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| | EUROPEAN COMMISSION<br>RESEARCH AND INNOVATION DG | Periodic Report |

**Project No:** 212337

**Project Acronym:** SWUP-MED

**Project Full Name:** Sustainable water use securing food production in dry areas of the Mediterranean region

# Periodic Report

**Period covered: from** 01/07/2011 **to** 30/06/2013

**Start date of project:** 01/07/2008

**Project coordinator name:**
Dr. Sven-Erik Jacobsen

**Version:** 1

**Date of preparation:** 18/10/2013

**Date of submission (SESAM):** 18/10/2013

**Project coordinator organisation name:**
Københavns Universitet

# Periodic Report

## PROJECT PERIODIC REPORT

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| **Grant Agreement number:** | 212337 |
| **Project acronym:** | SWUP-MED |
| **Project title:** | Sustainable water use securing food production in dry areas of the Mediterranean region |
| **Funding Scheme:** | FP7-CP-SICA |
| **Date of latest version of Annex I against which the assessment will be made:** | 14/03/2013 |
| **Period number:** | 4th |
| **Period covered - start date:** | 01/07/2011 |
| **Period covered - end date:** | 30/06/2013 |
| **Name of the scientific representative of the project's coordinator and organisation:** | Dr. Sven-Erik Jacobsen Københavns Universitet |
| **Tel:** | +45 353 33388 |
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| **Project website address:** | www.swup-med.dk |

# Declaration by the scientific representative of the project coordinator (1)

I, Dr. Sven-Erik Jacobsen Københavns Universitet , as scientific representative of the coordinator of the project SWUP-MED and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

The project has fully achieved its objectives and technical goals for the period.

The attached periodic report represents an accurate description of the work carried out in this project for this reporting period.

The public website is up to date.

To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.

All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

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| **Name** | Dr. Sven-Erik Jacobsen Københavns Universitet |
| **Date** | 18/10/2013 |

This declaration was visaed electronically bySabrina RUZANSKI(ECAS user name nruzansa) on 18/10/2013

# 1. Publishable summary

## Summary description of project context and objectives

Context

The Mediterranean region comprises an area between Europe and Africa, but due to climate changes, as outlined in the report from the Intergovernmental Panel on Climate Change (IPCC) of the United Nations, this border is moving north, so that the Mediterranean region including southern Europe will get a climate like presently in North Africa (IPCC, 2007). The Mediterranean climate is characterized by a hot dry summer and a cool wet winter (Turner, 2004), which can be considered as the transition between dry tropical and temperate climates. This climate occurs on the west coasts of all continents between latitudes 30 and 45, due to global air circulation patterns. Mediterranean climate constitutes an area of about 2.76 mill. km2, corresponding to 2.3% of the Earth's land surface. The largest part is the Mediterranean region with 1.68 mill. km2 (60% of the total area of Mediterranean climate), followed by 0.61, 0.28, 0.13 and 0.06 mill. km2 for Australia, California, Chile and South Africa, respectively (Joffre & Rambal, 2002).

Demographic pressures have led to widespread ecosystem degradation over recent decades and have exacerbated the Mediterranean region's vulnerability to drought and other abiotic factors through increased cultivation of marginal and fragile arid lands, soil erosion, runoff and desertification (FAO, 2002). Other EU policies having an impact on agriculture and water are the Common Agricultural Policy (CAP), WFD and special regulations such as the Nitrates Directive and the Groundwater Directive. A strategy paper on the vision for water usage, Water in Agriculture (TWG4, 2006), states how water should be used efficiently in agriculture for increasing food production while sustaining environment. Worldwide more than 40% of food production is from irrigated land (FAO, 2004). Irrigated agriculture is the biggest consumer of freshwater. In South Europe irrigation accounts for more than 60% of water use (EIIE, 2000). Freshwater is an increasingly limited resource (European Water Framework Directive [WFD; 2000/60/EC]).

In Morocco, three years of drought (1999-2001) have severely affected at least 40% of the region's livestock populations, worsened rural poverty and increased urban migration. The recurrent droughts and inefficient water use in North Africa are threatening livelihoods. By the year 2050, rainfall during the winter season (October-March) is predicted to increase in central and eastern Spain and north of Italy, while in the southern Mediterranean countries rainfall will decrease by 10-15%. The average temperature in the Mediterranean region will increase by 1.25-2.5 oC in winter (Ragab & Prudhomme, 2002).

