INNOMED

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Water JPI
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MOTIVATION

Innovative Options for Integrated Water Resources Management in the Mediterranean

INNOMED promotes a holistic approach to water resources management by: i) **considering the full water cycle as manageable and the catchment scale as the most relevant management level**; and ii) **addressing the integrated management of land and water, with a special focus on irrigated agriculture and forests**. Its main objective is to develop and test advanced modelling tools to quantify the physical and economic effects of alternative land management options in order to improve water use efficiency in both sectors and promote sustainable water management solutions.

INNOMED addresses specific scientific challenges in: i) **estimating the allocation of green- and blue-water flows of different land uses and their spatial and temporal variations**, at the catchment scale; ii) **determining the water footprint of different management options on forests and irrigated** crops, including experimental trials, field monitoring and modelling, at the field scale; iii) **integrating the physical and economic flows resulting from alternative management options**. An enhanced interface between scientists and stakeholders (water and forest managers and farmers) in five pilot study sites will allow: i) mapping and devising current and innovative water-use efficient land management options; ii) gathering relevant biophysical and socio-economic data needed for analysis; and iii) focusing on relevant issues for the practical implementation of IWRM in the pilot study sites and beyond.

Innovative Options for Integrated Water Resources Management in the Mediterranean

Although the main concepts that give rise to INNOMED (IWRM, blue- and green-water, upstream-downstream relationships) are not new, **technical difficulties remain that restrict a complete consideration of green water flows in water policy**.

These arise mainly from two fronts: i) difficulties in measuring the green- and blue-water footprints of different land uses and alternative managements; and ii) difficulties in the economic valuation of water. Specific challenges addressed in INNOMED are described in the following paragraphs.

OBJECTIVES

Develop and apply a multidisciplinary approach to quantify the **physical and economic effects** of **alternative management options in forestry and agriculture** on the **catchment's water balance**.

Catchment-wide water balance analysis – Eco-hydrological simulations will be carried out on five pilot study areas in order to:

i) compute spatially-explicit water balances for a range of (current and future) climatic conditions (*ch1*);

ii) determine the blue- and green-water footprint of current and alternative land managements (*ch1*);

iii) quantify the effect of current and alternative land managements in selected water quality parameters (*ch1*).

S1	**Monte Novo, Vigia and Esporão reservoirs (Portugal)** 261, 124 and 42 km2, representative of the Degebe River basin (1,586 km2) and the Alentejo region. Rainfed and irrigated agriculture, forest, urban water supply. Transformations from to irrigated agriculture in the last decades challenged water resources allocation and introduced water quality issues. EPAL, Agência Portuguesa do Ambiente (APA), farmers associations (ABOVigia) and private farms.
S2	**Alto Aragón regulation system (Spain)** 12,768 km2. Irrigated (125,000 ha) and rainfed agriculture, forests. Improving crop water productivity and resilience. Valuing forest management activities (thinning) in abandoned reforestations for reduced green-water footprint and higher resilience. Ebro Basin water authority (CHE), semi-public regional forest and environment company (SARGA), farmers association (Riegos del Alto Aragón) and fruit production companies and associations.
S3	**Bonis catchment, Calabria (Italy)** 1.39 km2, representative of the basins of the Sila Plateau (1,500 km2). 93% forests and rangeland. On-going and improved monitoring of forest water cycle (meteorological station, multiparametric sonde and eddy covariance) and model improvement to better quantify the green-water footprint of current and alternative forest management options. Basin Authority of Calabria, Sila National Park Agency, Multi-Risk Functional Centre of the Regional Agency for Environment Protection of the Calabria region.
S4	**Peristerona River catchment (Cyprus)** 112 km2. Forest, rainfed and irrigated (groundwater) agriculture. Crop selection and irrigation technologies are promoted as adaptation options in a water-stressed environment. Green-water footprint of forest and rainfed crops and its role on streamflow and groundwater recharge will also be an issue. Water management authorities, Department of Forests and Environment, Community councils, farmer associations.
S5	**Balti steppe (Moldova)** 1,900 ha. Irrigated (groundwater) agriculture. Deficit irrigation is being used in interaction with different fertilization schemes to improve crop water productivity and soil and water quality in experimental farms in Moldova. Agricultural companies: Climautanul, Oclanda, Danulischii, Agromex, Carpineni, Badicul, Focar, Ghevlandri.

