DRAFT MASTER PLAN

WATER MANAGEMENT IN THESSALY

IN THE WAKE OF STORM DANIEL

How to Address Thessaly's Water-Related Agricultural Challenges

VOLUME VI: RECOMMENDATIONS AND TIMELINES

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Introduction

Tackling Thessaly's water challenges will take time and cost money. This sixth volume of Thesally's Water Management Plan provides an overview of the recommendations, the timelines, the funding options, and the potential risks. The ambition is - in financial terms - that Thessaly's residents and businesses, and both the regional and central government's challenges remains at acceptable levels, while realizing a significant reduction of the risks of floods and simultaneously improving the efficiency of water for agricultural practices. It is important to emphasize that this ambition aims to secure long-term positive impact for the region and for all different stakeholders, even though there may be more financially convenient solutions available in the short-term or structured exclusively to specific target groups.

As a response to the devastating impact of Storm Daniel, significant EU funds have been committed to support Thessaly. In September 2023, EU Commission Chief Ursula von der Leyen stated, after meeting with Greek Prime Minister Kyriakos Mitsotakis in Strasbourg, that "*Our thoughts are with all the women, men and children who are courageously withstanding these disasters and we mourn the lives lost*." Greece can access up to 2.25 billion euros in European Funds to alleviate the impact. Von der Leyen said that "*If all member states agree to top up the bloc's solidarity fund, the European Union could additionally make up to 400 million euros available to Greece next year*". The latter funds would be from the specific EU's solidarity and emergency aid reserve.

However, considering the total investment required, and looking at long-term requirements, next to the significant EU contributions, the local government and private sector also have to contribute in order to 'build back better' It has been a well-known fact for years, long before the cyclones Ianos and Daniel, that significant funds need to be allocated toward water management. The challenges of inadequate water supply are particularly impactful on Greece's two key industries: agriculture and tourism. Due to the significant amounts of water needed for industrial practices, which is detailed in the agricultural section (Volume IV). Stakeholder resorted to non-natural water resources such as large-scale reservoirs and drilling thousands of boreholes to access groundwater. These kinds of solutions come at significant cost, however, they are crucial to adhere to ensure the long-term security against floods and to secure water for irrigation. Given that a significant portion of Thessaly's population depend on agriculture for their livelihoods, prioritizing investments in the protection and support of this sector is essential.

As the OECD stated in their report on Greece's water management in 2018, financing is an issue, especially with regard to user affordability and access to debt finance, and particularly for industries where EU funding is not available. Nowadays, while a broader range of financing options has become accessible, securing sufficient funds for both flood defense and agriculture continues to pose a challenge.

From a global perspective, however, the economic case for investments in water security is robust and with climate change and other drivers increasing pressure on water systems, the value of investments in resilience is continuously increasing. Globally, economic losses related to water insecurity are estimated at USD 260 billion per year from inadequate water supply and sanitation, of which USD 120 billion per year from urban property flood damages, and USD 94 billion per year of water insecurity to irrigators.

Action areas for funding

While public and official development finance remains crucial for ensuring water security, it should not be the only source for both the current and anticipated investment needs. Furthermore, for optimal benefits and synergies, investments and projects from the private sector should be integral component of a robust trajectory toward a resilient water management system in Thessaly. One example of this is the change for current agricultural and livestock practices, to the production of less irrigation reliant horticulture and fodders. As this transformation also has an very attractive economic business case, the investments should not come from the public sector entirely. However, the public sector does play a role in incentivizing this transformation. These kind of choices necessitates a comprehensive, multi-faceted approach to both financing and planning, in which regional and national government work together efficiently.

As available funding is not unlimited and is challenging to be secured, the recommendations presented in this report confirms that addressing the financing challenge requires more than calls for increased funding. It requires action on multiple fronts to:

1. Continuously strengthening the regulatory environment;
2. Making the best use of existing sources of finance and assets;
3. Optimize future investment needs by planning and sequencing investments;
4. Mobilizing additional sources of funding and finance.

1. Action 1: Continuously strengthening the regulatory environment

A strong enabling environment for water-related investment is characterized as a robust set of policies, regulations and institutional arrangements that facilitate investment in activities and assets that contribute to water security. Policy settings include both water specific policies and policies/incentives related to the financial sector.

Adequate policies, regulations and institutional arrangements are to ensure that individual investments deliver their intended benefits and contribute to the sustainable management of water resources and the delivery of water supply and sanitation. They are mend to further discourage investment in activities and assets that hold back water security, for example:

- By disincentivizing property development in flood-prone areas
- By disincentivizing irrigation dependent crops such as cotton
- By stopping subsidies on energy which is used for drilling deeper boreholes

A strong enabling environment also helps ensure the water sector’s ability to recover costs, secure sustainable financing, and thus enhance the sector’s attractiveness to investors.

2. Action 2: Making the best use of existing sources of finance and assets

Structural and operational inefficiencies pose significant hurdles in accessing available funding and utilizing existing assets efficiently. Globally, the water sector conventionally leans heavily on public finance, often resulting in the suboptimal allocation and utilization of funds. Moreover, reliance on public finance can potentially displace private sources of funding or deter collaboration with private financiers.

In order to address these challenges, governments, regulators, and service providers need to optimize both the planning of capital expenditures and operation expenditures. Capital expenditures in the water sector should be carefully planned to ensure that finance is used to maximize economic, social and environmental benefits and improve overall capital efficiency. The proposed setup of the WMO can support with safeguarding this efficiency of investments. Thessaly has seen a lot of inefficiencies of significant capital investments over the past years.

At the same time, investing in operational expenditures and timely management of water assets (e.g. reservoirs, pipes and wastewater treatment facilities), supports efficient operations and maintenance that in turn strengthens the sustainability of water services and supports water security. Many recommendations provided in this Masterplan are focused on more extensive maintenance, such as cleaning debris and clearing the rivers to ensure a better water flow.

Making more conscious and less counter efficient choices, has the aim to optimize the use of current and future financial resources. Existing subsidies and funds like the Rural Development Program for Greece should be used as efficient as possible.

1. Action 3: Optimize future investment needs by planning and sequencing investments

Investments in water-related projects must exhibit resilience to effectively navigate systemic changes. Resilient solutions recognize the possibility of disruptions to system functions, whether from anticipated or unforeseen events. Consequently, it is necessary to strategize how to recover from such occurrences.

While financiers typically emphasize a pipeline of bankable projects, government authorities and project developers should integrate these pipelines into comprehensive strategic investment pathways. This integration ensures resilience, contributing to long-term water security and sustainable growth, ideally at minimal cost.

This Masterplan has been setup as a strategic, long-term perspective, aiming to ensure that assets deliver anticipated benefits throughout their operational lifespan, mitigating the risk of premature obsolescence or costly retro-fitting in the future. This approach also fosters a steady flow of investment opportunities and returns for investors. One of these suggestions is the transformation to horticulture, the main incentive is a reduced irrigation water demand, but economically this will be very beneficial for the region.

The recommendations have all been assigned an indicative timeline, part of it no-regret activities that should be done directly, and other medium- and long-term. This is dependent on the business case to be built for each

specific region or project. For example the investments in dykes and the tunnel around Lake Karla, depend on the political decision whether to extend the lake or not. The sequencing of recommendations is therefore crucial.

- Action 4: Mobilizing additional sources of funding and finance

Securing additional sources of finance and funding is necessary to effectively bridge and close the financing gap for water-related investments. Numerous options exist to leverage additional funding and financing. The government and EU have the ability deploy a diverse array of economic and financial policy instruments to influence the behavior of individuals, communities, and organizations. For example, the existing EU subsidies on cotton and local subsidies on energy.

This Masterplan aims to align actions with flood safety, increasing private revenues for effective water management, water supply, and overall water resource governance.

