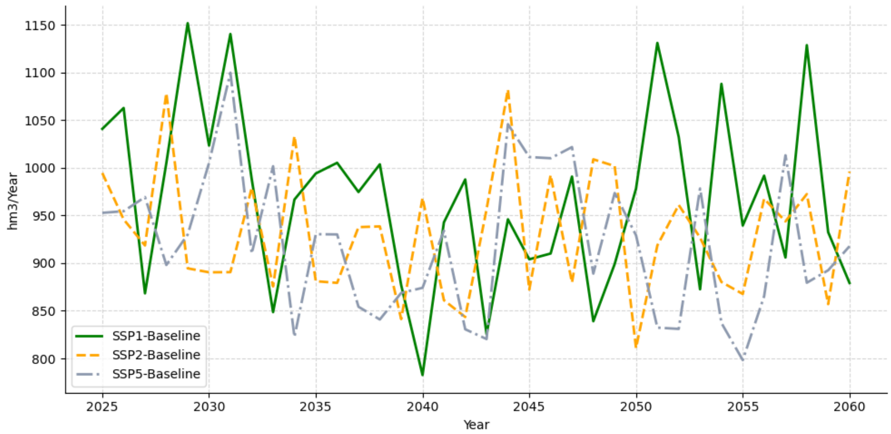

Figure 4.38: Water supply in Azores, for SSP1, SSP2 and SSP5, baseline scenarios.

Solar PV is expected to increase in all scenarios and periods. However, the height of possible increase depends strongly on the level of policies implementation, with stronger increase in higher levels of implementation, between 310MW for the high, 190MW for medium and 60MW for low, in 2060 (Figure 4.39).

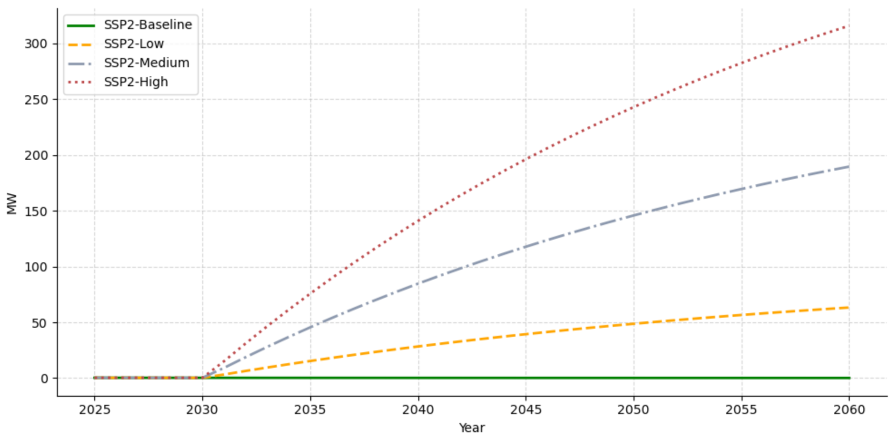

Figure 4.39: Solar PV installed in Azores for the SSP2 scenario, with Low, Medium and High level of implementation of the policies.

Projections indicate significant changes in the energy generation by primary type (Figure 4.40). An increase on the generation of this type of energy after 2030 is visible for all levels of implementation, except for the baseline. The increase on the energy generation is modelled to increase higher in 2060, for the higher level of implementation, reaching around 700 GW/year. Solar is the main expected source of energy after 2030, with growing values throughout 2060, again with the exception of the baseline scenario. Nevertheless, projections reveal that hydroelectric and wind power remains constant.

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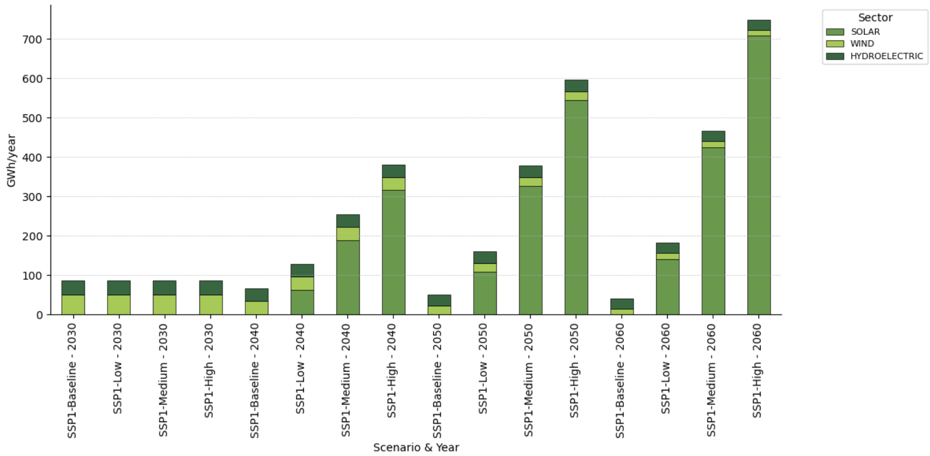

