European Cooperation in Science and Technology
- COST -

Secretariat

Brussels, 8 December 2011

COST 4164/11

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action ES1106: Assessment of EUROpean AGRIculture WATer use and trade under climate change (EURO-AGRIWAT)

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 183rd meeting on 30 November 2011.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action ES1106
ASSESSMENT OF EUROPEAN AGRICULTURE WATER USE AND TRADE UNDER CLIMATE CHANGE (EURO-AGRIWAT)

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4154/11 "Rules and Procedures for Implementing COST Actions", or in any new document amending or replacing it, the contents of which the Parties are fully aware of.

2. The main objective of the Action is to deliver integrated methodologies and databases for the European wide assessment of water use and trade associated to key food and energy crops at different spatial scales under current and future climatic conditions.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 60 million in 2011 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter V of the document referred to in Point 1 above.

A. ABSTRACT AND KEYWORDS

The COST Action EURO-AGRIWAT will focus on the assessment of water footprint (WF) and virtual water trade (VWT) of key food and no-food agricultural products, including their uncertainties, as well as scenarios concerning WF and VWT under future climatic conditions. The use of advanced tools and data such as remote sensing, updated climatic databases, climatic projections/scenarios and agrometeorological models represents the base of the activity. The use of such instruments will allow a detailed analysis of interactions between crops, climate and management that will be taken into account in the WF assessment. An important component of the Action will be the preparation and dissemination of recommendations and guidelines for enabling a more efficient water resource management in relation with agricultural activities under climate change and variability. The framework of a COST Action represents the most suitable way for facing the outstanding and multi-faceted problem of sustainable water use, being characterized by a non-competitive and interdisciplinary environment of high scientific level. These features will allow a collaboration between scientists and stakeholders and the development of common strategies to broaden the available research expertise.

Keywords: Climate change, agricultural water management, virtual water, water footprint, agrometeorological methods and models

B. BACKGROUND

B.1 General background

As water is a main resource for human activities, and therefore a critical trigger for the welfare of the whole society, priority has to be given to its sustainable and efficient use. Agriculture, in major areas a main water user, influences the regional water resources which are available for all key sectors. Increasing world population, changes in standard of living (especially consumption of meat) and the consequent increasing need for food, feed and bio-energy will require more efficient agricultural management practices, i.e. sustainable intensification of cropping systems.

This concerns, in particular, irrigation. In fact, under climate change, in many European countries, water scarcity is likely to impose limits not only to irrigation enlargement but also to the already existing systems (e.g. reduced irrigation practices may have to be applied). In this respect, the concept of water footprint has acquired a global recognition. The WF is defined as the quantity of water used to produce a good or a service. In particular, the WF of an agricultural product is the volume of water used during the crop growing period (Hoekstra and Chapagain, 2007 and 2008), and it has three components: the green water, that is rain or soil moisture transpired by a crop, the blue water that is the amount of irrigation water transpired and the grey water, that is the volume of water required to dilute pollutants and to restore the quality standards of the water body. The WF concept gains importance when applied to trade between countries or regions, because imports and exports of agricultural products involve a virtual water transfer. Virtual water is referred as the content of water embodied into a product. It is similar to the concept of WF but the former refers to the water volume embodied in the product alone, while the latter term refers to that volume, but also to which sort of water is being used and to when and where that water is being used (www.waterfootprint.org). As virtual water varies depending on products and place of production, virtual water trade between the nations and/or regions can represent an instrument to achieve regional water efficiency. Thus, the evaluation of the real conditions in water sources and water demands and their regulation can contribute to the regional and global water security.

Several European projects were or are dealing with water use and management in agriculture, also in relation to climate change impacts (e.g. CLIMSAVE, CIRCE, COST734, WADI, ACCELERATES, ACQWA, PRECIRIEG, SIRRIMED, TELERIEG). The results of such projects were in some cases compared and evaluated with respect to their significance for operational water management at the stakeholder level, but a coordinated approach to provide practical recommendations is still missing. In this sense, a dedicated interdisciplinary and inter-institutional platform for scientific information exchange, consensus building and model improvement is required. COST provides the best available mechanism for broad European networking and capacity building. The framework of a COST Action represents the most suitable way for facing the outstanding and multi-faceted problem of sustainable water use, being characterized by a non-competitive and interdisciplinary environment of high scientific level. These features should allow a strict collaboration between scientists and stakeholders. Such organization will allow the development of common strategies to broaden the available research expertise.

Running FP7 programs and international or national initiatives are dedicated to specific problems (i.e. drought, vulnerability to climate change, irrigation technologies, crop water demand). EURO-AGRIWAT is meant to offer an important transversal contribution to existing activities and an impulse for the development of future research directions.

The EURO-AGRIWAT Action will involve, support and harmonize the numerous existing European and not European (i.e. Australia, US, South Africa) activities. In addition, EURO-AGRIWAT will extend the scientific focus towards the use of not yet deeply investigated tools (i.e. crop models - including nitrogen balance models, crop water balance or irrigation models, remote sensing, climatic projection and scenarios) for a more realistic and complete computation of the water amounts consumed for producing food, feed and energy crops usually produced in and transported through Europe.