Recommendations

The Masterplan involved a comprehensive analysis within the study area to outline a range of recommendations for reducing flood risks and implementing anti-drought measures. This overview includes key recommendations, offering a description of the main features associated with these measures. The identified options encompass a blend of investments, maintenance costs, incentives, and research initiatives.

Ultimately, the choice to select and proceed with proposed recommendations rests with the Government. These recommendations are focused on the establishment of a future-proof water management ecosystem, focusing mainly on water aspects. While efforts were made to consider various other factors such as environmental and political, certain aspects, such as decisions related to the extension of Lake Karla and the diversion of the Archeloos River, have not undergone detailed analysis for these other factors.

The estimated total budget for all recommendations exceeds €4.5 billion. However, a substantial portion of these budgets, particularly the larger investments, is earmarked for medium- to long-term deployment. It is strongly suggested not to adopt this total budget, as it does not provide a complete picture without additional context. Specific political decisions are necessary for selecting and implementing the recommendations, for example both the option to extend Lake Karla and to not do so, are included in this total amount.

Vol 1. Flood Defense Infrastructure

Various measures, including floodplain storage, retention ponds, and revegetation, are designed to reduce peak flows. Conversely, measures such as riverbed modifications, cement channeling, and dikes aim to decrease peak stages for specific flow rates. Additionally, resettlement is considered as a measure to minimize susceptibility to flood damage. For a comprehensive overview of all recommendations, please refer to Table 11: Vol. 1 Recommendations (1/4), Table 12: Vol. 1 Recommendations (2/4), Table 13: Vol. 1 Recommendations (3/4), and Table 14: Vol. 1 Recommendations (4/4).

A substantial portion of the recommendations focuses on Flood Defense Infrastructures, amounting to nearly €3.3 billion. It's important to note that these investments are distributed across several years, with some extending up to 15 years. Furthermore, strategic decisions present scenarios where multiple options are considered. For instance, the decision on whether to extend Lake Karla (estimated at €161 million) or not (with an estimated cost of €116 million) both feature in the recommendation overview, highlighting the comprehensive approach taken in considering alternative courses of action.

The budget for the different regions is distributed as follows:

- Mountainous area € 206 million
- Trikala and Karditsa €1.294 million

- Larissa Area € 289 million
- Lake Karla Area €1.029 million
- General/other € 508 million

To proactively address potential future issues, a key recommendation involves the clearance of debris, repair of damaged dykes and culverts, removal of abandoned and destroyed buildings, and the dredging of river sediments. The projected budget for these measures is estimated at €328 million.

A major portion of this budget will be allocated to reconstructing and enhancing the dyke system across the middle-Pineios region, spanning a potential range of up to 250 kilometers. Budget uncertainty arises from sourcing materials and determining the precise specifications for dyke heights and widths. An overall budget of €500 million has been proposed, with €125 million earmarked for the expected 25 kilometers needed for the dyke on the East Bank of Enipeas.

Additionally, a significant budget of €540 million is anticipated if the decision is made not to extend Lake Karla. This amount accounts for compensating farmers for their lands due to production withdrawal. Comprehensive planning and consideration of these budget allocations are crucial for the effective execution of these vital preventive measures.

Vol	Category	Recommendation	Measure	Timeline	Costs
1	General - Thessaly	Procurement and Processing of High-Accuracy Digital Elevation Model (LIDAR): Digital elevation model through LIDAR technologyfor enhanced accuracy in geographical data including currently existing levees and floodsplains.	Modelling	Short-term (up to 2 years)	€ 1,300,000
1	General - Thessaly	Clearance of Illegal Dams: Removal of all unauthorized dams to safeguard proper water flow. EUR 8.000 per dam, on average. Our estimate indicate that there are around 200 illigal dams.	Maintenance	Short-term (up to 2 years)	€ 1,600,000
1	General - Thessaly	Clearance of Debris: Removal of all debris to safeguard proper water flow. EUR 134.000 per km on average, excluding additional, such as for example machines transfer, worker village, study costs, etc. Estimate around 500km.	Maintenance	Medium (up to 5 years)	€ 67,000,000
1	General - Thessaly	Clearance of certain Abandoned or Destroyed Buildings in the Floodplain which severly impede the water flow.	Maintenance	Short-term (up to 2 years)	€ 15,000,000
1	General - Thessaly	Restoration of Damaged Dykes and Culverts: Undertaking measures to repair and rehabilitate approximately 100 kilometers of damaged dykes and culverts. Estimated cost averages around EUR 970,000 per KM.	Maintenance	Short-term (up to 2 years)	€ 97,000,000
1	General - Thessaly	Clearance of Vegetation from Floodplains: Removing trees and shrubs from floodplain areas to enhance water flow and reduce the risk of flooding.	Maintenance	Short-term (up to 2 years)	€ 15,000,000
1	General - Thessaly	Dredging Riverbed Sediments: Essential for maintaining watercourse capacity and preventing flooding. Estimated cost: EUR 2,200,000 per km for 60 km.	Maintenance	Medium (up to 5 years)	€ 132,000,000
1	Mountainous areas	Implementation of Check Dams as Retention Structures in Mountains: Installation of check dams to effectively manage water flow and prevent soil erosion in mountainous regions.	Construction of small dams	Medium (up to 5 years)	€ 187,500,000
1	Mountainous areas	Revegetation in Mountainous Regions: Implementing initiatives to restore and promote vegetation in mountain areas for enhanced ecological balance and erosion control.	Revegetation	Medium (up to 5 years)	€ 15,000,000
1	Mountainous areas	Bridge Remodeling and construction: Undertaking the redesign and improvement of bridges, with the specific number, including a comprehensive survey.	Construction	Medium (up to 5 years)	€ 1,500,000
1	Mountainous areas	Study to determin the need for remodeling and construction of Roads, Offramps, and Railways: Enhancing crossings, culverts, and infrastructure.	Study/design	Medium (up to 5 years)	€ 1,500,000
1	Trikala and Karditsa prefectures	Detailed Design of Interceptor Drain: Planning and designing an interceptor drain, spanning a maximum of 40 km, with a minimum of 3 gate systems along the foothills of Karditsa Prefecture.	Study/design	Medium (up to 5 years)	€ 900,000
1	Trikala and Karditsa prefectures	Installation of 40 km Interceptor Drain(s) Along the Foothills of Karditsa Prefecture: The necessity for this project will be evaluated to determine its viability and benefits.	Construction	Medium (up to 5 years)	€ 80,000,000
1	Trikala and Karditsa prefectures	Construction of a Detour Canal in Trikala: Development of an approximately 5 km detour canal for improved water management in the Trikala region.	Canal (to be defined)	Short-term (up to 2 years)	€ 15,000,000
1	Trikala and Karditsa prefectures	Construction of Dyke Along Detour Canal in Trikala: Building a dyke spanning approximately 4.2 km along the detour canal in Trikala for enhanced flood protection and water control.	Dyke (to be defined)	Medium (up to 5 years)	€ 8,200,000
1	Trikala and Karditsa prefectures	Restoration, Elevation, and Leveling of Dyke System in Karditsa: Undertaking repairs, raising the height, and ensuring uniform levels of the dyke system in Karditsa for enhanced flood resilience. Estimated at 24km.	Construction/ maintenance	Medium (up to 5 years)	€ 26,000,000
1	Trikala and Karditsa prefectures	Expansion of Drain Crossings at Stavros and Mavrikas near Karditsa: Increasing the capacity of drain crossings through the addition of more or larger culverts to enhance water flow efficiency and mitigate potential issues.	Construction	Medium (up to 5 years)	€ 3,500,000

Table 11: Vol. 1 Recommendations (1/4)

