Template of Mid-Term Progress Report

Water Joint Programming Initiative
2018 Joint Call

Closing the water cycle gap - Sustainable management of water resources

This Template should be used by the Project Coordinator for the reporting of the project.

This template does not substitute national regulations

2018 Joint Call
Mid-Term Progress Report
Closing the water cycle gap - Sustainable management of water resources

Mind the Water Cycle Gap: Innovating Water Management Optimisation Practice

IN-WOP

This document must be filled in by the project coordinator with the help of its project partners and must be sent to the WaterWorks2017 Follow-up Secretariat by **31 October 2020** (for Consortium XXX**).**

The WaterWorks2017 Follow-Up Secretariat will ensure distribution to the concerned national funding agencies. The project coordinator is responsible for sending a copy of the report to its partners.

PROJECT TITLE AND ACRONYM

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Date of submission: 29 October

Project Website:
Project code: WaterWorks2017-IN-WOP

Duration of project: 3 years
Start date: **1 July 2019** End date: **30 June 2022**

Period covered by this report: July 2019 – September 2020

1. Publishable Summary

Maximum 1 page

Current practice in integrated water management predominantly use **multi-objective** optimisation approaches with aggregated objectives. This biases results towards the status quo and against innovative solutions, can foster stakeholder resistance when they do not recognize their values and objectives in the optimization formulation, while also raising ethical concerns related to the inclusion of undesirable and/or hidden trade-offs[1]. In contrast, **many-objectives** optimisation approaches can consider many non-aggregated objectives, which has the potential to enrich the solution space with alternative courses of action that better reflect the diverging perspectives of stakeholders, and align better with ethical concerns. From the viewpoint of ethics, disaggregated assessment criteria are preferred as these may avoid undesirable and hidden trade-offs. The overarching aim of this project is to investigate the contribution of many-objective optimization approaches to Integrated Water Resources Management. To achieve this aim, the project adopts a comparative perspective were we complement existing IWRM models for 3 case study areas (Lake Como, Italy; Seine River, France; Merguellil Basin, Tunisia) with many-objective simulation optimization formulations. We compare the solutions found for these novel many-objective optimization formulations with solutions identified previously in order to Assess the degree to which pre-mature aggregation of performance metrics in one or more composite objective functions (i) Negatively effects the identification of innovative solutions; (ii) reduces the alignment with interests and preferences of the various stakeholders; and (iii) are ethically more defendable. We also aim to disseminate these findings to operational water managers and policy makers in our case study areas and countries and beyond. Covid 19 has substantially affected progress in each of the work packages. The main reason for this is that the project plan contained various workshops both in each of the case study areas with local stakeholders as well as consortium workshops for the joint development of an ethically informed many-objective optimization framework that was applicable in each of the case study areas. These workshops have been delayed and replaced with online sessions. Presently, the main results are a first position paper on ethically informed many objective optimization in IWRM (WP1), and ongoing work in each of the three case study areas on model operationalization and implementation of the framework. First computational experiments are being executed for the lake Como case study (WP2). For the Seine (WP3) and Merguellil (WP4) basin, efforts are currently focused on model operationalization in light of stakeholder consultation. The emerging WP2 results, complemented by a planned more stylized example as part of WP1 can be used by WP3 and WP4 in their next steps. The expected scientific result is an empirical assessment whether theoretical potential of many-objective optimization can be realized in practice. By working closely with stakeholders in the three case study areas, we hope to contribute to mainstreaming many objective optimization in IWRM as well as develop case specific extensions of existing models to enable many-objective optimization. More broadly, we hope that the mainstreaming of many-objective optimization in IWRM contributes to the Identification of case specific innovative solutions, improved alignment of expected consequences of solutions with interests and preferences of the various stakeholders, and a move towards responsible water management innovations and value sensitive design

2. Work Performed and the Results achieved during the reporting period

Maximum 10 pages.

Please attach any deliverables produced and information on milestones achieved during the reporting period of this report.

a. Scientific and technological progress

The overarching aim of this project is to investigate the contribution of many-objective optimization approaches to IWRM. For this, we use three water management cases in a comparative evaluation of many-objective approaches in diverse hydrological and cultural setting.