Recent studies have revealed that the response of plants to a combination of two different abiotic stresses is unique and cannot be directly extrapolated from the response of plants to each of the different stresses applied individually. However, there are also many similarities, and for instance it was suggested that same genes might control the rate of seed germination under cold, salt and drought stress (Foolad et al., 2003). The co-occurrence of different stresses is rarely addressed, but tolerance to a combination of different stress conditions, particularly those that mimic the field environment, should be the focus of future research programs aimed at developing plants with enhanced tolerance to naturally occurring environmental stress conditions (Mittler, 2006).

Small, low-tech farms are much slower than industrialized farms in adopting new technologies, even if small farms provide the vast majority of agricultural production in rural areas in southern Mediterranean countries (WUEMED ). Boyer (1982) found that most of the time crop plants were reaching only about 20% of their genetic potential for yield, mostly as a result of environmental stresses. Therefore, utilizing crop plants with increased tolerance to abiotic stress could significantly contribute to yield increases towards the 70% predicted to meet population growth. Meanwhile, further abiotic stress might be alleviated by use of supplemental irrigation.

Strategic objectives

The SWUP-MED project will support the development of "climate proof" food crops that better utilize agricultural areas affected by erratic rainfalls, drought, salinity and other associated stresses such as heat and cold. SWUP-MED will run the experimental sites, where farmers and scientists work together in a participatory manner, available to receive stakeholders, conduct training, establish a Project Stakeholder Panel and organize open days for the stakeholders and the public. SWUP-MED aim at both investigating and introducing climate proof crops while developing and testing new agricultural technologies and techniques for more effective farming systems. This project also relates to the objectives of the European neighbourhood policy, which is based on strengthening the

prosperity, stability and security of an enlarged EU and our neighbours.
Food crop production is restricted in the Mediterranean region. Typical crop cultivation under semi-arid and arid conditions in Mediterranean countries, affected by multiple abiotic stress factors further influenced by climate change, are cereals in low yielding monoculture or eventually combined with fallow. The strategic objective of the project therefore is:
Improve food production by introducing climate-proof varieties in crop rotations of wheat, grain legumes and new crops (potentially high value food cash crops), in a rainfed system with supplemental deficit irrigation using marginal-quality water and harvested rainwater. This will accelerate adoption of improved agricultural practices supporting small farmers' livelihood and income levels.

## Description of work performed and main results

Description of Work and Main Results
With the objective of improving the cropping systems of the Mediterranean region, suffering from increasing drought, saline soils and temperature extremes, the existing mono-cropping was replaced by crop rotations combining wheat with three food legumes (chickpea, faba bean and lentil) and two new crops (quinoa and amaranth). The new system showed potential to improve overall agricultural productivity, soil quality and resilience. The project results will help farmers and extension workers in making smart decisions selecting appropriate food legumes and new crops for developing climate-proof cropping systems for food security and market potential.
As stress factors often act together, it is important to focus on multiple stresses affecting the crop, instead of looking at the individual stress separated from the rest. The rainfed farming systems are the most important in the Mediterranean countries. The question is how abiotic stresses can be overcome. First step is by using different crops of varying drought and salinity tolerance, and utilizing their stress adaptation mechanisms to optimize crop productivity. Supplemental irrigation used as deficit irrigation has the potential to overcome periods of low rainfall or high temperatures. Improvements in crop production may arise from several strategies such as early sowing enabled by minimum tillage, increased use of organic manure, and an efficient weed control. Further, crop rotations will play an important role in improving weed control, minimizing disease risk, and increasing nutrient availability. This project has tested these strategies in the different partner countries. Introduction of drought and salt tolerant crop species such as quinoa and amaranth showed more resilient crop rotations and high value cash crop products. Yield increases may arise from selection for early vigour, deep roots, increased transpiration efficiency, improved disease resistance, and high assimilate storage and remobilization. A range of crop and management strategies might be combined for a specific target environment in order to optimize crop productivity. These combinations can then be used as guidance to future decision support systems for crop production at limited water supply under arid Mediterranean conditions.
Our findings indicate that farmers are able to cultivate new crops like quinoa in the semi-arid Mediterranean region and that it may be possible to sell quinoa and possibly a similar crop like amaranth at the domestic market. However, new crops must add value to the existing farming systems in competition with established cropping systems in an economic viable crop rotation. A number of institutional- and market barriers as well as support schemes are likely to have an impact on the market as well as the field level for new crops.
Considering the existing mono-cropping systems in the Mediterranean region, three food legume crops (chickpea, faba bean, and lentil) and two new crops (quinoa and amaranth) showed potential to integrate and improve overall agricultural productivity and soil quality. These results are expected to help extension workers and farmers in making informed decisions in selecting appropriate food legume and new crops for developing site-specific crop rotations.
Water is scarce, and increasingly in the Mediterranean region due to climate changes. Therefore every drop of water must be used in the most efficient way. No water should be wasted, so therefore rain should be collected to be used when needed for the crop. Different strategies for water harvesting have been analysed, and the best one was the use of plastic cover in the bottom of a ditch. In the case of using untreated, inadequately treated, or diluted wastewater for agriculture, there is a need to assess environmental and health risks while having potential benefits in the form of savings on fertilizer use, enhanced farm-level income, and year-round employment opportunities. In addition, hygiene education and an action plan would help in improving water quality and promoting the use of protective measures in handling wastewater and its products. Using treated wastewater can be a valid option, reducing fresh water and nutrient requirements, but it must be used adequately, as soil EC increased for all tested crops when using treated wastewater for irrigation.