Vol	Category	Recommendation	Measure	Timeline	Costs
1	Trikala and Karditsa prefectures	Inland Dyke (Approx. 18.5 km) for Palamas and Markos Protection: Building a dyke spanning 18.5 km to safeguard Palamas and Markos from potential water-related risks.	Dyke (to be defined)	Medium (up to 5 years)	€ 92,500,000
1	Trikala and Karditsa prefectures	Elevation of Inland Dyke West of Vlochos (1.7 km): Raising the height of the inland dyke by 1.7 km to enhance flood protection in the western Vlochos area.	Dyke (to be defined)	Medium (up to 5 years)	€ 8,500,000
1	Larissa Area	Construction of Dyke on the East Bank of Enipeas at Blochos (1.8 km): Establishing a dyke approximately 1.8 km in length on the east bank of Enipeas at Blochos for improved flood protection.	Dyke (to be defined)	Medium (up to 5 years)	€ 9,000,000
1	Larissa Area	Construction of Inland Dyke in Makrichori (3.7 km): Implementing a dyke spanning 3.7 km in Makrichori for enhanced flood protection in the area.	Dyke (to be defined)	Medium (up to 5 years)	€ 18,500,000
1	Trikala and Karditsa prefectures	Inland Dyke for Psathochori and Koskinas (8.4 km): Constructing an 8.4 km dyke to enhance flood protection in Psathochori and Koskinas.	Dyke (to be defined)	Medium (up to 5 years)	€ 42,000,000
1	Trikala and Karditsa prefectures	Installation of Levee Gates on Kaletzis River North of Metamorfosi: Placing gates in both the eastern and western levees for improved water flow control and flood management.	Gate	Medium (up to 5 years)	€ 5,500,000
1	Trikala and Karditsa prefectures	Potential Inland Dyke, Artesiano & Northern Karditsa (Approx. 4 km): Considering a 4 km dyke to enhance protection in Artesiano and northern Karditsa.	Dyke (to be defined)	Medium (up to 5 years)	€ 20,000,000
1	Trikala and Karditsa prefectures	Inland Dyke for Proastio, Marathea, Pedino, Servota, and Korda (15.8 km): Constructing a 15.8 km dyke for flood protection in specified areas.	Dyke (to be defined)	Medium (up to 5 years)	€ 79,000,000
1	Trikala and Karditsa prefectures	Construction of Dyke West of the River Orgozinos (6.2 km): Building a 6.2 km dyke to enhance flood protection on the western side of the Orgozinos.	Dyke (to be defined)	Medium (up to 5 years)	€ 31,000,000
1	Trikala and Karditsa prefectures	Installation of 1-2 Gates in Levee West of the Sofaditis: Incorporating gates within the levee system on the western side of the Sofaditis for improved water control.	Gate	Short-term (up to 2 years)	€ 5,500,000
1	Trikala and Karditsa prefectures	Inland Levee or Interceptor Drain North of Mataragka (5.5 km): Planning for a 5.5 km project to enhance flood protection north of the road in the Mataragka area.	Dyke (to be defined)	Medium (up to 5 years)	€ 27,500,000
1	Trikala and Karditsa prefectures	Potential Inland Dyke for Premises East of Palamas (Approx. 2.8 km): Considering the construction of a 2.8 km dyke for flood protection in the eastern premises of Palamas.	Dyke (to be defined)	Medium (up to 5 years)	€ 14,000,000
1	Trikala and Karditsa prefectures	Inland Dyke for Premises East Bank of Pharsalitis, East of Palamas (1.0 km): Constructing a 1.0 km dyke for improved flood protection in the specified area.	Dyke (to be defined)	Medium (up to 5 years)	€ 5,000,000
1	Trikala and Karditsa prefectures	Dyke East Bank Enipeas and 25 km Inland Dyke for Fyllo, Orfana, Lefki: Implementing flood protection measures.	Dyke (to be defined)	Medium (up to 5 years)	€ 125,000,000
1	Trikala and Karditsa prefectures	Inland Dyke for Astritsa (5.8 km) or Villager Relocation: Considering options for flood protection, either through a 5.8 km inland dyke in Astritsa or exploring the possibility of relocating villagers.	Dyke (to be defined)	Medium (up to 5 years)	€ 29,000,000
1	Trikala and Karditsa prefectures	Inland Dyke for Ampelos (2.6 km) or Villager Relocation: Considering flood protection options, including a 2.6 km inland dyke in Ampelos or exploring the possibility of relocating villagers.	Dyke (to be defined)	Medium (up to 5 years)	€ 13,000,000
1	Trikala and Karditsa prefectures	Construction of Dykes in Itea (5.8 km): Building dykes spanning 5.8 km in Itea for enhanced flood protection in the area.	Dyke (to be defined)	Medium (up to 5 years)	€ 29,000,000

Table 12: Vol. 1 Recommendations (2/4)

Vol	Category	Recommendation	Measure	Timeline	Costs
1	Trikala and Karditsa prefectures	Installation of at Least 2 Gates in Levees of Pharsalitis: Incorporating a minimum of two gates within the Pharsalitis levee system to improve water control and flood management.	Gate	Medium (up to 5 years)	€ 5,500,000
1	Trikala and Karditsa prefectures	Construction of Dyke in Iperia (4.1 km): Implementing a dyke project covering 4.1 km in Iperia for enhanced flood protection.	Dyke (to be defined)	Medium (up to 5 years)	€ 20,500,000
1	Trikala and Karditsa prefectures	Construction of Dyke on the East Bank of Neochoritis at Oichalia Trikala (3.1 km): Building a 3.1 km dyke on the east bank of Neochoritis at Oichalia Trikala to enhance flood protection in the area.	Dyke (to be defined)	Medium (up to 5 years)	€ 15,500,000
1	Trikala and Karditsa prefectures	Dyke South Bank Eastern Neochoritis (2.9 km): Constructing a 2.9 km dyke for improved flood protection.	Dyke (to be defined)	Medium (up to 5 years)	€ 14,500,000
1	Trikala and Karditsa prefectures	Dykes West Bank Neochoritis, Klokotos, Georganades (3.9 km): Constructing 3.9 km of dykes for improved flood protection.	Dyke (to be defined)	Medium (up to 5 years)	€ 19,500,000
1	Trikala and Karditsa prefectures	Dyke along the south bank of the Pineios, in combination with the extension of the northern levee (10 km)	Dyke (to be defined)	Medium (up to 5 years)	€ 50,000,000
1	Trikala and Karditsa prefectures	Construct a protective dyke spanning a distance of 1.6 kilometers to safeguard the village of Piniada.	Dyke (to be defined)	Medium (up to 5 years)	€ 8,000,000
1	Trikala and Karditsa prefectures	Reconstruction and enhancement of the dyke systems along the Middle-Pineios region, spanning a potential range of up to 250 kilometers.	Dyke (to be defined)	Long (up to 15 years)	€ 500,000,000
1	Larissa Area	Enhance the current dyke infrastructure extending from the city of Larissa to the Gyrtoni Barrage, covering a distance of 32 kilometers.	Dyke (to be defined)	Medium (up to 5 years)	€ 80,000,000
1	Larissa Area	Conduct a localized study for the rehabilitation of the floodplain situated north of Larissa.	Study	Short-term (up to 2 years)	€ 600,000
1	Larissa Area	Clearance of structures within the Larissa floodplain, coupled with the provision of compensations as required.	Clearance	Short-term (up to 2 years)	€ 2,500,000
1	Larissa Area	Revitalization and reconstruction of the northern Larissa floodplain.	Clearance and remodelling	Medium (up to 5 years)	€ 12,800,000
1	Larissa Area	Building the Gyrtoni Barrage Spillway.	Spillway	Short-term (up to 2 years)	€ 12,000,000
1	Larissa Area	Construction of a dyke spanning 5.1 kilometers to the north of Gyrtoni.	Dyke (to be defined)	Medium (up to 5 years)	€ 25,500,000
1	Larissa Area	Establishment of dykes along the Titarisios River at Damasi covering a distance of 3.2 kilometers.	Dyke (to be defined)	Medium (up to 5 years)	€ 16,000,000
1	Larissa Area	Construction of a dyke along the north bank of the Titarisios River in Tyrnavos, extending for a distance of 6.2 kilometers.	Dyke (to be defined)	Medium (up to 5 years)	€ 31,000,000
1	Larissa Area	Revitalization of Argyropouliou Lake through the implementation of a dam or dyke system.	Dam or dyke	Medium (up to 5 years)	€ 13,000,000