B.2 Current state of knowledge

Water represents a main resource for human activities and its management. Together with food and energy production, water scarcity is one of the most outstanding problems for society. In most European regions agricultural productions are intensive water consumers. Therefore, these systems are very vulnerable to a potential decrease in water availability.

The impacts of climate change (increasing temperatures, shifts of seasonal precipitation and decreasing summer rainfall) could cause water availability to reach critical limits in many areas. In Europe 44 % of water abstraction is used for energy production, 24 % for agriculture, 21 % for public water supply and 11 % for industry. However, in southern Europe, agriculture accounts for 60 % of the total water abstracted. Many attempts have been undertaken to improve the effective use of water in agricultural crop production but many results are only locally valid and cannot easily be extrapolated to other regions. Also, the factors influencing water use efficiency in crop production are manifold and vary with soil type, crop, crop management, environment and scale. Regarding regional water resource management, a more holistic approach is recommended to solve the growing water conflicts driven by the increasing scarcity of water resources.

Agricultural water use efficiency should not be considered any longer only at the local level but should rather be examined at the catchment scale and beyond. This is also the scope of the EU Water Framework Directive. In this respect, the concept of water footprint (WF), introduced by Hoekstra in 2002, represents a benchmark. The WF, defined as the volume of freshwater used to produce a product measured over the full supply chain, can be seen as a multi-dimensional indicator of freshwater use and pollution. At the same time, the concept gains importance when applied to trading between countries or regions, because imports and exports of water intensive products involve a virtual water transfer (resulting in VWT). Based on these two important ideas, many efforts have been undertaken to assess the water consumption, pollution and trade related to agricultural activities and products and to define the environmental sustainability of water resources management. Such studies were developed at global, national (e.g. China, Germany, India, Kingdom of Morocco, Netherlands, Romania, Spain), regional and river basin (e.g. Chinese provinces, Indian states, Nile basin, Andalusia) scales and concerned many products (e.g. cotton, coffee, rice, wheat, pizza, pasta, biofuels). However, a coordinated activity systematically addressing all phases of the water footprint assessment at the European scale, under present and future climatic conditions, is still missing. In addition, as indicated by Hoekstra et al. (2011) past studies often did not consider the phase of water resources sustainability assessment. In this context the COST Action will be innovative with respect to the involvement of different research fields and to the availability of many case studies that can be provided by the participating countries. Moreover, the innovation is also intrinsic to the approach adopted and in the use of advanced tools and data such as remote sensing, updated climatic databases, climatic projections/scenarios and simulation models. The use of such instruments will allow a detailed analysis of interactions between crops, climate and management and therefore many new and complex elements will be taken into account. Also, agrometeorological models can be better linked to climate and adaptation scenarios for assessing climate change impacts (including extreme events) and options for sustainable use of water resources. Beside the use of models, also advanced and updated climatic data will allow an improvement of the results. With the use of climate data as those provided by E-OBS (http://eca.knmi.nl/download/ensembles/ensembles.php), the assessment of WF under current conditions will automatically consider climate variability (and not only long-term mean conditions).

E-OBS is a daily gridded observational dataset for precipitation and temperature in Europe based on European Climate Assessment & Dataset (ECA&D) information. The full dataset covers the period 1950-2009. It has originally been developed as part of the ENSEMBLES project (EU-FP6) and is now maintained and elaborated as part of the EURO4M project (EU-FP7). Of course, the improved methodology and improved data should also result in a better assessment of uncertainties. Finally, the current state of knowledge will be advanced by the assessment of WF under future climate change conditions including the effect of rising CO_2 on crop water consumption, which enables the identification of hotspots where WF are or could become critical in the near future.

EURO-AGRIWAT aims both at European scientific and technical advance through a holistic approach, harmonization of efforts, common guidelines and standard definitions (particularly concerning grey water). It is anticipated that EURO-AGRIWAT will satisfy socio-economic needs through dissemination efforts and support of water management planning.

B.3 Reasons for the Action

Although the number of research activities related to the assessment of food and energy crop water footprints is steadily increasing, none of them has yet addressed the question of how water footprints are affected by climate change and variability. Neither has the issue of change over years received attention. Under future climatic conditions, water will likely be scarcer in many areas of Europe and related problems will represent an even more critical challenge for society. This means that the sustainable and efficient management of the water resources, defined through an interdisciplinary approach, high-level scientific information and harmonized data and guidelines will become a primary goal for society. The networking, typical of the COST framework, of EURO-AGRIWAT will aim at defining such recommendations. In fact, the Action will be multi-disciplinary, bringing together different expertise and communities, from agronomists to meteorologists to physicists. Moreover, the involvement of important international (i.e. WMO, FAO, UNESCO-IHE), national and local bodies (i.e. Ministries, Local Authorities), will strengthen the Action and increase its impact. Another weakness of available assessments is that they do not tackle uncertainty, neither in relation to the data nor to the tools.

