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3rd PROGRESS REPORT

Covering the project activities from 01/08/2007 to 01/04/2008

Submission Date

01/04/2008

FULL PROJECT TITLE

'Design and Application of an Innovative Composting Unit for the Effective Treatment of Sludge and other Biodegradable Organic Waste in Morocco, MOROCOMP'

Data Project

Project location	El Jadida, Morocco
Project start date	01/02/2006
Project end date	01/08/2008
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Total Project duration	30 months (after extension of 6 months)

Data Beneficiary

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LIST OF KEYWORDS AND ABBREVIATIONS

Keywords:

Morocco, Greece, sludge, biodegradable organic waste, waste management, composting, in-vessel system, bioreactor, compost

Abbreviations:

University of Chouaib Doukkali:	UCD
National Technical University of Athens:	NTUA
Regional Office of Agricultural Development:	ORMVAD
Biodegradable Organic Waste:	BOW
Urban Wastewater Treatment	UWWT
Potable Water Refineries	PWR
Station Expérimentale de Mise en Valeur Agricole	SEMVA

TECHNICAL REPORT

1. Summary of activities and results since the start

This is the 3rd progress report of the Life-3rd Countries project MOROCOMP with title 'Design and Application of an Innovative Composting Unit for the Effective Treatment of Sludge and other Biodegradable Organic Waste in Morocco', (acronym MOROCOMP) covering a six month period from 01/08/2007 to 01/04/2008.

The beneficiary of the project is the University of Chouaib Doukkali (UCD) in El Jadida of Morocco, while the National Technical University of Athens (NTUA) in Greece and the Regional Office of Agricultural Development (ORMVAD) of El Jadida in Morocco are the partners that participate in the project.

1.1 Main objectives of the project

The main objective of the project is to develop an innovative in-vessel composting system for the treatment of sludge generated by Urban Wastewater Treatment Plants (UWWTP) and other BOW in Morocco. This composting unit will enable the operators and National Authorities to treat, control and use sludge and other BOW effectively and in consistence with the European Environmental Policy. The project implementation will protect the water-bodies and soil from untreated and uncontrolled sludge disposal in order to promote the protection of public health and the environment. At the same time, the use of treated sludge and other BOW as ferilizers and/or soil improvers will prevent the use of chemical fertilizers and subsequently protect arable land from degredation and the surface and groundwater from groundwater contamination. This composting system will be used as a pilot-demonstration unit for further applications in large-scale plants in Morocco and in European geographical areas with similar characteristics that face similar problems.

1.2 Main activities of the project

The main activities of the project are the following:

- Assessment of the existing situation in the European Union and in Morocco regarding sludge and other BOW generation and management (treatment, reuse and disposal). COMPLETED

- Assessment of the related legislation in the EU and in Morocco concerning sludge and other BOW. COMPLETED
- Review of composting success stories and best practices in the European Union and internationally. COMPLETED
- Design and construction of an innovative in-vessel composting system for treating sludge and other BOW. COMPLETED
- Development of sludge and other BOW aerobic composting processes – Optimisation of the operation of the demonstration composting system. COMPLETED
- Use of alternative effective additives of Mediterranean origin in the composting process. COMPLETED
- Determination of the most efficient compost mixture. COMPLETED
- Evaluation of the compost products as soil improvers in laboratory and open field applications. COMPLETED
- Examination of alternative uses of the end products. IN PROGRESS
- Assessment of compost market and jobs opportunities in Morocco. IN PROGRESS
- Development of specifications and guidelines covering the area of sludge and other BOW composting, characterization and use of compost as soil improver in large scale. STARTING ON 01/04/2008
- Dissemination of the project progress and results (trips, conferences, workshops, meetings, website, printed material, etc). IN PROGRESS
- Training of the staff of the competent authorities and personnel that shall be involved in the compost production and distribution. IN PROGRESS
- Public information and participation. IN PROGRESS
- Management of the project and reporting to the EC. IN PROGRESS

These actions are implemented by specialized personnel, including project manager, scientific staff, engineers, computer experts and technical staff.

1.3 Project's expected results

The expected project results include:

- Development and transfer of know-how for the efficient management of sludge and other BOW in Morocco

- Development of instruments for the competent authorities in order to design and apply appropriate schemes for the management of sludge and other BOW
- Autarchy in the technology means for the management of sludge and other BOW
- Reduction of the use of chemical fertilizers and protection of sensitive water bodies from eutrophication
- Well-trained staff that can be involved in the development of the technology under examination
- Adoption of the priorities of the EU concerning the recovery and reuse of materials
- Convergence towards the existing EU legislative framework and environmental policy concerning the management of sludge and other BOW
- Solving out the problem of the disposal of sludge and other BOW
- Promotion of sustainable agricultural practices
- Utilization of Mediterranean materials as additives
- Production of compost materials that can be used as soil improvers

