Proceeding the Economic Dimension of Land Degradation, Desertification and Increasing the Resilience of Affected Areas in the Region of Central and Eastern Europe (EDLDIR-2013). Mendel university in Brno press, Czech republic 2013, ISBN 978-80-7375-715-1.

Ecoremediation (ERM) as a Sustainable Approach to Environmental Protection

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ABSTRACT

On of Slovenia's environmental conservation goal is to preserve unique natural heritage and diversity of Slovenia's flora and fauna in the frame of Natura 2002 program. The objectives in the field of water are to increase the percentage of treated wastewaters. This includes point and non-point pollution sources. It is obvious that it would be difficult to ensure the setting up of expensive high technology solutions. Application of ERM methods offers the opportunity of fast adaptations to new legislative requirements. At the same time it represents an economically viable solution in less developed regions and for different pollution sources (agriculture, landfill leachate, motorway run-off) where treatment by devices that require complex operating processes and a constant source of energy is virtually impossible.

Taking into account the development of tourism, the size of communities, the present state of wastewater treatment systems, specific characteristics and economic situation of individual geographic areas and favourable climate conditions, the proposed technology could be applied in:

- areas of low population density where local communities do not have wastewater treatment systems;
- protected areas (natural parks, drinking water source areas);
- areas of diffuse pollution sources, such us landfills where leachate is not treated and its pollution potential is uncontrolled;
- Carst areas where underground water pollution represents a serious threat to the population due to poor self-cleaning capacity of underground water.

Ecoremediation system ERM systems do not require large investments. Arising from imitating nature, so they can immediately use in rural than in urban areas.

Key words: *ecoremediation, ecosystem, enivironmental protection, multi-purpose approach sustainable development.*

INTRODUCTION

The ecoremediation (ERM) concept relates to the application of sustainable systems and processes for environmental rehabilitation and protection. ERM methods may reduce and eliminate the consequences of natural disasters (floods, droughts, landslides, etc.), nonpoint pollution (agriculture, tourism, transport, industry, landfills and dispersed settlement). High efficiency may be achieved in the protection of living environment, water resources, streams, rivers, lakes, groundwater and the sea. The basic functions of ERM involve great buffer, self-cleaning and habitat creation capacities. The purpose of the introduction of ERM is to recreate the conditions specific to natural systems, the diversity of biotopes and preservation of ecosystem balance. The principles and guidelines of

sustainable environmental policy in Slovenia are laid down in the draft document on the environmental protection and Slovenia's Development Strategy until 2013 (Plut, 2004, p. 12).

In the world, and recently also in Slovenia, ERM has been recognised as a successful approach to the restoration of degraded environment and the protection of natural environment (Vrhovšek, Vovk Korže, 2009).

ADVANTAGES OF ECOREMEDIATION

ERM is a multi-purpose approach, enabling water retention, which has a positive effect on the stability of groundwater and the enrichment of habitats, increased biotic diversity and, therefore, the growth in biomass and improved self-cleaning capacity of landscape elements. ERM enables energy saving and even the generation of energy. In particular, the ERM methods have the following advantages:

- introduction and implementation of ERM methods do not involve large financial investment and they are environment-friendly (natural in functional and aesthetic aspects);
- their effects are multi-purpose (water retention, pollution abatement, restoration and creation of ecosystems and biologic diversity);
- they consist of simple, understandable and environmentally acceptable procedures;
- they perform functions supplementary to the already existing pollution prevention systems (tertiary treatment at farms, food industry and at the discharge of cesspools and Emsher tanks);
- they enable treatment of drinking water and recycling water (for irrigation);
- they prevent fast drainage;
- they create mitigation (buffer) areas (air barriers) and
- they include vegetation zones and wetlands before the outflow into standing waters.

In addition, ERM have an important educational role as they contribute to the understanding of the functioning of natural systems, the processes in the nature and the environment and the monitoring of processes (water treatment, retention of heavy metals in soil, noise mitigation). Education is of vital importance to the future society, as it is expected from the public to change their way of thinking and understanding the functioning of nature. ERM are an ideal learning environment for the observation of natural processes in the environment for schools as well as for the general public (www.ucilnicavnaravi.si).

