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Environmental Protection Based on Waste and Water Utility Service Management*

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1. Introduction

Technological solutions that are presently used in waste and water utility service management in Croatia require sizeable initial investments, incur high maintenance costs, and are always presented to the public and to the decision makers as the best option for the environment, with no alternatives available. Besides that, by approaching the European Union, Croatia is assuming significant commitments with regard to solid waste and wastewater management, while at the same time it must provide for protection of its enormous natural resources and healthy environment.

On the other hand, no integrated analytical approach has been conceived concerning management structure and performance of utility service management of water resources and waste disposal under the specific conditions of a Mediterranean region in a country in transition.

Research to date comprised only particular segments of the complex environmental protection issues, without taking into account mutual interactions of all the segments

Original scientific paper

The paper analyses the impact of water and waste utility service on the environment, presents the state of utilities sector analysing the interactions resulting from human activity in a conventional setup of utility services management, and the flows in local loops scenario, specifying feasible technological solutions. Data concerning utility service management in the Republic of Croatia are provided. Research of the environmental protection model based on waste and water utility management is presented which is elaborated so as to provide the review of present state, specifying major problems, challenges, possible technical, regulatory, institutional and educational solutions, as well as concrete measures.

* Defended Doctoral Thesis (2010)

Zaštita okoliša utemeljena na komunalnom gospodarenju otpadom i vodom*

Izvornoznanstveni članak

Rad analizira djelovanje na okoliš komunalnog gospodarenja vodom i otpadom, daje pregled stanja komunalne djelatnosti analizirajući međudjelovanja na koja utječe čovjek u konvencionalnom ustroju komunalnog gospodarenja, te tokove u infrastrukturi s lokalnim petljama, uz moguća tehnička rješenja. Iznose se podaci za komunalno gospodarenje u Republici Hrvatskoj. Razmatra se model upravljanja zaštitom okoliša utemeljen na komunalnom gospodarenju otpadom i vodom, koji pruža pregled postojećeg stanja, navodi ključne probleme, izazove, moguća tehnička, zakonodavna, institucionalna i obrazovna rješenja, te konkretne mjere.

* Obranjena doktorska disertacija (2010.)

of utility service management: water supply, sanitation and wastewater treatment as well as municipal waste disposal. That is because waste producing processes have always been considered and structured linearly. Likewise, the utilities sector in Croatia was until recently not paid particular attention, from either the public or science community, thus creating a need to study those issues integrally and from scientific perspective whereby solutions may hardly be comparable as each particular locality has specific features that should be respected, and a unique recipe is not applicable in the sense that any copy-paste solution would give rise to crisis of the entire receiving operator's system.

The paper provides the model of environmental governance articulated in putting forward the new approach to utility service management by contemplating the integrity of threat to the environment from technical and governance aspect of utility service management as well as in elaborating the proposal of concrete reform of management of water supply, sanitation, and municipal waste disposal.

2. Utility service management and environmental protection

Environment is a classical example of a policy field that infuses all others, where the targets and language are easy to adopt but achieving them is much more complex [1]. Thus the environment can not be protected insofar as its protection is not approached in an integral manner, considering simultaneously the protection of all its components. Likewise, resolving the problem of protection of public health, without considering the receiving capacity of the environment, has a boomerang effect in terms of space and time. For instance, the end 19th century centralized sewage solutions considered standard to date have been and are severely threatening drinking water sources [2], the sea, and the soil and air when considering disposal (landfilling or incinerating) of sludge from such centralized systems in which wastewaters originating from various sources mix, very often even from industry. Concurrently, enormous quantities of drinking water and electricity are used for transporting nutrients-rich black water over great distances, resulting in decomposition and unpleasant smells. On the other hand, rain falls on the roofs and washes them and all the impermeable municipal surfaces. Thereby it also becomes wastewater, without previous use, and very often, untreated, find its way to water bodies. Furthermore, water resources are not only naturally heterogeneous geographically and time-wise, but are also endangered by climate changes and physical interventions by man in the environment (land clearing, construction, etc.).

What the author perceives as being common to both solid waste and wastewater management is that basically everything is blended first, and then enormous resources and effort are wasted to separate such a mixture, with dubious success. The prevailing and established methods of waste and water utility service management, the flows of which are presented in Figure 1, are in the author's opinion unfriendly for the environment although they are considered and go under the name of environmental services. Namely, they are conceived in such a way that waste (solid, liquid) is only transferred elsewhere, thus jeopardizing the ecosystems which then directly or indirectly also affect the ecological state of the site (water, soil, air, nature) where the waste actually originated. Therefore, making utilities sector perform the function of protecting the environment, calls for substantial changes of established patterns, valid rules and perceptions.