1.4 List of project's deliverables

According to the project's proposal the list of all deliverables which are required is provided in the Table below:

Task No.	Deliverables
Task 1	• Report on the existing situation in Morocco regarding the production and management of sludge and other biodegradable organic waste **(Deliverable 1 & ANNEXES 1-5 submitted in the 1st progress report)** • Report on the existing situation in EU in connection to sludge and other biodegradable waste and the related legislation **(Deliverables 2-3 submitted in the 1st progress report)** • Report on sludge and other biodegradable waste composting practices and success stories in EU and internationally **(Deliverable 4A submitted in the 1st progress report)** • Report on Site Visits performed in Germany **(Deliverable 4B submitted in the 1st progress report)**

Task No.	Deliverables
Task 2	• In-vessel composting system - Technical description of system **(Deliverable 5A submitted in the 1st progress report)** - Detailed drawings of the completed unit and its components **(Deliverable 5B submitted in the interim)** - Detailed pictures of the various components of the composting system **(Deliverable 5C submitted in the 2nd progress report)** - Description of the Zemamra Site **(Deliverable 5D submitted in the 2nd progress report)**
Task 3	• Report on the physicochemical analysis of sludge, other biodegradable waste and additives **(Deliverable 13 submitted in the 3rd progress report)** • Report on the optimum operating conditions for the in-vessel composting unit **(Deliverable 13 submitted in the 3rd progress report)** • Report concerning the evaluation of compost products (level A) **(Deliverable 13 submitted in the 3rd progress report)**
Task 4	• Report on the phytotoxicity tests - Evaluation of compost products (level B) **(Deliverable 14 submitted in the 3rd progress report)** • Report on the effects of compost on the tested cultivations - Final evaluation of compost products (level C) **(Deliverable 14 submitted in the 3rd progress report)**
Task 5	• Report on the alternative uses of compost • Report on the market opportunities for the compost products
Task 6	• Technical specifications concerning optimum operation of compost units • Technical specifications concerning the quality and compost products and their potential uses • Development of guidelines concerning the requirements for compost uses • Manual for physicochemical compost analysis

Task No.	Deliverables
Task 7	• Complete set of training material and minutes from workshops • Printed material describing the project and its results • Website describing the project and its outcomes • Minutes of the kick-off meeting in Morocco **(Deliverable 6 submitted in the 1st progress report)** • Minutes of the kick-off meeting of Life Third Countries Projects in Brussels **(Deliverable 7 submitted in the 1st progress report)** • English and French Leaflet **(Deliverable 8 submitted in the 1st progress report)** • Publications in press **(Deliverable 9 submitted in the 1st progress report)** • Technical papers-publications **(Deliverable 11 submitted in the 2nd progress report)** • International conference proceedings • Proceedings from the International Conference
Task 8	• Endorsed action plan **(Deliverable 10 submitted in the 1st progress report)** • 1st progress report • Interim report • 2nd progress report • Final report • Minutes of the management meeting in Marrakech on 09/06/2006 **(Deliverable 12A submitted in the 2nd progress report)** • Minutes of the management meeting in Greece on 27/10/2006 **(Deliverable 12B submitted in the 2nd progress report)** • Minutes of the management meeting at the Zemamra Site on 15/03/2007 **(Deliverable 12C submitted in the 2nd progress report)**

2. TECHNICAL DEVELOPMENT

This section documents the progress that has been made with respect to the project's implementation from 01/08/2007 to 01/04/2008. Within this time period each of the tasks which are in progress or have been completed are presented and analysed.

Task 3: **Development of sludge aerobic composting processes – Optimisation of the operation of the pilot composting systems.**

Initial	*Start date: 10/10/2006*	*End date: 10/04/2007*	*Duration: 6 months*
Revised	*Start date: 15/03/2007*	*End date: 10/09/2007*	*Duration: 6 months*

The Deliverable of Task 3 has been successfully completed. This Task aimed to provide the following output:

- Physicochemical analysis of sludge and other BOW and additives.
- Development and optimisation of aerobic composting processes using sludge, individually and in combination with and other BOW.
- Optimisation of alternative aerobic composting processes using sludge and other BOW in combination with additives.

Deliverable 13 has been developed in the framework of Task 3 including

- Report on the physicochemical analysis of sludge, other biodegradable waste and additives
- Report on the optimum operating conditions for the composting unit
- Report concerning the evaluation of compost products (level A)

The start-up of the composting process took place with the collaboration of all partners. The NTUA team worked closely with the UCD and ORMVAD partners to operate, maintain and optimise the composting system. The activities of Task 3 have been completed successfully on 10/09/2007, according to the revised time schedule.