1. To complement the integrated water resources management models in our case study areas with a many-objective formulation and solving this using the Borg Many-Objective Evolutionary Algorithm.
2. To identify more innovative solutions for our case studies resulting from the many-objective optimization.
3. To disseminate these findings to operational water managers and policy makers in our case study areas and countries and beyond.
4. To assess the degree to which pre-mature aggregation of performance metrics in one or more composite objective functions negatively effects the identification of solutions that are innovative, more aligned with the interests and preferences of the various stakeholders, and ethically more defendable.

WP 1: Elaboration and comparative evaluation of a many-objective framework (TU Delft, The Netherlands)

This work package entails a collaborative effort in developing a many-objective evaluation framework and a comparative evaluation of the application of this framework in diverse (future) climatological, hydrological, and socio-economic environments. The envisioned steps are

1. Development of an ethically informed many-objective framework for water resources management
2. Specification and operationalization of criteria for comparison of methods
3. Cross-case and method comparison

Covid has strongly negatively affected progress on this work package. It was envisioned that this would be a collaborative effort with the TU Delft postdoc spending time at each of the other institutes to learn more about the specific concerns in each case study. Through this interaction and exchange, the envisioned framework of step 1 was to emerge. This interactive way of working has been put on hold and is being replaced with remote interaction. This limits engagement with local stakeholders, site visits, and other activities to properly ground the envisioned framework in the three case study sites. Despite this, the following activities have been employed and progress is being made.

During the project kick-off and through regular online partners and stakeholder meetings, insight into the key issues in each of the case study is being created. Commonalities and differences of case study situations with respect to ethical considerations in integrated Water Resources Management (IWRM) and the potential role and operationalization of distributive justice are being identified. For example, we identified that the decision involving several competing sectors in the Lake Como of whether or not, and how much, the lake be utilized for flood control, irrigation, tourism/aesthetic values poses ethical dilemma. Similarly, we identified that decisions involving extreme events of flood and drought in the Seine river basin (France) pose ethical dilemma about the distribution of risk (who/what/how/where to allocate risk), especially in the face of the changing climate. In the case of the Merguellil basin (Tunisia), we identified that the expansive extraction of ground water for agriculture, water supply of coastal areas, and other utility sectors presents questions of environmental justice and questions of depletion of natural resources.

Based on these findings, we are devising and testing an ethically informed many objective optimization framework based on aspects of justice that can be implemented and evaluated on all the three case study areas. With climate change likely to impact all the case studies, our framework proposes application of two critical categories of justice, inter-generational justice and distributive justice, for operationalization in all the case studies. A position paper on this is currently under review and an earlier version has been presented at EGU.

Since the planned close in person cooperation is on hold due to Covid 19, we are now working on the development of a stylized case study to demonstrate the framework. This stylized case study is being designed to have characteristics relevant to each of the three case studies. The aim of this stylized case study is to serve as a paradigmatic example of how the framework for ethically informed many objective optimization can be applied. The three case studies can then draw on this example (and associated open source code, data, and models), when implementing the framework in their respective case studies.

Besides communicating the proposed methodology through the stylized case study (step 1), we are currently developing cross-case comparative framework/model (step 2) where results and implications of inter-generational and distributive justice implementations in the three case studies will be cross-compared and evaluated, which will facilitate an objective cross-case comparison (step 3).

WP 2: Multi- versus many-objective optimisation - Lake Como Watershed, Italy (Politecnico di Milano, Italy)

This WP aims at demonstrating the value merits of many-objective optimization explicitly accounting for ethics and equity concerns in the Lake Como watershed, a complex, highly controlled water system that involves numerous economic activities. In particular, the existing regulation of the lake is driven by two primary, competing, objectives based on a tradeoff solution that "heuristically" balance water supply, mainly for irrigation, and flood control in the city of Como, which sits at the lowest point on the lake shoreline. However, ongoing climate and socio-economic trends are already impacting the area, opening the opportunity of revising this historically selected tradeoff, possibly by taking advantage of the results generated with the many-objective optimization approaches developed in the project in order to select solutions that better balance the competing stakeholders' interests to ensure a fair distribution of water resources and benefits.