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Monitoring schemes and indicators – Field monitoring of key aspects of the land water cycle will be carried out in the pilot study areas, utilizing and improving current monitoring facilities including cutting-edge technologies such as eddy covariance, or sensor networks. The newly acquired data will allow improving parameterization of challenging modelling issues (*ch2*).

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Field-scale water conserving agriculture and forestry practices – Controlled deficit irrigation field trials on economically relevant model crops will be carried out in order to calibrate water productivity curves in the eco-hydrological models (*ch3*). Field monitoring of green and blue water use and productivity will also be conducted in selected, commercial farms. Isotopic tree-ring analysis will be used to determine water productivity curves of forests before and after thinning(ch3). These assessments will result on useful information regarding the feasibility of water conserving practices, but it will also improve model calibration (*ch2*).

S6	**Aula Dei Experimental Station (Zaragoza, NE Spain)** Public-owned 60 ha experimental farm, representative of rainfed and irrigated annual and tree crops in Spain. A 14 years old 2.5 ha olive tree plantation with fully automated fertilization and irrigation in 16 independent sectors and a 16 y. o. 0.86 ha peach tree plantation with automated irrigation in 4 independent sectors will be used for field trials.
S7	**Alto Aragón reforestation (Spain)** Vast reforestation works were undertaken in the 1950's and 60's in the Pyrenees and pre-Pyrenees of Aragón, which are representative of similar works in mountain areas in Spain.
S8	**Peristerona River Catchment (Cyprus)** Field monitoring of key crops will be performed to compute and improve green and blue water use in 4 or 5 private farms for each of the following crops: citrus and potatoes in the lower catchment and deciduous fruit trees (apples and cherries) in the upper catchment.
S9	**Peristerona River Catchment (Cyprus)** Field monitoring of key crops will be performed to compute and improve green and blue water use in 4 or 5 private farms for each of the following crops: citrus and potatoes in the lower catchment and deciduous fruit trees (apples and cherries) in the upper catchment.

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Economic modelling – Catchment-wide economic valuation of green- and blue-water resources will allow assessing the feasibility of proposed management options, and payment-for-ecosystem services schemes (PES) will be simulated to assess their suitability to promote such changes (*ch4-5*).

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Close collaboration with stakeholders in the selected areas (*ch6*) will allow:

i) identify current and innovative land management options (with special attention to controlled deficit irrigation and forest thinning) and their framework conditions (legal, institutional, financial, etc.);

ii) gather biophysical and socio-economic data needed for analysis;