The development of aerobic composting processes using primary and secondary sludge, other BOW (green waste and manure) and effective additives (zeolite, perlite) were studied in this Task. To justify the successful implementation of the development of effective composting and co-composting processes and optimisation of the system various experiments were carried out. These

experiments were focused on the compost quality characterization and on the effects of the operational conditions on the efficiency of the process, as well as on the end product quality.

Extended physicochemical analyses were performed for the characterisation of the raw materials that had been used for composting. These materials included primary sewage sludge from the city of El Jadida, sugar beet leaves, straw residues, sheep and cow manures in various ratios.

Due to the unavailability of the UWWTP in El Jadida at the time of the execution of the project to provide us with secondary sludge, no composting trials have been performed using secondary sludge from an UWWTP as raw material for composting. Although there were other treatment plants operating outside the city of El Jadida that could provide us with sufficient amount of secondary sludge, the long distance as well as the high transport cost were prohibitive to apply this material into the bioreactor from those plants. Instead of secondary sludge from the UWWTP in El Jadida it was considered appropriate to perform a composting trial using secondary sludge from a food industry. In addition it was considered appropriate not to use sludge generated from PWRs into the composting system since the high content of inert material, mainly sand and minerals, was qualitatively inappropriate for the composting process. Furthermore, due to the high moisture content of primary sludge it was considered appropriate not to use primary sludge individually but to mix it with green waste which operate as excellent amendments and bulking agents. The high moisture content of sludge arises from the fact that there were not dewatering installations in the region where primary sludge was produced.

Green waste, that was used into the system, comprised of sugar beet leaves and straw residues provided by Moroccan farmers. Since sugar beet and wheat are the primary cultivations that are being practiced in Doukkala region, sugar beet leaves and straw residues were considered appropriate to be used as an input composting material due to their high availability and negligible cost. Manure of different origin (sheep and cow) was also used in the composting trials since the high availability and organic content, the low heavy metal content and the absence of other hazardous substances make manure excellent composting material. Furthermore manure acquires high nitrogen and phosphorous content which are basic nutrient components for plant growth.

Additives such as zeolite and perlite were obtained from Moroccan local market. Zeolite was used as additive in order to examine primarily the heavy metals removal from the substrate and secondly the its capability to adsorb the volatilized ammonia during composting. The importance of the later lies in the fact that nitrogen losses, which occur mainly during the initial stages of composting, result from ammonia volatilization. High losses of ammonia nitrogen represent a waste of a

valuable resource and reduce the agronomic value of the end-product. The importance of perlite use as an additive lies in the fact that it modifies the physical properties of the substrate (e.g. structural support, porosity, aeration) to promote composting by increasing the void volume of the substrate without involving into the biochemical process of composting due to its inert properties.

The collection and transport of the aforementioned feedstock material was performed by members of UCD and ORMVAD while the required laboratory analysis took place in the premises of UCD.

To determine the optimal course of composting four different composting trials have been performed using the aforementioned waste in various ratios and under different operational conditions. The selection of the experimental set-up was determined according to the feedstock material and its characteristics while at the end of each trial valuable feedback was obtained for the optimisation of the next composting trials. The temperature, moisture and oxygen content of the substrate was closely monitored on a daily bases during composting while for the evaluation of the processes complete physicochemical analyses have been performed (i) to the substrate[1] throughout the duration of the composting processes (ii) to the derived product[2] resulting from each composting trial and (iii) and to the leachates[3] produced from each composting trial. Furthermore biological and micro-biological analyses have been performed prior and after the composting processes to estimate the density reduction of pathogenic microorganisms since sludges contain great amounts of pathogens which constitute a health hazard for plant and human contamination. Finally heavy metal speciation has been performed to the produced compost in order to evaluate the potential accumulation level of heavy metals by plants when compost is applied.

The daily operation of the composting system was performed by UCD in collaboration with ORMVAD personnel, while NTUA provided expertise for optimizing the system's operation.

This Task was developed smoothly without any problem and it resulted in the operation of the composting unit under optimum conditions as presented in Deliverable 13 attached in this report. The NTUA team was responsible for the successful implementation of this Task, in close collaboration with UCD. The physicochemical analysis involved were performed by the UCD laboratory team while additional analysis have been carried out by NTUA members from compost samples that UCD had provided for consistency reasons.

[1] Analyses included measurements of the pH, total carbon, total nitrogen, nitrates and ammonium in regular time intervals

[2] Analyses included measurements of the water content, pH, total carbon, total nitrogen, C:N ratio, nitrates nitrogen, ammonium nitrogen, total phosphorous, total potassium, magnesium, manganese, calcium and heavy metals concentration.