Planned steps

1. Scoping and stakeholder identification
2. Model operationalization
3. Integration of many-objective approach
4. Preliminary results
5. Regional feed-back workshop
6. Final results
7. Dissemination and implementation workshop event

Progress and milestones

During the first RP, we mostly focused on steps 1-2-3. As far as the *scoping and stakeholder identification* is concerned, we revised the list of stakeholders that were involved in previous project and particularly the recently completed SOWATCH project, trying to identify the most relevant sectors and interests impacted by the lake operation. From this analysis, we eventually decided to focus the analysis on four objectives by adding tourism and navigation (related to an emerging problem with low lake levels) as well as downstream environment (dependent on the lake releases) to flood control and water supply. For each stakeholder, we then formulated an objective function trying to capture the associated interest. The validation of these objective formulations is ongoing (it was delayed by the COVID lockdown).

As far as the *model operationalization* is concerned, we integrated the existing models including the physically-based TOPKAPI-ETH hydrologic model of the upstream catchment, the dynamic model of the lake and its operation, and the spatially distributed model of the irrigation districts served by the lake releases. Thanks to the collaboration with the Regional Authority, the Regional Environmental Protection Agency, and the lake operator, we collected new data to refine the model set-up.

As far as the *integration of many-objective approach* is concerned, we first reviewed the literature to collect possible formulations of equity indicators and, in a few cases, their use as objective functions to inspire our analysis. Then, we developed the following work-plan to explore equity and intra-generational justice in the operation of Lake Como using a rival framings approach:

- 2-objective formulation, i.e. (flood vs irrigation) + a-posteriori evaluation of equity indicator
- 3-objective formulation including equity indicator, i.e. (flood, irrigation, equity)
- 4-objective formulation with all SHs objectives, i.e. (flood, irrigation, navigation, environment) + a-posteriori evaluation of equity indicator
- 5-objective formulation including equity indicator, i.e. (flood, irrigation, navigation, environment, equity)

These experiments are ongoing and we expect to obtain the first results in the next few weeks.

WP 3: Multi- versus many-objective optimization - The Seine River, France (Inrae, Artelia France)

This WP aims at demonstrating the value merits of many-objective optimization explicitly accounting for ethics and equity concerns in the Seine river basin. Because of the gentle slope of Seine Valley, the river has numerous meanders and a slow runoff. Four reservoirs, constructed between the 1950s and the 1990s, regulate the discharge on the Seine River, with the main objectives of reducing both floods and droughts. Presently, these reservoirs are operated independently. Recent research using MPC and Tree-Based MPC shows how a model-based, anticipatory and centralized control method can improve the level of flood protection. Ongoing climate and socio-economic trends are also impacting the basin. Together, this sets the stage for how the many-objective optimization approaches developed in the project can help in better balancing the competing stakeholders' interests.

Planned steps

1. Scoping and stakeholder identification
2. Model operationalization
3. Integration of many-objective approach
4. Preliminary results
5. Regional feed-back workshop
6. Final results
7. Dissemination and implementation workshop event

Progress and milestones

Several obstacles have been hindering the start of the project. Luciano Raso who was the post-doc initially planned for the project resigned in June 2019. A replacement has been found for early January 2020 and also resigned before beginning. Then, the confinement due to Covid 19 prevented the following hiring which is Quan Van Dau a Vietnamese post-doc previously employed in Scotland. Quan Van Dau began its contract in June 2020 but he's now facing resident permit issues because he didn't enter in France with the correct visa because French consulates in UK were closed at that time because of Covid 19. We are still uncertain about the risks associated with its administrative issues with the French authorities. Because of all these unforeseen problems in hiring someone for this project, some parts of the study case have been considerably delayed. Despite these staffing issues, progress is being made.

In September 2019, as part of step 1, Artelia and INRAE had a meeting with the director of hydrology of the EPTB Seine Grands Lacs which is the institution managing the 4 large reservoirs with a focus on minimizing floods and maintaining low water levels in the Seine catchment area. The identification of the concerns of this major stakeholder redirected the ins and outs of the case study. His first concern was to be able to define the impact of climate change on future floods with refined details on Paris and its region and the necessary adaptation of reservoir management. In addition, a first issue was that the calibration used in the previous project (IWRM-Net ClimAware 2010-2013) was based on data whose reliability is questionable.