Figure 4.40: Energy generation by primary type, for the High level of implementation, for different periods and scenarios.

Forest land area is projected to increase in Azores, varying on the level of implementation of policies. The highest area modelled is near 1040 km^2, for the medium implementation, followed by 975 km^2, for the low, and near 960 km^2, for the high, in 2060 (Figure 4.41).

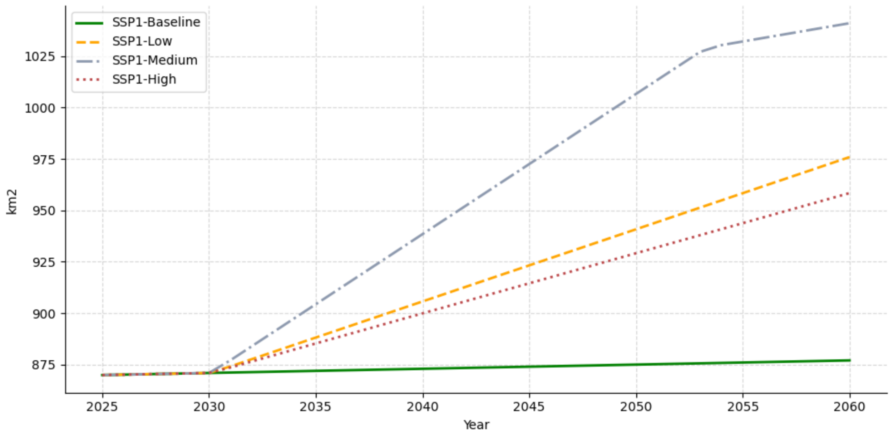

Figure 4.41: Forest land area for the Azores for the SSP1 scenario, at Low, Medium and High level of implementation of policies.

Carbon emissions due to land use changes, cropland and grassland management are expected to be low if policies are implemented, especially in the High level (Figure 4.42). The amount of lower carbon emissions can reach 8000 t/year, in 2053, for the Medium; and around 6000 or 5000 t/year, in 2060, for the High or Low scenario.

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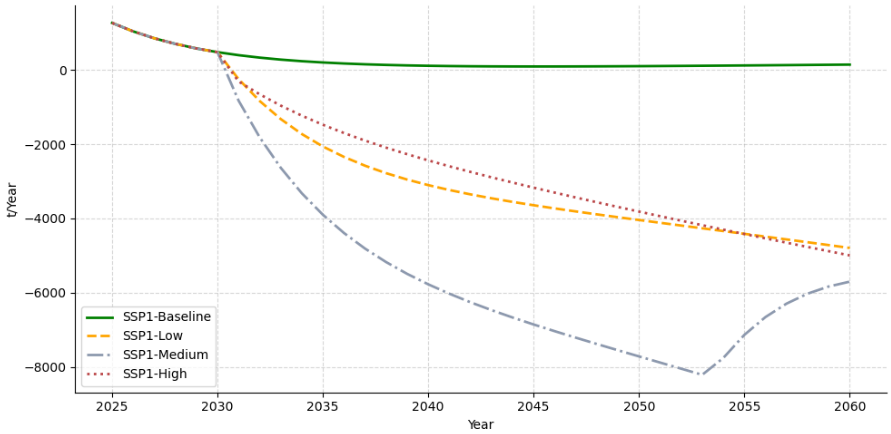

Figure 4.42: Carbon emissions due to LUC, cropland and grassland management in Azores, for the SSP1 scenario, at Low, Medium and High level of implementation of policies.

5 Policy recommendations per case study

In this section the policy recommendations are defined as a combination of the results of SD model and AquaCrop, the ranking of policy insights, the shared policy statement and the storyline. Policy recommendations are developed for each case study.

