



Δήμος Αχαρνών



Αναπτυξιακή Κηφισιάς
Δημοτική Επιχείρηση



Δήμος Νέας Χαλκηδόνας



LIFE03 ENV/GR/205

Promotion and implementation of systems for the production of high quality compost from biodegradable household waste separated at source

Project location	Municipalities of: Kifissia, Acharnes, Nea Halkidona, Attica, Greece
Project Beneficiary	National Technical University of Athens
Project duration	01/12/2003 – 31/08/2006
Project website	www.uest.gr/comwaste



The LIFE project: “COMWASTE – Promotion and implementation of systems for the production of high quality compost from biodegradable household waste separated at source - LIFE03 ENV/GR/205” deals with the use of a specifically designed and constructed prototype system at pilot scale application, in order to demonstrate and document the feasibility of the simultaneous separate collection and composting of the household biodegradable organic waste at source. The beneficiary/coordinator of the project is the National Technical University of Athens (NTUA) while the Municipalities of Kifissia, Acharnes and Nea Halkidona are the partners of the project.

Through the thirty-three months duration of the project, all the targets set were achieved leading to many benefits for the Municipalities, the householders as well for the authorities and the actors involved in the generation and the management of the household biodegradable organic waste.

Steps for the implementation of the project

➤ Assessment of the Existing Situation

A complete recording and analysis of the legislative framework with regard to the management of solid waste was carried out, which includes the objectives, the principles, the requirements and the restrictions that condition the individual stages of the activities for the management of solid waste, at national and EC level. Additionally, the quantitative and qualitative characteristics of the household waste generated in the Attica region in general and in the three Municipalities – partners specifically was determined and assessed. Moreover, the existing practices, systems and plants applied for the management of household waste in the Attica region were recorded and evaluated. Also, the existing problems and constraints have been identified. In addition, the special characteristics and habits of the households in the Attica region were identified, recorded and assessed, through the development, distribution and filling in of appropriate questionnaires.



➤ Identification and analysis of success stories in relation to the management of biodegradable household waste at source

All the programs and systems (pilot and large scale applications) that are applied internationally for the management of biodegradable household waste, as well as their technical details were recorded, aiming to obtain of a complete and up-to-date picture with regard to their application (problems that are faced at the implementation, ways of elimination of these problems, conditions of application, degree of participation of the citizens, results from their application etc.). Additionally, all the available composting systems (compost bins) that are used for the utilization of the biodegradable organic fraction of waste at source were recorded. A description of the

operation of these systems as well as of their technical characteristics/features was carried out, aiming at the obtainment of a representative and complete view concerning their use (advantages and disadvantages, conditions and restrictions of application, quality of product, categories of solid waste that can be treated, treatment time period, operational mode, etc.).

➤ **Design and development of an appropriate prototype system for the collection and composting at source**

All the alternative household composting methods, techniques and systems used for the household composting were recorded, described and analysed. Once the extensive analysis of all applied systems and techniques was completed, an evaluation was carried out aiming to determine the most suitable and efficient systems. The evaluation of the systems was carried out via the development and application of a multi-criteria method of analysis which was based on a wide range of criteria that were divided into three main categories, technological environmental and economic criteria. Through the analysis of the results obtained from the comparative evaluation via the multi-criteria method, conclusions were drawn concerning the effectiveness of the available systems. These conclusions were used as a preliminary basis for the development of the prototype system.

Then three household composting systems available in the market were provided and their operational functions and performance were recorded

Then, through the consideration of: i). the results obtained from the lab testing of the three systems ii). the overall evaluation of the performance of the three systems and iii). the most effective technical and operational characteristics of the other systems that were examined through the application of the multi-criteria analysis, and based on the experience of the working team on the development, control and optimization of the composting process, the first version of the components of the prototype system were manufactured and tested.



➤ **Organization of the implementation program**

An extensive information campaign was set up in the Municipalities under concern. This publicity campaign involved direct mailing to householders as well as visits to the households. Also, it included workshops organized in the three Municipalities, presentations and advertisements in newspapers and the radio. The outcome of these activities was an increase of the environmental awareness of the residents of the three Municipalities as well their willingness to participate in the program. Then, the households that would participate in the program were selected (according to the

content of the questionnaires that were distributed and filled in). The procedure was developed in such a way in order to ensure that representative households with respect to the persons that live at them, the age of the individuals, the hours that they spend at home, their consumption patterns, their standard of living etc. would participate.

