Mitigation of impacts to achieve ICZM via promising technologies

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Abstract

This article describes the method of approach for the mitigation of the impacts in coastal zones by using sustainable and innovative technology options. Promising technology alternatives are investigated and systematic information associated with the various features and levels of impacts is provided. A technology option search tool is developed. Implementation examples are carried out for specific environmental issues of the study sites.

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Introduction

Coastal zones (CZ) are vulnerable and liable to degradation more than inland areas. CZs worldwide occupy less than 15% of the earth's land surface. On the other hand, CZs house more than 60% of the world's population. Up to 80 % of tourist stays in CZs during the period of May to September when water availability is at a minimum level causing further water stress (EEA, 2009). Hence, the demand for environmental and water quality standards are often high in CZs. This issue moreover leads to divergence between the requirements of industry, agriculture, tourism and the environment. CZs are addressed as major European water problem and among the generic research pilots to achieve technological development in WSSTP. The importance of the European coastlines regarding to wildlife, economy and human health and well-being along with the multiple pressures, including habitat loss, degradation, pollution, climate change and overexploitation of fish stocks are emphasized in the EEA (2010) report. The hazard caused by pollution to the coastal and marine ecosystem is also recognized. The phenomena, includes changes in temperature systems and, discharges of toxic effluents and nutrients,

> *Directives relating the WFD*
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> - *The EU Water Framework Directive - integrated river basin management for Europe*
> - *Strategies against chemical pollution of surface water under the WFD including Priority substances as well as the Discharges of Dangerous Substances Directive,*
> - *Water pollution from urban waste water and certain industrial sectors,*
> - *The quality of bathing waters in rivers, lakes and coastal waters,*
> - *Ground water,*
> - *Chemical pollution of surface water,*
> - *Flood risk management*
> - *Marine Strategy, including a proposal for a Directive on the protection of the Marine Environment.*

irrevocable water consumption and damage to the water organisms.

In this manner, we have responsibilities to protect and build up sustainability through implementation of innovative technology. Development of methodologies to lessen the pollution for the industrial and domestic discharges for the point and non-point sources of pollution including surface run-off and agricultural activities and transport, development of wastewater discharge criteria based on the self purification capacity of CZs are crucially needed. Water Framework Directive (WFD) establishes a framework for water policy based on the principle of integrated river basin management.

In addition, climate change has adverse impacts on CZs. Climate change impacts were identified in WFD. Climate models envisage precipitation increase in northern Europe and a decrease in southern Europe. Several parts of Europe may experience drier summers (EEA, 2008, IPCC 2008). River flows are expected to decrease in southern and south-eastern Europe and increase in northern and north-eastern Europe. Some river basins may suffer 10% or more decreases as compared to today's levels by 2030 in Mediterranean region. Since, the pressure on water demand is quite high in CZs in Southern Europe, the reduced surface water during dry periods and reduced groundwater recharge will increase the pressure on groundwater significantly (EEA, 2007).

The existing approach of waste management in industrial culture prevents the reuse / recycle of water and wastes causes harm in CZs. In the current system of waste management the perspective of long term scheduling is habitually uncared. The energy and material resources follow a pattern of linear flow and resulted in generation of unlimited sinks for wastes. However, the concept of industrial ecology operates in cycles for the system components (Korhonen et al., 2004).

Integrated water resources management (IWRM) involves simultaneous consideration of social, environmental and technical aspects. Encouragement of IWRM supports municipal wastewater reclamation, implementation of decentralized management for household and small settlements, mitigation of non-point sources of pollution from agriculture and urban run-off, practicing cleaner production (CP) concept and the methodology for industrial sectors and at each stage focusing on development of innovative water resources and decreasing the impact of human activities on the environment.

Solutions proposed

The goal of integrated management may be managed by combining, centralized and decentralized systems to achieve ecological sanitation in harmonized way to mitigate pollution and to protect/develop water resources. In accordance with the Bellagio Principles, as an alternative to the present centralized decision making and service supply, the restoration of the broken cycles such as water, energy, carbon and nutrients are proposed. If this approach is applied to all sectors in an integrated way it would lead to the innovative development to alleviate the degradation and the level of pollution in CZs. The concept refers reducing waste transfer across virtual circle boundaries by minimizing waste-generating inputs and promotion of maximum levels of recycling hence, helping the processes of closing the cycles.

Advances in the WW treatment technologies have improved the potential to reuse the reclaimed water by achieving water quality regulations (US-EPA guidelines, WHO guidelines for water reuse). Treated wastewater can serve as an additional source as well as water quality protection and pollution abatement requirements can be achieved.

Climate change impacts – project examples

- *Aquastress*
- *TECHNEAU*
- *WATCH*
- *CLIMATEWATER*
- *SWITCH*
- *ENSEMBLES*
- *PREPARED*

Industrial pollution is mainly tackled through the implementation of the EU Directive on Industrial Pollution Prevention and Control (EU IPPC Directive). In this manner, applying Best Available Techniques (BAT) and the relevant reference documents (BREF) principles on most promising beneficial industry sectors, to control pollution media is indispensable.