5.1.1 CS1 – Gotland (Sweden)

In Gotland, stakeholders identified agriculture, water management, and tourism as the most relevant sectors due to their high dependence on freshwater and ecosystem services. Agriculture is particularly vulnerable to climate change impacts, with drought, low soil water retention, and seasonal water imbalances affecting both livestock and crop production. Water management is critical, as Gotland's small aquifers and porous limestone geology limit storage capacity despite sufficient annual rainfall. Most precipitation occurs in autumn and winter, while demand peaks in dry summer months, creating a mismatch that affects all major sectors.

Stakeholders emphasized the long-term costs of inaction, the importance of ecosystem services, and the need to prioritize sustainability over short-term implementation costs. Key measures include improving water governance, expanding rainwater harvesting through irrigation dams, promoting greywater reuse, and restoring wetlands. Nature-based solutions such as protecting infiltration zones and promoting agroforestry are essential complements to engineered infrastructure.

In the energy sector, the expansion of renewables must be carefully balanced with land use and biodiversity protection. Rooftop solar and upgrades to existing PV systems are preferred to avoid land-use conflicts, while local bioenergy initiatives offer added resilience and circularity.

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Tourism also faces growing pressure from water scarcity and ecosystem degradation. Ensuring water availability during peak seasons, diversifying tourism services, and investing in climate-resilient infrastructure are priorities. Awareness-building among residents and visitors can support shared responsibility.

Based on stakeholders' feedback and participatory assessments, the recommended actions to be implemented in Gotland are:

- Improve water-use efficiency in agriculture by promoting precision farming, optimized irrigation, and support for traditional grazing systems that align with seasonal water availability.
- Expand alternative water storage and reuse by developing irrigation dams for rainwater harvesting and promoting the reuse of greywater in agriculture and tourism to reduce pressure on shallow aquifers.
- Adopt medium-to-high policy intensity for measures that enhance water retention in the landscape—such as wetland restoration and protection of recharge zones—while incentivizing efficient water use across sectors.
- Plan for water-energy-land trade-offs by supporting rooftop solar expansion and bioenergy systems that reduce fossil fuel reliance without compromising farmland or sensitive habitats.
- Enable adaptive land-use strategies by integrating nature-based solutions like agroforestry, multifunctional landscapes, and retention basins into municipal spatial planning, ensuring alignment with long-term water and biodiversity goals.

To succeed, these solutions must be supported by cross-sectoral coordination, institutional capacity, and financial incentives that enable a just and sustainable transition for Gotland.

5.1.2 CS2 – Tarn-et-Garonne (France)

Policy Insights for Tarn-et-Garonne: Building a Climate-Resilient Agroecological Transition

The most relevant Policy Insights identified by stakeholders for Tarn-et-Garonne are: *"Emphasize the importance of climate adaptation, as well as the costs of inaction and maladaptation"*, *"Explore how food security can be strengthened by making farms more resilient to climate change"*, *"How can decision makers prioritize long-term sustainability over implementation cost?"*, and *"Which LAMS (low-cost, high-impact solutions) can most effectively conserve water resources?"*. Together, these priorities underline the urgency of fostering an agroecological and hydrological transition to ensure resilience in the face of climate change.

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Tarn-et-Garonne, a dynamic agricultural region in southwest France, depends heavily on water availability and ecosystem stability to sustain irrigated crops such as maize and orchards, as well as livestock. Increasingly frequent droughts, heatwaves, and competition over water use expose agriculture to significant risks. The region's long-term viability requires measures such as crop diversification, cover crops, conservation agriculture, improved soil organic matter, adoption of drought-adapted varieties, and more efficient irrigation systems.

Water management as a central challenge

Water governance emerged as the most pressing issue. Conflicts between agricultural, domestic, and ecological uses are intensifying, making efficient irrigation technologies, sustainable water storage, and the restoration of buffer zones (wetlands, hedgerows) indispensable. Nature-based solutions, such as enhancing soil water retention and maintaining ecosystem services, can complement technical infrastructure to build resilience. Communication campaigns were also seen as vital to raise awareness among the general public of the link between water use and food security.

Agroecological transitions and ecosystem services

Stakeholders highlighted the potential of agroecological practices to enhance both adaptation and mitigation. Intermediate and associated crops can maintain soil fertility and support carbon sequestration, while compost deployment can reduce reliance on costly fertilizers and contribute to circular economy approaches. Agroforestry and diversification strategies provide multiple co-benefits, including biodiversity support and landscape resilience. These measures can also generate opportunities for carbon credits, though economic viability and regulatory clarity remain essential.