iii) asses how information from modelling is presented to end users; and

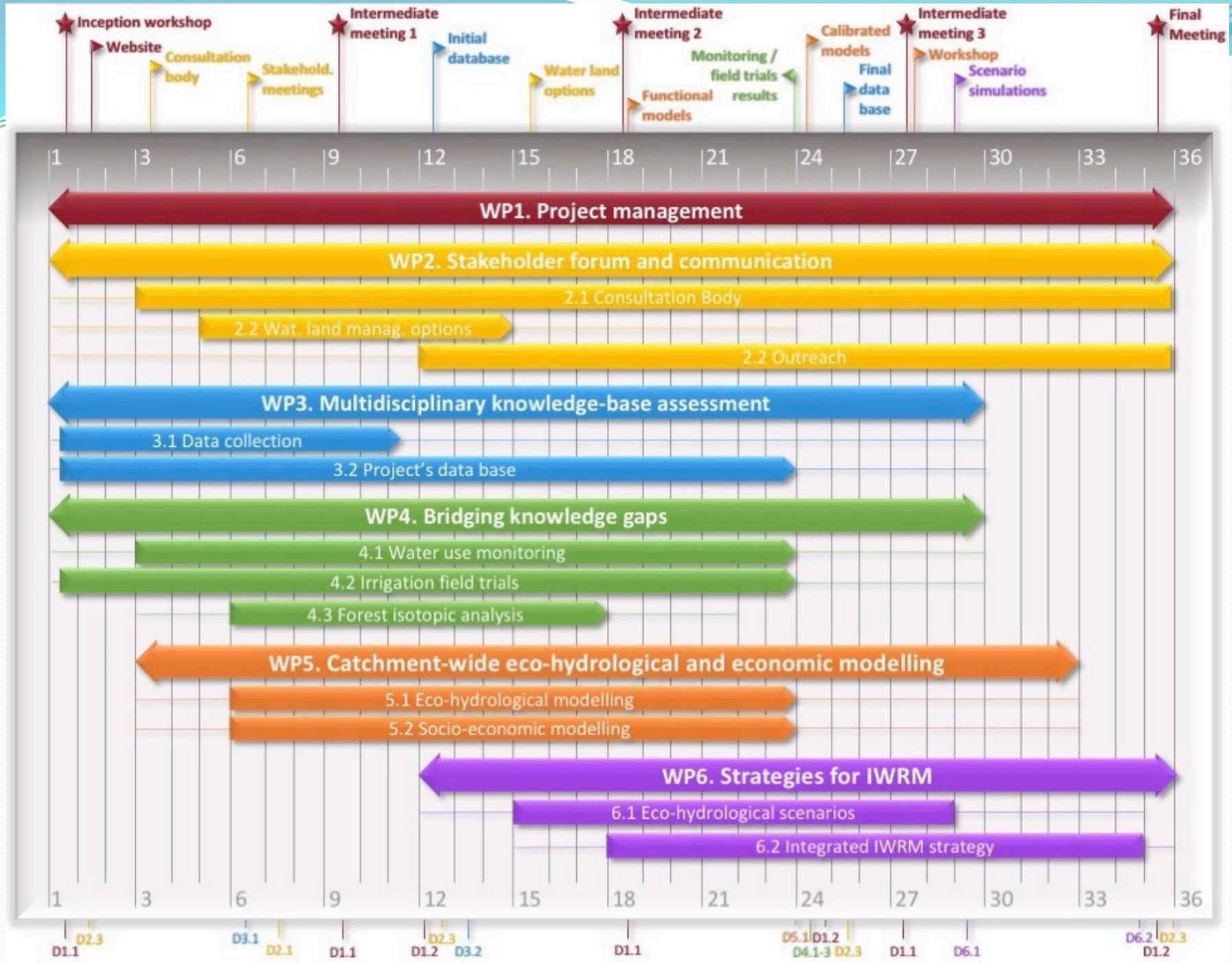
iv) propose new strategies for IWRM.

CONSORTIUM DESCRIPTION

Spain	Consejo Superior de Investigaciones Científicas - Estación Experimental de Aula Dei (EEAD-CSIC)	Santiago Beguería
Cyprus	The Cyprus Institute (CYI)	Manfred Lange
France	(CIRAD-UMR-CIRED)	Patrice Dumas
Italy	National Research Council – Institute for Agricultural and Forest Systems in Mediterranean (CNR-ISAFOM)	Tomasso Caloiero
Italy	Politecnico di Milano (POLIMI)	Giovanni Ravazzani
Moldova	Selectia Researh Institute of Field Crops (RIFCT)	Marin Cebotari
Portugal	(NOVA.ID.FCT)	Paulo A. Diogo

CONSORTIUM DESCRIPTION

Expertise	Partner 1 (CSIC)	Partner 2 (CYI)	Partner 3 (CIRAD – UMR CIRED)	Partner 4 (CNR-ISAFOM)	Partner 5 (POLIMI)	Partner 6 (RIFC)	Partner 7 (NOVA. ID.FCT)
Catchment hydrology, Hydrological modelling, Water footprint analysis	5	2	1	1	3		3
Climate change, Adaptation to CC	3	1	1	2	2		2
Forestry, Plant physiology, Tree-ring analysis	2	2		2			
Irrigation and fertilization	2	1		1		4	1
Fruit trees (Agronomy)	1	1		1			
Annual crops (Agronomy)		1		1		3	
Participatory research		3	1				1
Environmental and water economics	1	2	1			2	
Policy analysis, Water governance		2	1				


Inception workshop
Website
Consultation body
Stakehold. meetings
Intermediate meeting 1
Initial database
Water land options
Intermediate meeting 2
Functional models
Monitoring / field trials results
Calibrated models
Final data base
Intermediate meeting 3
Workshop
Scenario simulations
Final Meeting
1 3 6 9 12 15 18 21 24 27 30 33 36
WP1. Project management
WP2. Stakeholder forum and communication
2.1 Consultation Body
2.2 Wat. land manag. options
2.2 Outreach
WP3. Multidisciplinary knowledge-base assessment
3.1 Data collection
3.2 Project's data base
WP4. Bridging knowledge gaps
4.1 Water use monitoring
4.2 Irrigation field trials
4.3 Forest isotopic analysis
WP5. Catchment-wide eco-hydrological and economic modelling
5.1 Eco-hydrological modelling
5.2 Socio-economic modelling
WP6. Strategies for IWRM
6.1 Eco-hydrological scenarios
6.2 Integrated IWRM strategy
1 3 6 9 12 15 18 21 24 27 30 33 36
D1.1 D2.3
D3.1 D2.1
D1.1
D1.2 D2.3 D3.2
D1.1
D5.1 D1.2 D4.1-3 D2.3
D1.1
D6.1
D6.2 D2.3 D1.2