Consequently, we decided to redefine the aims of the case study by adding some preliminary tasks related to step 2 and 3:

1. Setting up a new integrated hydrological model and directly calibrate it with influenced flow
2. Use updated climate change projections to generate projections of the water basin hydrology
3. Use the hydrodynamic model of the Seine River built by Artelia for the EPTB Seine Grands Lacs and the Seine Moyenne-Yonne-Loing Flood Forecasting Service which allows to produce a cartographic representation of the floods in major bed at the scale of the Ile-de-France region, and possibly upstream of the watershed

The operationalization of the model is currently developed as an R Package (https://gitlab.irstea.fr/in-wop/griwrm). In cooperation with the catchment hydrology research group at INRAE Antony and funded by the PIREN-Seine initiative (interdisciplinary research program on the Seine River basin water and environment), an intern will be in charge of the calibration of the model the first semester of 2021. Meteorological projections from Meteo-France will be then processed in the model and uncertainty of each stage of the modelling chain will be addressed to be taken into account in further steps. Finally, the flows simulated by the semi-distributed model will be used as inputs for Artelia's hydrodynamic model providing impact information of future floods for the stakeholder. The results of this part are expected by the end of 2021.

At the same time, we are studying many-objective optimization approaches applied on the Seine River system with a special focus on uncertainties. This results in the development of a tool that produce a risk assessment of future failing of flood or drought objectives considering hydroclimatic conditions and the current filling level of the reservoirs. Eventually, outputs of the simulated climate change projections and their dedicated uncertainties on the Seine River will feed the hydroclimatic conditions for this tool.

WP 4: Multi- versus many-objective optimisation - The Meguellil Basin (INAT, Tunisia)

The overarching aim of this work package is to investigate the contribution of many-objective optimization approaches to IWRM by applying the interactively developed many-objective evaluation framework to identify innovative water management strategies for Merguellil watershed situated in Kairouan (central of Tunisia) taking into account the impact of climatic and anthropogenic factors on the water resources management. Therefore, we are building on the water evaluation and planning (WEAP) system for the Merguellil basin which will simulate underground and surface water resources deriving from numerous catchment sources and demand from four sectors (domestic, industrial, agricultural and external pumping). The Integrated Water Resources Modelling Approach will analyze the impact of future scenarios by involving three major markers, namely the evolution of climate forcing which mainly affects the water resources production, trends in water consumption for different sectors, and system management actions applied by authorities.

Kairouan is considered as the region with the highest potential for agricultural development in Tunisia for which access to water is fundamental. Catastrophic floods are now controlled by three dams over the three main rivers (*i.e.,* Zeroud, Merguellil, Nebhana). Many small dams have been built in the hilly upstream region but the most important one in the watershed isEl Houareb dam, which is separating the upstream and the downstream parts of the Merguellil basin, having a mean annual income about 20 Mm^3 but only 10 Mm^3 are used to irrigate public irrigated areas. However, compared to the sporadic surface runoff, groundwater is by far the most important source for drinking and irrigation water. Therefore to decrease the overexploitation of Kairouan aquifers, actually, the Ministry of Agriculture is conducting an important project to connect El Houareb dam, to Sidi Saad dam which is built on Zeroud river having a storage capacity of 154 Mm^3 in order to reinforce surface water supply in Kairouan during periods of pick water demand. A large part of the Irrigated areas are private (with a large variety of arrangements about land, water, rights, rents and crops) where their real consumption is not well known for the authorities because of the high number of illicit wells (i.e. drilled without the required preliminary license) which has exploded since the Tunisian Revolution, and by now exceeds 10,000. Consequently, the real amount of water pumped for agriculture is considerably underestimated by authorities. Thus, an innovative solution is needed to preserve the Kairouan aquifer where a general drawdown of the water table is varying between 0.25 m and 1 m per year (1999-2013) because of the overexploitation.