The system that was designed and developed was procured and properly tested (re-examination of the functions of the prototype system, as a whole, in order to make sure that the required performance has been achieved) and then 100 pieces of the prototype system with high operational functions and high performance were produced. 90 composting systems were installed in the 90 selected households (30 in each Municipality), 8 systems were installed in the households of 8 members of the NTUA scientific team and 2 systems run in the Laboratory of Environmental Science and Technology of NTUA.

Special attention was given on the training of the people involved, on the use of the system according to its operational and technical specifications. For this purpose: i). special training modules were organized, where members of the working group of the NTUA explain in details, the functions and the using of the prototype system. (three modules of 8-12 householders were held in each Municipality). Special adhesive informative material was prepared and distributed to the householders that are participating in the individual training modules. ii) Printed material was prepared and distributed to the participants of the three workshops– awareness events that contains information about the composting procedure, the prototype system and the program in general iii) additional training was given by the working groups of NTUA, to the householders during the installation of the prototype system at each household. The members of the beneficiary explained analytically the use of the system and demonstrated its operation to the householders in practice (training of the householders on site).



The prototype household composting system

➤ **Implementation of the Program**

The pilot implementation of the program lasted for a sufficient time in order that the householders become familiar with the activity of the separation and

composting of the biodegradable waste at their households and consider it as a daily common practice. The householders separated and composted the biodegradable waste as trained, using the prototype equipment with which has been provided.

The householders were provided with the prototype system as well as with additives that were used for the efficient development of the process. In particular, the householders fed the system with the appropriate biodegradable waste generated at their kitchen together with Greek zeolite of a specific particle size and dose in order to eliminate the odor and improve the quality characteristics of the final product. Moreover, a low quantity of mature compost is added to the system in order to support the composting process as well as a specific quantity of sawdust (in order to increase the carbon content that was available for the development of the biochemical actions in the composting compartment by the microorganisms as well to optimize the aeration conditions of the material that was subjected to composting). The product obtained was temporarily stored by the householders in appropriate biodegradable bags. The bags had the capacity to store the quantity of compost that produced during a period of three months for each household.

The working teams of the project were in constant communication with the householders participating in the program (visits at the selected households on a regular basis, frequent phone communication) in order to overcome potential difficulties and malfunctions. In addition, the householders were provided with a telephone number, where they could get all required information by the working groups. Further explanations and directions were given to some householders at the beginning, when the system was installed. Also, in few cases, additional instructions were given to some householders during the operation of the system in order to improve the performance of the system. Overall, the implementation of the program ran smoothly and the cooperation of the householders with the members of the individual working teams of the NTUA was continuous and efficient.



**Compartment for the collection
of leachate**



**Compartment for the collection
of compost**

Moreover, an appropriate questionnaire was developed and distributed to the householders that participated in the implementation of the program in order to complete it regularly with their observations about the operation of the system. Also, during the visits that took place by the working groups to the householders, additional observations and comments were recorded directly but also after discussions with the householders.

Additionally, compost samples from all the participated households as well as from the composting systems that operated at the premises of the NTUA were collected and analysed properly at the lab of the NTUA in order to determine the quantitative and qualitative characteristics of the product and assess its quality level.

➤ **Evaluation of the results of the implementation – suggestions for full - scale introduction of the System**

The pilot implementation of the program was evaluated properly, through:

i. the analysis and the assessment of the content of the filled in questionnaires that were distributed to the householders as well as through the observations and remarks obtained by the working groups during their visits to the households. According to the content of the questionnaires, some problems were determined mainly during the first stages of the implementation program (first composting cycle) due to the fact that the householders were not fully familiar with the use of the prototype composting system. The direct and on time response of the members of the working groups in combination with the high level of collaboration of the householders led to the quick and efficient elimination of each problem.

ii. the analysis and the evaluation of the results that were obtained by appropriate measurements and analyses for the determination of the qualitative and quantitative characteristics of the compost samples that were taken during the implementation of the program. The individual and the overall results of the laboratory analyses indicated that the compost is of a high quality level (as it was confirmed by the values of the quantitative and qualitative characteristics and the non presence of phytotoxicity) and it fulfills the legislative quality standards for its safe use.