[3] Analyses included measurements of the pH, BOD_5, nitrates, ammonium and heavy metals in regular time intervals

The indicators for Task 3 are the following:

- number of sludge samples in which physico-chemical analysis is performed, 48
- number of sludge samples in which biological and microbiological analysis is performed, 48
- number of physico-chemical, biological and micro-biological parameters measured, 23
- number of bench-scale lab trials performed, >3000
- number of alternative aerobic composting processes developed, 4

Task 4: Evaluation of compost products as soil improvers

Initial	*Start date: 10/04/2007*	*End date: 10/10/2007*	*Duration: 6 months*
Revised	*Start date: 10/09/2007*	*End date: 10/03/2008*	*Duration: 6 months*

The Deliverable 14 of Task 4 has been successfully completed. This Task aimed to provide the following output:

- Development of phytotoxicity tests
- Application of compost products in agriculture
- Effects on the production quantity and quality of selected cultivations

Deliverable 14 has been produced in the framework of Task 4 including the following:

- Report on the phytotoxicity tests - Evaluation of compost products (level B)
- Report on the effects of compost on the tested cultivations - Final evaluation of compost products (level C)

The aim of this Task is to evaluate the quality characteristics and suitability of composts, resulting from Task 3, as soil amendments and/or fertilizers for agricultural practices since composts that use raw material which originates from sludges can be potentially harmful to human health as well as to the environment when applied on land. To evaluate the suitability for agricultural application of each of the compost products, series of laboratory phytotoxicity tests have been performed to examine the effects of composts on seed germination and plant growth whereas open field experiments were implemented to examine the effects of compost application to the quantity and quality of the yield of the selected cultivation and the effects of compost to the physicochemical characteristics of the soil where compost was applied. The obtained results are presented analytically in Deliverable 14.

The laboratory phytotoxicity tests indicated that the produced compost was phytothreptic for all the composting trials that have been performed during the 3rd Task. This is evident of the absence of phytotoxic compounds that can inhibit seed germination or damage plant growth. With respect to the open field experiments three species of seeds were selected for cultivations, namely maize, wheat, sugar beet roots. The cultivation of wheat was abandoned due to plant illness caused from an external source while maize plantation will be ready in June. The experimental programme on sugar beets was successfully carried out. The experimental procedure involved the testing of compost in different doses. According to the obtained results, presented in Deliverable 14, the compost had no negative effect on the germination, nor on sugar beets growth at the 48th day after sowing. On the 82nd day after sowing it was confirmed that different doses of compost had positive effects on sugar beets growth. In particular biomass evolution of plants showed an exponential growth in relation to the amount of compost used confirming the stimulating effects of compost on sugar beets growth. Despite the fact that sugar beet roots have shown a positive behaviour regarding the biomass production, other measurements need to be made too. This includes further analysis in order to evaluate the quality of the yield (e.g. heavy metals concentration) as well as the potential negative impacts that compost may have on soil where compost is applied. The aforementioned experiments are expected to be carried out at the end of the cultivation cycle of sugar beet leaves in June.

Task 4 was subjected to a delay since it was considered appropriate that the composts resulted from the 3rd Task had to remain outdoors for a sufficient period of time for further maturation. During the maturity phase composts were applied on an open area just outside the bioreactor site and they were subjected to regular manual agitation and aeration in order to improve furthermore their properties. The incorporated ammonium in composts was an issue of concern due to the potential toxic impact that may have on plant growth and seed germination. For the aforementioned reason the first series of the experimental results on sugar beet cultivations were obtained in March 2008 while the remaining results will be presented on the final report of the project. Furthermore on April 2008 a second field experiment was initiated using maize in order to verify the beneficial effect of composts as soil additive. Results from maize will be available in June.

UCD and NTUA in close collaboration with ORMVAD were responsible for the successful implementation of this Task. The UCD laboratory team performed the phytotoxicity tests whereas NTUA members had carried out additional analysis for consistency reasons from compost samples that UCD had provided. With respect to the open field experiments, ORMVAD provided the arable land area necessary for the cultivation tests located near the composting site in the SEMVA in

Zemamra region. The performance of tests as well as the daily supervision of the site was performed by UCD in collaboration with ORMVAD personnel.

The indicators for Task 4 are the following:

- number of phytotoxicity tests performed, 56
- number of different types of cultivations in which the compost end product is applied, 3

Task 7: Evaluation of compost products as soil improvers

Initial	*Start date: 01/02/2006*	*End date: 01/02/2008*	*Duration: 24 months*
Revised	*Start date: 01/02/2006*	*End date: 01/08/2008*	*Duration: 30 months*

Task 7 is currently under progress and it will last until the end of the project. The training and dissemination activities, occurred during the period from 01/08/2007 to 01/04/2008, involve the formulation of the 1st training session – workshop that took place on 8 November 2007 in Morocco and was addressed to Moroccan competent authorities in order to promote capacity building and the concept of composting of sludge and other BOW in Morocco. The topic of the 1st training session – workshop was the "Production, management and valorization of sludge from wastewater and other biodegradable organic waste" and initiated after the welcoming speech of Mr. Senior of the Faculty of Science El Jadida of UCD who referred, inter alia, on the role of the 1st training session – workshop in the promotion of clean technologies for sustainable environmental management. The event's program is attached Deliverable 15 and involves speeches from members of NTUA and UCD a constructive discussion between the beneficiary, the project partners and the participants as well as a visit to the composting pilot unit.

