# NEW LIFE PROJECT

# Layman's Report

This expository paper, the Layman's Report, was written within the:

## NEW LIFE PROJECT

NEW LIFE

ENVIRONMENTAL REHABILITATION OF A DEGRADED AND DESERTIFICATION AFFECTED WITH THE USE OF A NEW TECHNOLOGY FOR SOIL TREATMENT AND RECONSTITUTION
LIFE 10 ENV/IT/0400

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# 1 LAND DEGRADATION – DESERTIFICATION

Degradation, the loss of agricultural and forest land, poses a major threat to one of the key, non-renewable natural resources which secure food production, prosperity and ecosystems balance to the living: soil.
Only a decade ago, just institutions and academics were aware of a decline in agricultural and forest soil conditions, whereas today the problem is distinctly perceived especially in the agricultural context. Over the years we have been witnessing an ever increasing soil degradation which has affected even the most fertile areas.

Results more frequently observed are the following:

- soil compaction;
- loss of soil fine fraction – erosion;
- organic matter decrease, soil mineralization;
- decrease in the ability of the soil to retain necessary water;
- loss and decrease of nutrients availability;
- decline in soil structure;
- diminished biodiversity;
- humification absence.

Land degradation originates from a number of causes most of which are human related and can be divided into two groups. The first, slow and progressive, includes intensive agricultural activities which ever increasingly fail to provide the appropriate amount of organic matter; the second and faster one is connected with landscape transformation, inappropriate land exploitation, overbuilding and pollution. As far as pollution is concerned, soil loss occurs very rapidly affecting large areas and resulting in the total loss of such resource.
The patent and progressive decline of soil conditions, the presence of arid farmland and the loss of land due to anthropic activities, have urged to implement a technology that may regenerate degraded soil or produce one to be used in soil-lacking areas to replace lost agricultural and forest land.

# 1.1

## LAND DEGRADATION – DESERTIFICATION

The urgency, even as far as European economic strategies are concerned, to implement agricultural and forest rehabilitation is justified by the fact that there are vast areas affected by degradation, especially in Mediterranean countries. In such areas land loss is often irreversible because rehabilitation is not economically viable.
The lack of technologies which may reverse soil loss and guarantee the provision of ecosystem services has encouraged the development of a complex treatment defined as reconstitution. The treatment approaches the problem by drawing on soil science and applied pedology.
Research activities conducted by the company Ecosistemi have generated a conceptual model and a soil treatment method which has demonstrated its feasibility by running experimental testing. Following results achieved, the technology, which was granted a patent, has drawn considerable attention because of its potentialities.



# 2 Project motivations – Aim

The project NEW LIFE (LIFE10 ENV/IT/0400) was created in order to verify whether the reconstitution method could allow a large-scale-replication. It planned to implement the rehabilitation of a severely degraded area over a span of six years by using the mentioned technology and conducting a prestigious research activity aimed at demonstrating the environmental, agronomic and economic feasibility of the method.

Picture representing the site prior to rehabilitation

# 2.1 Project motivations – Aim

**NEW LIFE major aim was demonstrating the effectiveness of the technology in opposing soil degradation and desertification by using a treatment based on disintegration and subsequent reconstitution of degraded and desertification affected soil.**

The overall aim was assessing replication whilst developing technical-scientific aspects. In order to do so, fertile soils were produced from degraded soils and alluvial sediments, converting an area of more than 100,000 $m^2$ into natural environment. An ambitious project of forest revegetation was planned which involved placing the newly produced reconstituted soil in such area and planting 3,000 trees and shrubs of varied native species with the purpose of studying their root development and growth. Thus, the plan achieved to restore a stable ecosystem with an elevated biodiversity.

The project developed two additional particularly ambitious issues which are currently the focus of attention of environmental and economic policies. The first is the creation of a perfect circular economy model by recycling large amounts of waste materials and restoring their production ability; the second is the production of a substrate suitable for agricultural and forest rehabilitation (Technosoil) without the use of additional soil, thus allowing to save the precious non-renewable resource.

# 3 Use of innovative technology and experiences prior to Life

In the process of reconstitution organic matter is incorporated and englobated within either the soil mineral fraction or an assimilable mineral matrix. The process takes place in parallel with aggregates destructuring. The final stage performs a targeted compression of disaggregated masses.
The treatment is a chemical-mechanical one and generates a final product whose characteristics and properties are different from originating matrices.
Following physical and chemical characterization of all materials involved, and specific planning of blends, the treatment performs a preliminary blending of components - namely soils and alluvial sediments - with additional materials and waste from industrial, agro-industrial and construction activities.

