



# **MASTER PLAN**

## **WATER MANAGEMENT IN THESSALY IN THE WAKE OF STORM DANIEL**

How to Address Thessaly's Water-Related Agricultural Challenges

### **EXECUTIVE SUMMARY**

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Storm Daniel that devastated Thessaly's agricultural sector in September 2023 laid bare the following disconcerting facts:

- Firstly, that climate change-induced extreme weather that can potentially wipe out entire towns and cause destruction for billions was no longer at Thessaly's doorstep; it was already a recurring reality. Being the second severe medicane / cyclone to hit Thessaly in just 3 years' time, the extreme rainfall could no longer be discounted as an anomalous event or as a "once in a thousand years" storm; such deluges now had to be regarded as potentially seasonal events that require prompt adaptation in order to ensure survival, else future storms would risk causing far more damage and loss of life.
- Secondly, the storm laid bare the fact that Thessaly's water resources had been overexploited for years and Thessaly's agricultural sector was already in serious trouble due to near depletion of Thessaly's otherwise substantial, high-quality groundwater reserves.

The challenges facing Thessaly are largely due to the region having fragmented governance. The lack of an overarching Water Basin Authority that could make decisions from a wholistic perspective and coordinate intermunicipal cooperation was making water management ineffectual. This was further compounded by a sociological tendency of individualism with disregard for rules, regulations and obligations regarding waterway management. Farmers had been erecting illegal dams and municipalities grossly neglecting maintenance of waterways, which exacerbated the flooding disaster.

In order for Thessaly's agricultural sector to not only survive but to thrive, a number of measures need to be undertaken. This Master Plan seeks to address the intertwined challenges of water inundation and water scarcity by addressing all major facets that will help Thessaly "Build Back Better". The plan is divided into six volumes and outlines the measures needed to fortify Thessaly's water security, flood preparedness and reform of its agricultural sector. The Master Plan addresses both the immediate, no-regret measures that need to be undertaken to help protect Thessaly from future floods and remedy the water scarcity crisis, as well as long-term infrastructural remedies, changes to agricultural practices, and how to effect changes to the psychosociological mindset of Thessalian farmers.

Once implemented, these remedies will hopefully help to not only avert future flash floods and solve Thessaly's water scarcity issue but catapult its agricultural sector to a more competitive level so that the region thrives in the long term.

It is the firm belief of HVA International that the slogan “*Building Back Better*” is fitting and feasible but will require significant effort. The adversary is a formidable one but not insurmountable. Thessalian farmers not only need to join hands and roll up their sleeves; they must lead the way for all of Europe and demonstrate how to tackle such challenges in a unified way.

The people of Thessaly also need to accept, just as inhabitants of other European countries have been forced to do after severe floods, that some built-up areas will need to be relinquished in order to make room for rivers. As Margaret Thatcher famously stated when she implemented austerity measures to save the British economy: “*Yes, the medicine is harsh, but the patient requires it in order to live.*”

### **Flood Defense Infrastructure**

The largest chunk of investments in flood management will be needed for flood defense infrastructures. These are for the most part very cost-effective seeing as they almost always cost less to build than the cost of repairing the damage that would otherwise be incurred, while simultaneously having numerous social, health and environmental benefits.

The planning and development of the flood defense infrastructures in Thessaly are directly linked to the socio-economic development policies and priorities for the region, namely, to safeguard and ensure that the agricultural sector remains the core economic driver. The proposed measures therefore refrain from large-scale conversion of agricultural lands into permanent flood retention or nature areas, with the exception of a few cultivated areas that must be designated for temporary, controlled inundations in the event of severe floods.

This Master Plan focuses on short-term actions and interventions that can be implemented rapidly rather than conduct exhaustive research into what might be the most cost-efficient.

Priority levels for the development of the flood defense infrastructure have been proposed by contrasting the level of importance (safety standard) of each area with its flood risk.

The development of the flood defense infrastructures requires thorough technical and financial assessments in combination with policy dialogues. In view of the great urgency to act, this Master Plan has developed a strategy that can be implemented in the shortest possible timeframe without compromising scientific accuracy or financial soundness.

Approximately half the land area of Thessaly is mountainous, consisting mainly of non-cultivated and pastoral lands. Implementing extensive flood management measures in these areas will safeguard the intensely cultivated, populated valleys. By constructing between 100 and 250 check dams in the smaller valleys and gullies, combined with nature-based solutions, the peak surface discharges from the mountainous areas will be attenuated. The dissipation of the energy from surging water will reduce soil erosion considerably. The operation of existing and future large dams will need to be finetuned with flood management requirements.