The present situation is in no way the result of necessity, but solely of the fact that patterns of behaviour whose shortcomings are identified now when the situation has turned critical, have prevailed for years. At the same time it is necessary to invest in renewal of the now worn-out sanitation systems and in their construction in unsewered areas, in cities which are otherwise burdened with increasing quantities of waste, both at landfills and incinerating plants which both in a certain way damage the environment. On the other hand, there are smaller communities which are, for the most part, not covered by organised water and waste management schemes.

Therefore, the utilities sector, if it is indeed to protect the environment, is in reality confronted with problems

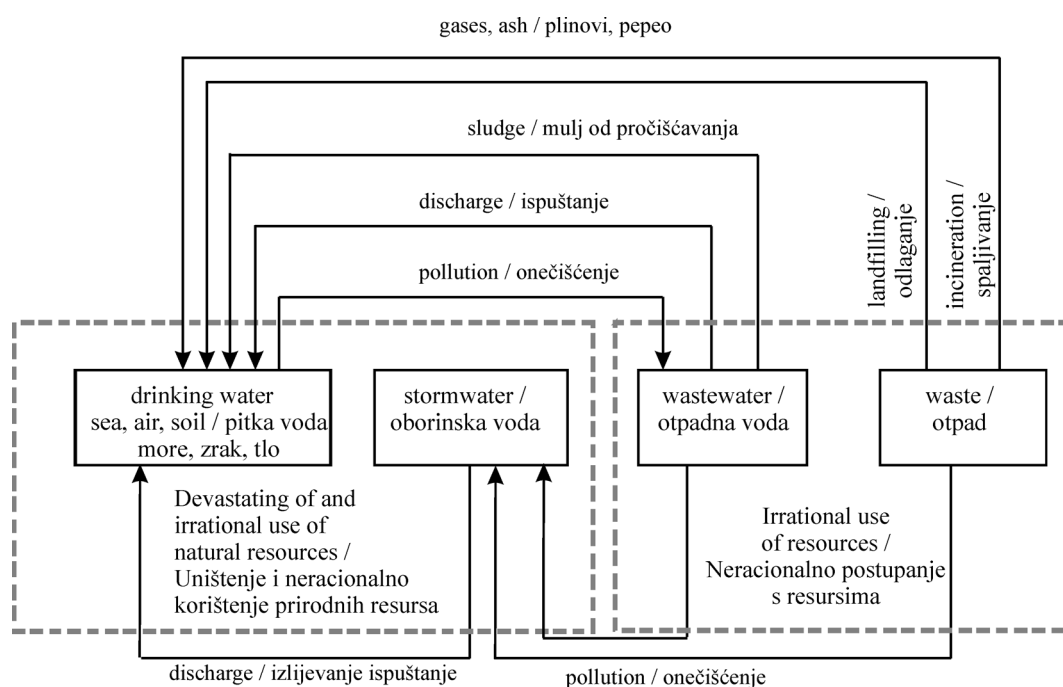


Figure 1. Interactions resulting from human activity in a conventional setup of utility service management

Slika 1. Medudjelovanja na koja izravno utječe čovjek u konvencionalnom ustroju komunalnog gospodarjenja

the resolving whereof goes beyond the very context of the sector, but impinges upon the issue of established patterns of behaviour, investments, interests and know-how.

3. The significance of local level in environmental governance

There were 172 nations attending the Earth Summit in Rio de Janeiro in 1992 who sustained the principles of environmental governance on the occasion of signing Rio Declaration on Environment and Development, a charter stating 27 principles for steering the global community towards sustainable development. The problem in implementing such principles of good governance is not their novel character, but the fact that they question the traditional governmental institutions and economic practices. Namely, the decisions concerning the ecosystems and natural resources are often made far from the very resource, by persons whom local context or knowledge on local impact of certain decision is not known. Sometimes it is better to allow local communities to issue decisions regarding the resources surrounding them. Relying on local know-how may very often result in making the decisions which serve ecosystems and people better. On the other hand, local governance is not necessarily appropriate or practical in all cases, so that agencies above local level must intervene. Generally speaking, appropriate level for decision making is determined by the scale of natural system governed [3].