**Each waste material employed has at least one property of special relevance to agricultural soil. In fact, many of these matrix typologies cannot be used individually whereas, if they are conveniently measured prior to reconstitution they can be very valuable for the production of reconstituted soil.**

Picture of two types of waste materials

The treatment follows a sequence of consecutive stages where calibrated mechanical processes such as: disaggregation, cleavage, defibering, dissociation and polycondensation are performed in relation to the chemical-physical characteristics of involved materials. Following disaggregation and restructuring stages, a targeted compression is performed to enable the formation of new aggregates.

The first application was started on an unproductive land plot ranking between Class IV and V in land capability. Existing unfavourable conditions of the soil had been aggravated by former mining activities which had taken place at the site and had been followed by inadequate rehabilitation. Soil reconstitution restored the land plot to an excellent productivity, as assessed by research activities conducted by two experimental institutions whose final report, when mentioning the fertility of soils produced, reads as follows: 'As it was hoped, rehabilitation activities at this site have restored the soil to an excellent fertility level thus allowing cultivation of such demanding crop species as maize and avoiding over-fertiliza-

# 3.1

## Use of innovative technology and experiences prior to Life

tion'. As far as crop yields are concerned the same report reads: 'Reconstituted soils have produced, on average, ears by 21% heavier than those on natural soil' (Experimental farm 'Vittorio Tadini' Region Emilia Romagna). About fertilizers cost saving, it further reads: 'Results have confirmed the effectiveness of the treatment and demonstrated that reconstituted soil increases production levels while saving 50% on nitrogen fertilization' (Institute of Agricultural and Environmental Chemistry, Università Cattolica del Sacro Cuore, PC). And last, about saving on irrigation it reads: 'Reconstituted soils have preserved high production levels by saving 45% of water' (Institute of Agricultural and Environmental Chemistry, Università Cattolica del Sacro Cuore, PC).

Comparison of productivity between natural and reconstituted soil

# 4 Project partners – beneficiaries

The proposal NEW LIFE, supervised by the company Ecosistemi  who has devised the technology that joined partners interested in the project, stems from above mentioned successes.

ECOSISTEMI

The company Ecosistemi has the leading role in the project: it's the creator of the technology addressing the project NEW LIFE and owner of the patents for the innovative treatment of soil reconstitution.
The company runs its own research laboratories and develops studies dealing with applied technology issues  in the fields of: soil science, agricultural and industrial ecology and circular economy.

Ecosistemi was established in 1997 and is an expert in:

- theoretic and applied research on advanced pedotechnologies;
- implementation of projects and activities involving agronomic, environmental and forest rehabilitation;
- management of its own operating sites and plants for the production of reconstituted soil;
- development of circular economy models addressing agro-industrial symbiosis;
- research projects, chemical-physical and microbiological analyses.

# 4.1

## Project partners – beneficiaries

UNIVERSITÀ CATTOLICA del Sacro Cuore

Università Cattolica del Sacro Cuore is the most important catholic college in Europe. It's also the only university in Italy which can boast a role of national importance with its five campuses in Milan, Brescia, Piacenza-Cremona, Rome and Campobasso. Ever since it was founded in 1921 thousands of students have completed their degrees at Università Cattolica and have reached important positions in different career fields.
Being aware of its national and international prestige, Università Cattolica is devoted to the development of professional skills, cultural resources and life skills which are crucial for working with confidence and pragmatism and looking to the future which is already part of our present.

# 4.2 Project partners – beneficiaries

PROVINCIA DI PIACENZA

The Province of Piacenza is a local authority which has the role of coordinating all the municipalities within its administration area.

It's administrative functions embrace the following areas:

- territorial and economic development planning;
- rural development policy and infrastructure management;
- civil defence;
- environmental conservation of territory, flora and fauna;
- promotion of industrial activities, marketing, sport, innovation technology;
- policies supporting work, small businesses and artisans.

# 4.3 Project partners – beneficiaries



COMUNE DI PIACENZA

The Municipality of Piacenza is the local authority on whose territory the project was implemented. The administration, which has already been involved many times in European projects, has taken part in the project in order to identify rehabilitation technologies that may solve a number of problems in its territory. In addition, since the authority is also responsible for raising environmental awareness, it has coordinated activities to get schools and citizens involved.

# 5 Aims of the project

Essentially the project focused on demonstrating its technological feasibility on a medium-large scale by implementing soil rehabilitation in a severely degraded area.