Table 13: Vol. 1 Recommendations (3/4)

Vol	Category	Recommendation	Measure	Timeline	Costs
1	Larissa Area	Installation of a dyke along the south bank of the Pineios River at Tempi, spanning a distance of 1 kilometer.	Dyke (to be defined)	Medium (up to 5 years)	€ 5,000,000
1	Lake Karla area	Option No Lake Extention: Construction of a northern dyke around Lake Karla spanning 12.6 kilometers, with the specific option of not extending the lake.	Dyke (to be defined)	Medium (up to 5 years)	€ 63,000,000
1	Lake Karla area	Option No Lake Extention: Development of a southern dyke surrounding Lake Karla, covering a distance of 10.6 kilometers, with the specified option of not extending the lake.	Dyke (to be defined)	Medium (up to 5 years)	€ 53,000,000
1	Lake Karla area	Option Lake Extention: Construction of a northern dyke, extending over a distance of 10 kilometers, with the option to facilitate the extension of the lake.	Dyke (to be defined)	Medium (up to 5 years)	€ 50,000,000
1	Lake Karla area	Option Lake Extention: Implementation of a southern dyke spanning 9.7 kilometers, with the flexibility to consider the extension of the lake as an option.	Dyke (to be defined)	Medium (up to 5 years)	€ 48,500,000
1	Lake Karla area	Option Lake Extention: Construction of an eastern dyke covering a distance of 5.5 kilometers, with the added flexibility to explore the option of extending the lake.	Dyke (to be defined)	Medium (up to 5 years)	€ 27,500,000
1	Lake Karla area	Option Lake Extention: Dredging of Lake Karla for increasing the capacity.	Dredging	Short-term (up to 2 years)	€ 35,000,000
1	Lake Karla area	Integration of additional discharge systems, incorporating pump stations, for Lake Karla.	Pump station	Long (up to 15 years)	€ 43,000,000
1	Lake Karla area	Consideration of an optional tunnel as part of the overall project for Lake Karla towards the Sea. Minimum estimate.	Tunnel	Long (up to 15 years)	€ 232,000,000
1	Lake Karla area	Option No Lake Extention: Establishment of a Capitalized Fund for Compensations to address future inundation issues related to Lake Karla. Only to setup the Fund construction. Sourcing funds for compensations to be	Creation of trust fund	Short-term (up to 2 years)	€ 300,000
1	Lake Karla area	Option No Lake Extention: Alternative compensation approach Lake Karla: Land expropriation and withdrawal from production.	Once-only compensation	Long (up to 15 years)	€ 540,000,000
1	Thessaly	Potential relocation of premises, to be determined based on the findings of a survey. Budget estimated for an incentives program for reallocation.	Relocation	Long (up to 15 years)	€ 100,000,000
1	Thessaly	Possible relocation of residents, a decision to be made based on further considerations. Construction of prefab houses on state-owned land and no compensation for existing houses.	Relocation	Long (up to 15 years)	€ 45,000,000
1	Thessaly	Deployment of mobile pumps to assist with urban drainage in diked villages during flood events.	Pump systems	Medium (up to 5 years)	€ 7,000,000

Table 14: Vol. 1 Recommendations (4/4)

Vol. 2 Water Management Organization

The recommendations outlined in Table 15: Vol 2. Recommendations, under the Water Management Organization, predominantly center around the creation of the Water Management Organization. This endeavor is relatively cost-effective, leveraging existing resources collated from various decentralized bodies. The principal expenses are earmarked for establishing the organization, covering expenditures such as software, hardware, and ongoing staff salaries. The overall budget for this initiative is estimated at slightly more than €6 million.

A key initiative involves the strategic relocation of personnel currently engaged in water management-related departments of local authorities, the estimated budget here is excluding the annual salaries of these employees. To ensure robust leadership within the WMO, there is a proposal to hire a top management team comprising 10 managers and one lawyer. This move takes into account the associated annual budget just below €1 million. To streamline processes, the recommendation includes a re-engineering of the licensing procedure, with a budget of €0.5 million.

Ensuring competitive compensation, the WMO will determine annual salaries for essential roles, with an annual budget around €3 million once all departments are fully up and running, this budget includes the transfer of approximately 20 employees from their current organizations.

Vol.	Category	Recommendation	Timeline	Costs
3	Early Warning	Development of ultra accurante Hydrological Model: Serving as the foundation for planning, detailed infrastructure design, and early warning systems. Including scenario assesstment	Short-term (up to 2 years)	€ 560,000
3	Early Warning	Provision of consultancy services to establish an operational system, including the implementation of software and capacity building efforts. The scope and complexity of the project will be tailored to leverage potential efficiencies	Short-term (up to 2 years)	€ 1,450,000
3	Early Warning	Acquisition of Hardware: Procurement of computers to serve as the backbone for the Early Warning System (EWS), encompassing master control, modeling, archiving, etc. This includes surge protectors, large screens for the situation	Short-term (up to 2 years)	€ 400,000
3	Early Warning	Establishment of Field Stations (Hydrometeorological): Equipped to measure wind speed and direction, precipitation, and surface air pressure.	Short-term (up to 2 years)	€ 250,000
3	Crisis Management	Acquisition of at least five 4x4 Vehicles: Essential for field station maintenance and facilitating effective warning dissemination, equipped with loudspeakers. Budget allocation: 5 vehicles at EUR 50.000 each.	Short-term (up to 2 years)	€ 250,000
3	Crisis Management	Crisis Management Packages; 50 comprehensive kits, featuring essential tools such as safejackets, smartphones, bicycles, megaphones, ropes, water, food and more.	Short-term (up to 2 years)	€ 650,000
3	Early Warning	Establishment of a Database and Information System with the observation network and central coordination center for data flow and efficient coordination.	Short-term (up to 2 years)	€ 100,000
3	Early Warning	Implementation of a Flood Forecasting System for large dams, along with the development of operational procedures. Budget allocation: 4 projects, estimated at EUR 75.000 each.	Short-term (up to 2 years)	€ 300,000
3	Early Warning	Technical Assistance for the Evaluation of Meteorological Forecast Reliability and Accuracy: Meteorological Service to assess the precision and dependability of weather forecasts.	Short-term (up to 2 years)	€ 45,000
3	Early Warning	Acquisition of Software Systems and Associated Fees, including licensing and associated fees.	Short-term (up to 2 years)	€ 150,000
3	Education	Training for Diverse Functions: Comprehensive skill development for various roles and responsibilities within the designated functions.	Short-term (up to 2 years)	€ 250,000

Table 15: Vol 2. Recommendations

Vol 3. Early Warning & Crisis Management

The recommendations outlined in Volume 3 primarily focus on establishing the Early Warning System and enhancing Crisis Management, as illustrated in Table 16: Vol 3. Recommendations. The estimated total budget for these initiatives amount lies just over €4 million, with a significant portion allocated to the establishment of a 24/7 operational Early Warning Center. This includes substantial investments in the right systems, hydrological models, field stations, and monitoring equipment. Additionally, a considerable investment is necessary for recruiting and training qualified staff.

