	EUROPEAN COMMISSION 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 01/07/2010 **to** 30/06/2011

Start date of project: 01/07/2008

Project coordinator name:
Dr. Sven-Erik Jacobsen

Version: 1

Date of preparation: 14/11/2012

Date of submission (SESAM):

Project coordinator organisation name:
Københavns Universitet

Periodic Report

PROJECT PERIODIC REPORT

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:	3rd
Period covered - start date:	01/07/2010
Period covered - end date:	30/06/2011
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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.

Name	Dr. Sven-Erik Jacobsen Københavns Universitet
Date	

This declaration was visaed electronically byManzoor QADIR(ECAS user name nqadirma) on

1. Publishable summary

Summary description of project context and objectives

Objective

Improve food production by introducing climate-proof varieties in crop rotations of wheat, grain legumes and new crops, in a rainfed system with supplemental deficit irrigation using marginal-quality water and harvested rainwater.

Description of work performed and main results

WP1
WP1 main objective is to improve Mediterranean farming systems productivity under multiple abiotic stresses through sustainable agronomic, genetic and environmental approaches. Under this work package, both farmers' rotation trials at two locations Bouchane Morocco and Ishraf, Syria, and rotation experiments at experimental stations Hac#ali Farm of Çukurova Agricultural Research Institute in Adana, Turkey and Complexe Horticole Agadir, of the Institute of Agronomy and Veterinary Hassan II, Agadir, Morocco are conducted.
Farms trials were conducted to develop demonstration plots and collect data on specific tasks such reduced tillage, use of organic manure, cultivars adaptation, supplementary irrigation etc.
Quinoa cropping have been extended to farmers from Bouchane also to a new community of Marrakech region, Sidi Bouathman, and to Souss Massa irrigation perimeter, Agadir. Many factors affect the sustainability of the cropping system. The rotation is among the most important, as it influences soil fertility and structure, pests and diseases. No tillage, or zero tillage is a promising approach
Within WP1, tasks 1.1, 1.2 and 1.3 have been reported in the annual report 2. The farming systems of the selected sites were characterized during the first six months of the project by conducting a local survey. Farmers were identified and involved in the rotation trials.
Work under WP1 is carried in three countries, Morocco, Turkey and Syria, where new crop rotations and new crops are tested. There has been great variations in cropping techniques in the farmers' communities, where research work took place. This indicates potential for increasing yield by optimizing cropping systems with respect to land and water management. New crops like quinoa and amaranth have been of special interest, as they were just recently introduced. Yields were promising of quinoa (up to 2.1 t/ha) and amaranth (up to 4.4 t/ha). These yields were similar to yields obtained for chickpea.
In Morocco the activities have been concentrated in the Bouchane site with six dedicated farmers, with one rotation per farm. A new site, Sidi Bouathmane, has been added mainly for testing quinoa. Cropping systems, rotations and specific factors to improve productivity were studied.

WP2
Task 2a. Identifying new traits (morphological, physiological, molecular) for multiple stress resistance
Adaptation trials of 15 accessions of chickpea, 13 from the ICARDA collection and 2 from the Portuguese national catalogue, took place during three years in three different countries (Portugal, Syria and Morocco). The trials were conducted under rainfed conditions (as well as under different water supply – see WP3) using a late sowing date to naturally expose the plants to drought and heat stress.
Adaptation trials of chickpea indicated a high variability in yield response among genotypes and regions, with the genotypes of a short growth cycle having higher grain yield. Quinoa had higher economic value and better water use efficiency in newly reclaimed sandy soils compared to wheat in Egypt. Salinity increased root resistance and decreased plant water potential. Different quinoa cultivars had similar chemical composition, but differed in saponin content.
The accumulated results indicate a high variability in the yield response among genotypes and regions, with differences in Portugal between the most (ILC588) and the least productive genotype (FLIP03-002C) higher than 1000 kg/ha in 2009. In 2010 (a rainy year) the difference was higher than 1500 kg/ha between ICL3279, the highest productive, and ICL10722, the least productive. In general, genotypes that can fasten their development cycle showed higher grain yield, especially in drought years. Comparing the two years in Portugal (dry 2009 and rainy 2010), was observed three