The author holds that people are much more willing to decide jointly on natural resources management when their personal experience and know-how are involved and local resources concerned with that local knowledge on upgrading the environment must not be underestimated. It is also important to point out that there is no unique route for communities to follow on their path to sustainability.

4. Feasible technological and management solutions

In the integrated resources management model [4] the infrastructure should be designed in harmony with nature, so as to maximize net revenue from recovered resources, thereby minimising the expenses for taxpayers (instead of minimising the waste management costs). The model incorporates water supply, liquid and solid waste management systems, energy supply, transport, land use and building projects in an integrated approach to urban planning. The components of integral resources management are not new, but the model integrates them in a novel manner with a view to generating revenue and restoring the ecosystems. Sound ecology may only be based on sound economy and vice versa.

The objectives of sustainable water utility management should be environmental compatibility in order to avoid and reduce the pollution of water, air and soil, flexibility as the systems must be adaptable to variable conditions (time, place, performance or duration), cost reduction of the entire system (including supplementary investment costs) and transferability of solutions to other communities [5]. Figure 2 shows the flows in «local loops» which entirely abandon a centralized water supply and sanitation. Decentralized systems for a single or a group of houses provide potable water from rainwater and technological water obtained by recycling water of various qualities. Faecal matter and organic waste are used as raw material for decentralized production of biogas.

Developed countries are sometimes in a less beneficial position with regard to developing countries in that investments made in their conventional systems render difficult their transfer to new approaches, while regulations with regard to water, storm water and wastewater are mutually incoherent and concentrated on performance of wastewater treatment plants only. Managed decentralized systems can facilitate certain areas to develop without supplementary investments in expensive treatment capacities [6].

Smaller communities in particular are confronted with specific pressures and wastewater solution options. It is necessary to decide whether to have on-site systems such as septic tanks or switch to municipal sewerage. The following solutions are feasible:

- On-site systems in which wastewater is treated and returned back into the ecosystem within the limits of locality where it was produced,
- Cluster system for two or more houses,
- Centralised system where all wastewater is collected at its source and then transferred (through sewer pipes) to a central treatment site,
- Simplified or condominium sewers which redefine a unit that is being serviced, similar to connection of a multi-story building, except that in this case the condominium is physically horizontal and institutionally informal.

Individual management of on-site systems by households is increasingly under scrutiny of public health agencies. It is commonplace to claim that septic tanks and other local systems are badly managed.

The US Environmental Protection Agency (EPA) established five management models [7] for increasing management control in function of treatment system complexity and/or environment sensitivity. Models shown in Table 1 could be adopted by local governments, utilities, and other entities.

As regards municipal solid waste, the market is not dominated by criteria which favour environmental