The comprehensive development plan entails the establishment of an ultra-accurate Hydrological Model, serving as a foundational tool for planning, detailed infrastructure design, and early warning systems. This modeling initiative, with an allocated budget of €0.6 million, is set to be executed within the short-term, spanning up to two years. Concurrently, consultancy services, budgeted at €1.5 million, will be engaged to establish an operational system, implementing software and conducting capacity-building efforts.

The procurement of essential hardware, including computers, surge protectors, large screens, and internet connectivity, forms a crucial element with a budget of €0.4 million. Further infrastructure enhancements involve the establishment of hydrometeorological field stations, acquisition of 4x4 vehicles, crisis management packages, and the implementation of a flood forecasting system. These short-term initiatives, collectively amounting to €2 million, underscore the commitment to bolstering the region's resilience through advanced hydrological modeling and strategic preparedness measures.

Vol	Category	Recommendation	Measure	Timeline	Costs
3	Early Warning	Development of ultra accurante Hydrological Model: Serving as the foundation for planning, detailed infrastructure design, and early warning systems. Including scenario assesstment	Modelling	Short-term (up to 2 years)	€ 560,000
3	Early Warning	Provision of consultancy services to establish an operational system, including the implementation of software and capacity building efforts. The scope and complexity of the project will be tailored to leverage potential efficiencies	Consulting	Short-term (up to 2 years)	€ 1,450,000
3	Early Warning	Acquisition of Hardware: Procurement of computers to serve as the backbone for the Early Warning System (EWS), encompassing master control, modeling, archiving, etc. This includes surge protectors, large screens for the situation	Equipment	Short-term (up to 2 years)	€ 400,000
3	Early Warning	Establishment of Field Stations (Hydrometeorological): Equipped to measure wind speed and direction, precipitation, and surface air pressure.	Equipment	Short-term (up to 2 years)	€ 250,000
3	Crisis Management	Acquisition of at least five 4x4 Vehicles: Essential for field station maintenance and facilitating effective warning dissemination, equipped with loudspeakers. Budget allocation: 5 vehicles at EUR 50.000 each.	Equipment	Short-term (up to 2 years)	€ 250,000
3	Crisis Management	Crisis Management Packages; 50 comprehensive kits, featuring essential tools such as safejackets, smartphones, bicycles, megaphones, ropes, water, food and more.	Education	Short-term (up to 2 years)	€ 650,000
3	Early Warning	Establishment of a Database and Information System with the observation network and central coordination center for data flow and efficient coordination.	Education	Short-term (up to 2 years)	€ 100,000
3	Early Warning	Implementation of a Flood Forecasting System for large dams, along with the development of operational procedures. Budget allocation: 4 projects, estimated at EUR 75.000 each.	Equipment	Short-term (up to 2 years)	€ 300,000
3	Early Warning	Technical Assistance for the Evaluation of Meteorological Forecast Reliability and Accuracy: Meteorological Service to assess the precision and dependability of weather forecasts.	Equipment	Short-term (up to 2 years)	€ 45,000
3	Early Warning	Acquisition of Software Systems and Associated Fees, including licensing and associated fees.	Equipment	Short-term (up to 2 years)	€ 150,000
3	Education	Training for Diverse Functions: Comprehensive skill development for various roles and responsibilities within the designated functions.	Education	Short-term (up to 2 years)	€ 250,000

Table 16: Vol 3. Recommendations

Vol. 4: Agriculture & Livestock

The comprehensive overview of recommendations for Agriculture and Livestock, as detailed in Table 1: Safety standards per land-use.Table 17: Vol 4. Recommendations. encompasses a total budget close to €1.3 billion, although just as the other budgets, this is only to be allocated over an extended timeframe. The primary objective of these recommendations is to secure a sustainable, long-term income for farmers in the region.

The budget for transition farmers towards horticulture, is one of the most significant, reaching €11.7 billion, and an additional €1.6 billion for transitioning the farmers of fodder production to less water demanding crops. However, these costs are with the purpose of transitioning the private sector, which will also benefit from the economic results of these higher-value crops. Therefore, it has been assumed that 10% of the total costs should be taken as initial investments, of which 40% should be budgeted by the government as incentives to stimulate the transition. This results in €600 million for the transition to farmers, and an additional €75 million allocated for the promotion of less water-demanding fodder production

Another noteworthy allocation involves if the political decision is made to divert the Achelous River, which is estimated to require a budget of €400 million. Additionally, the promotion of a local machine hiring company is strongly recommended, fostering increased efficiency for local farmers through the adoption of innovative tools and techniques. These strategic investments aim to ensure the resilience and prosperity of the agricultural and livestock sectors in the region.

Vol	Category	Recommendation	Measure	Timeline	Costs
4	Water use	Suggestion to cease the current electricity subsidies, as they are being deployed to facilitate the pumping of irrigation water to greater depths.	Policy	Short-term (up to 2 years)	€ -
4	Water use	Incentives: Revamp the current animal fodder production to include varieties that necessitate minimal or no irrigation. Estimate the costs for incentives, considering the unchanged land conditions.	Incentives	Medium (up to 5 years)	€ 75,000,000
4	Water use	Incentives: For transforming the agricultural sector and move to higher-margin horticulture, in order to reduce the quantities of irrigation water used. Total change over 6 years costs 11.6 billion, 10% to be incentivicezed, of which 40%	Incentives	Medium (up to 5 years)	€ 600,000,000
4	Water use	Incentives to expand the livestock sector. Simultaneously, upscale and modernize farms for improved efficiency.	Incentives	Medium (up to 5 years)	€ 75,000,000
4	Watersupply	Continuously conduct in-depth studies and monitor the groundwater balance, as well as the quantity and usage of boreholes.	Research	Long (up to 15 years)	€ 4,000,000
4	Watersupply	Improve the water supply through initiatives such as the transfer of water from Achelous.	Investments	Medium (up to 5 years)	€ 400,000,000
4	Water use	Phase out subsidies for cotton to encourage farmers to transition to agricultural products that are both less water-intensive and financially sustainable independently. (budget for studies, lobbying, etc.)	Policy	Medium (up to 5 years)	€ 650,000
4	Agricultural efficiency	Establish an open-source information platform for all farmers to be leveraged.	Extension	Short-term (up to 2 years)	€ 2,500,000
4	Agricultural efficiency	Implement a levy on agricultural produce to fund research and marketing initiatives (budget for studies, and roll-out, etc.)	Policy	Short-term (up to 2 years)	€ 200,000
4	Agricultural efficiency	Boost the percentage of educated and trained farmers, currently less than 1%, by establishing agricultural colleges in every prefecture.	Education	Short-term (up to 2 years)	€ 20,000,000
4	Agricultural efficiency	Further promote the establishment of large-scale farming cooperatives to foster collaboration among farmers, fostering knowledge-sharing and empowering them as a unified collective.	Investments	Medium (up to 5 years)	€ 4,000,000
4	Agricultural efficiency	Establish a local machine hiring company; stimulated and initiated by the government. Allowing farmers to rent Machinery, such as tractors, including the operator, for their specific farming needs	Investments	Medium (up to 5 years)	€ 75,000,000

Table 17: Vol 4. Recommendations

Vol. 5: Sociological Adaption

The overview of recommendation for the Sociological Adaption volume can be found in the table below: Table 18: Vol 5. Recommendations. The total budget for this part is €8 million.

In an effort to foster public awareness and community engagement for the promotion of water-reduction strategies, a comprehensive plan has been outlined. The allocation of €5 million for education initiatives over

a medium-term span of up to five years reflects a commitment to sustained community outreach. This approach includes public awareness campaigns strategically designed to encourage cooperation and compliance with water-saving measures. Simultaneously, a budget of €3 million has been designated for regulatory reforms aimed at facilitating smoother transitions for farmers. The focus here is on reducing bureaucratic obstacles, enhancing digitization processes, and ultimately fostering an environment conducive to effective water management. These medium-term educational and regulatory initiatives underline a holistic strategy to encourage community participation and streamline agricultural practices for sustainable water use.