groups of chickpea genotypes: i) Stable genotypes, well adapted to distinct environments (ILC588). ii) Genotypes adapted to adverse conditions, but not responding to favourable conditions (ICL 216, which was also among the best performers under drought conditions in Syria). iii) Genotypes adapted to good conditions, but with bad performance under adverse conditions (ICL 3279).
Across the two locations, Portugal and Syria, FLIP03-145C, FLIP87-8C and ILC 588 were on the top 5 during 2009. In 2010, only FLIP87-8C was among the best performers under drought conditions in both countries. Larger variation in chickpea yield was observed in Morocco as compared to Portugal and ICARDA, with values ranging in 2009 from 60 to 4460 Kg/ha, as a result of these studies being performed in farmer's lands and not in experimental research stations. In 2010, only 8 accessions were studied in Bouchane (Morocco) because it was not possible to produce seeds from the others genotypes.
Lentil and faba bean accessions were tested in Morocco in two farms (15 accessions in lentil and 11 in faba bean) and in ICARDA where different irrigation schemes were used (see WP3). Throughout the two years in Bouchane data collected was not consistent enough to select the best lines yet; this was due to late sowing the first year and heavy rain at seeds maturation stage before the harvesting, in the second year, which led to large yield losses, especially for the early lines.
In Syria, ICARDA, three lentils genotypes (ILL 7201, ILL 10707 and ILL 6994) were identified as good performers for rainfed conditions. Interestingly, among the most promising under irrigated conditions ILL 10707 was included, together with three others not fit to drought conditions.
In Morocco two trials with four durum wheat varieties, as well as the four bread wheat varieties, were installed to test cultivars performance under rainfed condition of Bouchane, Ben Guerir. Significant differences were found for the number of shoots per plant, plant size, spikes density per hectare, the number of grains per spike and the yield. Also barley was studied in order to compare an improved variety Massine with the local farmers' seeds.

Task 2b. Test new crops with potential to cope with multiple stress factors in target environments
Adaptation trials of quinoa were performed in Morocco and Turkey. In general, quinoa had higher economic and water saving values of grain and straw yields in newly reclaimed sandy soils compared to wheat.
Five different quinoa lines were tested in Morocco. Important differences among lines were observed in relation to yield, with the more productive line (L142) yielding 1890 kg/ha, twice the yield of the lowest producer (L123), which produced 910 kg/ha. Harvest index of five quinoa was 37-43.5%.
In Turkey quinoa seed yield obtained in trials performed in the experimental field of the Cukurova University, Adana, was much higher than in Morocco, from 3500 kg/ha in non-irrigated plots to 6000 under irrigation. WUE ranged from 0,3 to 0,7 kg/m3.
Amaranth was studied in Italy with field experiments being conducted in Volturno river plain. Yields ranged from 0,7 ton/ha in rainfed plots to 2.5 ton/ha under irrigation. These differences were associated to different sizes of leaf canopies.
An adaptation trial with Lupinus albus (10 accessions) was undertaken in the Experimental Station in Elvas, Portugal, with the different accessions exhibiting large differences in phenology. namely in what concerns the beginning of flowering and the type of growth (determined versus undetermined) as well as in yield parameters. Seed quality parameters - protein, fat, %C and N, galactans, alpha-galactosides and starch, were measured in the ten lines. A large range of values were observed, depending on the line and the year. For example, estimated protein ranged from 27 to 43%, fat from 6.3 to 9.6% and starch from 0.11 to 0.24%, with all percentages referring to seed dry weight.

WP3
#WP3 reports the following research findings during the period covering from 2009 to 2011: (1) Crop rotation including quinoa, wheat and chickpea was compared with monocropping in Turkey and Morocco, and the three years results revealed the positive impact of crop rotation over monocropping on yield and soil organic matter; (2) Supplemental irrigation increased yield and water productivity of legumes in Turkey, Syria, and Portugal. The results reveal that by using a relatively small amount of water for supplemental irrigation under rainfed conditions, farmers in dry areas can get substantial increases in crop yield; (3) Quinoa could be irrigated with saline water up to 20 dS/m without significant yield reduction in Turkey, Italy and Denmark. However, increased irrigation water salinity caused soil degradation; (4) There was demonstrated good adaptation and a high degree of flexibility of quinoa and amaranth for tolerance to drought and salt stress in a Mediterranean-type environment; (5) The replacement of traditional spring sowing of chickpea with winter sowing is possible but only with cultivars possessing cold tolerance and resistance to key