Other sectors at stake

While agriculture is central, other sectors cannot be overlooked. Rural tourism, an important activity in Tarn-et-Garonne, is sensitive to both climatic risks and landscape quality, requiring integrated land-use planning. Renewable energy development—such as agricultural photovoltaics (AgriPV)—is progressing, but raises questions regarding land competition, long-term contracts, and synergies or conflicts with existing uses such as agrotourism. Local bioenergy initiatives, composting, and waste valorisation are considered promising if supported by appropriate economic and regulatory frameworks.

Barriers and enablers

Major barriers include fragmented policies, heavy administrative procedures, complex technical knowledge requirements, and limited financial incentives. Social tensions also arise around water allocation. On the other hand, strong territorial coordination, financial support schemes (e.g., subsidies,

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tax incentives), local innovation, capacity-building of advisors, and citizen engagement are recognized as key enablers.

Towards a shared vision for resilience

The shared policy statement formulated by stakeholders emphasizes the need to *"Foster a resilient agroecological and hydrological transition for Tarn-et-Garonne in the face of climate change."* Achieving this requires a long-term integrated strategy linking agriculture, water, biodiversity, and social cohesion. By combining technical innovations, nature-based solutions, and inclusive governance, Tarn-et-Garonne can strengthen food security, ensure sustainable water management, and support a just and climate-resilient transition.

Based on stakeholders' feedback and the results of the system dynamic model in which different policy action scenarios have been tested, the recommended actions to be implemented in Tarn-et-Garonne are:

- Adopt comprehensive water-use efficiency policies across agriculture, domestic, and economic sectors to mitigate the risk of seasonal droughts and more permanent water scarcity issues in the future.
- Promote the transition to regenerative and precision agriculture to build more resilient and sustainable farming systems. This includes enhancing irrigation efficiency and adopting complementary measures such as agroforestry, crop diversification, cover cropping, conservation agriculture, improved soil organic matter management, and the use of drought-adapted varieties.
- Integrate land-use strategies to mitigate the trade-offs of renewable energy deployment on other existing uses such as agrotourism.
- Expand the use of renewable sources, particularly rooftop photovoltaics but also ground-mounted photovoltaics, repowering initiatives, and wind farms, to reduce greenhouse gas emissions from the energy sector.
- Support local bioenergy initiatives, composting, and waste valorisation to cut the emissions and reduce land competition.
- Implement afforestation, and strengthen the protection of forests and grasslands, including regenerative grassland management, to enhance carbon capture and ecosystem resilience.
- Integrate nature-based solutions like multifunctional landscapes, enhancing soil water retention and maintaining ecosystem services.

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5.1.3 CS3 – Southern Great Plain (Hungary)

Among the most important sectors of the region agriculture stands out as a prominent one both economically and historically. It provides a considerable ratio to the national sum and to the GDP as well. Main produces are cereals and forage – wheat, corn, barley and sunflower, with a growing area of rape. The industry sector is also prominent but shows a centralized picture - manufacturing and construction claim significant parts of regional GDP, whereas the former one is built on small number of factories (automotive and battery manufacturing) and the latter one is dominated also by a smaller number of construction companies with nationwide coverage. Water management, though a rather supportive sector of the ones mentioned above, influences fundamentally not only these sectors but also the very shape of the region in terms of ecosystem and society.

Based on stakeholders' input, the ranking of policy insights revealed the importance of better coordination on policy level, in terms of coherent policies being in line with local characteristics (*Increase knowledge about land scarcity to decide about the implementation of different policies*), targeting and strategising effective means for long-term sustainability (*How can decision makers prioritize achieving long-term sustainability over implementation cost?*), and a more inclusive and decentralized decision making process (*How important is diversity of backgrounds and opinions in decision-making processes?*). Meanwhile the social dimension the conservation and sustainable use of ecosystem services should be articulated better (*How to increase social acceptance (education and engagement) for conservation, restoration and sustainable use of ecosystems?*). But the value of practical knowledge at the operational level regarding adaptive land-based solutions for water conservation seems to be of highest relevance in the region (W*hat LAMS are of high-impact and low-cost solutions for water resources conservation?*).