Vol	Category	Recommendation	Measure	Timeline	Costs
5	Sociological adaptation	Public awareness campaigns and community outreach & engagement to promote cooperation and compliance with water-reduction strategies	Education	Medium (up to 5 years)	€ 5,000,000
5	Sociological adaptation	Regulatory reforms to facilitate transitions for farmers, reducing bureaucratic red tape, improving digitization	Education	Medium (up to 5 years)	€ 3,000,000

Table 18: Vol 5. Recommendations

Timelines

The Water Management Plan cannot be executed at once, it will require phased implementation, requiring many years to undertake all the steps recommended. Hence, why many 'no-regret' actions have been proposed, and other more significant long(er)-term actions. There are several key milestones that have to be achieved.

The damage wreaked by the floods resulting from Storm Daniel is immense. Compensations to affected farmers and required investments in flood prevention and management run into the billions. Seeing as it will take time to rebuild the area and the required financial resources may not be made available immediately, it will be necessary to set priorities.

Ideally, the flood recovery measures would be developed and implemented by the newly setup Water Management Organization and River Basis Authority, and on the basis of the government endorsed Masterplan Water Management. It will, however, take time to establish and equip the WMO and RBA with the required staff and mobilize investments for assets and equipment, and develop and approve the legal framework in which they can operate and train staff.

Following the detailed study and the Masterplan Water Management, three categories of timing have been established:

- Short-term interventions: 0-2 years
- Medium-term interventions: 2-5 years
- Long-term interventions: 5-20 years

Below is the overview of recommended activities to be developed per timing category. All interventions should be initiated after the issue and endorsement of the Master Plan.

Short-term measures

- Procurement and Processing of High-Accuracy Digital Elevation Model (LIDAR): Digital elevation model through LIDAR technology for enhanced accuracy in geographical data including currently existing levees and floodplains.
- Clearance of Illegal Dams: Removal of all unauthorized dams to safeguard proper water flow.
- Clearance of certain Abandoned or Destroyed Buildings in the Floodplain which severely impede the water flow.
- Clearance of Debris: Removal of all debris to safeguard proper water flow. EUR 134.000 per km on average, excluding additional, such as for example machines transfer, worker village, study costs, etc. Estimate around 500km.

- Restoration of Damaged Dykes and Culverts: Undertaking measures to repair and rehabilitate approximately 100 kilometers of damaged dykes and culverts.
- Clearance of Vegetation from Floodplains: Removing trees and shrubs from floodplain areas to enhance water flow and reduce the risk of flooding.
- Construction of a Detour Canal in Trikala: Development of an approximately 5 km detour canal for improved water management in the Trikala region.
- Installation of 1-2 Gates in Levee West of the Sofaditis: Incorporating gates within the levee system on the western side of the Sofaditis for improved water control.
- Conduct a localized study for the rehabilitation of the floodplain situated north of Larissa.
- Clearance of structures within the Larissa floodplain, coupled with the provision of compensations as required.
- Building the Gyrtoni Barrage Spillway.
- Transfer personnel currently employed in water management-related departments of local authorities, considering the potential benefits of minimizing transportation costs.
- Hire a top management team consisting of 10 managers and one lawyer, taking into account the associated annual costs.
- Optimize the use of existing local authorities' office facilities for establishing the Water Management Organization (WMO).
- Determine annual salaries for essential roles within the Water Management Organization (WMO).
- Development of ultra accurate Hydrological Model: Serving as the foundation for planning, detailed infrastructure design, and early warning systems. Including scenario assessment
- Provision of consultancy services to establish an operational system, including the implementation of software and capacity building efforts. The scope and complexity of the project will be tailored to leverage potential efficiencies through integration with existing systems.
- Acquisition of Hardware: Procurement of computers to serve as the backbone for the Early Warning System (EWS), encompassing master control, modeling, archiving, etc. This includes surge protectors, large screens for the situation room, enhanced and faster internet connectivity, and related essential equipment.
- Establishment of Field Stations (Hydrometeorological): Equipped to measure wind speed and direction, precipitation, and surface air pressure.
- Acquisition of at least five 4x4 Vehicles: Essential for field station maintenance and facilitating effective warning dissemination, equipped with loudspeakers.
- Crisis Management Packages; 50 comprehensive kits, featuring essential tools such as safe jackets, smartphones, bicycles, megaphones, ropes, water, food and more.
- Establishment of a Database and Information System with the observation network and central coordination center for data flow and efficient coordination.
- Implementation of a Flood Forecasting System for large dams, along with the development of operational procedures.

- Technical Assistance for the Evaluation of Meteorological Forecast Reliability and Accuracy: Meteorological Service to assess the precision and dependability of weather forecasts.
- Acquisition of Software Systems and Associated Fees, including licensing and associated fees.
- Training for Diverse Functions: Comprehensive skill development for various roles and responsibilities within the designated functions.
- Suggestion to cease the current electricity subsidies, as they are being deployed to facilitate the pumping of irrigation water to greater depths.
- Establish an open-source information platform for all farmers to be leveraged.
- Implement a levy on agricultural produce to fund research and marketing initiatives (budget for studies, and roll-out, etc.)
- Boost the percentage of educated and trained farmers, currently less than 1%, by establishing agricultural colleges in every prefecture.

Medium-term measures

- Dredging Riverbed Sediments: Essential for maintaining watercourse capacity and preventing flooding. Estimated cost: EUR 2,200,000 per km for 60 km.
- Deployment of mobile pumps to assist with urban drainage in diked villages during flood events.
- Implementation of Check Dams as Retention Structures in Mountains: Installation of check dams to effectively manage water flow and prevent soil erosion in mountainous regions.
- Revegetation in Mountainous Regions: Implementing initiatives to restore and promote vegetation in mountain areas for enhanced ecological balance and erosion control.
- Bridge Remodeling and construction: Undertaking the redesign and improvement of bridges, with the specific number, including a comprehensive survey.
- Study to determine the need for remodeling and construction of Roads, Offramps, and Railways: Enhancing crossings, culverts, and infrastructure.
- Detailed Design of Interceptor Drain: Planning and designing an interceptor drain, spanning a maximum of 40 km, with a minimum of 3 gate systems along the foothills of Karditsa Prefecture.
- Installation of 40 km Interceptor Drain(s) Along the Foothills of Karditsa Prefecture: The necessity for this project will be evaluated to determine its viability and benefits.
- Construction of Dyke Along Detour Canal in Trikala: Building a dyke spanning approximately 4.2 km along the detour canal in Trikala for enhanced flood protection and water control.
- Restoration, Elevation, and Leveling of Dyke System in Karditsa: Undertaking repairs, raising the height, and ensuring uniform levels of the dyke system in Karditsa for enhanced flood resilience. Estimated at 24km.
- Expansion of Drain Crossings at Stavros and Mavrikas near Karditsa: Increasing the capacity of drain crossings through the addition of more or larger culverts to enhance water flow efficiency and mitigate potential issues.