Agricultural drainage water can be used for irrigation of wheat and quinoa. However, in the long run, there is a need for monitoring salinity build-up in the soil to avoid soil degradation and crop yield loss. In case of soil EC reaching high levels, irrigation for leaching should be applied to push the salts accumulated in the root zone to deeper soil layers.
While deficit irrigation can result in higher levels of crop water productivity than full irrigation under similar agro-climatic conditions, the impacts of deficit irrigation need to be evaluated through soil salinity monitoring as salts in upper layers of the soil may accumulate due to lack of the leaching of salts added via deficit irrigation water.
Irrigation with saline water for legumes (chickpea, faba bean, and lentil) can be undertaken provided there is an appropriate integration of soil and water management practices such as leaching of salts from the root zone and use of salt-tolerant food legume cultivars, which can withstand higher levels of irrigation water and soil salinity. Amaranth and especially quinoa can tolerate salinity levels up to seawater strengths.
The SALTMED model is a useful tool in deciding the best water, soil, crop and field management that could minimize the input, maximize the profit and safeguard the environment. It can provide information on crop growth stage length and the relative yield for future climatic scenarios so this approach represents a useful decision system for sustainable agronomic management. In addition, when applied using deferent water salinity levels, waste water, deficit irrigation, organic matter, different crop rotations, the model showed its potential as a field management tool.
In conclusion, the results of introducing the agronomic measures of the SWUP-MED project, i.e. improved rotation, cropping and irrigation systems including use of low quality water, and new varieties and crops, showed significantly positive effects on overall agricultural productivity, soil quality and resilience. The project results will help farmers and extension workers in making smart decisions, selecting appropriate food legumes and new crops for developing climate-proof cropping systems for food security and market potential, and to choose best strategies for water use. Finally, new market channels were recommended for the new crops.

**Expected final results and potential impacts**

Potential impact and use
Potential impact of the project is an understanding of social and economic factors affecting farmers´ acceptance to adopt proposed farming systems and new crops. We have demonstrated ways to introduce these systems and crops of benefit for the farmers of semi-arid parts of the Mediterranean region. We have also identified institutional and market barriers on these farming systems and new crops.

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| **Project public website address:** | www.swup-med.dk |

# 2. Core of the report

**Project objectives, Work progress and achievements, and project management during the period**

The Project Summary Pdf document contains the core of the report.

# 3. Deliverables and milestones tables

**Deliverables (excluding the periodic and final reports)**

| Del. no. | Deliverable name | Version | WP no. | Lead beneficiary | Nature | Dissemination level | Delivery date from Annex I (proj month) | Actual / Forecast delivery date | Status | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | FP7_Periodic-report_SWUP-MED.pdf | 1.0 | | | | | 0 | 19/01/2010 | Submitted | |
| 10 | RP2 PAYMENT_212337.pd f | 1.0 | | | | | 0 | 11/07/2011 | Submitted | |
| 3 | Recommendations | 1.0 | 1 | INSTITUT AGRONOMIQUE ET VETERINAIRE HASSAN II | Report | PP | 60 | 30/06/2013 | Not submitted | |
| 5 | D0.1 Information on creation and use of website | 1.0 | 1 | Københavns Universitet | Other | PU | 4 | 01/11/2010 | Submitted | |
| 7 | D1.1 Overview of selected farmin systems and selection of experim ental sites | 1.0 | 1 | INSTITUT AGRONOMIQUE ET VETERINAIRE HASSAN II | Other | PU | 4 | 01/11/2010 | Submitted | |
| 8 | D1.2 Database is established for the selec ted farming systems | 1.0 | 1 | INSTITUT AGRONOMIQUE ET VETERINAIRE HASSAN II | Other | PU | 12 | 01/11/2010 | Submitted | |
| 11 | Annual reports, year 1 + 3-4 reports | 1.0 | 1 | Københavns Universitet | Other | | 36 | 11/01/2012 | Submitted | |
| 3 | Characterization of local and ICARDA germpl asm tolerant to multip le stresses by using molecular, physiologi cal and morphological tools. | 2.0 | 2 | INSTITUTO DE TECNOLOGIA QUIMICA E BIOLOGICA - UNIVERSIDADE NOVA DE LISBOA | Report | PU | 18 | 02/12/2010 | Submitted | |
| 16 | Report on selected genotypes for abiotic st ress | 1.0 | 2 | INSTITUTO DE TECNOLOGIA Q | Report | PU | 60 | 18/10/2013 | Submitted | |