The interaction between different fields of research will be particularly important concerning the computation of the grey component of the WF related to nitrogen fertilizations. At the moment grey water is estimated assuming a mean 10% loss of fertilizer N through leaching into the groundwater (which can however significantly vary with consideration of rainfall patterns, soil -proprieties and agronomic practices). On the other hand, experts assume that there is still an overall 30% over-fertilization of N in Europe in view to keep optimum yield levels under optimized N-fertilization management. In this respect, expertise in climate, soil science, nitrogen and water balance into the soil will work together for finding a common and flexible methodology considering also potential effects of irrigation to improve nitrogen use efficiency. Moreover, a challenge is also to develop guidelines and indications about the optimum or maximum load of nitrogen inputs in various agricultural ecosystems and regions. The participation of many different countries, which will supply researchers and wide databases, will represent a unique opportunity for validating experimental procedures.

B.4 Complementarity with other research programmes

Because water resource, together with food and energy, is probably one of the most serious current and future challenges of society, in Europe there are many ongoing and planned projects with which EURO-AGRIWAT should be integrated. Among them, the main programmes considered are:

- EU WATCH (FP6, www.eu-watch.org): this is an integrated project on Water and Global Change that brings together the hydrological, water resources and climate communities to analyse, quantify and predict the components of the current and future global water cycles and related water resource states; evaluate their uncertainties and clarify the overall vulnerability of global water resources. This represents an important starting point for assessing the impacts of agriculture WF on local and regional water resources.
- ACQWA (FP7, www.acqwa.ch): the main goal is to assess the impacts of a changing climate, focusing on the quantity and quality of water originating in mountain regions and including the water demand in agriculture. EURO-AGRIWAT will provide the necessary complement for the quantification of the amounts of water used and consumed by agricultural activities.

- EU.WATER (SEE, www.eu-water.eu): the main goals are to give concrete answers to the problem of water consumption and water contamination caused by intensive agriculture in selected rural communities across SEE space, where agriculture represents the major user of natural resources and supplier of environmental services. The quantification of water consumption and water pollution is also one of the main goals of EURO-AGRIWAT. The Action aims at providing a complement for their determination and facing the problem at different scales.
- CLIMSAVE (FP7, www.climsave.eu): this pan-European project is developing a user-friendly, interactive web-based tool that will allow stakeholders to assess climate change impacts and vulnerabilities for a range of sectors, including agriculture, forests, biodiversity, coasts, water resources and urban development. COST Action will be able to use the Integrated Assessment Platform for some of the experiments and could carry out independent testing of its reliability. At the same time gained knowledge could be used to improve the platform and identify further research needs.
- WatNitMed (FP6, http://www.iamz.ciheam.org): the project was based on the premise that understanding the physiological bases of the responses to water x nitrogen shortages would allow the design of more consistent management practices. Although the project ended in 2009, the results on the improvement of WUE (water use efficiency) and NUE (nitrogen use efficiency) of Mediterranean strategic crops will be integrated into and considered for the WF computations.
- Forthcoming pilot actions of Joint Programming Initiative on Agriculture, Food Security and Climate change (JPI FACCE): joint programming is a concept introduced by the European Commission and FACCE is one of five initiatives aimed at implementing the European Research Area (ERA). The core themes of FACCE that are especially relevant for interaction with EURO-AGRIWAT are: 1) Environmentally sustainable growth and intensification of agricultural systems under current and future climate and resource availability as well as 2) Assessing and reducing trade-offs between food production, biodiversity and ecosystem services.

To guarantee the international dissemination of the Action activity and outcome, liaison is established with the World AgroMeteorological Information Service (WAMIS), managed by the WMO (www.wamis.org). WAMIS, a global modular portal system with interconnected servers in Italy, the United States and South Korea, is able to provide a resource delivery system for all products, analyses, and resources to distribute among all collaborators.

Section E will give more information on how interactions with these and other national and international projects will be achieved.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The main objective of the Action is twofold. On the one hand, the Action will deliver improved methodologies and databases for the European wide assessment of water footprints of agricultural systems at different spatial scales (local case study areas, watershed, country) associated to key food and energy crops and the virtual water trade associated to the import/export of such agricultural products. On the other hand, the Action will also deliver an updated assessment of water footprint and virtual water trade under climatic conditions, including their uncertainties, as well as scenarios concerning WF and VWT under future climatic conditions or under different agricultural practices. In this sense, an important component of the Action will be the preparation and dissemination of recommendations and guidelines for enabling a more efficient water resource management in relation with agricultural activities under climate change and variability. To guarantee the international dissemination of the Action activity and outcome, liaison is established with the World AgroMeteorological Information Service (WAMIS), managed by the WMO.