fungal diseases. Chickpea yields were 3.97 t/ha for winter planting, and 2.72 t/ha for spring planting; (6) Reduced tillage, ridge tillage and direct sowing techniques were compared. The tillage systems were examined and analyzed in terms of fuel and time consumptions, working efficiency, the percentage of emergence, soil moisture content, porosity, bulk density, yield, plant height, grain weight, harvest index, number of spikes, and hectoliter weight. Maximum efficiency was obtained with minimum tillage techniques. Lowest fuel consumption and maximum working efficiency was found with direct sowing. Zero-tillage generated the highest total income followed by reduced tillage; (7) Pre-sowing seed treatment approaches and seed priming have been used on wheat in order to improve germination both under laboratory and field conditions. According to laboratory and field experiments, PEG application to the seeds of bread wheat could increase germination and yield of bread wheat.

WP4

Freshwater resources and population densities are unevenly distributed across the Mediterranean region. With almost 7% of the global population, the Mediterranean region accounts for only c. 2% of the worlds freshwater resources; two thirds of them are concentrated within the south European countries. Water quality deterioration is another crucial factor affecting agricultural productivity and environmental quality in the region. There is a need to use the available fresh and marginal-quality water resources in agriculture more efficiently in conjunction with the selection and evaluation of cultivars with improved abiotic stress tolerance of cereals and grain legumes, and new crops.
Initial results on environment impact assessment when using wastewater irrigation revealed chromium concentration exceeding the permissible level according to WHO. The study on health implications of wastewater irrigation on children (8-12 years) revealed an increased incidence of waterborne diseases leishmania, gastroenteritis and typhoid (13, 30 and 4 incidents) compared to freshwater-irrigated areas (1, 5 and 1 incidents). On the average, the children living in a wastewater-irrigated environment had 8 times more risk to be affected by waterborne diseases than those living in freshwater-irrigated area.
Overall, the quality of the surface water is low due to heavy metals, mostly Cu and Cd, and the level of pathogens. Even the lowest values of Cu measured in the river water exceed 20 times the maximum allowed from WHO guidelines. The levels of 108 E. coli is considered raw sewage, and we found peaks of 107, just 1 log10 higher. There is also presence of helminth eggs in the irrigation water. The eggs have not been quantified, but among the most common ones were Ascaries lumbricoides, Trichuris trichuria and Enterobius vermicularis. High levels of salinity and very high values of nitrates are the most prominent characteristics of the groundwater. Cd can constitute a threat to consumers' health as it can easily be absorbed by the plants in high concentrations with implications for human health. 100% of the farmers in the regions B and C acknowledged health risks when using wastewater, but only 17% in the region A did. Nevertheless, most of them still prefer this marginal-quality water for irrigating their crops despite anticipated health risks. These results demonstrate that treated wastewater can be used for irrigation of quinoa in arid areas of the Mediterranean region to save freshwater resources for other valuable purposes.

WP5

A survey was conducted to describe farmers' and consumers' opinion on new crops and traits as well as crop rotations in selected Medeterranian countries. Based on this survey a country report has been developed (Country Specific Social and Economic Conditions for Farming Systems in Mediterranean Countries). Main focus has been on crop water requirements, food security, yield, consumption and production costs.
A method to analyze the economic potential of the new crops has been outlined. In particular nitrogen and water responses of the new crops quinoa and amaranth have been assessed. Nitrogen response functions have been developed based on experimental and literature studies for wheat, barley, quinoa and amaranth. Experiments with the combination of nitrogen and irrigation strategies as well as crop rotation effects are seldom reported in literature for neither actual nor new crops.
A first study and literature review on markets and institutional barriers for quinoa and amaranth have been initiated. A description of the agricultural supply chain has been made in Turkey.