- Inland Dyke (Approx. 18.5 km) for Palamas and Markos Protection: Building a dyke spanning 18.5 km to safeguard Palamas and Markos from potential water-related risks.
- Elevation of Inland Dyke West of Vlochos (1.7 km): Raising the height of the inland dyke by 1.7 km to enhance flood protection in the western Vlochos area.
- Inland Dyke for Psathochori and Koskinas (8.4 km): Constructing an 8.4 km dyke to enhance flood protection in Psathochori and Koskinas.
- Installation of Levee Gates on Kaletzis River North of Metamorfosi: Placing gates in both the eastern and western levees for improved water flow control and flood management.
- Potential Inland Dyke, Artesiano & Northern Karditsa (Approx. 4 km): Considering a 4 km dyke to enhance protection in Artesiano and northern Karditsa.
- Inland Dyke for Proastio, Marathea, Pedino, Servota, and Korda (15.8 km): Constructing a 15.8 km dyke for flood protection in specified areas.
- Construction of Dyke West of the River Orgozinos (6.2 km): Building a 6.2 km dyke to enhance flood protection on the western side of the Orgozinos.
- Inland Levee or Interceptor Drain North of Mataragka (5.5 km): Planning for a 5.5 km project to enhance flood protection north of the road in the Mataragka area.
- Potential Inland Dyke for Premises East of Palamas (Approx. 2.8 km): Considering the construction of a 2.8 km dyke for flood protection in the eastern premises of Palamas.
- Inland Dyke for Premises East Bank of Pharsalitis, East of Palamas (1.0 km): Constructing a 1.0 km dyke for improved flood protection in the specified area.
- Dyke East Bank Enipeas and 25 km Inland Dyke for Fyllo, Orfana, Lefki: Implementing flood protection measures.
- Inland Dyke for Astritsa (5.8 km) or Villager Relocation: Considering options for flood protection, either through a 5.8 km inland dyke in Astritsa or exploring the possibility of relocating villagers.
- Inland Dyke for Ampelos (2.6 km) or Villager Relocation: Considering flood protection options, including a 2.6 km inland dyke in Ampelos or exploring the possibility of relocating villagers.
- Construction of Dykes in Itea (5.8 km): Building dykes spanning 5.8 km in Itea for enhanced flood protection in the area.
- Installation of at Least 2 Gates in Levees of Pharsalitis: Incorporating a minimum of two gates within the Pharsalitis levee system to improve water control and flood management.
- Construction of Dyke in Iperia (4.1 km): Implementing a dyke project covering 4.1 km in Iperia for enhanced flood protection.
- Construction of Dyke on the East Bank of Neochoritis at Oichalia Trikala (3.1 km): Building a 3.1 km dyke on the east bank of Neochoritis at Oichalia Trikala to enhance flood protection in the area.
- Dyke South Bank Eastern Neochoritis (2.9 km): Constructing a 2.9 km dyke for improved flood protection.
- Dykes West Bank Neochoritis, Klokotos, Georganades (3.9 km): Constructing 3.9 km of dykes for improved flood protection.

- Dyke along the south bank of the Pineios, in combination with the extension of the northern levee (10 km)
- Construct a protective dyke spanning a distance of 1.6 kilometers to safeguard the village of Piniada.
- Construction of Dyke on the East Bank of Enipeas at Blochos (1.8 km): Establishing a dyke approximately 1.8 km in length on the east bank of Enipeas at Blochos for improved flood protection.
- Construction of Inland Dyke in Makrychori (3.7 km): Implementing a dyke spanning 3.7 km in Makrychori for enhanced flood protection in the area.
- Enhance the current dyke infrastructure extending from the city of Larissa to the Gyrtoni Barrage, covering a distance of 32 kilometers.
- Revitalization and reconstruction of the northern Larissa floodplain.
- Construction of a dyke spanning 5.1 kilometers to the north of Gyrtoni.
- Establishment of dykes along the Titarisios River at Damasi covering a distance of 3.2 kilometers.
- Construction of a dyke along the north bank of the Titarisios River in Tyrnavos, extending for a distance of 6.2 kilometers.
- Revitalization of Argyropouliou Lake through the implementation of a dam or dyke system.
- Installation of a dyke along the south bank of the Pineios River at Tempi, spanning a distance of 1 kilometer.
- Option No Lake Extention: Construction of a northern dyke around Lake Karla spanning 12.6 kilometers, with the specific option of not extending the lake.
- Option No Lake Extension: Development of a southern dyke surrounding Lake Karla, covering a distance of 10.6 kilometers, with the specified option of not extending the lake.
- Option Lake Extension: Construction of a northern dyke, extending over a distance of 10 kilometers, with the option to facilitate the extension of the lake.
- Option Lake Extension: Implementation of a southern dyke spanning 9.7 kilometers, with the flexibility to consider the extension of the lake as an option.
- Option Lake Extension: Construction of an eastern dyke covering a distance of 5.5 kilometers, with the added flexibility to explore the option of extending the lake.
- Re-engineer the licensing procedure through process optimization to reduce processing time, considering the possibility of external assignments for enhanced efficiency.
- Acquire and implement new IT systems, including software, to enhance the technological infrastructure.
- Procure and deploy IT infrastructure, encompassing hardware such as PCs, servers, and printers.
- Acquire and set up office equipment, including furniture and supplies, for the designated workspace.
- Incentives: Revamp the current animal fodder production to include varieties that necessitate minimal or no irrigation. Estimate the costs for incentives, considering the unchanged land conditions.
- Incentives: For transforming the agricultural sector and move to higher-margin horticulture, in order to reduce the quantities of irrigation water used. Total change over 6 years costs 11.6 billion, 10% to be incentivized, of which 40% by the public sector.

- Incentives to expand the livestock sector. Simultaneously, upscale and modernize farms for improved efficiency.
- Improve the water supply through initiatives such as the transfer of water from Achelous.
- Phase out subsidies for cotton to encourage farmers to transition to agricultural products that are both less water-intensive and financially sustainable independently. (budget for studies, lobbying, etc.)
- Further promote the establishment of large-scale farming cooperatives to foster collaboration among farmers, fostering knowledge-sharing and empowering them as a unified collective.
- Establish a local machine hiring company; stimulated and initiated by the government. Allowing farmers to rent Machinery, such as tractors, including the operator, for their specific farming needs
- Public awareness campaigns and community outreach & engagement to promote cooperation and compliance with water-reduction strategies
- Regulatory reforms to facilitate transitions for farmers, reducing bureaucratic red tape, improving digitization

Long-term measures

- Potential relocation of premises, to be determined based on the findings of a survey. Budget estimated for an incentives program for reallocation.
- Possible relocation of residents, a decision to be made based on further considerations. Construction of prefab houses on state-owned land and no compensation for existing houses.
- Reconstruction and enhancement of the dyke systems along the Middle-Pineios region, spanning a potential range of up to 250 kilometers.
- Integration of additional discharge systems, incorporating pump stations, for Lake Karla.
- Consideration of an optional tunnel as part of the overall project for Lake Karla towards the Sea. Minimum estimate.
- Option No Lake Extension: Alternative compensation approach Lake Karla: Land expropriation and withdrawal from production.
- Continuously conduct in-depth studies and monitor the groundwater balance, as well as the quantity and usage of boreholes.
- Option Lake Extension: Dredging of Lake Karla for increasing the capacity.
- Option No Lake Extension: Establishment of a Capitalized Fund for Compensations to address future inundation issues related to Lake Karla. Only to setup the Fund construction. Sourcing funds for compensations to be determined.

Sourcing Funding

Ensuring the effective safeguarding of Thessaly, demands a substantial financial commitment, with several billion euros earmarked for investment in the coming decades. An estimated budget projection for the initiatives related to Water Management are in total €4.5 billion, however as stated in the previous chapter, the this total is not a fair or complete reflection.

Summarized per Volume, the allocation is as follows:

- Vol 1: Flood Infrastructure Defense €3.298 million
- Vol 2. Water Management Organization € 6 million
- Vol 3. Early Warning and Crisis Management € 4 million
- Vol 4. Agriculture and Livestock €1.256 million
- Vol 5. Sociological Adaption € 8 million

For a Masterplan Water Management, with many projects that serve multiple goals, more than either just flood risk management, or irrigation for agricultural organizations, financial responsibility is borne by many stakeholders.

There are a number of long-term challenges that require a durable, future-proof financing system. It is recommended that the Government endorses, as a starting point, the principle that it is not merely a donation to those who benefit from or take measures that impact water management, but that new long-term business models are explored and implemented which on the long-term recover the associated costs. If this can be done efficiently, funding will be organized at a local level.