Planned steps

1. Scoping and stakeholder identification
2. Model operationalization
3. Integration of many-objective approach
4. Preliminary results
5. Regional feed-back workshop
6. Final results
7. Dissemination and implementation workshop event

Progress and milestones

The work started by studying the literature describing the case study and different works done till now in the context of IWRM. As part of step 1, we identified the main stakeholders. These are the Regional Agricultural development Office and Grouping of Agricultural development in Kairouan, and the National Institute of cereals and Food quality company. This later is an agricultural and agri-food consulting and analysis company specializing in irrigation management, fertilization and weather equipment,offering advices principally to farmers and agricultural actors which is working a lot with farmers in the study area. Unfortunately, because of Covid 19, it was not possible to have a workshop to discuss with the different stakeholders the existing problems and difficulties in the study areas and the management ideas an solutions that they suggest to help us in the implementation of the many -objective optimization approaches.

As part of the second step, a PhD student was selected in Junuary 2020 to work on the modelisation of dams operation and the integration of the many objective approach but she resigned because she found a permanent workstation and it was impossible to select another student because deadlines have passed. Therefore a Plan B was chosen, we selected a master student in March 2020 to start the preparation of the WEAP model in order to continue the work next year (Junuary 2021) as a phD student. Given the containment measures to halt the spread of Covid 19 in Tunisia, we succeded to collect data about different water demand sectors (drinking water, industrial, agricultural and coastal areas supply) and different water resources: Kairouan aquifer, El Houareb and Sidi Saad dams in order to understand and design their operations. Also, climatic, hydrological and agronomic data supplied by different authorities and remote sensing data to identify the cropping pattern for each year from 2000 to 2019. This step is almost finished.

b. Collaboration, coordination and mobility

The original project plan delegates clear responsibility to each of the partners (see also section A). To complement this, at the kick off meeting, it was agreed to have in person meetings every 6-9 months. Each meeting would be hosted in a different case study area and would include field visits and interactions with local stakeholders. Next to these in person meetings, we planned monthly online progress meetings. To support these meetings, a sharepoint platform has been setup by Artelia for sharing documents and other relevant resources.

Covid 19 has derailed the plans with respect to in person meetings, as well as the planned mobility and exchange of people amongst the participating organizations. Presently, these are being replaced with online meetings. However, these online meetings cannot substitute for field visits and interactions with local stakeholders.

Presently, TU Delft is actively developing a stylized case implementing the ethically informed many objective optimization framework. This is done in close interaction with Politecnico di Milano. This collaboration is benefiting particularly from the fact that a former post doc from Politecnico moved to Delft to join as a faculty member. Politecnico di Milano, as a leading group globally in field of many-objective optimization for IWRM is actively interacting with both INAT, and Inrea and Artelia. They are guiding them in how to operationalize and set up models for simulation optimization using state of the art Many Objective Evolutionary Algorithms. If and when in persons visits become possible again, these can built on the collaboration and interaction which has been developing through online interaction.

The next phase of the research will involve the sharing of the stylized case study as being developed at TU Delft with all other partners. The exact format for and timing of this is to be decided and is discussed at the monthly online progress meetings.

The collaboration between partners is effective with clear roles and responsibilities for each project partner. Covid 19 has forced upon us an online mode of working rather than the planned in person meetings and mobility. Due to the monthly online meetings were are able to continuously adapt to the changing situation in each of the countries of participating partners.

Aside from the collaboration, coordination and mobility within the consortium, TU Delft is interacting with the WUR in relation to SIMTWIST (another 2018 JPI-Water project). The main focus of this interaction is on modelling with stakeholders and how experiences and knowledge present at TU Delft could benefit SIMTWIST. Politecnico di Milano, in parallel to the analyses on the Lake Como, is setting-up a similar analysis on the Zambezi Watercourse, a case study they are working on for another project (DAFNE) which looks particularly interesting for exploring the value of including ethics and equity concerns in the planning of new dams and management of existing and new infrastructures that impact on eight countries (Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe) and almost 40 million inhabitants.

c. Impact and knowledge output

The envisioned impacts of the project are

- Empirical assessment whether theoretical potential of MOEAs can be realized in practice
- Mainstreaming many objective optimization in IWRM

- Case specific extensions of existing models to enable many-objective optimization
- Case specific innovative solutions
- Improved alignment of expected consequences of solutions with interests and preferences of the various stakeholders,
- Responsible water management innovations / value sensitive design

The main vehicle for achieving these impacts are the three case studies. In these three case studies, we are still in the operationalization phase with emerging results only for the lake Como case study. Moreover, the envisioned impacts relied strongly on transdisciplinary interaction and collaboration with local stakeholders. Something that is particularly challenging to do given the current Covid 19 pandemic.