The main speakers were Prof. Loizidou (NTUA), Profs. Mr. Mountadar and O. Assobhei (UCD) and several other members of NTUA and UCD. More details related to the presentations are attached in Deliverable 15

After the presentations a debate was initiated among the participants and the members of NTUA, UCD and ORMVAD covering a range of issues such as:

- The importance of setting demonstration systems to promote technologies for solid waste and sludge management in Morocco
- The solid waste management in Morocco and the related legislation
- The composting process of sludge and BOW and the use of compost as a soil improver

The participants that joint the 1st training session – workshop included researchers and students of the UCD, representatives of competent authorities (ministries, regional and local) as well as representatives of various companies and associations concerned with the management of wastewater and solid waste.

The participants had also the opportunity to visit the in-vessel bioreactor installed at the experimental station of ORMVAD at Zemamra (approximately 70 km from El Jadida). This visit intended to get the participants familiar with the unit controls and the aerobic composting process. Returning from Zemamra, a meeting was held at the Faculty of Science of El Jadida of UCD for the evaluation of the 1st training session – workshop. The participants concluded that the event was a success since it provided thorought information to numerous target groups related to sludge and BOW management.

The indicators for Task 7 so far are the following:

- Number of participants in the 1st training session – workshop event = 19 organizations (including NTUA, UCD)
- Number of times the project web-site has been updated = 10
- Number of other web-sites in which the project is mentioned > 35
- Number of articles were the project was published = 5
- Number of visitors in the project web-site > 1500
- Number of technical and scientific papers in preparation = 6

Submitted Deliverables

The submitted deliverables associated with the 3rd progress report for the period from 01/08/2007 to 01/04/2008 are listed in the Table below:

Deliverable Number	TITLE	Project Task
13	Report on the physicochemical analysis of sludge, other biodegradable waste and additives	3.1

13	Report on the optimum operating conditions for the compost unit	3.2
13	Report concerning the evaluation of compost products (level A)	3.3
14	Report on the phytotoxicity tests - Evaluation of compost products (level B)	4.1
14	Report on the effects of compost on the tested cultivations – Final evaluation of compost products (level C)	4.2
15	Report on the 1st training session – workshop	7
15	Leaflet of the 1st training session – workshop program	7
16	Report on Steering and Management Committee meetings	7

3. PROJECT MANAGEMENT

Describe the management structure of the project

The beneficiary of the project is the University of Chouaib Doukkali (UCD) which is solely legally and financially responsible for the Project implementation and Project Management.

The project partners are:

National Technical University of Athens (NTUA) from Greece and

Regional Office of Agricultural Development of Doukkala from Morocco (ORMVAD)

In the Tables below the name and organization of each member of the Steering Committee and the management team is given consisting of members of UCD, NTUA and ORMVAD.

Members of the Steering Committee

Name	Organisation
M. Kouam	President, University Chouaib Doukkali
A. El Hattab	Director of Sciences, Ministry of National Education, Higher Education, Executives Training and Scientific Research
A. Moulid	Director of Regional Office of Agricultural Development of Doukkala
K. El Hariry	Member of Moroccan Parliament
Y. Boughaleb	Dean of Faculty of Sciences El Jadida
A. Sahibi	Chief of the Cooperation Division, Ministry of Regional Planning, Water and Environment
M. Loizidou	Professor, National Technical University of Athens
O. Assobhei	Professor, Faculty of Sciences of El Jadida
S. Bakkas	President, Association ANDALOUS
N. Brine	Regional Inspection of Doukkala Abda, Ministry of Regional Planning, Water and Environment
K. El Moutai	Vice President, Association ANNAMAE for Self-employment
M. Fekhaoui	General Secretary, Moroccan Association of Limnology

M. Lahlou	Ministry of National Education, Higher Education, Executives Training and Scientific Research
M. Mountadar	Professor, Faculty of Sciences of El Jadida
M. Rafrafi	Regional Office of Agricultural Development of Doukkala (ORMVAD
K. Zourarah	President, Association GREPEN

Members of the Management Team

Name	Organisation
O. Assobhei	University Chouaib Doukkali – Co-ordinator
M. Mountadar	University Chouaib Doukkali
A. Aajjane	University Chouaib Doukkali
J. Amine	University Chouaib Doukkali
S. Etahiri	University Chouaib Doukkali
M. Kabil	University Chouaib Doukkali
M. Loizidou	National Technical University of Athens
S. Malamis	National Technical University of Athens
E. Kapetanios	National Technical University of Athens
M. Rafrafi	Regional Office of Agricultural Development of Doukkala
B. Droussi	Regional Office of Agricultural Development of Doukkala

The working group of the beneficiary is in regular contact with the working groups of the partners in order to organise their tasks, discuss the progress on their field of activities and find suitable solutions when problems arise. The project management structure has not changed since its formulation and is running smoothly.