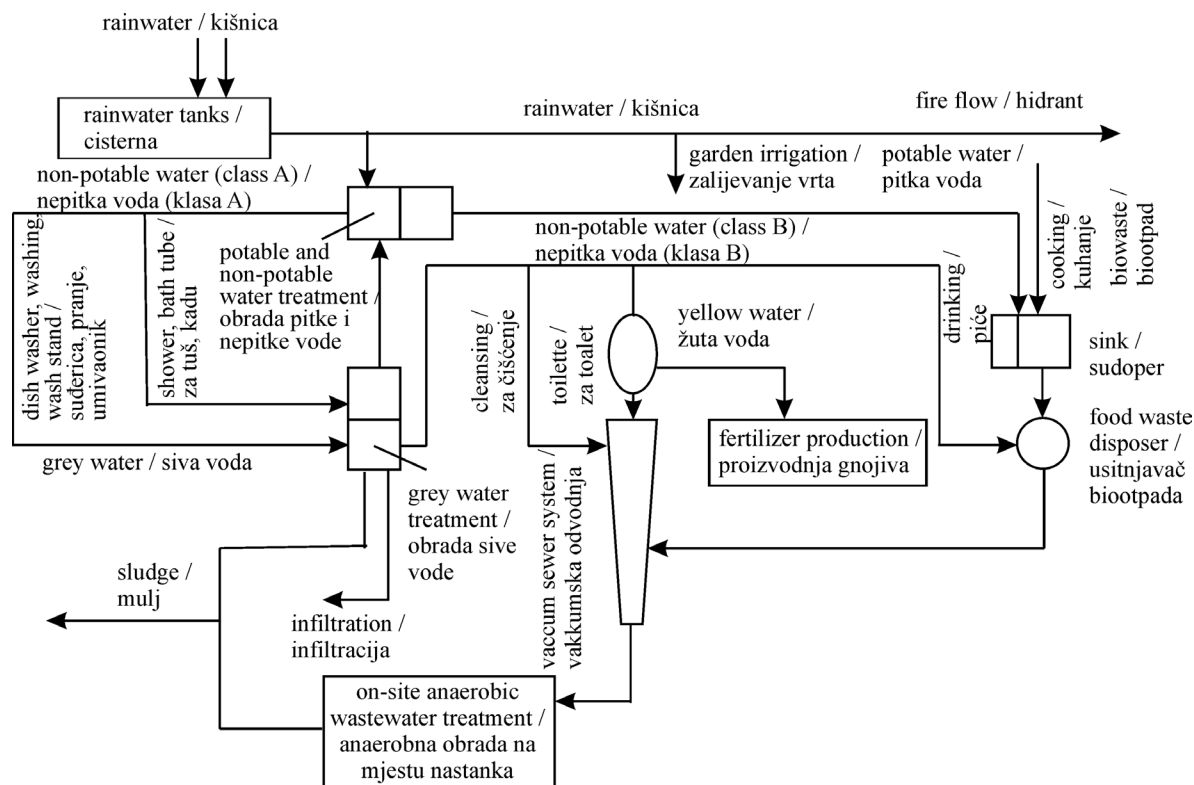


Figure 2. Flows in local loops scenario [8]

Slika 2. Tokovi u infrastrukturi s lokalnim petljama [8]

benefits, but economic benefits which in the interest of marketing impose production processes and distribution procedures based on excessive packaging and consumption of products for disposal, instead of their minimisation and recovery [9]. Over the last decades environmental regulations focused on controlling pollution from individual facilities with no regard to pollution arising at other stages of product life cycle. Under this limited view of environmental responsibility, solid waste management has been the responsibility of the individual householder or the local government. As solid waste burdens have increased and more stringent disposal regulations have made solid waste management more expensive, the budgets of local governments have been stretched thin, and local taxes have been increased. At the same time, the siting of solid waste facilities has become a major political battleground. Local governments have been saddled with the responsibility for a problem that is not of their own making and about which they can do little on their own to prevent [10].

The strategies available for sustainable municipal waste management are the following:

- Zero waste strategy
- Reduction at source
- Pay-as-you-throw
- Extended producer's liability

Current chemical-energy modernisation uses simple flows and complex treatments and is organised around the stages of disposal. Waste minimisation through eco-modernisation, on the other hand, depends on complex flows and simple or specialist treatment. It is organised around material streams and creates a circular flow of separate materials as an alternative to the linear flow of mass waste. Its central concept is the "closed loop". As a result, the innovations of eco-modernisation are in collection systems rather than high tech plants. The large enterprises, with finance and system-wide skills, find it difficult to produce the grassroots skills required for smart waste management. Small enterprises have, up to now, lacked the systems organisation to deliver large contracts. And municipal authorities have been torn between the old world and the new, unable to move financially along a path to which they aspire. Experience suggests that new systems depend on strong government commitment as regulatory structures lay down the direction of the industry. But government itself is often caught in the net of the old order since large capital-intensive solutions and centralised bodies are easier to deal with than a population of small firms. This is a big obstacle to changes that depend on diversity and multiplicity [1].

Table 1. Management models for decentralized wastewater systems**Tablica 1.** Modeli za upravljanje decentraliziranim sustavima otpadnih voda