Whereas the check dams in the mountains will significantly reduce the risk of damage in the lower-lying region of Thessaly, this does not obviate the need for flood prevention measures in the valleys. The flood defense infrastructures in the valleys are focused primarily on residential and industrial areas. The infrastructures will primarily consist of river dykes as well as secondary, inland dykes that will serve as backup in the event of dyke breaks or extreme overland flooding.

A detour canal is proposed for the city of Trikala. Seeing as all areas cannot be fully protected, such as areas with few inhabitants or isolated premises, these have been designated for temporary, controlled inundations in the event of extreme flooding. The premises in these areas have already been severely damaged or destroyed and it is therefore recommended to relocate them rather than rehabilitate.

The City of Larissa and its surroundings require special attention. The discharge of flood waters towards the Lake Karla Basin must be prevented by reinforcing dykes and constructing a spillway at the Gyrtoni Barrage, in combination with creating downstream retention capacity.

A major concern is the floodplain along the City of Larissa. Due to the floodplain having been developed for industrial and commercial purposes, the discharge capacity of the Pineios River is at less than 50% of its potential. The removal of all obstructing buildings and the execution of maintenance works on the floodplain are badly needed. It goes without saying that a strict ban must be imposed on any new constructions in this floodplain.

The buffer capacity of Lake Karla is not sufficient to store the excess water from future extreme weather events. The storage capacity in the area needs to be tripled to accommodate such quantities. The man-made tunnel that can discharge water to the Pagasetic Gulf was not designed for post-disaster flood recovery. The lake area must either be extended or retention capacity needs to be created on existing lands in the valley. Increasing the discharge capacity of the tunnel is not recommended, at least not



as a stand-alone measure. It would be more feasible to take some agricultural land out of production and turn it into nature areas.

A series of generic measures are also presented in this Master Plan, along with preparatory activities that can be undertaken for making the detailed designs.

A Task Team will need to be assembled to implement the flood defense infrastructures, consisting of technical, social, financial and environmental experts as well as policy makers from both the regional and central levels of government. A Steering Committee also needs to be assembled.

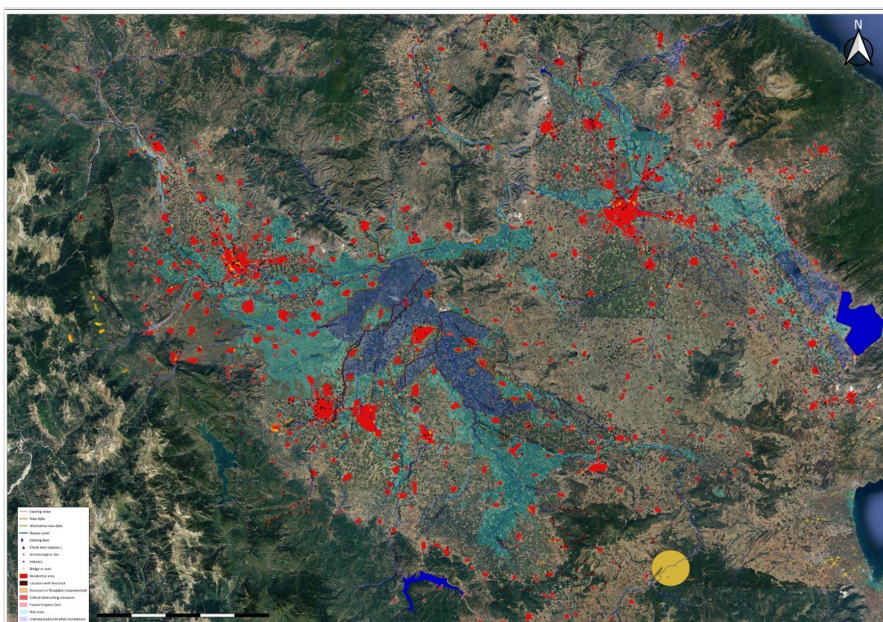


Figure 1: Overview of key recommendations for Flood Defense Infrastructure

Note: For practical reasons, the map images in the figures are low resolution and for reference purposes only. Please refer to the annexes for the high resolution versions of maps.