WP1	Title	Leader	Duration (months)	Starting Month	Ending Month
WP1 (CSIC)	**Project management (administrative, quality, technical and scientific)**	**CSIC**	**36**	**M1**	**M36**

The management WP will coordinate all technical activities of INNOMED, ensuring the time schedule of the project and the scientific quality of the results. Specific tasks are: i) coordination of five project meetings (one on each study catchment) and project events (post-meeting field trips and one workshop); development and maintenance of an external website and internal (intranet) resources, including a discussion groups virtual platform; iii) monitoring and supervising of all financial aspects; iv) fostering dialogue between WP leaders and between partners; v) coordination of annual progress reports.

Participation: all teams. Deliverables: D1.1, D1.2.

WP2	Title	Leader	Duration (months)	Starting Month	Ending Month
WP2 (CYI)	**Stakeholder forum and communication**	**CYI**	**36**	**M1**	**M36**

From the early stages of the project, this WP will promote a dialogue between scientists, water managers, and end-users in the forestry and agriculture sectors, contributing to achieve *Challenge 6*. In addition to the groups of stakeholders interested in INNOMED (see letters of commitment on section 5), other relevant private and public stakeholders will be invited from an early stage of the project.

T2.1. Consultation body – Online social media and discussion groups will be used to create a permanent communication channel for each study site such that stakeholders and researchers can exchange news and opinions in an informal manner, in their own language. This will constitute a permanent consultation body that will help keeping INNOMED RDI activities within relevance.

Participation: CSIC, CYI, CNR-ISAFOM, POLIMI, RIFC, NOVA.ID.FCT.

Continuous reporting to PR.

T2.2. Water and land management options – A stakeholder forum will be organized at each study site at the beginning of the project for guiding the INNOMED research activities and mapping current and innovative land management options, including private initiatives and public policies. Planned monitoring activities (WP4) will be discussed and adjusted as needed. Water and land use scenarios will be discussed to serve as the basis for scenario modelling in WP5. A meeting with water authority's officers will be held in each site to gather information on projected future water resources availability and demand, in coordination with WP3. A final stakeholder meeting will be held to review and discuss the results of WP4-5 and to draft the final policy recommendations (WP6).

Participation: CSIC, CYI, CNR-ISAFOM, POLIMI, RIFC, NOVA.ID.FCT. Deliverables: D2.1.

T2.3. Outreach – Dissemination and outreach activities will also be carried out within this WP. A periodic newsletter will be generated and translated to local languages, and published on the project's website and institutional repositories; diffusion on social networks; regional, national and international web platforms[13].

Participation: all teams. Deliverables: D2.3 and continuous reporting to PR.

WP3	Title	Leader	Duration (months)	Starting Month	Ending Month
	Multidisciplinary knowledge-base assessment	**NOVA.ID.FCT**	**30**	**M1**	**M30**

WP3 (NOVA.ID.FCT)

This WP will collect and make available current knowledge and data relevant to the case studies regarding the natural science, socio-economic data, institutional aspects, and policy and management options. This task will be undertaken early in the project timeline, although it will also take care of archiving and data sharing of new data generated during the entire project.

T3.1. Data collection – Existing data will be gathered for each study site, regarding natural science (topography, soils, climate, climate change scenarios from past and on going RDI projects such as FP6-ENSEMBLES, FP7-ACQWA or INTERREG-EFA-CLIMPY); land use, including main crop rotations; hydraulic infrastructures (location, capacity, transfers, operation rules), sectorial water demands, use of groundwater; economic data (irrigation costs, agricultural and forestry rents, costs, yields and prices); and the social and legal contexts of water governance. A thorough scientific and technical literature review will also be done.

Participation: all teams. Deliverables: D3.1.

T3.2. Project's data base – Design and maintain the project's database. Make sure that all data, including those generated during the project, are made available to the partners and that it meets the same quality standards and formats, check the spreading level of the data (e.g. internal and public), and take care of licensing issues.