Still, we have submitted a position paper making the case for ethically informed many-objective optimization in IWRM. This position paper lays out the theoretical potential as well as illustrates this potential. The uptake of initial ideas in the Dafne project (see section B) further highlight ongoing steps in mainstreaming these ideas. Case specific results are only beginning to emerge and are a focus for the coming months. First steps are being taken to develop case specific extensions of existing models to enable many-objective optimization for both the Seine and Merguellil case study. The degree to which case study results are contributing to the alignment of stakeholder interests and preferences, and more broadly to responsible water management is, given also the timeline and the challenges posed by Covid 19, still an open issue.

3. Table of Deliverables

Please indicate whether the planned deliverables are completed, delayed or readjusted. Explain any changes/difficulties encountered and solutions adopted. Please add/delete rows, as necessary in the table below.

Deliverable name	Lead partner (country)	Date of delivery (dd/mm/yyyy)	Changes, difficulties encountered and new solutions adopted
WP1			
1.1 Evaluation framework review and ethical perspective	TU Delft	30/06/2020	Paper is under review
1.2 Integration and final design of optimization framework	TU Delft		Decision to include a paradigmatic stylized example to help translation to case studies is delaying this. A stylized case is close to being finalized and optimization formulations are being refined.
1.3 Water management model operationalization and testing guidelines	TU Delft		See 1.2. Paradigmatic stylized case is replacing guidelines
WP2			
2.1 - Case study base line document and stakeholder identification	POLIMI		Stakeholders engagement has been substantially delayed by the COVID pandemics and we are still interacting with them to share and discuss the proposed formulation of indicators/objective functions
2.2 - Scoping and framework stakeholder workshop	POLIMI		Stakeholders engagement has been substantially delayed by the COVID pandemics. In addition, it has been decided to adapt deliverable 1.2, which has knock on effect for 2.2, 3.2, and 4.2.
2.3 - Water management model operationalization and testing	POLIMI	31/08/2020	Water management models are running

Deliverable name	Lead partner (country)	Date of delivery (dd/mm/yyyy)	Changes, difficulties encountered and new solutions adopted
WP3			
3.1 - Case study base line document and stakeholder identification	Inrea, Artelia		Stakeholders engagement has been substantially delayed by the COVID pandemics and we are still interacting with them to share and discuss the proposed formulation of indicators/objective functions
3.2 - Scoping and framework stakeholder workshop	Inrea, Artelia		Stakeholders engagement has been substantially delayed by the COVID pandemics. In addition, it has been decided to adapt deliverable 1.2, which has knock on effect for 2.2, 3.2, and 4.2.
3.3 - Water management model operationalization and testing	Inrea, Artelia		Models are being calibrated and updated in light of latest climate scenarios
WP4			
4.1 - Case study base line document and stakeholder identification	INAT		Stakeholders engagement has been substantially delayed by the COVID pandemics and we are still interacting with them to share and discuss the proposed formulation of indicators/objective functions
4.2 - Scoping and framework stakeholder workshop	INAT		Stakeholders engagement has been substantially delayed by the COVID pandemics. In addition, it has been decided to adapt deliverable 1.2, which has knock on effect for 2.2, 3.2, and 4.2.
4.3 - Water management model operationalization and testing	INAT		WEAP model is available and being updated with novel data. Setting it up for simulation optimization, with assistance of Polimi is ongoing

4. Budget review

Please include a budget breakdown here, i.e. how the funding has been used so far.

TUDELFT spent €83,862 on personnel, 4383 on equipment and materials, and 555 on travel

POLIMI spent 3.25 PMs (13,996 €) of personnel, plus 13,300 € for a new collaboration aiming at finalizing the interactions with the stakeholders.