C.2 Objectives

Secondary objectives contributing to the fulfillment of the main goal are:

- Critical review and inventory of existing models, tools and methodologies applied in WF assessment
- Data, tools and methodologies evaluation

- Sustainable water management
- Recommendations and guidelines
- Identification of critical gaps in current knowledge
- Evaluation of the most suitable methodologies for addressing WF and VWT at the European scale
- Evaluation of the utility of agrometeorological and crop models for assessing climate change impacts (including elevated CO2) on WF at the local, regional and continental scale and implications for virtual water trades
- Tackling the question of how data assimilation (including agrometeorological, hydrological, climatic and soil information) can contribute to improved WF assessment under various agroclimatic conditions in Europe
- Evaluation of the potential of remote sensing to improve the WF assessment
- Assessment of water footprint of the main food and no-food crops cultivated in Europe for both irrigated and rain-fed systems
- Investigation of the concept of VWT with the regards to national and regional water use efficiency in agriculture in Europe
- Identification of regional hotspots where water availability could represent a limiting/critical factor through the analysis of the impact of climate change and variability and potential effects on WF
- Assessment of sustainable water management strategies in relation to identified hotspots and to water resources availability
- Assessment of virtual water trade impacts on importer and exporter countries
- Development of improved recommendations and guide-lines, based on the results, for agrometeorological services, regional water management, etc. in order to protect water resources and improve water use efficiency of agriculture in Europe
- Organization of training schools and seminars for enhancing capacity building in the field of water resources management

C.3 How networking within the Action will yield the objectives?

The above objectives will be achieved by:

- Integrating expertise and interdisciplinary teams both at the scientific and institutional levels
- Organizing open workshops and dedicated meetings for planning, harmonizing, disseminating and collecting activities and results
- Assuring openness and flexibility to the Action and its structure in order to permit the inclusion, at the implementation stage, of perspectives and activities not foreseen during the preparation of the proposal
- Interacting with EU projects and Joint Programming Initiatives on similar fields, existing networks and associations dealing with water management, International Bodies (e.g. WMO, FAO, UNESCO-IHE), National Agronomical, Hydrological and Meteorological Institutes and Research Centers, National and International Scientific Societies (e.g. ESA, ISB, EMS), reclamation authorities.
- Knowledge transfer between different scientific communities and between different levels through the organization of training schools dedicated to Early Stage Researchers, Short-Term Scientific Missions
- Collaborating with stakeholders in the organization of activities, definition of needs and data supply (e.g. commercial companies for irrigation systems or irrigation associations)
- Implementing a continuous dissemination of information, methodologies and results (e.g. by a Web page, summer schools, conference participations, national seminars and publications)
- Collaborating with non-COST countries to give the Action a relevant and up-to-date role at international level, both in scientific and dissemination activities

C.4 Potential impact of the Action

Benefits of the Action include:

- Assessment of the amounts of water consumed and polluted for key food and no-food crops in European agriculture and identification of water flows across regions/countries
- Identification of research needs and gaps in the field of agricultural water use under present and future climate conditions (recommendations to national and European research policy)
- Identification of hotspots and assessment of climate change impacts on crop water footprints and related sustainable use of water resources
- Improvement of operational services (agrometeorological services, extension services, reclamation authorities) for farmers and stakeholders e.g. through recommendations for regionally adapted water management
- Improvement of knowledge and tools for decision support and policy planning (e.g. in regional water management, agricultural commodities trade and infrastructure planning)
- Improvement of multidisciplinary interaction between research institutions, extension services and stakeholders in the field of efficient and sustainable water use

C.5 Target groups/end users

A first target group is represented by Universities and Research Institutions. EURO-AGRIWAT will allow an advancement of knowledge in the fields of data processing, analysis and model development, integration and assimilation of data. Early Stage Researchers will be specifically supported. End-users are also represented by policy makers and legislative executive bodies. The results of the Action, in particular the use of common protocols and the creation of guide-lines, will allow decision makers to have coherent and comparable information for the planning of management activities. A further group of end users is represented directly by farmers, technicians or advisers of agricultural extension services and research units, reclamation authorities, Meteorological and Hydrological Centers, who will be supplied with high quality information for supporting short- and long-term decision making processes. Finally, international bodies (i.e. WMO, FAO) are natural target groups interested in the outcomes of EURO-AGRIWAT and potential disseminators of the results at the global level.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

The general scientific focus of EURO-AGRIWAT is, on the one hand, the analysis of the global water footprint in agriculture and the consequent virtual water trade for some key food and no-food crops and, on the other hand, the collection and dissemination of relevant know-how at the research and institutional levels. Taking into account the general aim and the specific objectives described above and in section C, the Action will coordinate the following five activities:

Activity 1

Setting-up of a comprehensive inventory of studies, data, tools and needs in the field of water consumption, management and trade in European agriculture. Here the goal is to identify gaps, avoid duplications, integrate existing findings and improve applied methodologies. All the different sources of data and information will be considered and capitalized (national to local databases, European statistics, international network websites, available simulation models, etc.). Based on such analysis, the evaluation of cropping systems across Europe, needed to identify representative food and non-food crops, and the creation of a corresponding database of crop management data will be carried on. Task 1 belongs to Activity 1.