Participation: NOVA.ID.FCT, CSIC. Deliverables: D3.2.

WP4	Title	Leader	Duration (months)	Starting Month	Ending Month
WP4 (CNR-ISAFOM)	**Bridging knowledge gaps**	**CNR-ISAFOM**	**30**	**M1**	**M30**

This WP will deal with data gaps identified within WP2 and will generate new data needed by the project, including hydrological monitoring on forest and agricultural farms, experimental field trials, and forest thinning isotopic analysis, in close cooperation with stakeholders (farmers and forest managers). These data will be used for calibrating critical model parameters and processes in WP4.

T4.1. Water use monitoring – Relevant aspects of the forest and agricultural hydrological cycle will be monitored in already existing and new experimental sites in Italy, Spain, Portugal and Cyprus in order to improve determination of green and blue water use and economic water productivity (*Challenge 2*). Field campaigns to complete the data base on specific model parameters. Forest water balance monitoring data from previous RDI projects will also be used in all study sites. Field monitoring of irrigation water use will be undertaken in collaboration with farmers (4-5 farmers per crop) in the Peristerona watershed, involving citrus and potatoes in the downstream area and deciduous fruits (apples & cherries) in the upstream.

Participation: CSIC, CYI, CNR-ISAFOM, POLIMI, NOVA.ID.FCT. Deliverables: D4.1.

T4.2. Irrigation field trials – Deficit irrigation field trials will be carried out in order to determine the water productivity and water savings of different irrigation schemes (*Challenge 3*). Winter wheat and sugar beet trials will be undertaken in Selectia (Moldova), with six treatments (control and two irrigation schemes x two fertilization) and four replicates. Peach and olive trials will be undertaken in EEAD (Spain), with three or four treatments and at least four replicates. Productivity (yield) will be assessed and quality indicators and market price of the produce will be determined.

Participation: CSIC, RIFC. Deliverables: D4.2.

T4.3. Forest management isotopic analysis – Forest management trials require long-term experiments and cannot be addressed within the scope of INNOMED. Long-term data from previous projects in sites S3 (Italy) and S4 (Cyprus) will be used to characterize the forest water balance under alternative management practices, including thinning. Innovative assessment based on tree-ring C isotopic analysis[14]

WP5	Title	Leader	Duration (months)	Starting Month	Ending Month
WP5 (CIRAD-UMR-CIRED)	**Catchment-wide eco-hydrological and economic modelling**	**CIRAD-UMR-CIRED**	**30**	**M3**	**M33**

This WP will develop a conceptual framework and numeric tools for quantifying, in physical and economic terms, the outcomes of different land management options in terms of improved green and blue water estimates.

T5.1. Eco-hydrological modelling – Simulation models such as SWAT[16], ECH2O[17] and FEST-WB[18] will be used to model the land-water cycle in the five pilot areas based on data from WP2 and WP3. Reservoir management will be modelled based on existing operating rules and hydro-economic principles (ODDYCCEIA[19]). These codes will be adapted to Mediterranean conditions and to the tested management options (*Challenge 1*). Water-productivity functions for deficit irrigation and forest thinning from WP3 will be incorporated in the codes (*Challenge 3*). Different land use / management scenarios, possibly combined with climate change forcing, will be simulated to quantify the effect of alternative management options on the land-water cycle.

Participation: CSIC, CIRAD-UMR-CIRED, CYI, CNR-ISAFOM, POLIMI, NOVA.ID.FCT. Deliverables: D5.1.

T5.2. Socio-economic modelling – A reliable estimation of the rent of green- and blue-water in market goods will be performed using rent differentials for irrigation and other land-uses, based on existing large-scale databases explored in WP2[20] (*Challenge 4*). Model outputs will be compared to results obtained using precise local information and stakeholder input[21].

Participation: CIRAD-UMR-CIRED, CYI, CSIC. Deliverables: D5.2.