WP6

The SALTMED model is under development, upgrading data on crop rotation and the impact of stress factors (temperature, drought, salinity and N deficiency) on crop growth. Modelling was performed on treatments to analyse the water and salt balance. Model testing was done with data sets

from Turkey and Italy.
The model is now near completion and has already produced realistic results. Software, example files, user manual, trouble shooting document, input file templates, publications, help documents on installation and step by step running the model, model equation document, power point presentations and supporting documents are available for public download at SWUP-MED web site http://www.swup-med.dk/SALTMED.aspx
The model tests have used data from Italy (quinoa), Morocco (quinoa, chickpea and sweet corn), Denmark (quinoa), Turkey (quinoa), and Syria (legumes: fababean, lentil and chickpea). The results indicated the model is able to predict soil moisture, salinity, biomass and grain yield under different climatic conditions, irrigation systems, irrigation strategies (full irrigation, deficit irrigation, etc.) and water qualities (saline, wastewater, fresh and rain water).
The model results indicated good water saving practice when using micro-irrigation instead of surface irrigation. In addition, the results also showed that a moderate stress at certain growth stages using deficit irrigation can save water without significant reduction in yield (e.g. at flowering stage in quinoa, chickpea and sweet corn in Morocco; quinoa in Italy, Turkey and Denmark; and chickpea in Portugal). The model can be used to determine the crop water requirement more accurately without resorting to use excessive irrigation amounts. Also, the model showed that quinoa is a salt and drought tolerant crop (e.g. Denmark, Turkey and Italy experiments) suitable for Mediterranean and European climatic conditions. The salinity tolerance level of quinoa exceeds by far the tolerance level of legumes (Syria and Portugal experiments).
The modelling work highlighted the importance of measuring soil salinity in situ rather than laboratory measurements of salinity of the soil saturated paste extracts of soil samples taken from the field. It was also highlighted the importance of calibrating the field (in situ) soil moisture sensors and instruments rather than relying on the standard calibrations of average soil provided by the user manual and software of the instrument.
New applications of the model has emerged. Some difficult parameters to obtain or measure (e.g. #50 and photosynthesis efficiency) were derived from calibrating the model against known or easy to measure parameters (e.g. yield, biomass, soil moisture, salinity, etc.).

WP7
Number of publications until now is 14 peer-reviewed articles, 11 conference proceedings, 1 book, 3 book chapters and 1 MSc thesis and 2 popular articles. Number of meetings disseminating project ideas and output for farmers, scientists etc. 20.

Expected final results and potential impacts

se above

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	
5	D0.1 Information on c reation and use of we bsi te	1.0	1	Københavns Univ ersitet	Other	PU	4	01/11/2010	Submitted	
7	D1.1 Overview of sele cted farmin systems and selection of experim ental sites	1.0	1	INSTITUT A GRONOMIQUE ET VETERI NAIRE HASSAN II	Other	PU	4	01/11/2010	Submitted	
8	D1.2 Database is esta blis hed for the selec ted farm ing systems	1.0	1	INSTITUT A GRONOMIQUE ET VETERI NAIRE HASSAN II	Other	PU	12	01/11/2010	Submitted	
11	Annual reports, year 1 + 3-4 reports	1.0	1	Københavns Univ ersitet	Other		36	11/01/2012	Submitted	
3	Characterization of l ocal and ICARDA germpl asm tolerant to multip le st resses by using molecular, physiologi cal and morph ological tools.	2.0	2	INSTITUTO DE TECNOLOGIA Q UIMICA E B IOLOGICA - UNIVERSIDADE NOVA DE LIS BOA	Report	PU	18	02/12/2010	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	1.0	3	UNIVERSITY OF CUKUROVA			36	11/01/2012	Submitted	

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13	Report summarising su ccess of agronomic	1.0	3	UNIVERSITY OF CUKUROVA			36	11/01/2012	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	01/07/2010	Not 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	

Milestones

Milestone no.	Milestone name	Work package no	Lead beneficiary	Delivery date from Annex I	Achieved Yes/No	Actual / Forecast achievement date	Comments
5	M0.5 Year 1 + 3-4 an nual project meetings and open sessions with stakeholders	0	UCPH	30/06/2011	Yes	30/06/2011	
12	M1.2Agronomic improv ement measures inclu ding crop rotations teste d	1	IAV	30/06/2011	Yes	30/06/2011	
32	M3b.2 Crop yield and quality response functio ns to saline irrigation w ater are determined	3	CU	30/06/2011	Yes	30/06/2011	

4. Explanation of the use of the resources

During the transitional period the **use of resources** can be edited both in SESAM and in FORCE by those who started to edit their scientific reports before it became available in FORCE.
In c ase of inconsistencies, please contact the coordinator.