INRAE spend 22.240€, detailed as follow: 20.689€ of temporary staff salaries, 563€ of travel expenses, 988 € of equipment.

ARTELIA spent 2 PMs of personnel (exchanges with stakeholders, collaborative work with INRAE on the climatic scenarios/models, Seine River hydrodynamic model, consortium meetings and INWOP dedicated SHAREPOINT platform development) + travel budget for Kick off meeting in Delft, which give an overall expense of 28 641 Euros (from April 2019 to the end of August 2020).

INAT spent 14,325 € divided as 55% for personnel engaged in the project (engineer helping in data collection and writing scientific reports and the Master student, without taking into account Person months of senior researchers) and the rest went for the purchase of consumables and scientific equipment.

5. Consortium Meetings

Please list below the Consortium meetings which took place during the reporting period, by filling in the table below. Add/delete rows as necessary in the table below.

N°	Date	Location	Attending partners	Purpose/ main issues/main decisions?
1	4-5 November 2019	Delft	All	Kick off, case study introductions, possibilities for collaboration and exchange, logistics
2	5 December 2019	Online	All	Monthly progress meeting
3	2 January 2020	Online	All	Monthly progress meeting
4	7 February 2020	Online	All	Monthly progress meeting
5	5 March 2020	Online	All	Monthly progress meeting Covid 19, lock down in Italy
6	3 April 2020	Online	All	Monthly progress meeting Covid 19
7	7 May 2020	Online	All	Monthly progress meeting Covid 19
8	4 June 2020	Online	All	Monthly progress meeting
9	2 July 2020	Online	All	Monthly progress meeting Summer break, preparing mid-term report
10	3 September 2020	Online	All except INAT because of maternity leave	Monthly progress meeting Mid-term report
11	1 October 2020	Online	All	Monthly progress meeting Mid-term report

6. Stakeholder/Industry Engagement

Maximum 1 page

Stakeholder engagement in the Lake Como basin has been significantly challenged and delayed by the COVID pandemics and the strict lockdown measures Italy implemented over spring 2020. Relying on the previous projects, we were able to identify the main stakeholders and formulate candidate indicators/objective functions accounting for their interests, whose validation is ongoing. In parallel, we managed to interact remotely with the Regional Authority, the Regional Environmental Protection Agency, and the lake operator for collecting new data that were useful for refining the existing models during the model integration.

In September 2019, Artelia and INRAE had a meeting with the director of hydrology of the EPTB Seine Grands Lacs which is the institution managing the 4 large reservoirs with a focus on minimizing floods and maintaining low water levels in the Seine catchment area. The identification of the concerns of this major stakeholder redirected the ins and outs of the case study. His first concern was to be able to define the impact of climate change on future floods with refined details on Paris and its region and the necessary adaptation of reservoir management. Due to Covid situation, the meeting planned with the stakeholders in Spring 2020 has been postponed.

The main stakeholders in the Merguellil watershed are the Regional Agricultural development Office and Grouping of Agricultural development in Kairouan, and the National Institute of cereals and Food quality company. With them we strongly collaborated long time ago in several european projects (Aquastress, Wassermed, AMETHYST) dealing with water resources management in the case study. Firstly, they are continuing providing us with all needed data described in WP4 to update the existing WEAP model for Merguellil watershed and modelize the functioning of the two dams. Secondly because of the COVID panademic, we are remotly discussing with them the different problematics and possible solutions.

7. List of Publications produced by the Project - Open Access

- List all presentations, posters, and publications in scientific, peer-reviewed journals derived from this project, separating those in preparation, those in review and those accepted or in press.
- Provide websites and/or electronic copies of the key ones.
- Indicate all the co-authors for each publication.
- Order publications per date (chronologically) and for each year by alphabetical order.

Metadata on all project publications are required to be submitted as part of the final reporting. This will be done via the **Open Data & Open Access platform**, available at: http://opendata.waterjpi.eu/ (also accessible from the bar menu of the Water JPI website).