In the period covered by the 3rd Progress Report, from 01/08/2007 to 01/04/2008, the Steering committee as well as the Management team met on the 9th of November 2007 in El Jadida where the University of Chouaib Doukkali (UCD) is located. The meetings were held at that time since the 1st training session/workshop was scheduled to take place on the 8th of November, and thus not

burdening further the budget of this project in relation to travel expenses. technical and scientific needs of the project.

The Steering Committee aims to promote more active stakeholder involvement during the project, resulting in the wider dissemination level of the project, in capacity building and in its successful implementation of the project. In these meetings the problems which have occurred and are related to the dissemination, training activities, proposed guidelines and proposed specifications etc, are thoroughly discussed.

The responsibility of the Management team is to discuss the progress of the project, to resolve any potential problems, to enhance communication among the participants in the project and to make sure that all deliverables and required reports are submitted on time and represent work of high standard.

Details concerning the minutes of the Steering Committee and the Management team are given in Deliverable 16.

The role and the responsibilities of the beneficiary and the two partners

The University of Chouaib Doukkali (UCD) is legally, technically and financially responsible for the project implementation. UCD organized the 1st training session/workshop on the 8th of November 2007 and has produced the necessary analysis of the feedstock material and the quality characterization of the composting end product. UCD in collaboration with the NTUA and the ORMVAD operated the composting unit. UCD performed most of the required physicochemical and biological analysis of the raw material, the composting end products as well as for the produced leachates. Furthermore UCD developed the required analysis for the evaluation of composts suitability for agricultural application through a series laboratory phytotoxicity tests and open field experiments on selected vegetable cultivations.

More specifically the analyses included extended series of experiments that have been carried out, namely:

- physicochemical analysis of primary and secondary sludge, BOW and additives
- physicochemical analysis of the end product
- physicochemical analysis of the produced leachate

- biological and microbiological activity of compost
- laboratory phytotoxicity tests of compost
- open field experiments applying compost on soil for the cultivation of sugar beet, wheat and maize

Finally, being the project beneficiary, UCD is responsible for the organization of all project meetings taking place in Morocco (management team and Steering Committee meetings) and for all dissemination and training activities such as the creation and updating of the project web-site, organization of training/workshops events and an International Conference, the development and distribution of printed material, site visits to the composting unit, publications in technical papers as well as for the Management of the project and the reporting to the European Community. UCD continuously mobilizes all relevant Moroccan organizations in order to increase the project's impact.

The **National Technical University of Athens (NTUA)** is mainly responsible for developing certain technical issues of Tasks 3 and 4 of the project. NTUA was responsible for developing alternative composting processes and for optimizing the composting system operation. The latter was performed in close collaboration with UCD and ORMVAD. Moreover, NTUA was responsible for the development of guidelines and specifications on sludge composting processes and for the characterization and use of compost as fertiliser and/or soil improver through the conduction of physicochemical analysis and laboratory phytotoxicity tests on composting end product and by supervising the conduction of open field experiments. To this purpose, NTUA provided the necessary staff, i.e. senior technical manager/scientific and technical responsible, experienced researchers and engineers, technical staff, computer experts, secretariat support, etc.

The **Regional Office of Agricultural Development of Doukkala (ORMVAD)** actively participated in all project meetings and has provided land for the installation of the composting system and for the application of compost on open fields. ORMVAD has provided personnel for the daily maintenance and operation of the composting unit and has been actively involved in the conduction of the experimental cultivations.

ASSESSMENT OF PROGRESS

Compare the actual implementation of the project with the proposed work plan

A significant (5-month) delay was noted during the completion of Task 2 related to the design and construction of an innovative sludge aerobic composting system. More specifically, Task 2 should have been completed by 10/10/06 and was completed on 10/03/07. Although the design of the composting system finished on time, there was a 2-month delay in the construction of the system as a supplier did not provide the required equipment at the specified time frame. A further 3-month delay was caused by the inability to transfer the bioreactor from Peiraias to Casablanca due to the long period of strikes that took place in the port of Peiraias. Thus, the unit could not be shipped from Greece to Morocco, as it was planned according to the first time schedule.