| Level / Razina | Management model / Model upravljanja | Description / Opis |
|----------------|---|--|
| 1 | Homeowner awareness / Svijest vlasnika kuće | Specifies appropriate program elements and activities where treatment systems are owned and operated by individual property owners in areas of low environmental sensitivity. This program is adequate where treatment technologies are limited to conventional systems that require little owner attention. To help ensure that timely maintenance is performed the regulatory authority mails maintenance reminders to owners at appropriate intervals. / Predviđa program i aktivnosti kada je vlasnik i operator sustava jedini vlasnik parcele u područjima niske ekološke osjetljivosti. Ovaj program je primjeren kada su tehnologije obrade ograničene na konvencionalne sustave koji zahtijevaju malu pažnju vlasnika. Da bi se osiguralo pravovremeno održavanje, regulatorna vlast šalje vlasnicima podsjetnike za održavanje u odgovarajućim vremenskim intervalima. |
| 2 | Maintenance contracts / Ugovori o održavanju | Specifies program elements and activities where more complex designs are employed to enhance the capacity of conventional systems to accept and treat wastewater. Because of treatment complexity, contracts with qualified technicians are needed to ensure proper and timely maintenance. / Predviđa program i aktivnosti kada se koriste složeniji projekti za povećanje kapaciteta konvencionalnih sustava da prihvate i obrađuju otpadnu vodu. Zbog složenosti obrade, potrebni su ugovori sa kvalificiranim tehničarima kako bi se osiguralo pravilno i pravovremeno održavanje. |
| 3 | Operating permits / Pogonske dozvole | Specifies program elements and activities where sustained performance of treatment systems is critical to protect public health and water quality. Limited-term operating permits are issued to the owner and are renewable for another term if the owner demonstrates that the system is in compliance with the terms and conditions of the permit. Performance-based designs may be incorporated into programs with management controls at this level. / Predviđa program i aktivnosti kada je u pitanju održavanje učinkovitog rada sustava obrade za zaštitu zdravlja ljudi i kakvoće vode. Vlasniku se izdaju ograničene dozvole za rad koje su obnovljive za naredno razdoblje ako vlasnik dokaže da je sustav sukladan uvjetima iz dozvole. U program sa kontrolom upravljanja na ovoj razini mogu se uvrstiti tehnička rješenja koja se temelje na radnom učinku. |
| 4 | Responsible Management Entity (RME) operation and maintenance / Rad i održavanje od strane odgovornog upravljačkog subjekta | Specifies program elements and activities where frequent and highly reliable operation and maintenance of decentralized systems is required to ensure water resource protection in sensitive environments. Under this model, the operating permit is issued to an RME instead of the property owner to provide the needed assurance that the appropriate maintenance is performed. / Predviđa program i aktivnosti gdje je potreban čest i jako pouzdan rad i održavanje decentraliziranih sustava kako bi se osigurala zaštita vodnog resursa u osjetljivom okolišu. Prema ovom modelu dozvola za rad se izdaje spomenutom upravljačkom subjektu umjesto vlasniku parcele kako bi se osiguralo da se izvodi odgovarajuće održavanje. |
| 5 | RME ownership / Vlasništvo od strane odgovornog upravljačkog subjekta | Specifies that program elements and activities for treatment systems are owned, operated, and maintained by the RME, which removes the property owner from responsibility for the system. This program is analogous to central sewerage and provides the greatest assurance of system performance in the most sensitive of environments. / Predviđa da program i aktivnosti budu u vlasništvu, da njima upravlja i da ih održava subjekt koji skida sa vlasnika parcela odgovornost za sustav. Ovaj program je analogan centralnoj odvodnji i najviše od svih osigurava da sustav radi učinkovito i u najosjetljivijem okolišu. |

5. Situation in the Republic of Croatia

Key data concerning utility service management in the Republic of Croatia are presented below [11-14]:

- according to estimated water quantities available per inhabitant, Croatia is ranked 5th at European and 42nd at global level,
- 75 % of population is connected to water supply and 40 % to sewer networks,
- 50 % of industrial wastewaters are discharged into municipal sewer networks, 20 % is treated, and the rest is discharged directly into recipients,

- about 5 % of municipal wastewater from households is treated, of which only 4.4 % undergoes secondary treatment,
- 92 % of municipal waste ends on the landfills,
- almost the entire quantity of biodegradable municipal waste is landfilled,
- Croatia belongs to a group of low-urbanised countries, where the urban population makes up slightly above one half of the overall population.

The author of this paper conducted an anonymous survey among utilities operating in water supply and/or sanitation and/or municipal waste disposal sector in

all Croatian counties. The results of the survey coincide with author's standpoints that when making capital investments account is not being taken of maintenance costs, that investments in municipal infrastructure are not always the most optimum ones and in function of environmental protection, that environmental protection does not necessarily entail major investments, that better organisation could result in less costly and more efficient solutions, that knowledge of the concept of decentralized wastewater technology is not diffused, that utilities are not entirely familiar with the operations of Croatian Waters, public institution which manages water resources in the Republic of Croatia, that the "polluter pays" principle is not prevailing, that treating waste close to the place it was generated is beneficial both for the environment and cost-wise, and that it is inappropriate to have private capital controlling the public service.