Along these lines, various levels of mitigation measures associated with environmental, ecological, economical and social concerns focusing on different human activities (HAs) may be acquired. The scope includes a range of waste management technologies, LCA based approach, implementation of CP alternatives for industry relevant for the SSAs, implementation of SWM concept alternatives for domestic wastes, sustainable solutions for the impacts due to transport activities, erosion and surface run-off. Moreover, implementation of representative case studies accomplished to show the methodology undertaken and the socio-economic and environmental benefits obtained from the approach to promote integrated coastal zone management (ICZM).

Methods

Assessment study was accomplished based on the main issues encountered in SSAs in SPICOSA. Their impacts are classified taking into consideration basically HAs and natural sources. In accordance with the phases and the nature of the associated risks the TOs are proposed in diverse manner to reach the sustainable and efficient solution. The main strategy is to avoid the impact prior to the impact becomes evident and damaging, to consider the options for reuse and recycling of wastes in the first occurrence. It is presumed that waste is not a waste but something that can be processed to form a valuable product or raw material.

The TOs are intended to present smart, effective, easily applicable, cost-wise and best practical selections for the SSAs to achieve ICZM. These options could be established into the simulations to form a Decision Support System.

Agricultural activities and domestic sources of pollution are considered to be the fundamental sources of eutrophication in water and coastal waters ecosystems. Hence, the assessment study is focused on nutrient removal and, in some cases environmentally sound nutrient recycle technologies for various forms point and non-point sources of pollution.

Water management - project examples

INNOWATECH - treatment of industrial wastewater
aquafit4use – sustainable water use for industry
Zer0-M – Zero outflow municipality,
AQUAREC – integrated concepts for reuse
EU MBR projects network (AMEDEUS, EUROMBRA, MBR-TRAIN, PURATREAT)
MEDAWARE- urban wastewater treatment and reuse
EMWATER - treatment and reuse in the Mediteranean countries
ADIRA – autonomous desalination
AGRINET – sewage sludge projects
SUSAN - sewage sludge
GloBallast – ballast water management
MAFCONS – fisheries

Common industrial activities are classified for the SSAs. Moreover, sustainable and feasible solutions are proposed. Special attention is given to the application of Cleaner Technologies and LCA approach so that not to allow waste generation rather than costly treatment. The proposed technology options (TOs) provide basic design criteria. They are classified in three different levels (avoidance, mitigation and rehabilitation measures), considering timing of the remediation action to be taken, level of prospective effort to be provided, stage and the current and potential importance of the deterioration to be faced. At each stage, existing EU laws and regulations, standards, criteria and limits are taken into account, especially focusing on EU water/wastewater regulations and recommendations and implementation examples and references for ongoing or realized EU relevant projects are presented.

The TOs search tool was designed, based on the information collected from SSAs to provide specific solution alternatives. The tool sets basic technical criteria on the innovative technical implementation options. In this manner, HAs including industrial activities, urbanization, urban and agricultural run-off, sludge, agriculture, aquaculture, fishing, air pollution interactions, transport activities, tourism, land use/planning, climate change impacts, water scarcity, natural sources such as erosion, salt water intrusion, were listed and explored. Though, the tool sets criteria and facilitates technical staff and decision makers for the selection of the TOs to mitigate impacts for ICZM, it does not formulate precise judgment for sizing and feasibility of the proposed instruments.

Results

*Using the TOs tool and the relevant TO prototype document assessment study was conducted as implementation examples for 3 SSAs, **Mar Piccolo, Izmit Bay and Pertuis Charante** (links may be provided to assessment sheets for each SSA and scenario-SPICOSA page). The scenarios, depending on the problems, include,*

- *designing/planning or upgrading of urban wastewater treatment plants to achieve reusable streams to be used mainly for irrigation (it would help mitigation of water scarcity and conservation of valuable water resources),*
- *surface run-off collection and treatment within catchment basin to mitigate non-point source of pollution to receiving waters and to provide irrigation water,*
- *management of animal wastes by anaerobic digestion and/or composting processes to obtain energy and natural fertilizer.*

The phases of TOs assessment study are, assessment of existing conditions, determination of the needs, data collection, selection of TOs to be implemented, design and feasibility study for the proposed options and cost-benefit analysis, using the levelized cost assessment approach by taking into account environmental benefits, economic benefits and in turn potential social benefits and calculation of pay-back period for the investments accordingly (Fig. 1-2).