Activity 2

Development and test of methodologies (including data) for assessing WF, with respect to all three components, and virtual water trade at the European level. This represents the core of Action activities. Experts in different fields such as agricultural science, meteorology, climatology and hydrology, soil science, agronomy, chemistry, economy, computer science and modelling, and environmental sustainability are expected to collaborate to define and carry out comprehensive case studies from which the complete analysis will be developed. Particular attention will be devoted to (a) assessment of advantages of using crop/agrometeorological models for quantifying blue, green and grey water; (b) assessment of uncertainties in relation to WF and virtual water trades evaluations. Tasks 2 and 3 belong to Activity 2.

Activity 3

Assessment of climate change impacts and climatic variability on water footprints and virtual water trades. This is a key activity of the Action. In fact, the global change is undeniable and the vulnerability of water resources in the medium-long term should be considered as well as the related food security problems. Such analysis, mainly based on the use of climatic data, climate change scenarios and crop/agrometeorological models will give information about the possible evolvement of the present situation and about the effect of the different management options that can be adopted for mitigating impacts. Task 4 belongs to Activity 3.

Activity 4

Analysis of sustainable water management. This will be achieved through the evaluation of the impacts on water resources at different scales (national to watershed to local case studies) and by the identification and characterization of critical hotspots. In this respect, the limits of natural and maximum nitrogen concentration would be considered for the different water resources (groundwater, surface water, drinking water, etc.). Evidently, a binding requirement would also be the common and shared identification of the more suitable indicators for defining water resources sustainability. This task is an essential step for creating the necessary links between the scientific activities and the official Institutions dealing with the governance of water resources management at different levels (local to European). Principal instruments of European international policies (Water Framework Directive, International Conference on Freshwater, EU Water Initiative, current and post-2012 Common Agricultural Policy, etc.) will be analysed for identifying the fundamental needs both for scientific-technological advancement and economic-societal necessities. Task 5 belongs to Activity 4.

Activity 5

Activity 5 will focus on a) integrations and interactions with other research programmes, existing organizations/networks/initiatives working on water and stakeholders; b) dissemination of the results at different levels (e.g. general public, scientific communities, official authorities, soil, agricultural and water associations, Institutions). Task 6 belongs to Activity 5.

D.2 Scientific work plan - methods and means

The scientific program is defined along the above mentioned objectives and organized in **six tasks**.

Task 1: Data and tools

The main goal of Task 1 is defining the framework for the development of Tasks 2 to 5. The work will mainly consist of the inventory and analysis of data (e.g. climatic data, climate change scenarios, data on yields, cropping systems and land use, soil data, crop water used data, management data, economic data, trade data) and tools (e.g. empirical formulas, statistical models, mechanistic crop models, Geographic Information Systems) that could serve for the computation of WF and VWT at various spatial and temporal scales. The possibility to use remote sensing data, as well as the application of crop models for estimating grey water footprints will be evaluated with special care. Crop and land use data will provide the basis for identifying the most representative food and non-food crops. All data will be organized in a database for which the access will be free for the WGs components. A regulated access to the database for external users will also be evaluated.

Deliverables: a) list and survey of data on major food and non-food crops; b) catalogue and repository of data and their characteristics depending on spatial and temporal resolutions; c) catalogue and repository of tools; d) database

This task constitutes a horizontal activity involving **all WGs**

Task 2: Assessment of crop water footprints under present climatic conditions

The aim of Task 2 is the assessment of water footprint (green, blue and grey components) for each of the selected crops at the different identified spatial scales, based on the outcomes of Task 1. Alternative approaches will be applied and compared in order to identify, on equal results, the simplest one. In particular, the use of crop growth and water balance models, statistical yield and irrigation data, measured data, evapotranspiration formula, remote sensing imagery will be investigated. The ability of models and methods to consider the impacts of current and future climate change on water footprint will be evaluated.

An important activity that Task 2 should develop is the evaluation of a specific methodology for the accounting of grey WF based on the limits of natural and maximum allowed concentration of nitrogen compounds into the different water sources used (surface, ground, drinking water). For that, the calibration and application of crop/agrometeorological models is planned. Specific case studies will be identified in order to investigate different and representative cropping systems, irrigation methods, soil types and climates.

The problem of quantification of uncertainties will also be addressed by Task 2.

Deliverables: a) crop footprints (long-term +/- standard deviation and related uncertainties) for blue, green and grey water across Europe; b) suggestions and examples concerning the possibility to integrate remote sensing into WF accounting; c) reports

Task 2 will be addressed by **WG1: water footprint**

Task 3: Assessment of virtual water trade under present climatic conditions

Task 3 will evaluate the virtual water trade of the selected crop products with the aim to analyze the relations existing between water distribution and its transfer between regions and countries in Europe. Data about the trade of the selected agricultural products through Europe will be collected from the different available sources (statistical databases, local data, etc.). In this sense, the results of past and ongoing food risk studies will be taken into account. The goal is defining the crop product flows across the different countries and/or regions. In particular, the product traded (i.e. type of crop, raw, processed or pre-processed material), the volume of product imported and/or exported, the quantity of national production will be explored. This information, together with WF accounting made under Task 2, will be used to calculate the volumes of water imported by and exported to a Nation by means of trading products. As a consequence, the accounting of National WF will be possible as well as the water savings or losses of that Nation. The problem of quantification of uncertainties will also be addressed by Task 3.