WP6	Title	Leader	Duration (months)	Starting Month	Ending Month
WP5 (CIRAD-UMR-CIRED)	**Strategies for IWRM**	**POLIMI**	**24**	**M12**	**M36**
	Based on the outputs of WP5 and WP4, science-based IWRM strategies and policy recommendations will be developed for the five pilot study cases. Dissemination material with best practice models targeted at different end-users (water managers, policy makers, agricultural and forest managers) will be produced, in coordination with WP4 and WP5. Up scaling to the national and EU scales will also be dealt with within this WP, in particular by evaluating the applicability of the evaluated management options. **T6.1. Eco-hydrological scenarios** – Definitions of land uses and management options will be developed in collaboration with WP2 and WP4-5. Integration of physical and economic modelling in scenarios will be performed individually on each study site. (*Challenge 5*). Participation: CSIC, CIRAD-UMR-CIRED, CYI, CNR-ISAFOM, POLIMI, NOVA.ID.FCT. Deliverables: D6.1.				
	T6.2. Integrated IWRM strategy – Synthesis collaborative report with the results of WP4, WP5 and T6.1. The heterogeneity of the study sites and climatic and land use management scenarios considered will allow synthetize benefits coming from integrated IWRM on cultivated and forested areas and their impact at the catchment level, and will ensure its transferability to other areas of the European Mediterranean region. Participation: all partners. Deliverables: D6.2.				

Expected Impact of the Project

Contributing to WaterWorks2015 – INNOMED will promote sustainable management of water resources in agriculture and forestry, with a scaling-up approach that goes from the field to the catchment level. It addresses directly several challenges identified in the Joint Call.

Strengthening the Water JPI – INNOMED will contribute to the implementation of the JPI strategy on Water, in line with the call topic WATER-3-2015, by: i) improving transnational collaboration on water RDI; ii) enhancing coordinated integration of new knowledge; and iii) delivering innovations relevant to private and public stakeholders.

By doing so, it will contribute to the implementation of **EU water policy on sustainable water use** by increasing water use efficiency in agriculture and forestry, in line with the scope of the call topic.

INNOMED objectives are also fully aligned with the **Water JPI Strategic R&I Agenda (SRIA) 2.0**, especially through its Theme 4, subthemes 4.2.2 (Designing measures underpinning water and land-use policies), 4.1.1 (Implementing efficient water use systems and practices), 4.1.2 (Developing integrated water-conserving farming and forestry practices), 4.1.3 (Setting up water valuing schemes for agriculture and forestry), 4.1.4 (Progressing towards future-proof agricultural water use), 4.1.5 (Ensuring the efficient use of water resources in the bio-economy sector); and Theme 5 (Improving Sustainable Water Resource Management), subthemes 5.1.1 (Promoting water RDI infrastructures for a better understanding of the water hydrological processes on different scales); 5.1.2 (Promoting adaptive water management for global change); 5.2.1 (Integrating economic and social analyses into decision-making processes); 5.2.2 (Connecting socio-economic and ecological issues).

Expected Impact of the Project

Contributing to the H2020 Societal Challenge 5 (Water) and beyond – Other expected impacts include increased understanding of how water, food and land use policies are linked together, along with climate and sustainability goals (WATER-2-2015).

By developing an enhanced interface between scientific knowledge and forest and agricultural managers in the area of water use efficiency, and by promoting water-related solutions among end-users which will result in reduced pressure for water, INNOMED will contribute to the implementation of the European Innovation Partnerships (EIPs) on 'Agricultural Productivity and Sustainability' and 'Water' (WATER-4-2015). Other expected impacts in line with other topics of the H2020 Work Programme include SFS-2-2015 (Sustainable crop production); SFS-8-2015 (Resource-efficient eco-innovative food production and processing); and ISIB-4-2015 (Improved data and management models for sustainable forestry).

Broader-scale policy implications – The outcomes of INNOMED will contribute to the development of innovative policy programs with regards to IWRM, which are relevant at the national and international (EU) levels. In particular, INNOMED methods and tools are supportive to the following EU regulations and policies: 7th Environment Action Programme; Blueprint to Safeguard Europe's Water Resources; Water Framework Directive; Nitrates Directive; 'Towards a Circular Economy' Communication; Roadmap to a Resource Efficient Europe; Bio-economy Strategy; Common Agricultural Policy (CAP); EU Climate Change Adaptation Strategy; and Soil Thematic Strategy. The project may also contribute to the UN Sustainable Development Goals (SDGs), especially: SDG 2: 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture'; SDG 6 'Ensure availability and sustainable management of water and sanitation for all'; and SDG 12 'Ensure sustainable consumption and production patterns'.

How will your project target the following aims of the call:

INNOMED will:

- promote multi-disciplinary, collaborative work;
- combine fundamental and applied approaches;
- stimulate mobility of researchers within the Consortium, with a specific mobility program for young researchers and one technical workshop;
- enhance collaborative research and innovation during the project life and beyond.