The potentialities offered by the technology for the production of fertile soil generated from reconstitution were therefore assessed by operating on the ground cover of a vast area, where the soil produced was placed and then planted with shrubs and trees.

**The main aim of the project was assessing the effectiveness of the technology in countering processes such as soil degradation and desertification by using a method which performs disaggregation and reconstitution of employed matrices.**

# 5.1 Aims of the project

The project had to prove that the system could be replicated and was suitable for environmental, agronomic and forest application, that is was economically viable and that it allowed large-scale implementation. And finally, that it provided a useful method for recycling a wide range of waste typologies, thus participating in an extended circular economy vision.

Summing up the main goals were:

- proving the effectiveness of the technology in the production of a techno-soil suitable for agricultural and forest rehabilitation;
- verifying the excellent fertility of such soil and its environmental conformity;
- producing soil with an elevated content of stable organic matter;
- demonstrating that it's possible to recycle non-hazardous waste materials, thus offering an adequate alternative to traditional recycling methods;
- developing the technology toward the improvement of specific product qualities in order to advance soil treatment, placement and farming methods;
- implementing environmental rehabilitation in a degraded area close to desertification.

Sample studies were associated to above mentioned goals to provide scientific in-depth investigation, in order to improve knowledge in this field. Studies focused on the following issues:

- detailed framework of the agronomic properties of produced reconstituted soils;
- characterization of a wide range of waste materials which could be potentially suitable for reconstitution;
- identification of the most suitable pre-blends;
- plant responses assessment covering a wide-ranging spectrum of species; assessment of germination, root growth and development of different plant typologies on reconstituted soil;
- development of analytical lab methods suitable for waste materials and reconstituted soil characterization;

Such topics have been dealt with and illustrated in scientific publications and conferences, providing in-depth studies for institutions and academics.

# 6 Project description – Activities performed

The project was carried out by combining production and implementation activities with study and research activities.
The project area was a site with a severely degraded soil located on the right bank of the river Trebbia. The location, within the territory of the Trebbia River Park, is partially included in a Site of Community Importance.
The area covers the surface of a former landfill for solid waste which was started in the 70s and completed around the mid 80s. The soil covering the whole surface was a heterogeneous mass of different types of soils, rather shallow in thickness (less than 30 cm.). The condition of compaction and degradation was such that it didn't allow any re-naturalization process despite many attempts having been made over the years.

After performing detailed site characterizations, which included identifying the morphology of the area, soils conditions and phytocoenosis, the project moved on to planning stage which involved investigating the most suitable treatment conditions for soil production. This was done by means of laboratory testing and

Photo representing the site

in-situ field testing (experimental plots), which allowed to identify the methods for the production of reconstituted soil to be placed in the designated area.

After preliminary testing operations, on site soil underwent reconstitution treatment according to arranged procedures.

The soil produced was then placed at the site to cover an area of more than 10ha (100,00 sq.mt.).
The new soil layer, approximately 1 m thick, reproduced a fertile soil horizon. An accurate pedological investigation was carried out by dividing it into plots in relation to soil typologies, crop typologies etc..

Following maturation and stabilization,

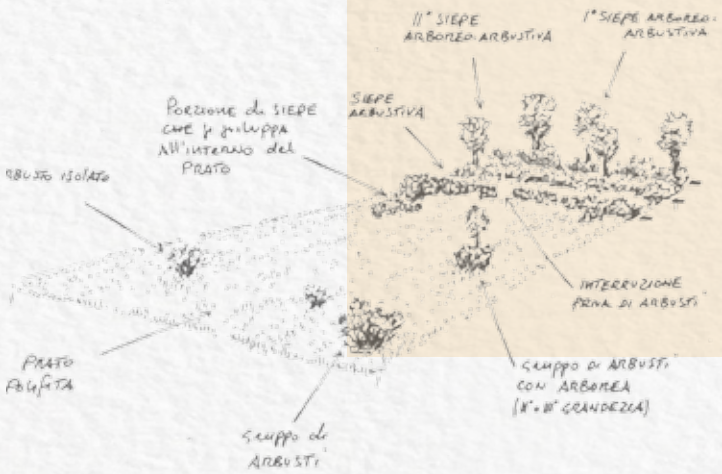
# 6.1

## Project description – Activities performed

which took six months, reconstituted soils were planted with shrubs and trees of native species.