Beside the water trade accounting, a clear picture of existing legislation at European, regional and local levels would be described and considered.

Deliverables: a) virtual water trade of the different agricultural products; b) suggestions and examples concerning the possibility to integrate remote sensing into VWT accounting; c) maps and gridded data on main water flows across Europe; e) reports

Task 3 will be addressed by **WG2: water trade**

Task 4: Assessment of crop WF and VWT under future climatic conditions

Essential goal of Task 4 will be the assessment of the impacts of climate change and variability on the crop WFs and crop products VWT. In particular, climatic historical series, climatic projections and climate change scenarios will be applied. In addition, scenarios concerning land-use, shift in cropping patterns, likely changes in trading patterns of agricultural products across Europe and scenarios for economic development will be investigated. The impact of climate change and variability will be also analyzed for different scenarios through the application of crop/agrometeorological models that allow the verification of the effect of different management options. This task is the base for assessing the trends of global WF and its components (green, blue and grey) in representative areas of Europe and for understanding the possible implications for the virtual water trade through the different regions.

Deliverables: a) crop footprints (+/- standard deviation and related uncertainties) for blue, green and grey water across Europe under future climate; b) virtual water trade of the different agricultural products under future climate; c) maps and gridded data on water flows under the different considered climatic and management scenarios; d) reports.

Task 4 will be addressed by **WG1 and WG2**

Task 5: Assessment of management and adaptation options for the sustainable management of WF

Once the WF and the VWT are calculated, the results would be contextualized in order to compare the WF to the available fresh water for the assessment of sustainability. First of all, sustainability criteria will be identified. They will concern the environmental (i.e. water quality and pollution, rainfall, river flows, run-offs) and socio-economic (water allocation to different products cost-benefit of WF) dimensions. Then, the presence of "hotspots" will be investigated, also in relation to the component of the WF (green, blue, grey). A hotspot is a specific area and/or a specific period in which the WF is not sustainable. These conditions can be determined by different factors such as water scarcity, rainfall intensity, intensive irrigation or occurrence of drought periods, and their identification and evaluation is a main goal of Task 4. To better understand the complex relations between the consumption of water, the environment sustainability and the crop production, a further activity addressed by this Task is the evaluation of the eventual unsustainable stage of the production process. This represents a very important analysis for the improvement of water management in agriculture. In fact, agricultural production affects water resources at different levels and in different ways depending of soil, crop type, irrigation management, cropping system, etc. On the bases of the results, the possible strategic managements and adaptation options will be identified.

Deliverables: a) identification of sustainability criteria; b) identification of hotspots; c) list and evaluation of management options for the suitable handling of WF; d) list and evaluation of management options for the suitable handling of VWT; e) guidelines

Task 5 will be addressed by **WG3: sustainability**

Task 6: Integration and dissemination

Aim of Task 6 is to develop improved recommendations and guidelines, based on the results, for agrometeorological services, regional water management, etc., in order to protect water resources and improve water use efficiency of the main water consumer – agriculture – in Europe. Beside dissemination, Task 6 will also address the integration and interaction with existing programmes and official networks, initiatives and groups actively working on water issues at European level and beyond.

Deliverables: a) web site; b) dissemination and training activities; c) information material (presentations available in website, leaflets, etc.).

WAMIS can be the effective resource mechanism for: a) web site; b) dissemination and training activities.

This task constitutes a horizontal activity involving **all WGs**

A direct consequence of the small number of WGs, that keeps the topic broad, is to give the Action an open and flexible structure in order to allow the inclusion, at the different implementation stages, of perspectives and activities not foreseen during the preparation of the proposal and to encourage the joining of interested parties.

E. ORGANISATION

E.1 Coordination and organisation

The Action will be implemented through a concerted effort in which the development and financing of the research will be provided by the participating countries, while COST will provide the necessary coordination. The Action activity will be performed with the management of the Management Committee (MC) led by a Chair and a Vice-chair. The MC and WGs will meet twice a year, usually in conjunction with each other. WG and expert meetings may be organized on different occasions, according to specific aims. Each WG will be coordinated by a leader and co-leader, who will report back to the MC. Coordinators will also be allocated for each sub area of the WGs. When required, external experts will be invited to MC and WG meetings to seek advice and/or enlarge the application basis of the Action. The activity of non-COST participants and international bodies, and the liaison and interaction with other research programmes will be monitored and supported. The MC will supervise the overall progress of work, link and coordinate WG-activities in a way that the information, the needs and the results of each WG will serve as input to the others, and will ensure wide dissemination of results. The MC chair and Vice-chair and the leaders and co-leaders of the WGs will constitute the leading structure of the Action (Steering Committee). High priority will be given to STSM for maximizing the exchange of experience among the participants. Early Stage Researchers (ESR) will be encouraged to participate in the COST activities and assume leading roles.