The most important advantage of ERM is its multi-purpose aspect. In practice, the applied ERM exits if the form of constructed wetlands, sustainable remediation of landfills, coastal vegetation zones – mitigation areas, river branches, artificial wetlands, noise and/or dust barriers, phytoremediation of polluted sediments, soil treatment, drinking water treatment, tertiary treatment and treatment of hazardous waste water, revitalisation of water courses, etc.

Picture 1. ERM artificial lake is the financial cost 10 times less than the conventional rules of construction materials (photo Ana Vovk Korže, 2012) .

Financial comparison (strengths and weaknesses) of ecoremediaton

The existing ERM systems have proven that the maintenance cost of ERM systems is far lower than in the event of conventional approaches. Namely, ERM utilises the energy of the environment and integrates it appropriately into the functioning of the environment as a whole. In particular, the essence of sustainable management is preventive environmental protection, which implies saving due to reduced negative effects that would otherwise result.

The article takes into account the input data on the present state in Slovenia, which indicate that the state of some environmental elements has been deteriorating (groundwater). In addition, natural disasters have caused huge material and moral damage. It has been observed that the present approaches to protection and remediation of the environment are insufficiently consistent with natural possibilities and the needs of local population. Initially, there may arise a problem of inadequate knowledge of ERM as a system for preservation and remediation of natural environment and water resources (Leser and others, 2005).

DISTINCTIVE STRENGTHS OF ERM APPLICATION ARE:

- development potential directed to sustainable development of all activities in space;
- complementary possibility of sustainable elimination of environmental damages and establishment of contacts with various stakeholders;
- multi-purpose – each ERM has at least four basic functions;
- long-term effectiveness – financial stability (saving) and increased environmental effectiveness;
- public participation in environmental protection systems;
- education and training;
- development and an incentive to scientific support;
- simple construction and maintenance of ERM;
- employment (also of people at a disadvantage);
- preservation of nature and biodiversity;
- sustainable use of natural resources;

- mitigation of catastrophic effects of natural disasters;
- rational environmental management, in particular of water;
- restoration of degraded areas;
- incentive to regional development (Falkermarkt, 2003), where ERM approaches represent a mechanism for obtaining grants and refundable means from Ministries, public funds and agencies as well as from European Funds.

Considering the global effect, ERM may play a considerable role also in:

- renewable energy sources (wood biomass, biodiesel, electric power);
- production of specific natural products;
- binding of CO_2 to wetland systems and biomass;
- education and research in the field of environmental technologies and environmental innovations;
- harmonised environmental policy and
- economic development and social security.

WEAKNESSES AND THREATS OF ECOREMEDIATION

The ERM systems takes into account the input data on the present state, which show that the environmental situation has been deteriorating (e.g. groundwater). In addition, natural disasters cause huge material and moral damage. It has been observed that the present approaches to protection and remediation of the environment are insufficiently consistent with natural possibilities and the needs of local population. For this very reason, the proposed project has all the elements for efficient realisation.

Initially, there may arise a problem of inadequate knowledge of ERM as a system for preservation and remediation of natural environment and water resources. However, we have been solving it by organization of professional training of various target groups, educational programmes and public round tables.

Some additional difficulties may be caused by certain lobbies and the advocates of classical systems of remediation and treatment of waste water for which, in some cases, ERM represent undesirable competition due to favourable price. However, it must be pointed out that ERM may efficiently help in remediation and environmental protection where the extent of environmental effects is so large that ERM alone cannot solve them satisfactory. In such cases, classical methods are still needed (however, it should not be overlooked that large environmental damages happen for the very reason of unilateral classical “arrangements”). It has been observed in the world that complementary cooperation is a very efficient approach due to cost-effectiveness and landscape/social aspects. On the basis of these facts, it would be possible to attract the general public and avoid getting into the problems of refusal of any cooperation.