Finally, a framework of guidelines and specifications were developed for the implementation of the program in larger scale, including a preliminary cost – benefit analysis.



Comparison to the project objectives

All the individual objectives set through the project were achieved. In particular:

- A complete, clear, cohesive and representative picture related to the household waste generation and management in the Municipalities and the Communities of the Attica Region generally, and in the three Municipalities that participated in the project specifically was obtained.

- Knowledge and experience on scientifically sound and effective practices, systems and technologies on biodegradable household waste collection-composting at source was acquired.
- A suitable and effective prototype system for the simultaneous separate collection and composting at source of the household biodegradable organics was designed, constructed and installed in selected households. The outcome is very important, since: i. it is the first application of such a system (simultaneous collection/composting at source) in the country ii. the householders became familiar with the practice of separate collection/composting of their waste at source, placing this practice among their daily activities (common daily practice)
- The results that were obtained through the pilot implementation of the program resulting to conclusions that are well-documented (documentation according to application in practice). Also, the problems that were identified during the implementation were overcome on time and they will be used as a guide in order to avoid similar problems in further applications. Moreover, the application was tested in practice and its viability was well-documented and finally, the Local authorities were provided with a well-documented, in terms of technical and economic nature, tool for the application of the prototype systems in the households of their Community or Municipality.

Furthermore, all the overall objectives set through the implementation of the COMWASTE project were achieved. In particular:

- i. development of a prototype system for the simultaneous separation and composting of the biodegradable household waste at source, that is tailored to the needs and the special characteristics of the densely inhabited area of the Attica Region and it is characterized by flexibility, convenience in using and capability to treat small quantities of waste in short time period.
- ii. Contribution to meeting local recycling targets as set by the relevant EU legislation (e.g. Directive 99/31/EC) and the national strategy.
- iii. Increase of the environmental awareness of the citizens (they take more ownership of efforts to protect the environment)
- iv. Assistant of the local Authorities in introducing successful and cost-effective home composting and biodegradable waste-separation schemes in their localities



Environmental benefits

The outcome of the project results in significant environmental benefits such as:

- diversion of the biodegradable organics from landfills

- raising the environmental awareness of the public – Increasing the sensitization of the citizens on environmental issues – placing good environmental practices among their daily activities
- reduction of the nuisance that occurs during the collection and transfer of the municipal solid waste
- lower burden of the landfill sites, in terms of quantity and polluting load, due to the reduction of the amount of municipal solid waste that are disposed, fact that results in the increase of their operation life cycle
- generation of leachates at landfill sites with reduced organic load due to the decrease of the organics that are disposed
- reduction of the air emissions from landfills in qualitative and quantitative terms (concentrations of carbon dioxide and methane)
- production of a product with added value that could be used for landscaping or for agricultural purposes such as soil fertilizer, improvement and conditioner – reduction of the use of synthetic fertilizers
- the application of the practice of the separation of organics at source offers the opportunity of a high-quality “clean” feedstock for composting and the prospect of an uncontaminated end-product, compared to the organic material derived from central mechanical sorting plants)
- the separate collection and simultaneous composting of the kitchen organic waste fraction by the householders facilitates a reduction of the frequency for the collection of the residual household waste fraction. This is an important consideration, especially in Southern European and other Mediterranean countries where the climatic conditions demand more frequent collection of easily degraded wastes



Results of the project for potential target groups

The outcome of the project has a great impact to all the actors involved in the field. In particular:

- i. citizens/householders: Their environmental awareness is increased, they take more personal efforts to protect the environment, they include the practice of simultaneous separation/composting of biodegradable household waste as a common daily activity, they produce a product with added value originated from the waste that they generate, they participate actively in material recycling schemes, they possess a sense of responsibility for their waste, etc.
- ii. Local Authorities: They are provided with an effective tool in order to re-organize the existing practices that are applied for the management of the household wastes

generated at their localities (re-organization of the management of waste in a more environmental and cost effective way)

iii. Private companies: Private companies that deal with the trading of products for agricultural applications could include the compost produced through household composting in the products that they sell.

iv. Public Authorities/decision and policy makers: The application of the household separate collection/composting of the biodegradable organic wastes in large scale, will contribute to the achievement of the quantitative national targets concerning the diversion of the biodegradable organics from landfilling. In addition, by incorporating this practice in the existing solid waste management schemes the principles and the priorities of the European and national environmental policy and legislation are enforced in practice providing tangible results.