Gender balance will be taken into account during action management. Specific training schools will be used to support outcome dissemination to end-users and countries. A WEB site will be implemented and updated in a timely and continuous manner to serve as a resource information management tool, as a focus for information exchange and as a medium for disseminating the results of the Action.

The planned activity will be implemented by three separate WGs, but three main phases can be identified for all of them during the four year period:

- INVENTORY. During the first year, the MC will supervise the establishment of the WGs. The participants will specify their contributions and goals. It is envisaged that the three WGs would broadly establish and develop the involved research areas. Participants will be encouraged to allow the WGs to have a similar number of participants. All the WGs will contemporaneously start in the first month and end in the last month of the four year period. The overall research activities will be conducted in a flexible framework in order to optimize the specific expertise of each individual institution, delegate and expert involved in the Action. The **milestones** are: definition and agreement of Action management and rules; definition of participants' role and contributions; establishment and specific goals of WGs; WG and Action reports; Action web site, STSMs.
- DEVELOPMENT, ASSESSMENT, APPLICATIONS AND EVALUATION. During the second and third year, the detailed work programme for the Action will be established. The opinions of the wider community will be sought through its participation in the first Workshop to set up the detailed work programme. At this stage the preliminary results and plans will be discussed and the activities and membership of WGs will be finalised. Over the main period of work, interactions between the WGs will be firmly established so that they will work in synergy rather than independently. Aspects of the activity will be also presented in workshops, meetings, etc., and published at national and international level during the intermediate period. The **milestones** are: first workshop; collection of information and data for scientific activity; WG and Action reports; main outcome dissemination and end-user feedback, STSMs, Training School.

- SYNTHESIS AND DISSEMINATION. During the final phase, joint recommendations of the WGs will be published as a final report for wide dissemination. Particular attention will be paid to the dissemination of the results to effectively reach end-users. Scientific dissemination will be realised. The **milestones** are: protocols and guide-lines assessed; training schools; Final Workshop; Final report, STSMs, Training School.

E.2 Working Groups

The interdisciplinary activities will be developed by three working groups: WG1 - water footprint, WG2 - water trade and WG3 – sustainability. Each WG will involve scientists with different expertise and competences in order to completely fulfill the tasks and the objectives planned. Beside the specific tasks, each WG has to develop some horizontal activities in which the interactions, the exchange of information and the effective networking is essential. At the beginning of the Action the MC will establish the WGs and their tasks. In order to enhance not only the collaboration between the different WGs, but also the interaction with scientists and experts not directly involved in the Action, a set of common activities will be organized. Among them, open symposia and meetings in common with other programmes are foreseen.

E.3 Liaison and interaction with other research programmes

For the formulation of this proposal and during the Action activity, continuous links and exchanges are established with international Organization and Bodies (e.g. WMO, JRC, FAO, European Environmental Agency, and European Drought Center) and ongoing research programmes (e.g. COST Actions, JPI pilots, Water CoRE, CC-WaterS, EU-FP7 Project ACQWA, Swiss National Research Programm 61 “Sustainable Water Management”, Swiss Development Programme “Adaptation to Climate Change in Peru”). Such relations are considered as one of the bases of the Action which should represent an international platform for multidisciplinary and multilevel interactions and networking rather than just a development of activities.

In particular, these liaisons and relations will be established in different ways:

- Organisation of joint Symposia
- Invitation of ad hoc experts and scientists to meetings and workshops
- Links with national and international programmes in which the Action participants are involved. This will have a double goal. First, these participants will inform COST Action on the projects activities and vice versa, second, they will assure a wide dissemination of the results in the scientific communities
- Links to other research programmes and Organisations in the Action website
- Invitation of experts for giving lectures at the Training Schools
- Encouragement of early-stage researchers from other research programmes to participate at the Training Schools
- Short-Term Scientific Missions

The described interactions will ensure exchange and transfer of knowledge, data and information to avoid duplication and to encourage and promote synergies, both for scientific and dissemination activities.

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve early-stage researchers. This item will also be placed as a standard item on all MC agendas.

Within the Action, gender mainstreaming strategies, that promote equality between women and men and are already adopted by the European Union, will be implemented. Some specific actions are planned for assuring the gender balance:

- Identification of female scientists as potential members of the Action
- Target for women participation between 35 to 40%
- Stimulating the integration of gender within the WGs

- Attribution of leading positions, such as WG leader and/or MC Chairs and Vice-Chairs, to women
- Encouraging young female scientists for participation to STSMs in order to sustain their career development and to improve their scientific networks
- Monitoring the gender balance through yearly surveys and reports to the MC
- Creation of specific facilitations for allowing woman with young children to participate to the Action activities (research, management, missions, etc.)