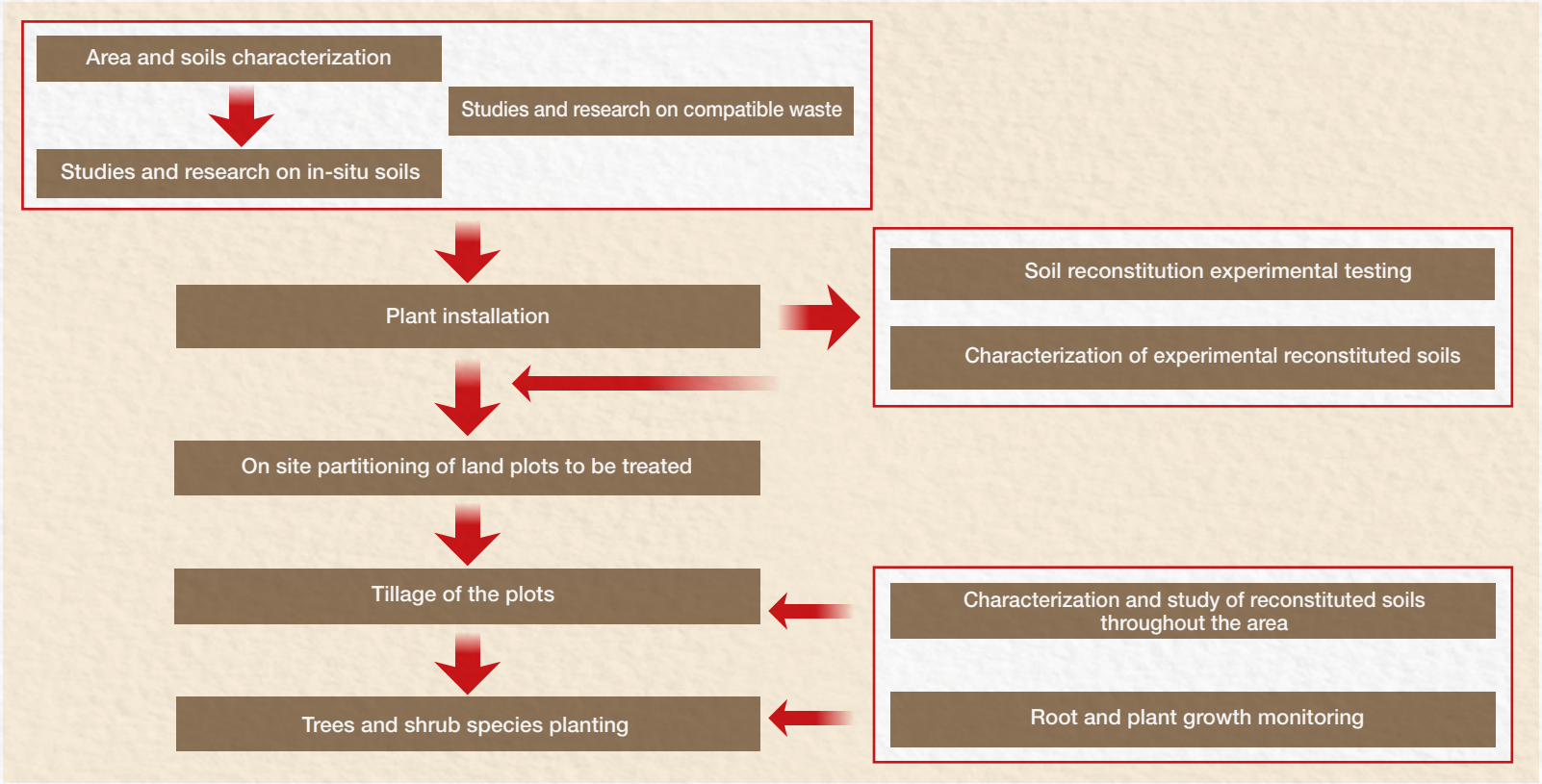


**The project involved planting native species of shrubs and trees in the area – large nurseries were supplied by plant nurseries – An associated study was carried out in order to assess germination and development of plant species that can be grown from seeds in reconstituted soil.**




# 6.2 Project description – Activities performed

Sequencing project actions



# 7 Results

All results directly related to the project are aimed at achieving previously set goals.

Rehabilitation has enabled to produce a fertile soil from degraded and low-quality ones, delivering a significant improvement of its properties and increasing thickness of the layer for root development. In addition, it successfully demonstrated that it's possible to produce fertile and mature soil by performing reconstitution of alluvial sediments.

The method examined enables to generate fertile soil from unproductive mineral matrices such as: degraded and sterile soils, sediments and inert sewage sludge.

The first agro-forest rehabilitation was carried out by using a soil generated from an innovative technology named 'reconstitution'.