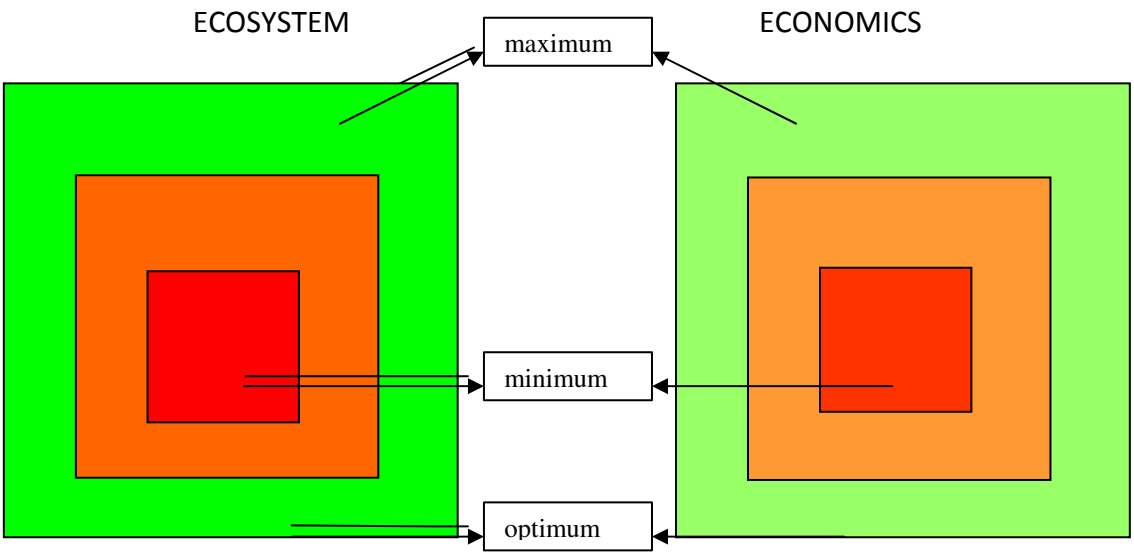
ERM has been accepted as a system of environmental protection and remediation (treatment of waste water and drinking water) also in Europe. In order not to repeat a mistake of some years ago when foreign knowledge was uncritically brought to Slovenia, now there exists a possibility (and requirement) to develop own knowledge useful in specific Slovenian circumstances and this Europe cannot provide.

TOLLERANCE BORDERS OF ECOSYSTEM AND HUMANBEING

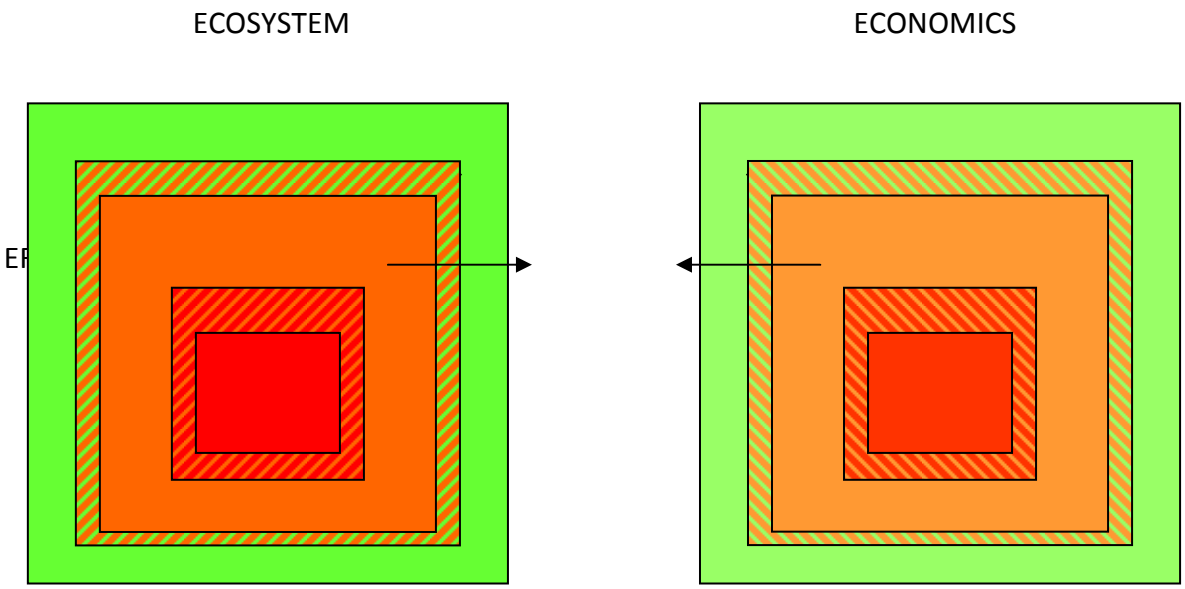
Every ecosystem has its own optimal conditions where it is in a kind of dynamic balance (Wilfing, 1993). Of course it has a lower and upper tolerance limit that is defined by the constitution and function of ecosystem. Every change as for natural as well as human impacts on upper or lower tolerance limit can destroy ecological balance and ecosystem changes or is degraded in another dynamic balance or ecosystem with different structure and function.