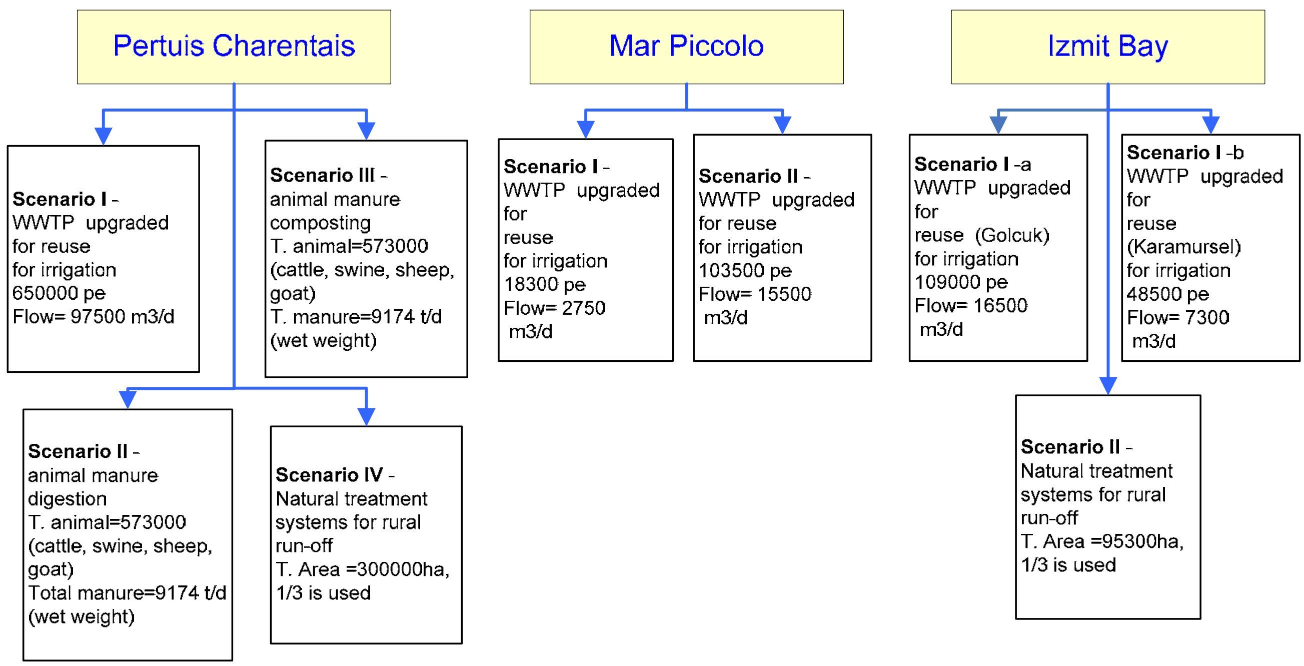
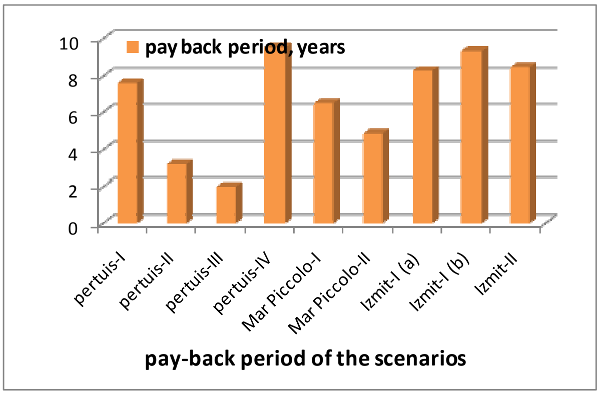


Figure 1. TOs scenarios



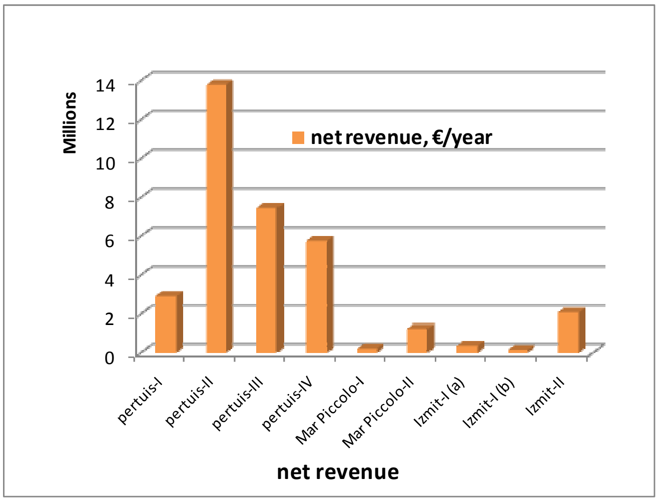


Figure 2. TOs scenarios – cost assessment

Conclusions

The implementation studies relieved that ICZM is attainable by reducing pollutant loads, water consumption and energy or production of other valuable material from wastes in a rational way. The calculated pay back periods for the investments turned out to be in the range of 2-9 years for all cases, which may be considered as reasonable along with the other environmental and social profits gained. It is noted that, the net revenue obtained increased or pay-back period decreased, with the escalating scale of the implementation carried out.

Hence, the presented methodology for the selection and implementation of appropriate TOs may provide a base for the policy options to reach the objectives within the SPICOSA SAF approach. The TOs would not only offer alternative solutions for the specific problems of SSAs in SPICOSA but can be supportive for the relevant cases in another locations and circumstances. TOs are expected to offer innovative and integrated alternatives that were not considered or implemented for the CZs in question. TOs in SPICOSA can be used as a DST in such a way that allows continuous modification and improvement with the changes of conditions, environmental and socio-economical pressures.