Early-stage researchers will be strongly and continuatively involved in the Action through the organization of STSMs for an extensive exchange of knowledge between the different communities and to create their own personal career profile at an international level. Beside the individual opportunities for young scientists supplied with STSMs, two Training School will be organized during the last years of the Action. Training Schools will be planned for disseminating knowledge, methodologies and results in order to supply young researchers with instruments for their specialization and growth in a collaborative context and to enhance their networking capacity. If a selection of participant will be necessary it will take into account both candidates profiles/curricula and gender balance.

Capacity building for young researchers is foreseen by means of STSMs, one-week Training Schools and plenary workshops in which they will present their works.

F. TIMETABLE

The overall duration of the Action is 4 years and it is organized into three main phases, as described in the following table divided in quarters. The different phases are (A) Inventory, (B) Development, Assessment, Applications and Evaluation and (C) Synthesis and Dissemination of Action results.

	Year 1				Year 2				Year 3				Year 4			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Phases	A	A	A	B	B	B	B	B	B	B	B	B	C	C	C	C
Kick-off meeting	X															
MC-meetings			X		X		X		X		X		X		X	
WG-meetings			X		X		X		X		X		X		X	
WG reports					X		X		X		X		X		X	
Reports to DC				X				X				X				X
Final report																X
Training Schools											X				X	
Workshops							X								X	
Web site		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Overall dissemination of products				X	X	X	X	X	X	X	X	X	X	X	X	X

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, BE, CH, CZ, DE, EE, EL, ES, FI, HR, IL, IT, PL, SK, SI.

On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 60 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

H.1 Who?

Universities, Research Institutes and Early-Stage Researchers in the fields of:

- Agriculture, water, soil and land management
- Climatology and meteorology
- Environmental, social and economic sustainability
- Crop modelling
- Remote sensing

World/European Organizations:

- WMO – Agricultural Meteorology Division, Climate and Water Department (WMO-CAgM)
- FAO – Food and Agriculture Organization
- European Commission
- COST
- Joint Research Center
- European Environmental Agency

Policy makers, planner/managers and Authorities at European, national, regional, and local level:

- Ministries of Environment, Agriculture, etc.
- Environmental organizations
- Networks, Associations and Initiatives (i.e. European Water Partnership, The Gender and Water Alliance, Global Water Challenge, World Water Council, Water Footprint Network)
- Hydrological and Meteorological Institute
- Water management bodies, water reclamation authorities

Farmers, Extension services

H.2 What?

Scientific and technical knowledge generated by this COST Action will be disseminated to the target groups through different means:

- Publications: papers in scientific journals, workshop and meeting proceedings (scientific), guidelines, reports, publications for the general public (technical)
- Website: public access website and password protected website;
- Events: Action workshops and conferences; other national and international conferences and symposia
- Links: with existing European networks, organizations, projects and bodies
- Capacity building: STSMs, Summer Schools, roving seminars for farmers

H.3 How?

Publications: publications of the results of the Action are of two types: scientific papers and technical manuals. The first should be promoted and encouraged by the MC in terms of co-authored papers in peer reviewed international journals and reviews. This acknowledges the scientific value and justifies the COST support. Joint publications with international research centers and organizations (e.g. WMO-CAgM) may be prepared to improve the visibility and more clearly demonstrate the main output of the Action. Technical manuals are a very useful mechanism to disseminate the results to the recipients and particularly policy makers, legislative and executive bodies, technicians of extension services and farmers in national languages. This allows these users to put in practice the procedures and protocols established by the Action through specific and well organized guides. Also the general public will be reached for communicating general findings and specific guidelines through leaflets.

Website: a public access website will be established to provide the stakeholders, scientific community and generally interested subjects with information about the Action. Such information will concern the Action organization, activity and results, as well as information on STSMs and Training Schools; reports of workshops and meetings; links to other COST Actions and programmes. The website will also contain a restricted area with a password access for communication among the Action members.

Events: Organized workshops are a mean for disseminating the results especially among potential users and for promoting COST activities in Europe and worldwide. Special efforts may be made to invite external keynote speakers and publicize the Workshop outside the Action. Wherever possible the Action hosts workshops jointly with other international meetings.

Links: Direct links will be established with the European Commission (relevant DGs, e.g., Research, Environment, Agriculture and Rural Development), existing European networks, projects and bodies. Links will also be established with the National and International Societies interested in problems of agriculture, water and land management (European Society of Agronomy, International Society of Biometeorology, European Meteorological Society, etc.). Every year, during the meeting of MC and WGs, international agencies involved in the fields of the COST activity, and representatives of the users, may be invited for exchange of information, coordination and developing synergies and collaborations.

Capacity Building: Short-Term Scientific Missions will allow the dissemination of knowledge, especially to early-stage researchers. The STSM will facilitate information transfer within the Action, increase the opportunities for networking and allow the creation of an international profile for early-stage researcher. Training schools will be organized to disseminate the activities and transfer knowledge, also including countries not directly involved in COST Action. Thus, members and non members of the Action will have the opportunity to attend the Summer Schools to become fully acquainted with the state-of-the-art theories, approaches and technologies.

The dissemination plan will be updated during the course of the Action taking into account the progress of the Action as well as the results of its evaluation.