Using ERM it is possible to mitigate the consequences that originate from the ecosystem and so to reduce the differences at tolerance limit of ecosystem as well as economical calculation of human impact.

Scheme shows tolerance limits of ecosystem as well as tolerance of economical impacts Changes at one as well as at another must range limits of orange colour (optimum).



Scheme 1: Ecological and economical tolerance limits



Scheme 2: Tolerance limits by using ERM

As it is shown in scheme 2, the tolerance can be changed with ERM to a certain limit by not destroying ecological balance. With right measures it can also be increased, increase water retention, selfcleaning capacity and biodiversity or protect endangered species and habitats (Lah, 2002). On the other side with these kinds of measures we can enable bigger economical usage of the one that interferes with ecosystem.

THE NEED TO AN INTEGRAL APPROACH

Today it is put out that from the side of developmental needs it is important to reestablish policy and suitable programmes of water management aiming to assure enough water quantities for usage that includes suitable technologies for rational water usage as well as measures for loss reduction. For increased water disposability of suitable quality water, the essential importance is on protection and renewal of ecosystems like rivers, wetlands, forests and soils that using natural way of capturing, filtering, nourishing and supplying water (Bailey, 1996).

The main purpose is multipurpose and co-natural managing with water streams, lakes, wetlands, which contributes to symbiosis of human being and nature and mitigates natural disasters, if they happen. Because of that ERM are economically, ecologically and in long term one of the most successful ways of environment protection nowadays.

We forecast that in next decades the landscape changes will increase due to the growth f population, globalization, industrialization and efforts to demolish poverty and famine. Because of that it is urgent to introduce environmental approaches with the right integration between elements already connected to each other.

Not connecting existing knowledge as well as administrative institutions reflects in limited expectations of different expert groups and represents intellectual heritage from the times of French philosopher Descartes from the 17th century. Physics understand most of all physical phenomena, chemists chemical phenomena, biologists biological phenomena. Because the views of these

different groups differ a lot, they have big problems communicating, also with policy makers, so it is hard to reach a unified understanding of dilemmas concerning human environment.

CONCLUSION

Water, food and raw material that assure the survival of human kind originate from natural environment that surrounds human settlements. These sources can not be exploited without changing the landscape (digging wells, drain water into canals, constructing reservoirs, contracting natural vegetation for cultivation of land, contracting forests for wood, levelling of ground) and these kind of changes are a disturbance for those ecosystems. Because there was need to grow more food for growing population, people used fertilizers at first, but later herbicides as well. These impacts had Harmful side effects for the environment (eutrophication, water pollution, water retainance, soil and water salting). Some of the side effects can be avoided; the others are difficult to abolish. In the ontogenesis of ecosystems the ones have developed, which are adapted to the most unpleasant factors. In there live organisms that can not be found anywhere else. These conditions are nowadays made by men with his activities that often mean a deviation from nature.

Ecosystems have a big puffer capacity and can with natural processes retain, treat or neutralize many organic and anorganic pollutants. ERM use natural processes in natural and partly artificial ecosystems to ensure better usage of water sources, for elimination of harmful pollution impacts and preservation of biotic diversity. Renewal of devaluated ecosystems using ERM means besides more stabile natural systems as well better state of natural elements in living environment, which improves human's and other living creatures' lives. Above all they offer big educational and pedagogical possibility, which is perhaps more important than technical effect. Natural sources are already exploited and because they are limited we are obliged to protect and repair them as long as it is possible.

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