The 5-month delay for the completion of Task 2 inevitably caused a series of delays in the implementation of the remaining Tasks and subsequently to the Tasks of the reporting period. More specifically, Task 3, which involves the development, operation and optimisation of sludge aerobic composting processes, was initially set to start on 10/10/06, but it actually started on 10/03/07 and finished on 10/09/2007, five months later than it was originally planned. The aerobic composting process involves series of biological activities which have to be developed for the degradation of organic matter. Since the 5-month delay was inevitable and the system involves biological processes that need time to develop, it was extremely difficult to compensate this time. For this reason EC has agreed, in December 2007 to prolongate the duration of the project by 6 months. Task 4, which involves the evaluation of compost products as soil improvers, was also subjected to 5-month delay since the implementation of its objectives required the implementation of Task 3 to produce sufficient end products for the quality evaluation of the effects of compost on tested cultivations. Furthermore Task 4 was subjected to an additional delay according to the revised time schedule since the composts resulted from the 3rd Task had to remain outdoors for a period of time for further maturation prior to compost application on land in order to improve furthermore the characteristics of the produced composts. This delay will not change the end date of the project but it will shift the duration of Task 4 till June 2008 instead of March 2008. Apart from the aforementioned delays no other deviations from the revised time schedule had occurred.

Evaluate how well the project is going

The project has a 5-month delay compared to its original time schedule due to the late arrival of the bioreactor in Morocco. As a result Task 2 has been completed with a 5-month delay and Task 3 has also started with a 5-month delay. Task 3 has been completed on time as the in-vessel composting system has been successfully operated and the conditions have been optimised while all the relevant analysis required have been performed. As has been stated earlier Task 4 was subjected to a delay due to further improvements of the characteristics of the produced composts through maturation prior to their application on arable land. The cooperation and the internal communication among the project partners are effective and they are working according to the roles assigned in the project proposal and the kick-off meeting.

Describe dissemination of successes or corrective actions if needed

The project is well disseminated in Morocco. The 1st training session – workshop on the 8th of November 2007, was a success since it achieved to attract numerous participants from various fields. Researchers and students of the UCD, representatives of competent authorities (ministries, regional and local) as well as representatives of various companies and associations concerned with the management of wastewater and solid waste had participated and were actively involved in the event. Moreover the participants had the opportunity to visit the in-vessel bioreactor and to get familiar with its operation.

Include the successes you have identified and how you will make sure that will be sustainable

The area of Zemamra is located about 70 km south of El Jadida, at the centre of the irrigated perimeter of Doukkala (approximately 60 000 hectares). This area is a rural area and contributes with approximately 20 % of the production of the sugar in Morocco and with approximately 25 % of the dairy production of the country. The ORMVAD has installed an experimental station to promote new technologies such as new irrigation technologies, choice of performing seeds and formation of farmers. The Zemamra station is a platform of experimentation of various different seeds and farming techniques. It is also an important meeting place for the stakeholders in this field of agricultural development such as farmers, industrialists, administrations, associations, researchers. The composting system has been installed in this station. Thus the unit profits from all this structure and it will be easier to achieve the highest possibly dissemination level and the sustainability of the project since there will be always involvement of the system to produce

compost and thus use it for agricultural purposes. Also all the cultivations took place in the Zemamra station where stakeholders and actors interested in the field had access to.

Describe problems or difficulties encountered or foreseen and their implications for future actions

As it has been explained in detail in the previous sections, there has been a 5-month delay in the completion of Task 2. This also impact in the development of the future Tasks. In particular, Task 3 could only commence once the system had been installed, while Task 4 could start only once the system operation had been optimized and the laboratory analyses show that compost of high quality was produced. In addition, Task 4 was subjected to a delay as explained earlier. Due to that delay Task 4 has not been completed yet since further analyses must be performed to make definite conclusions with respect to the fertility of the produced compost the quality of the cultivated plant (e.g. heavy metals concentration) and its potential impacts to the soil where compost is applied. It will be necessary to wait until the end of the cultivation cycle (June 2008) when the results will be completed and all data will be available for plants and soil in order to draw final conclusions. As has been stated this delay will not change the end date of the project but it will shift the duration of Task 4 till June 2008 instead of March 2008.

Lessons learned and suggestions for improvement for the remaining period

All efforts will be made so that future delays are minimized and no changes will be required for the end date of the project.

The active involvement of the Management and Steering Committees is a major success factor of the project. The joint meetings of the project are considered to be very essential and contribute to the progress of the project and to the effective internal communication of the Partners. It is important for all the employees involved to participate in all the future actions of the project in order to maintain their interest and effectiveness.

4. FUTURE PLANNING

This Section describes mainly the future planned activities-tasks from 01/04/08 till the end of the project on the 1st August 2008 and gives a short reference to previous activities that have been completed.