What seems to be less of importance or urgency are those insights focusing on further theoretical knowledge or characterisations, e.g. articulating the importance of ecosystem services (H*ighlight the importance of ecosystem services to society for adaptation and mitigation*) and further defining adaptation for better policies (*Use rigorous definitions of adaptation and mitigation to formulate policies, their criteria and objectives*).

Facing drought, on both ecosystem and agricultural levels, challenges many sectors in the region, and putting increasing pressure on the local water regime and -management. Though model results do not reflect foreseen water shortages or decrease in yields, the case in the summer terms is worsening and drought effects are manifesting in increasing losses and damage particularly in the agriculture sector, but also on the general ecosystem-service level. What can be seen from model results is that water inflow is sufficient to cover demand, hence the use of a more significant amount of surface water for irrigation could have mitigating effect.

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On the other hand, voices from the scientific community articulate that irrigation in intensive agricultural context and on large arable lands is not feasible – rather inefficient, requiring immense infrastructure of canals and waterworks, and their proper maintenance. Moving beyond mitigation, incorporating irrigation on suitable territories (higher absorption efficiency) could be a step on transitioning into a rather adaptive agricultural system in the region. Such adaptation can potentially be foreseen via a systemic combination of policies like regenerative- and precision-based agriculture and water-keeping, according to local stakeholders.

Based on stakeholders' feedback and the results of the system dynamic model in which different policy action scenarios have been tested, the recommended actions to be implemented in Southern Great Plain are:

- Promote the transition to regenerative and precision agriculture to build more resilient and sustainable farming systems. This includes improving water and fertilizer use efficiency, as well as adopting practices that reduce carbon and nitrogen emissions.
- Adopt a combination of water-use efficiency measures in agriculture to optimize irrigation and reduce the risk of seasonal droughts and water scarcity in the region.

5.1.4 CS4 – Valle d'Aosta (Italy)

The four most relevant Policy Insights identified by stakeholders for Valle d'Aosta are: "Explain how conservation, restoration and sustainable use of ecosystems combined with mitigation" (ranked 1st), "Emphasize the importance of climate adaptation and the cost of inaction" (2nd), "Highlight the importance of ecosystem services to society" (3rd), and "Explain how sustainable consumption of natural resources in agriculture and forestry combines with the conservation of water resources" (4th). Together, these priorities reflect the centrality of ecosystems, agriculture, and water in building resilience, and the need to integrate climate adaptation and mitigation in a coherent way.

Agriculture and livestock farming are not only economic pillars but also key to maintaining landscapes, biodiversity, and the region's carbon absorption capacity. Sustainable soil management in alpine grasslands, will be essential to improve infiltration, reduce erosion, and strengthen water retention. Supporting traditional livestock farming, crop diversification, and precision agriculture can increase resilience, while fair remuneration for farmers and breeders is necessary to sustain rural communities. Water scarcity remains a critical issue: improved irrigation efficiency, grey-water reuse, and wetland restoration could ease seasonal stress, while the conservation of primary forests and the afforestation of degraded land would improve water regulation and reduce disaster risks such as floods or landslides.

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In the energy sector, adaptation and mitigation strategies should focus on renewable diversification, while minimizing land-use conflicts in a territory where one-third of the land is protected. Rooftop photovoltaics and selective repowering of existing PV plants are no-regret options that limit visual and ecological impacts. Ground-mounted PV and wind farms must be carefully located to avoid sensitive landscapes, while hydropower modernization should aim to balance ecological flows with production needs. Coordinating energy expansion with water availability is crucial, since reduced glacier melt and increasing demand may undermine hydropower capacity at precisely the time when energy demand peaks. Storage solutions, such as pumped-hydro combined with renewables, could enhance flexibility but must be developed with transparent governance to avoid competing with agricultural and tourism water needs.

Tourism, a cornerstone of the local economy, is highly exposed to climate variability. Adaptation policies should include diversifying tourism models beyond snow-reliant activities, strengthening summer offers such as trekking, cultural tourism, and eco-experiences. Artificial snowmaking requires significant water use and will be increasingly difficult to sustain under hotter and drier winters. Investments in adaptive infrastructure, protection of water infiltration zones, and awareness-raising campaigns for both residents and visitors will be essential to ensure that tourism remains viable while reducing its ecological footprint.