Københavns Universitet

Work Package	Item description	Amount	Explanations
0,1,2,3,4,5,6,7,	Personnel costs	134201.37	researchers, research coodinator, accountant
	Other direct costs	16136.99	.
	Indirect costs	90203.02	.
	Total:	240541.38	

INTERNATIONAL CENTRE FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

Work Package	Item description	Amount	Explanations
1,2,3,4,6	Personnel costs	36250.00	salary for researchers, technicians and field breeders.
4	Major cost item 1, Consum eables, Farm and research supply	18147.00	Insect roof rolls, mesh rolls, waste water analysis, soil and water analysis. laboratory and research materials
	Remaining direct costs	19080.00	.
	Indirect costs	14695.40	.
	Total:	88172.40	

INSTITUTO DE TECNOLOGIA QUIMICA E BIOLOGICA - UNIVERSIDADE NOVA DE LISBOA

Work Package	Item description	Amount	Explanations
2,3	Personnel costs	16457.37	researchers, phd student and research students
2	Major cost iten A, Equipment, Thermal imaging camera	9480.00	Corresponding to the fraction affected to the 3rd year of the project
	Other direct costs	29950.05	.
	Indirect costs	33532.45	.

	Total:	89419.87	

CONSIGLIO NAZIONALE DELLE RICERCHE

Work Package	Item description	Amount	Explanations
2,3,5,6,7	Personnel costs	18342.94	research scientists
	Other direct costs	7588.19	.
	Indirect costs	22549.71	.
	Total:	48480.84	

NATURAL ENVIRONMENT RESEARCH COUNCIL

Work Package	Item description	Amount	Explanations
6,7	Personnel costs	39429.83	Salary Research scientist
6,7	Other direct costs	5707.05	.
	Indirect costs	46119.11	.
	Total:	91255.99	

CENTRE FOR ENVIRONMENT AND DEVELOPMENT FOR THE ARAB REGION AND EUROPE

Work Package	Item description	Amount	Explanations
5	Personnel costs	7000.00	Salary research scientists
5	Other direct costs	2202.12	.
	Indirect costs	5521.27	.
	Total:	14723.39	

INSTITUT AGRONOMIQUE ET VETERINAIRE HASSAN II

Work Package	Item description	Amount	Explanations

1,2,3,4,5,6	Personnel costs	61682.26	reseach scientists, research student, technician
	Other direct costs	12678.08	.
	Indirect costs	44616.20	.
	Total:	118976.54	

UNIVERSITY OF CUKUROVA

Work Package	Item description	Amount	Explanations
1,3,4,5	Personnel costs	20840.05	Researchers
1, 3	Major cost item A, Drip irrigation system	2762.76	New drip system pipes and connection pieces
1, 3	Major cost item B, Vacuum pump	1483.50	for saturation soil extract at the lab
	Other direct costs	18614.46	.
	Indirect costs	26220.46	.
	Total:	69921.23	

THE UNIVERSITY OF WESTERN AUSTRALIA

Work Package	Item description	Amount	Explanations
	x	0.00	No expences
	Total:		

Attachments	Cost_statement_3_ITQB_2011.pdf, Milestone_M3b.2 Milestones.pdf, Appendixes_SWUP_MED_Period report 2011m.pdf, Deliverable_Report_D3a.2.pdf, Cost_statement_7_IAV_2011.pdf, Cost_statement_9_UWA_2011.pdf, Cost_statement_periode3_UCPH.PDF, Audit_Report_SWUP_MED_UCPH.pdf, Deliverable_Report_D3b.1.pdf, Milestone_M0.5MinutesEvora2011Final.pdf, Cost_statement_6_CEDARE_2011.pdf, Cost_statement_adjusment_til periode2_UCPH.PDF, Cost_statement_4_ISAFOM_2011_r.pdf, Milestone_M1.2.pdf, Publishable summary.pdf, Cost_statement_5_NERC_2011.pdf, Cost_statement_2_ICARDA_2011_r.pdf, Cost_statement_8_CU_2011_r.pdf, FP7periodic_Report_2011Final_signed_1[1]_ECAS_juni_2012.pd
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:	30/06/2012
Name of the scientific representative of the project's coordinator and organisation:	Dr. Sven-Erik Jacobsen Københavns Universitet
Period covered - start date:	01/07/2010
Period covered - end date:	30/06/2011
Name	
Date	

This declaration was visaed electronically by Manzoor QADIR (ECAS user name nqadirma) on