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| | tolerance | | | UIMICA E B IOLOGICA - UNIVERSIDADE NOVA DE LIS BOA | | | | | | |
| 17 | D2b.1 The potential of se lected crops for p roducti on and use in t arget envi ronment des cribed | 1.0 | 2 | INSTITUTO DE TECNOLOGIA Q UIMICA E B IOLOGICA - UNIVERSIDADE NOVA DE LIS BOA | Report | PU | 60 | 18/10/2013 | Submitted | |
| 21 | D2a.1 Characterization of local and ICARDA ge rmplasm tolerant to multi ple stresses by u sin 2.21 | 1.0 | 2 | INSTITUTO DE TECNOLOGIA Q UIMICA E B IOLOGICA - UNIVERSIDADE NOVA DE LIS BOA | Report | PU | 18 | 19/09/2013 | Submitted | |
| 1 | D3a.1 Agronomic interve ntions have been iden t ified | 1.0 | 3 | UNIVERSITY OF CUKUROVA | Report | PU | 48 | 24/09/2013 | Submitted | |
| 4 | Agronomic interventio ns have been identifi ed. Yearly reports | 2.0 | 3 | UNIVERSITY OF CUKUROVA | Report | PU | 24 | 02/12/2010 | Submitted | |
| 12 | Determination of the p ote ntial of use of marg inal-quality water resources, and selecti on of water ha rvestin g | 1.0 | 3 | UNIVERSITY OF CUKUROVA | | | 36 | 11/01/2012 | Submitted | |
| 13 | Report summarising su ccess of agronomic | 1.0 | 3 | UNIVERSITY OF CUKUROVA | | | 36 | 11/01/2012 | Submitted | |
| 1 | D4.1 Identification o f the soil and water q uality implications f rom the use of marginal-qu 4.1 | 1.0 | 4 | INTERNATIO NAL CENTRE FOR AGRIC ULTURAL RE SEARCH IN THE DRY AREAS | Report | PU | 60 | 02/09/2013 | Submitted | |
| 2 | D4.2 Identification o f the implications of supplem ental and defi cit irrigat ion | 1.0 | 4 | INTERNATIO NAL CENTRE FOR AGRIC ULTURAL RE | Report | PU | 60 | 02/09/2013 | Submitted | |

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| | | | | SEARCH IN THE DRY AREAS | | | | | | |
| 2 | D5.2 Report on local c rop production in diff e rent regions with gr oss m argin analysis o n field s ites | 1.0 | 5 | Københavns Univ ersitet | | | 60 | 18/10/2013 | Submitted | |
| 3 | D5.3 Report on social and market acceptance of new management pra ctices and new crops | 1.0 | 5 | | | | 60 | 18/10/2013 | Submitted | |
| 6 | D5.1 Report on Countr y Specific Social and Ec onomic Conditions for Farming Systems | 1.0 | 5 | CENTRE FOR ENVIRONMENT AND DEV ELOPMENT F OR THE ARAB REGION AND EUROPE | Report | PU | 7 | 01/11/2010 | Submitted | |
| 2 | Report on models stru cture, development, ca li bration and validat ion us ing data from t he project field expe riment sites | 1.0 | 6 | NATURAL EN VIRONMENT RESEARCH C OUNCIL | Other | PU | 24 | 30/06/2010 | Not submitted | |
| 3 | D6.3 Model Performance | 1.0 | 6 | NATURAL EN VIRONMENT RESEARCH C OUNCIL | Report | RE | 60 | 24/09/2013 | Submitted | |
| 4 | D6.2 SALTMED model S o ftware | 1.0 | 6 | NATURAL EN VIRONMENT RESEARCH C OUNCIL | Other | PU | 60 | 18/10/2013 | Submitted | |
| 9 | D6.1 Report on models str ucture, developme nt, cali bration and va lidation us ing data f rom the project field experiment sites | 1.0 | 6 | NATURAL EN VIRONMENT RESEARCH C OUNCIL | | PU | 24 | 14/12/2010 | Submitted | |
| 1 | D7.1 Guidelines on bes t s uited crops, cultiv ars and management pr actices for multiple stre 7.1 | 1.0 | 7 | | | | 60 | 18/10/2013 | Submitted | |
| 2 | D7.2 Guidelines on how | 1.0 | 7 | | | | 60 | 18/10/2013 | Submitted | |