Finally, territorial governance and integration must act as the overarching framework. The region is characterized by fragile ecosystems, competing land uses, and a strong dependence on shared water resources. Policies should promote integrated land and water management, enhance transparency in data and modeling, and strengthen collaboration between science, institutions, and citizens. Empowering local communities, ensuring their right to remain in the region, and investing in capacity building will be fundamental for long-term sustainability. Only through an integrated approach that recognizes the interdependence of energy, agriculture, tourism, and ecosystems can Valle d'Aosta reconcile climate adaptation, the green energy transition, and the protection of its alpine heritage.

Based on stakeholders' feedback and the results of the system dynamic model in which different policy action scenarios have been tested, the recommended actions to be implemented in Valle d'Aosta are:

- Expand the use of renewable energies, such as photovoltaic, wind and hydropower, to decrease energy emissions.
- Adopt high values for policy intensities in those policies that directly affect the total energy generation, such as PV repowering, photovoltaics (rooftop and ground-mounted), wind farms and

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hydropower deployment to avoid a faster decrease in energy production compared to the baseline trend.

- Integrate land-use strategies to minimize the trade-offs of renewable energy deployment on existing land uses, with particular attention to reducing visual and ecological impacts.
- Foster regenerative practices in grassland including soil management to increase the soil carbon sequestration, improve infiltration, reduce erosion, and strengthen water retention.
- Promote the transition to regenerative and precision agriculture to build more resilient and sustainable farming systems.
- Adopt a combination of water-use efficiency measures together with alternative water sources such as grey-water reuse to reduce the risk of water scarcity in the region.
- Promote wetland restoration, forest protection and afforestation of degraded land to ease seasonal stress and improve water regulation.
- Foster diversification of tourism models by strengthening summer and non-snow-based offerings, ensuring the resilience of the tourism sector in the face of climate change.

5.1.5 CS5 – Almería province (Spain)

In Almería province, agriculture and water management are considered the most relevant sectors. Agriculture stands out due to its economic importance, while water management is critical given the region's scarcity of water and its direct link to key economic activities. As a consequence, the most significant measures to be implemented focus on these two sectors, which are closely interconnected since actions in the water sector often generate positive effects on agriculture.

Beyond sector-specific measures, stakeholders emphasized the importance of considering the long-term impacts of solutions. They highlighted the crucial role of decision-makers, as effective action should be driven from institutional and governance levels. Climate adaptation was also regarded as highly relevant, since inaction or maladaptation could ultimately cause higher costs than proactive adaptation strategies. On the water side, stakeholders stressed the need for high-impact yet cost-effective solutions. This is particularly challenging, as alternatives to groundwater extraction often rely on energy-intensive technologies, which raise implementation costs. Food security was also identified as a priority. Almería is one of Europe's largest producers of vegetables and fruits, yet stakeholders believe the focus should shift towards long-term sustainability rather than short-term gains. This is influenced by the crop production approach considering a probable future transition to more irrigated crop areas. Finally, to ensure stronger alignment between regional and national policies, it was noted

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that these and other solutions should ideally be implemented within the framework of the Plan Andaluz de Acción por el Clima (PAAC) and the Plan Nacional de Adaptación al Cambio Climático 2021–2030.

Based on stakeholders' feedback and the results of the system dynamic model in which different policy action scenarios have been tested, the recommended actions to be implemented in Almería province are:

- Prioritize water-use efficiency by implementing policies to achieve at least 60% efficiency improvements in agriculture, domestic, and economic sectors.
- Expand alternative water sources with an increase in the desalination capacity and the promotion of reuse of treated water to reduce pressure on aquifers.
- Adopt medium-to-high values for policy intensities in those policies that directly affect the water supply (desalination and water reuse) and the water demand (efficiency) to avoid continuous aquifer overexploitation.
- Plan for energy-water trade-offs by incorporating strategies for managing the rising energy demand linked to desalination and water reuse. These strategies could include an increase of solar or wind farms but their implications in land-use changes should be analysed in depth.
- Promote adaptive land-use changes to support the transition from rainfed to irrigated crops, ensuring it is coupled with sustainable water management policies.

5.1.6 CS6 – Azores (Portugal)

Azores future climate can cause several impacts in the most relevant sectors: agriculture, tourism and energy. Increasing temperatures and modifications in precipitation regimes will be the main drivers of future risks.