In order to enhance the competitiveness and resilience of the livestock sector, there is a crucial need to upscale and modernize business capacities. This involves striving for higher profitability and lower cost prices through the adoption of improved practices, quality produce, and enhanced management and organization. To facilitate this transformation, incentives must be made available; however, their allocation should be contingent upon applicants committing to invest in the enhancement and modernization of their farming and processing operations.

The following four steps are recommended in order to mobilize additional funding and financing for the Water Management Plan:

1. Stimulate and thereby increase income and tax income

With the proposed change to horticulture, the total economy will grow significantly within six years. This additional income will also lead to additional taxes, which enables the government to reinvest. Such additional income streams are the main driver of financial sustainability and fulfil several functions.

2. Reducing and sharing investment risks

On top of the recommendations additional funding is required to come from commercial investors, which in practice will be in majority the commercial regional banks. Commercial investors/lenders are primarily concerned about the risk-return profile of their funding and are cautious about uncertainty regarding any of the risks related to an opportunity.

Investors are confronted with a range of risks, including business risks (e.g. credit risks), regulatory and political risks (e.g. changing regulations or political unrest) and commercial and technical risks (e.g. performance risks for innovative approaches). Public funds should be used strategically to reduce these risks and hence improve the risk-return profile of water-related projects. These strategic financing approaches include:

- Credit Enhancement (including public guarantees)
- Pooled Finance
- Political and Insurance Risk
- Increasing Transparency (Benchmarking, Credit Ratings)

3. Matching supply and demand for finance

One critical limiting factor for commercial investments is a lack of well-prepared, bankable projects and a mismatch between the demand (e.g. water agencies, utilities or other service providers) and supply (e.g. financing institutions) of finance. There is a wide range of organization playing various roles at the interface between demand and supply of finance. There are identified gaps, redundancies and misalignments of financing activities with functions needed and calls for a shift from the current opportunistic approach to a more strategic approach in the design and activities of intermediaries, supported by governments and financial institutions.

It is recommended that the government assigns an intermediary who can be the linking pin between these organizations and solve the gaps, redundancies and misalignments.

4. Financing vehicles and approaches to create opportunities for scaling up investment

Private investors and particularly institutional investors are increasingly looking for opportunities to grow their sustainable finance portfolios but often lack adequate financial products to channel their investments. Appropriate vehicles (such as a fund) for water related investments would account for and help overcome the specificities of the water sector, such as the need for long tenors, small ticket sizes, limited creditworthiness

and the lack of clearly defined revenue streams. Examples include; use of proceeds bonds, special purpose vehicles, revolving funds.

5. Leveraging blended finance

Development finance can be used strategically to mobilize additional commercial finance. Blended approaches aim at mobilizing additional capital for investments for sustainable development in developing countries and can act as risk reducing mechanism to increase lenders' confidence. By deploying development finance in a way that addresses investment barriers that prevent commercial investment in SDG-relevant sectors, such as water and sanitation, blended finance operates as a market building instrument that provides a bridge from reliance on grant and other donor finance towards commercial finance.

Risk analysis

The risk analysis presents a selection of the key risks that are to be considered in relation to this Master Plan of Water Management. The list is by no means complete, and merely aims to ensure awareness and education for decision-making based on the recommendations presented in the Master Plan.

Risks of new floods

One of the main risks is the "Law of Unintended Consequences", i.e. that implementing one or more strategies to safeguard against floods can, paradoxically, give rise to other inundation with consequences that are just as dire or even more so.

To illustrate, the construction of dams, dykes, and infrastructure aimed at controlling water flow are interventions that are intended to protect vulnerable regions but may inadvertently disrupt the hydrological balance, altering patterns of runoff and sediment flows. Flood management strategies should therefore not be static; they must evolve alongside the shifting risk profile. The timing of historic risks should also be taken into account with the construction, as both Medicane Ianos and Storm Daniel occurred in the first half of September.

An adaptive management approach is required for effective flood mitigation. This involves constant monitoring, reassessment, and adjustment of strategies in response to evolving conditions, which is recommended to be organized as centralized effort.

Risk of unclear mandates/ownership

With the decentralized governance of Thessaly, challenges arise, the risk posed by unclear ownership amidst the implementation of water management structures. As regions embrace decentralization, transferring authority and responsibilities to local entities, the potential for ambiguity in ownership becomes a pressing concern. As has been seen during the recent floods caused by Storm Daniel, regional actions have been taken to protect one's own region, without considering the risks caused to neighboring regions.

Consider the establishment of local administrative bodies and the delegation of powers. While these initiatives aim to empower communities, the absence of clear delineation of responsibilities may result in inefficiencies, overlapping jurisdictions, and a lack of accountability. The challenge, then, lies in striking a balance between granting autonomy and ensuring a transparent framework for ownership and accountability.

The proposed institutional setting aims to overcome these challenges, however, it will take time to establish this organization. An adaptive governance approach emerges as a crucial element in navigating the

uncertainties associated with unclear ownership. This involves constant reassessment and adjustment of governance structures to align with evolving needs and challenges.

The risk posed by unclear ownership in decentralized governance underscores the need for a clear national approach. By acknowledging the complexities introduced by autonomy, anticipating challenges related to accountability, and actively engaging communities, regions can navigate the intricacies of decentralized governance with resilience and effectiveness.

Risk of inability to source funding

Another key challenge is the risk of being unable to fund essential projects for the long-term water management plan. The journey towards effective strategies unfolds against the backdrop of a critical challenge – the risk of failing to attract the necessary financing. This narrative delves into the profound implications of being unable to secure financial support, a potential barrier that could impede the realization of comprehensive flood and irrigation management plans. The availability of funds is not merely a matter of monetary transactions; it is the lifeblood of executing strategies that fortify communities against floods and optimize agricultural practices.

Project may face delays or undergo downsizing, limiting their potential impact. The adoption of cutting-edge technologies and the execution of large-scale infrastructure developments may stall, leaving communities vulnerable to the unpredictable forces of floods and hindering the optimization of irrigation practices.

Yet, attracting financing for flood and irrigation management proves to be a formidable challenge. The competing priorities, economic uncertainties, and the long-term nature of project benefits add layers of complexity to the endeavor. In navigating these challenges, governments and other stakeholders engage in collaborative efforts to raise awareness about the critical importance of flood and irrigation management.

In order to mitigate the risk of being unable to attract financing, multifaceted strategies emerge. The creation of financial mechanisms, such as public-private partnerships and innovative funding models, diversifies funding sources and enhances the financial sustainability of projects. More detail about this has been provided in the dedicated chapter on financing.

Risk of resistance from local population

Another risk is the risk of sociological change management required for the successful adoption of new policies and plans by local communities. As regions transition towards decentralized models, empowering local entities with decision-making authority, there arises a need for sociological shifts to align community values, beliefs,

and behaviors with the proposed changes. The challenge lies in the potential resistance to change, where the very actions taken to enhance local governance may be met with skepticism or reluctance from the community.

Change, while aiming to cater to local needs, often necessitates a restructuring of societal norms and expectations. New policies and plans may challenge established routines, traditional power structures, and community dynamics. The challenge lies in managing these sociological changes effectively to ensure that local communities embrace and adopt the proposed governance models.

An adaptive sociological approach emerges as a crucial element in navigating the challenges associated with resistance to change. This involves continuous dialogue, community involvement, and a nuanced understanding of local cultures and dynamics. Flexibility becomes paramount in the face of diverse sociological landscapes, ensuring that proposed changes resonate with the values and aspirations of the community.

However, if there is a lack of adoption by locals, the plans and policies crafted for decentralized governance risk becoming ineffective or even counterproductive. Resistance to change may result in the failure of intended benefits, leaving communities without the empowerment and improvements envisioned through decentralization.