### Water Management Organization

The severity of Storm Daniel revealed the undeniable need for a stronger and far more effective governance model for Thessaly’s water-related activities and infrastructure. The current institutional framework is fragmented, complicated and unable to effectively respond to sudden-onset weather events and flash floods. A single, robust institution

with a wholistic perspective endowed with executive powers is needed in order to coordinate all relevant authorities and stakeholders towards a common objective.

“VOLUME II: WATER MANAGEMENT ORGANIZATION”, focuses on how to redesign the institutional framework for water management in Thessaly, integrating the water system’s management responsibilities and enhancing water quality, availability, and safety.

Vol. II proposes the formation of an independent Water Management Organization (River Basin Authority). Its objectives will be to:

- formulate and implement Thessaly’s water strategy
- manage water use so as to safeguard sustainability of water resources (counteract water scarcity)
- enforce water stakeholder involvement
- enhance public awareness
- strengthen the coordination and implementation of water infrastructure
- oversee preparation and response efforts to flash floods

It is advised that the Water Management Organization be established as a Legal Entity under Private Law (L.E.Pr.L.) and that its scope of authority spans the entire Thessaly Water Basin. All responsibilities and activities for water management in Thessaly will be merged with existing personnel and infrastructure, excluding those already being performed by municipality water organizations (DEYA). The detailed structure and responsibilities are presented in VOLUME II: WATER MANAGEMENT ORGANIZATION. The volume also outlines an implementation plan to facilitate the transition to this new framework.

### **Early Warning System and Crisis Management**

Based on the serious repercussions and damage incurred by the floods caused by Medicane Ianos and Storm Daniel, and that climate change is making such extreme weather events regularly occurring phenomena, there is an urgent need to establish an Early Warning System that is operational 24/7, with a round-the-clock coordinating center that continuously receives, analyzes and processes relevant meteorological information and processes this into wind and flood maps as well as corresponding wind and flood early warning. This needs to have sufficient accuracy and spatial resolution for Disaster Risk Management authorities to be able to make decisions on what response actions to take, such as mobile phone alerts, warnings and evacuations.

The key objectives of the Early Warning Systems are to minimize human and animal losses and to reduce material damage.

The four main elements of an Early Warning System are:

1. Risk knowledge
2. Monitoring and warning service
3. Dissemination and communications
4. Preparedness and response.

The operational EWS should be based at the national level so as to serve not only Thessaly but all regions of Greece. The Coordinating Center that receives and processes the meteorological and flood-related information must be vested with authoritative powers, coupled with the essential expertise and tools, enabling comprehensive analysis of various situations, risk assessment, and informed decision-making regarding appropriate responses or courses of action.

The Coordinating Center must also have access to all relevant information crucial for flood forecasting, encompassing meteorological and hydrological data such as surface water levels, discharges, dam levels, and fillings.

The National Observatory of Athens must play a pivotal role, providing essential forecasts. These predictions will be vital for assessing flood risks well in advance. Equally critical are the roles of operators from the Thessaly-based Water Management Organization managing hydrological stations (monitoring water levels and discharges) and the dam operators overseeing levels and fillings. The monitoring and data storage and transfer systems must be robust so as to ensure reliability.

Recommended organization / governance:

1. Establishment and/or strengthening of the National DRM and Early Warning Center within the General Secretariat for Civil Protection. This Center will be responsible, among other things, for the smooth operation of the Early Warning System and will closely collaborate with meteorological services.
2. Development of accurate flood models and risk maps as part of the predictions of flood risks to instruct the relevant regions and coordinate the emergency services' responses.
3. Establishment of the regional Water Management Organization (WMO) for Thessaly with executive powers. The Thessaly WMO will be responsible for all

- aspects related to Integrated Water Resources Management, including the monitoring and data collection for the National DRM and Early Warning Center.
4. Establishment of substations in municipalities and communities.
  5. Formulation of Early Warning System protocols with clear delineations of roles, responsibilities, and action plans achieved through collaborative consultation with relevant stakeholders.

It is advised that a phased and scalable approach be adopted so as to ensure that institutional improvements and improved technologies are assimilated into the daily procedures of relevant institutions.

The models that current exist, made with HEC-RAS, and the information collected for this purpose, could serve as a basis for further application for the Master Plan. The final selection of software packages should however be based on more detailed assessment of the existing models and on uniform application based on a national strategy and not made by various project implementing organizations.