Taking into account the future climate, therefore more important Policy Insights for the Azorean stakeholders are "Emphasize the importance of climate adaptation, the cost of inaction and maladaptation", "Explain how conservation, restoration and sustainable use of ecosystems combined with mitigation (reducing CO_2 in the atmosphere)", "Explain how sustainable consumption of natural resources (used in agriculture and forestry) combines with the conservation of water resources" and "Explore how food security increases by making farms more adapted to climate change".

AquaCrop model results show increases in potato and grape crops, up to 22% and 34%, respectively. It is expected that maize production can be mostly constant (please see in Annex III – AquaCrop yields projections).

The Shared Policy Statement emphasizes practices such as crop rotation, intercropping, sustainable management of livestock and land to improve soil health, enhanced water storage and distribution, and

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investment in precision farming, for the Agricultural sector. For Energy, adaptation and mitigation solutions should include the expansion and diversification of renewable energy through repowering of wind energy, the introduction of solar power, increased electricity storage capacity, and the promotion of electric mobility, in order to reduce reliance on external energy sources and lower carbon emissions. In the tourism sector, adaptation solutions should include assessing the visitor's capacity of tourism sites, ecosystem restoration, expansion of protected areas, safeguarding water infiltration zones, and raising awareness among visitors and residents about environmental and resource impacts.

From the storyline, we can emphasize the solutions that need to be implemented, starting with water use efficiency increase. In the agriculture sector, intercropping and precision agriculture are considered necessary. Adequate soil management with protection of primary forest and afforestation will improve the water retention and prevent landslides or erosion, both focused on agriculture and tourism sectors. Because the tourism sector needs to limit the load factor, the protection of natural land should be included. The energy sector needs to deploy more photovoltaic energy that should be accomplished along with the implementation of more energy storage which is important in the context of islands.

Based on stakeholders' feedback and the results of the system dynamic model in which different policy action scenarios have been tested, the recommended actions to be implemented in Azores are:

- Expand the deployment of renewable energy, energy storage solutions and electric mobility, to reduce emissions and ensure reliable energy supply.
- Promote diversification of renewable energy through repowering of wind installations and photovoltaic deployment.
- Foster soil management solutions including forest protection and afforestation to strengthen water retention and prevent landslides or erosion.
- Implement measures to protect natural lands by assessing the visitor capacity of tourism sites, restoring ecosystems, expanding protected areas, safeguarding water infiltration zones, and raising awareness among visitors and residents about environmental and resource impacts.
- Support sustainable management of livestock solutions to enhance soil health and fertility, protect biodiversity and reduce gas emissions.
- Promote the transition to regenerative and precision agriculture to build more resilient and sustainable farming systems. This includes enhancing irrigation efficiency together with water storage and distribution and adopting complementary measures such as crop diversification, intercropping and improved soil health management.

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- Adopt a combination of water-use efficiency measures to reduce the risk of seasonal droughts and water scarcity.

6 Conclusions

In Task 6.5, the objective was to make an evaluation of local solutions, based in the land-based adaptation and mitigation solutions (LAMS), to provide recommendations, simulated and holistically evaluated by local System Dynamics (SD) models. Suitable packages of solutions were tested based in policy local narratives as to contribute to local strategies and policy design.

Therefore, the SD model was used, integrating LAMS driven solution in different scenarios, modelling different levels of implementation (Low, Medium and High). These solutions were previously assessed and discussed in local workshops, where stakeholders evaluated several policy insights about their importance in their case study. Moreover, a co-created summary and discussion of the most relevant sectors, respective risks and possible solutions was developed, entitled Shared Policy Statement, for each case study. This includes not only the most relevant sectors but also LAMS that can respond to climate driven challenges and risks, considering drivers and barriers of implementation. Using the framework of construction of policy recommendations used in this deliverable (Figure 1.1), proved that the local SD model can be useful for risk analysis and solution testing for future climate scenarios.

As such, local SD model results, together with AquaCrop yield results, Shared Policy Statements and Ranking of Policy Insights were integrated to develop the Policy Recommendations, that discloses and contextualizes key package of solutions for each case study.

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Annexes

This document integrates three annexes that are listed below. These annexes have been developed as supplementary documents to improve the understanding of the results presented in the main document.

D6.5 | Annex I – Adaptation and Mitigation potential

D6.5 | Annex II – Guidelines for the 5th Workshop

D6.5 | Annex III – AquaCrop yields projections

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