More specifically, the rehabilitation of a vast area, has delivered an increase in stable organic matter supply and improved soil structure and porosity. The increase in water retention has favoured spontaneous colonization by grass species, thus allowing significant revegetation in the area; the organic substance occurs in the soil is in a stable humic form.
Rehabilitation of the area has created the necessary conditions for planting hedges, rows of trees and shrubs alongside with groups or isolated trees for an amount of more than 3,000 indigenous species.

The fertility of the soil produced has favoured a sharp increase in biodiversity.

# 7.1 Results

From a scientific point of view, the project has accomplished significant results by developing new information on soil degradation, on the processes which determine a decline in physical and chemical properties and on the relationships between these processes and spontaneous vegetation in the area. It has also developed new analytical methods for waste characterization, thus improving knowledge of analysis procedures aimed at identifying its agronomic and environmental properties.

Activities have enabled to extend the range of applications of the technology to other waste typologies that are often produced in large quantities and for this reason have very high disposal costs. In some cases they are even impossible to recycle and keep accumulating thus impairing the same production activities.

A wide range of production activities that generate waste materials, which are potentially useful for reconstitution technology

# 7.2 Results

and are aimed at fertile soil production, has been identified. Research has revealed great potentialities for recycling large quantities of non-hazardous waste materials which are maximized by reconstitution technology. Such matrices can be turned into a resource, thus achieving the creation of an innovative circular economy model.

To date, such waste materials, which represent a resource for reconstitution technology, have been a serious problem for producers.
Rehabilitation has demonstrated in concrete terms that the technology is suitable for converting waste into a raw material which in turn re-enters the production cycle, thus regenerating degraded sites.

**Soil samplings and phytosociology studies conducted during investigation activities at the rehabilitation site have produced an important herbarium to be used for scientific and educational purposes.**

**Important experimental protocols have been devised for reconstituted soil production planning.**

**The research carried out has outlined a condition of severe degradation in the area both from a pedologic and scientific point of view. Studies have produced a number of scientific publications which have contributed to the analysis of soil degradation processes.**

# 7.3 Results

It has been demonstrated that it's possible to produce a fertile and mature soil from the reconstitution of alluvial unproductive sediments and industrial waste.

By using reconstitution technology the project has tested a perfect circular economy process, which allows the regeneration of a non-renewable resource by means of waste recycling, and thus re-starts productivity.

The ecological restoration of the area has offered the opportunity for different species of vertebrates and invertebrates to find shelter and food.

A cyclic and continuous soil monitoring has shown the ability of reconstituted soil to preserve physical, chemical and microbiological properties.

# 8 Conclusions

The project has successfully demonstrated the viability of reconstitution technology by producing a fertile soil where a variety of grass, tree and shrub species have grown roots. Generated soils show an elevated fertility and a high environmental protection ability. The applied technology has shown that it can be useful in dealing with a number of problems - mainly, in countering soil degradation and desertification - by restoring barren land and degraded soils to a stable level of fertility. Such results have disclosed large potentialities for agronomic rehabilitation and enabled to recover useful land. The cost of these treatments is such as to allow possible implementation in a number of situations where the treatment wouldn't be economically viable.

The project NEW LIFE has shown that reconstitution technology can be used for the rehabilitation of large areas (greater than 10 ha) which have been compromised by erosion, anthropic activities, mining and overbuilding by implementing activities based on a circular economy model, and thus delivering a fertile and productive soil.

The high quality of soils produced allows to implement rehabilitation activities aimed at converting areas ranking in land capability Class VII, which is low, into excellent value ones ranking between class I and II. Such a result was never

achieved before and provides a solution for converting marginally productive agricultural areas into highly productive ones with enhanced environmental characteristics.

As the project developed, the technology has enabled to compare various aspects of applied ecology, thus revealing a great number of possible applications in contaminated sites remediation where reconstitution can acquire a significant role, especially as far as bioremediation is concerned.

Results from implementation activities have demonstrated the great potential offered by reconstitution in waste

# 8.1 Conclusions

recycling. Specific waste materials from industrial and construction activities can be massively recycled, thus providing precious alternative opportunities. The technology offers significant opportunities for recycling huge amounts of waste materials which are hardly ever used appropriately.

Such waste materials, like dredging sludge generated from dam sediments build-up, cause siltation of these resources which are precious for water availability. The technology offers the possibility to convert such sludge into fertile soil and make it available for the rehabilitation of degraded sites.

The technology proves to be a tool of global interest, as it can be applied to different geographic and economic contexts providing significant opportunities for the production of fertile and productive soil, for the benefit of environmental and economic prosperity.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