Replicability and transferability

The project is characterized by a high level of replicability and transferability since:

- The application of such a system in large scale applications presents a high level of viability, taking into consideration that:
 - i. the total cost for the procurement, operation and maintenance of the systems is significantly lower compared to other practices that are applied for the management of wastes such as central mechanical recycling and composting plants, thermal treatment and sanitary landfilling of wastes.
 - ii. the cost for the entire management of the mixed household wastes is reduced significantly (reduction in costs for collection and transfer of mixed waste for final disposal, in demands for the operation of the anti-polluting systems at landfill sites, in final disposal fees etc.)
 - iii. the system is based on a well-documented and reliable technology
 - The application of the system is based on the principles and the priorities of the European and national environmental legislation and policy, fact that facilitates its easier incorporation in the existing waste management schemes.
 - The incorporation of such systems in the local municipal waste management schemes will lead to limitation of the nuisance occurred during the collection and transportation of the mixed household wastes
 - The end-product is characterized by a high quality level, fact that allows its possible trading utilization through the development of the relative market
 - The technology that was developed through the project focuses in solving of a common problem such is the generation of kitchen waste by the citizens and the prototype household composting system can be used by any householder in an easy and simple way.
 - The management of the biodegradable household waste is a widespread environmental problem, common in all the countries, fact which indicates that the prototype system could be used extensively in other European and international areas and countries.
 - The setting, planning-design and implementation of the project follows an integrated methodology that do not respond only to COMWASTE project but as a methodology could be implemented to a variety of topics of environmental concern such as the management of batteries and accumulators,

small quantities of hazardous materials in household waste etc in Greece as well as at European and international level.

- The project presents a high level of visibility since it leads to concrete, direct and tactile results that are evident by the people who use the prototype system (transformation of the household organic waste into a useful end-product, within a short time period).

Innovation

The content and the outcome of the COMWASTE project are characterized by a high level of innovation on national and international level, since:

i. The use of the system based on the simultaneous separation and composting of the household biodegradable organic waste, at source which represents the new trend in the treatment of this type of household waste (until now, the biological treatment of the biodegradable organic material was, mainly, taking place at central plants after its pre-separation from the mixed household waste)

ii. The household composting applications are very limited at European and international level, while it is the first attempt in Greece to establish such a system for simultaneous collection/composting of kitchen waste at source

iii. The prototype system that was designed, manufactured and operated through the COMWASTE project has significant unique characteristics - advantages, compared to other similar systems that are available internationally, such as:

- Separate feeding system that minimizes the odours from the composting compartment during feeding of fresh organic material
- Simplified and fluent feeding procedure
- Composting compartment (reactor vessel) that is isolated from the feeding system, feature that leads to: i. the avoidance of mixing of fresh organic material with the composted material, ii. the procedures of insertion of fresh organic material and the collection of composted material do not affect the composting procedures.
- Provision for the collection of leachate
- Agitation of the system without contacting waste and compost
- Use of specific additives and in particular, clinoptilolite - a natural zeolite of Greek origin - that assist to the control of odour and the improvement of the quality of the composted product.
- The composting system operates on a continuous basis (continuous feeding of new organics in parallel with continuous collection and removal of composting product).

iv. The use of such a system by the householders activates the participation at a full level, fact that provides them with a high sensation of responsibility about their waste and furthermore it gives to them the ability to get involved in the management of their waste more effectively and dynamically

Job creation

The use of the prototype systems in large scale applications, covering high population areas will lead to the production of large quantities of household compost providing the opportunity for its trading. As a result, requirements for new jobs will be created since the need for increased number of employees who will work in the entire management scheme will be raised. These employees could be technicians, collectors of the composting product, drivers, engineers for the provision of technical supporting, agriculturists, etc.