International	Peer-reviewed journals	**Under review** Yalew, SG., Kwakkel, J., Doorn, N., (Under Review) Distributive justice and sustainability goals in trans-boundary rivers. Front. Environ. Sci.,
	Books or chapters in books	
	Communications (presentations, posters)	**2020** Castelletti, Cazzaniga, Giuliani (2020), "Stability and equity in transboundary river basins facing changing climate and society", abstract accepted for 2020 AGU Fall Meeting Yalew, S. G., Kwakkel, J., and Doorn, N.: Distributive Justice in Water Resources Allocation and Management, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-7274, https://doi.org/10.5194/egusphere-egu2020-7274, 2020 **2021** Dorchies, Van Dau, Bader (2021), "Many-objective risk assessment framework for guiding operational decisions on multiple reservoirs", abstract submitted for 2021 IAHR World Congress
National (separate lists for each nationality)	Peer-reviewed journals	
	Books or chapters in books	
	Communications (presentations, posters)	
	Popular articles	

Dissemination initiatives		
	Popular conferences	
	Others	Mind the Water Cycle Gap: Innovating Water Management Optimisation Practice: IN-WOP, authors : Delft University of Technology (coordinator), ARTELIA, INRAE, Institut National Agronomique de Tunisie, Politecnico di Milano (paper submitted in October 2020 to the International Network of Basins Organisations newsletter)

8. Knowledge output transfer

For each of the Knowledge Output arising from the project so far, please complete the following table.

Short Title *Please provide a short and concise title to describe the Knowledge Output*	
Knowledge Output Description *Please only include generated Knowledge Outputs, not those that are expected. Note: Knowledge Outputs can be non-deliverables, milestones or 'grey knowledge'. Also, multiple Knowledge Outputs could exist within one deliverable, and should be separated.* *Try to give a comprehensive description, making the Knowledge Output fully understandable to a non-expert.* *If relevant please provide detail of where the Knowledge Output differs from its equivalent, e.g. What are the key characteristics of the Knowledge Output? What research is it adding to and what is innovative about the Knowledge Output? (Max 500 characters).*	
Knowledge Type	
Link to Knowledge Output *If you can provide a link to the Knowledge Output then please do so, e.g. digital object identifier (DOI), web address, download, research paper.* *If the Knowledge Output is not publicly available currently but will be in the future, please provide details. Also, if it is available but only upon request, please state this.*	

If the Knowledge Output is not planned to be publicly available, please state "Not available for public".	
Sectors & Subsectors *Choose as many options as required from the list. Pick those sectors that you think would benefit from the application of this Knowledge Output.*	
End User *Choose as many options as required* *Per identified End User, please identify possible applications of the Knowledge Output.*	
IPR *Please indicate whether IPR has been applied to this Knowledge Output (applied for a patent, copyright etc), or not.* *Please insert "n/a" if no IPR has been applied.*	
Policy-Relevance If the Knowledge Output is relevant to the WFD or any other related Directives, please list and explain why	
Status *Please identify whether the Knowledge Output is finalised, is still being generated or whose status/future is unknown. Consider:* *• Is your knowledge conclusive enough that it provides sufficient evidence to make an impact on, or be applied by, an End User?* *• Is there a corroborating body of evidence, or are contradictory results, available?* *• Does your knowledge progress beyond the current state-of-the-art / evidence base?* *• Is more research or demonstration needed to validate the results?*	

9. Open Data

In relation to Open Data, the funded projects will be requested to submit metadata on all the resources directly generated by the project, as well as additional information on how these data will be exploited, if and how data will be made accessible for verification and re-use, and how it will be curated and preserved. Metadata on all project resources are required to be submitted as part of the final reporting. This will be done via the **Open Data & Open Access platform**, available at: http://opendata.waterjpi.eu/ (also accessible from the bar menu of the Water JPI website).

10. Problems Encountered during Project Implementation

Covid 19 is severely affecting the implementation of the project. All planned stakeholder workshops have been postponed. The envisioned mobility of key personal is also on hold and replaced with online meetings.

11. Suggestions for improvement regarding project implementation?

It is paramount that clarity is provided on how COVID19 impacts will be handled by JPI. Either an extension or some other adaptation seems appropriate.