Task 1: Assessment of the existing situation in Morocco and in the EU - <u>COMPLETED</u>

Initial	*Start date: 01/02/2006*	*End date: : 01/06/2006*	*Duration: 4 months*

Task 2: Design and construction of an innovative sludge aerobic composting system - COMPLETED

Initial	*Start date: 10/04/2006*	*End date: 10/10/2006*	*Duration: 6 months*

Task 3: Development of sludge aerobic composting processes – Optimisation of the operation of the pilot composting systems - <u>COMPLETED</u>

Initial	*Start date: 10/10/2006*	*End date: 10/04/2007*	*Duration: 6 months*
Revised	*Start date: 15/03/2007*	*End date: 10/09/2007*	*Duration: 6 months*

Task 4: Evaluation of compost products as soil improvers – <u>NEARLY COMPLETED</u>

Initial	*Start date: 10/04/2007*	*End date: 10/10/2007*	*Duration: 6 months*
Revised	*Start date: 10/09/2007*	*End date: 10/03/2008*	*Duration: 6 months*

Task 4 is near completion since the end of the cultivation cycle will take place in June 2008 and that is when the remaining analyses of the cultivated plants will be carried out in order to be able to make definite conclusions with respect to the fertility of the produced compost the quality of the cultivated plant and its potential impacts to the soil where compost was applied.

Task 5: Alternative uses of compost – Market opportunities in Morocco

Initial	*Start date: 10/10/2007*	*End date: 10/12/2007*	*Duration: 6 months*
Revised	*Start date: 10/03/2008*	*End date: 10/05/2008*	*Duration: 2 months*

This Task is currently under development. The objective of this Task is to find and suggest (i) possible alternative uses of compost products (ii) the criteria needed for the development of a niche compost market in Morocco as well as (iii) possible job opportunities that may arise from compost production and distribution processes. The Task is assessed through the use of various literature

reviews, internet survey, meetings with experts, authorities and representatives of existing compost networks worldwide. The USD is responsible for the successful implementation of this Task in close collaboration with NTUA. It is foreseen that there will not be any difficulties in accomplishing the aforementioned objectives since UCD has a complete and representative view of the Moroccan market and there is also strong support from the Moroccan government through the ministry of environment.

The deliverables following the implementation of this task are:

- Report on the alternative uses of compost
- Report on the market opportunities for the compost products

Task 6: Development of guidelines and specifications covering the sludge composting process Characterization and use of compost as soil improver

Initial	*Start date: 01/11/2007*	*End date: 01/02/2008*	*Duration: 6 months*
Revised	*Start date: 01/04/2008*	*End date: 01/08/2008*	*Duration: 4 months*

Task 6 has not started yet. During this task, the technical specifications concerning the optimum operation of the composting system will be determined. Moreover, in this task, quality requirements of the compost products will be set-up. The quality requirements should allow the categorization of the end products derived from the treatment of sludge and other BOW. Furthermore, guidelines concerning the requirements for compost used in agriculture, horticulture, private gardening, covered cultures and landscaping will be appointed. Finally, test methods and analyses for compost samples will be specified. The successful completeness of this Task shall result in setting the specifications and guidelines covering the area of sludge and other BOW composting process, the characterization and the use of compost as soil improver in large-scale applications. To achieve this goal, reference material from the related literature (e.g. national guidelines and success stories from other countries) and the experience derived from the project will be used.

The deliverables following the implementation of this task are:

- Report on the specifications about the optimum operation of compost units
- Report on the specifications concerning the quality and compost products and their possible uses
- Manual for physicochemical compost analysis

Task 7: Dissemination and training

Initial	*Start date: 01/02/2006*	*End date: 01/02/2008*	*Duration: 24 months*

Revised	*Start date: 01/02/2006*	*End date: 01/08/2008*	*Duration: 30 months*

The following dissemination and training activities are foreseen for the period from 01/04/08 until the end of the project:

- Continuous up-dating of the web-site to include the progress of the project
- Organisation of the 2nd training session - workshop addressed to Moroccan farmers to inform them on the benefits of using compost as a soil conditioner both economically and in terms of its properties (planned for July 2008).
- Organisation of the 3rd training session - workshop addressed to Moroccan private companies and industries that are interested in the development of a compost market scheme in Morocco competent authorities (planned for July 2008).
- Continuing disseminating printed material, leaflets and brochures describing the progress and the results of the project.
- Internal meetings of the working groups with those interested in being informed about the project during the whole implementation of the project
- The remaining technical papers will be produced by NTUA and UCD
- Efforts will be made to continue the project dissemination in newspapers and in articles on the Internet.
- Dissemination of the project in other web-sites
- Organisation of an International Conference where all relevant parties from Morocco and from other countries shall be invited. The international conference will be held in 9-11 July 2008 in Morocco in order to present the project findings and other related issues. Preparations for the conference have already started.

Task 8: Management

Initial	*Start date: 01/02/2006*	*End date: 01/02/2008*	*Duration: 24 months*
Revised	*Start date: 01/02/2006*	*End date: 01/08/2008*	*Duration: 30 months*

The following activities of Task 8 are foreseen:

- Meeting of the management team and the Steering Committee
- Preparation and submission of the final report

ANNEX

GANTT DIAGRAM