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| | to conserve soil mois ture using different field mana gement tool s | | | | | | | | | |
| 3 | D7.3 Guidelines on cro p management under sal ine conditions includ ing seed treatments techn 7.3 | 1.0 | 7 | | | | 60 | 18/10/2013 | Submitted | |
| 4 | D7.4 Guidelines on irr iga tion strategies usi ng mar ginal-quality w ater (sali ne water and tr 7.4 | 1.0 | 7 | | | | 60 | 18/10/2013 | Submitted | |
| 5 | D7.5 Guidelines on soc io-economic impacts i n local communities wh en introducing new crops 7.5 | 1.0 | 7 | | | | 60 | 18/10/2013 | Submitted | |
| 7 | D7.7 Handbook | 1.0 | 7 | | | | 60 | 18/10/2013 | Submitted | |

## Milestones

| Milestone no. | Milestone name | Work package no | Lead beneficiary | Delivery date from Annex I | Achieved Yes/No | Actual / Forecast achievement date | Comments |
|---|---|---|---|---|---|---|---|
| 311 | The potential and av ailability of marginal-qu ality water resources in the beneficiary countries have been determined. Appropriate water harv esting techniques for eac h condition are selected | 3 | 8 | 01/07/2010 | Yes | 01/07/2010 | Report. Name: M3a.1 |
| 51 | Country specific ana lyses on farming sys tems in the Mediterr anean countries cond ucted | 5 | 6 | 01/10/2009 | Yes | 01/10/2009 | Report. Name: M5.1 |
| 212 | Genotypes with impro ved tolerance to the most important abiotic s tresses identified | 2 | 3 | 01/01/2010 | Yes | 01/01/2010 | Under rainfed conditions accessions of chickpea, f aba bean and lentils with high yield have been ide ntified across envir onments. Their high yield potential will be f |

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| | | | | | | | urther tested in the rema ining two years of the pr oject, potentially coveri ng different cli |
| 321 | Agronomic and salinity conditions in the expe rimental sites are charac terized | 3 | 8 | 01/01/2010 | Yes | 01/01/2010 | See Annual report year 2 |
| 61 | The new codes are wr itten up and impleme nted into the existing mo del | 6 | 5 | 01/07/2010 | Yes | 01/07/2010 | SALTMED 2010 Beta ve rsion has been distributed to all partners for testing. However, there is more d evelopment work to take place to account for crop growing by degree days (heat units) and possible i nclusion of a factor to a ccount for future CO2 increase |
| 06 | Year 2 annual project meeting, and discussion of future work | 0 | 1 | 01/07/2010 | Yes | 01/07/2010 | Completed, see Minutes year 2 |
| 222 | Physiological perfor mance and critical p henological stages under abiotic stress conditions described. | 2 | 3 | 01/07/2010 | Yes | 01/07/2010 | See Annual report year 2 |

# 4. Explanation of the use of the resources

The **explanation on the use of resources** was removed from the scientific periodic reports in SESAM. These deta ils now have to be entered in the cost statement forms in FORCE instea d.

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| **Attachments** | 4. Periodic Report_SWUP-MED_212337.pdf, 4. Periodic Report_SWUP-MED_212337.pdf |
| **Grant Agreement number:** | 212337 |
| **Project acronym:** | SWUP-MED |
| **Project title:** | Sustainable water use securing food production in dry areas of the Mediterranean region |
| **Funding Scheme:** | FP7-CP-SICA |
| **Project starting date:** | 01/07/2008 |
| **Project end date:** | 30/06/2013 |
| **Name of the scientific representative of the project's coordinator and organisation:** | Dr. Sven-Erik Jacobsen Københavns Universitet |
| **Period covered - start date:** | 01/07/2011 |
| **Period covered - end date:** | 30/06/2013 |
| **Name** | |
| **Date** | 18/10/2013 |

This declaration was visaed electronically by Sabrina RUZANSKI (ECAS user name nruzansa) on 18/10/2013