Considering the urgent need for the EWS implementation, the activities for its implementation need to commence as soon as possible. A consultation will need to be conducted prior to the procurement of equipment and training activities so as to determine the detailed requirements, design and training requirements of the system. The consultations should be done with national and regional stakeholders, bearing in mind current data availability and the capabilities of implementing, managing and operating the system.

## **Agriculture & Livestock**

The livestock and agriculture sector in Thessaly has been grappling with substantial challenges in the aftermath of Storm Daniel. The adverse effects include significant losses in livestock and disruptions to farming operations, creating a ripple effect throughout the entire value chain. Urgent interventions are imperative for the recovery and modernization of the sector. More importantly, these sectors are under threat due to an impending water scarcity crisis caused by excessive extraction of groundwater which must be addressed immediately.

The long-term resilience and competitiveness of the industry is contingent on addressing several critical factors. The Thessaly region currently faces an annual water deficit of approximately 500 million m<sup>3</sup> and this quantity will increase due to climate change which is predicted to cause a rise in temperature and reduction in rainfall. While that will

hopefully be a gradual change, the shortfall is projected to be an additional 400 million m<sup>3</sup> per year by the year 2050.

Thessalian farmers' widespread reliance on groundwater (via tens of thousands of boreholes) has led to groundwater levels becoming so depleted that seawater intrusion is already beginning to contaminate the groundwater. As the groundwater turns more saline, farmers will not be able to rely on it for water and the agricultural sector will run the very real risk of serious, irreversible damage, as has occurred in several other countries that over-extracted water for irrigation. Thessalian farmers are currently drilling deeper and deeper into the Almyros Aquifer in order to extract groundwater in order to irrigate mainly low-value, highly water-demanding crops. This is unsustainable and the dire fact is that by mandating low electricity prices in Thessaly, the government is inadvertently encouraging farmers to deplete the region's groundwater. Urgent and comprehensive reforms to water management for irrigation are therefore imperative to ensure the survival of the agricultural sector. Without extensive interventions, the sector and the regional economy will be imperiled. In order to address this impending crisis, the following key measures must be implemented:

- Curbing water use
- Augmenting water supply
- Remodel the agricultural sector to produce higher-value crops

A shift must be undertaken from the predominantly low-value, high-water-demanding crops such as cotton and maize to horticultural crops and fruit orchards that require far less water and acreage thanks to being higher value crops. Current fodder production must also be transformed, either to less water-demanding types or purchased from other parts of Greece and the land be utilized for production of higher value crops so as to curb groundwater extraction.

It is proposed that this transition be executed over the course of six (6) years, via a meticulously planned implementation strategy.

Whereas reducing water usage is imperative, that intervention alone cannot ensure the sustained viability of Thessaly's agricultural sector. An augmentation of water supply in Thessaly is also imperative. Given that additional small water reservoirs need to be constructed in the mountainous areas as a part of the flood management, this will facilitate a more consistent water supply to the lower-lying agricultural areas. However, this is not enough, as is detailed in calculations in Vol. IV. The only sustainable, long-term solution would entail the diversion of the Achelous River so as to bolster water supply with at least another 300 million m<sup>3</sup> per year.

Optimizing water management also necessitates a substantial improvement in agricultural efficiency. This entails the need for comprehensive education initiatives and fostering of cooperative practices. Currently, a mere fraction (~0.7%) of Thessaly's farmers possess adequate education, resulting in them having a very limited understanding of solutions regarding efficient water usage and other innovative practices. Enhanced education and learning to collaborate are pivotal to overcoming the water scarcity challenges that Thessaly's farmers are facing.

Fostering collaboration among farmers and compliance with regulations is also crucial among stakeholders and government authorities in order to achieve effective governance and policy implementation. Establishing trust and transparency within these relationships will play a key role in navigating the challenges and achieving sustainable growth. This challenge is addressed in Vol. V of this Master Plan.

### **Sociological Challenges**

Many farmers in Thessaly have been severely affected by the devastating flood events in recent years. Seeing their life's work demolished in an instant has taken a significant toll and care therefore needs to be taken when proposing sweeping changes and reforms. Whereas the interventions proposed herein are crucial, one needs to be tactful and Vol. V outlines the best means of affecting long-term change that can be difficult for many farmers.

Like many traditional farmers around the world, Thessalian farmers tend to stick to tried-and-true techniques as they cannot afford to have a failed harvest. However, in order for Thessaly to be able to tackle the water scarcity issue and environmental challenges of the future, the farmers must embrace innovation and adopt new practices, whether they like it or not. Adopting new technology and techniques is the only proven way for struggling agricultural sectors to survive and Vol. V delineates how this was achieved in other European countries that faced similar predicaments. The crucial component for this to succeed is the fostering of a strong spirit of cooperation and collaboration among farmers. Whereas farmers in Thessaly do have strong social cohesion and well-knit communities, there is currently not a strong tradition among them to cooperate with one another, so this must change.

A spirit of compliance also needs to be fostered in the region as some farmers tend to have an individualistic mindset. Everyone must toe the line and adopt a mentality of



solidarity, focusing on what is best for the greater, collective good, abiding by regulations so that all will benefit in the long term.

In order to become a truly thriving, competitive agricultural producer in Europe, Thessaly's agricultural sector needs to improve the quality of its produce. While quality always improves with the adoption of innovative practices, a commitment to stringent quality control practices also needs to be adopted, and that goes for the entire value chain, not just the farmers.

An aging farmer demographic is a further challenge that needs to be surmounted as a transition to younger farmers will greatly facilitate the adoption of innovative practices. The farming demographic in Greece, particularly in Thessaly, skews older, with the average age of farmers being 55 years, compared to the national average age of 44 years. Farmers often resist retirement due to their deep passion for farming and financial concerns stemming from inadequate retirement savings. The older the farmers are, however, the less open they are to change. Vol. V therefore outlines a number of measures for encouraging intergenerational farm succession and fostering of youth agripreneurship.

An additional sociological hurdle that needs to be overcome is that of excessive bureaucracy. While efforts have been ongoing to reform bureaucracy, additional measures to reduce red tape and facilitate the interventions proposed in this Master Plan are presented in Vol. V.

If the above is achieved, it is very likely that Thessaly will rapidly become a thriving, competitive supplier of high-quality agricultural produce. The key is for farmers to understand that they will only thrive if the whole region thrives. In other words, they need to adopt a mentality of "*One for all and all for one*". Given that the farmers now face a formidable, common enemy, it is possible that they will agree to join hands and fight climate change and the impending water scarcity crisis. A series of measures are outlined in Vol. V that will likely help the stakeholders embrace the profound benefits of solidarity, compliance and cooperation, open the doors to younger farmers and more readily adopt new technology and practices.

The risk for populist uprisings among farmers is prevalent all over Europe. The mood in Thessaly since Storm Daniel has been subdued due to the tragedy that has befallen so many, but that may change. Farmers are particularly prone to expressing their wrath seeing as they are at the mercy of weather and climate, unlike other sectors. Being providers of food, they rightly consider themselves entitled to assistance and subsidies seeing as they provide such a vital service to their country. The challenges they are

currently facing, compounded by anxiety over water scarcity and having had two cyclones destroy many livelihoods in just 3 years' time, can lead to a breaking point. In order to prevent farmers' grievances from deteriorating, it is advisable to take a proactive approach and have a constructive dialogue.

## **Recommendations and Timelines**

Volume VI contains a compilation of all the recommendations made in this report. This overview, however, is not to be used to calculate the total budget as a cursory look at the total amount may present a distorted picture. The actual budget will be based upon the specific recommendations in the Master Plan that get selected by the Ministers of the relevant ministries. Furthermore, there are several duplications of budgets in the overview that can be misleading; for example, the costs for the Extension of Lake Karla, and the costs for No Extension of Lake Karla, are both mentioned. In addition, the budget for diverting the Achelous River has been included, whereas a decision on that intervention has not been made. Taking into account the above, the total of all the budget for recommendations will be close to €4.5 billion.

In order to provide a high-level timeline and execution plan, the recommendations have been designated as short-term, medium-term, and long-term measures. These classifications are based on the expected timelines for the execution of each recommendation and the complexity involved in their implementation. Additionally, the classifications serve as a strategic guide for allocating resources and efforts in a logical sequence.

The sourcing funding section delves into the mechanisms for financing the recommendations, considering both private and public initiatives. It also explores strategies to instill confidence in potential investors, fostering a conducive environment for financial support.

In the risk analysis section, key risks associated with plan execution are identified. These include the risk of insufficient ownership, the potential occurrence of a new flood during implementation, and other pertinent factors. Addressing these risks is crucial in the selection and implementation of the recommendations, ensuring a robust and resilient execution of the Masterplan.