6. Environmental governance model based on waste and water utility service management

6.1. Environmental governance

As stated in point 2, utilities sector is not organised sustainably and it contributes to greenhouse gases creation. Problems to be dealt with are listed below:

- traditional 19th and 20th century utility infrastructure is becoming increasingly expensive for management and inappropriate for new demands,
- following established patterns, both liquid and solid waste is mixed at source,
- wasting enormous funds and resources and degrading the environment in treating mixed waste,
- water is as a rule used only once, energy is necessary for its transport and purification, and finally energy-rich sewerage as well as organic waste are discharged or disposed of in the environment,
- consumption of energy and resources is rarely accounted for in a private economy and the costs are transferred to next generations.

Here are the challenges:

- in order for utilities sector to be actually in function of sustainability or environmental protection and sanitation within the meaning of protecting public health and hygiene, essential changes of established patterns, current regulations and concepts are necessary,
- limiting the consumption of resources through managing demand sustainably,
- polluter-pays principle is insufficient for preserving the ecosystem,

- the best model for utility service management is the one that is acceptable in a particular milieu and uniform solutions should not be pursued,
- upgrading utility services while keeping down costs for the community,
- extending services to users while adhering to highest environmental standards,
- distribution of responsibility and costs.

The author's proposal of the model with regard to achieving sustainability in the utilities sector is presented in Table 2.

6.2. Management model in utilities sector

The utilities are organized following various business and management models with the following problems to be dealt with:

- growing water commercialisation,
- public sector is often slow, costly, inefficient or viewed as such,
- private capital is interested in quick money and not in extensive investment in environmental protection,
- services of general interest outdo the capacities provided by systems controlled by private capital.

Here are the challenges:

- utilities should provide high-standard service to local community or citizens-users of utility services and integrate various types of utility services so that citizens could resolve anything that is related to communal issues at a single spot (one-stop-shop),
- the functions of public sector management, particularly those related to public health and environmental protection should not be based on profit, but on investing in the well-being of the community,
- environment is immanently a public issue,
- employees with a share in company ownership and participating in its management are motivated to have the company operate in a sound manner,
- citizens are interested in quality services and the environment they live in, development of the society and lower price.

Table 3. presents application of the model with regard to organization of utilities.

Many investments in utilities sector are not sustainable, with the following problems to be solved:

- when taking decisions on investment projects, no objectives of the investment are defined, there are no alternative proposals, benefits and costs of each alternative are not mentioned, project sensitivity is not determined and selection of the most optimum alternative is missing,

Table 2. Model of sustainable utilities sector

Tablica 2. Model održive komunalne djelatnosti

| Possible solutions / Moguća rješenja | Concrete measures / Konkretnje mjere | Economic benefits / Ekonomska korist |
|---|--|---|
| <ul style="list-style-type: none"> Water conservation, rainwater harvesting, separating wastewater flows at source, separating organic waste in household, treatment and reuse of water and nutrients / Očuvanje vode, prikupljanje oborinske vode, odvajanje na izvoru tokova otpadne vode, odvajanje organskog otpada u kućanstvu, obrada te ponovna uporaba vode i hranjivih tvari Decentralized treatment of black water and household biowaste / Decentralizirana obrada crne vode i kućnog biootpada Green infrastructure and on-site infrastructure / Zelena infrastruktura i infrastruktura na mjestu nastanka Valuing local and traditional knowledge in favour of ecosystems and local population / Uvažavanje lokalnog i tradicijskog znanja u interesu ekosustava i lokalnog stanovništva Sanitation (water supply, sanitation, solid waste disposal) should be integrated technically and management-wise in order to achieve the environmental, social and economic benefits / Sanitaciju (vodoopskrbu, odvodnju, zbrinjavanje komunalnog otpada) objediniti u tehničkom i upravljačkom smislu radi postizanja ekološke, društvene i ekonomske koristi | <ul style="list-style-type: none"> Regulating gradually at local level the rainwater harvesting (green roofs, rain gardens, rainwater tanks) and its use for particular purposes, and the obligation to separate at source or grant concrete incentives therefor in the transitional period / Postepeno na lokalnoj razini regulirati prikupljanje (zeleni krovovi, kišni vrtovi, spremnici za kišnicu) i korištenje oborinske vode za određene namjene, te obvezu odvajanja na izvoru, odnosno u prijelaznom razdoblju osigurati konkretne poticaje za takvo postupanje Utilities should acquire the capacity and adapt to sustainable water and waste management where the present big infrastructure will not dictate the method of operation, but will constitute an integral part of big and on-site systems combined / Komunalne tvrtke trebaju se osposobiti i prilagoditi održivijem načinu gospodarenja vodom i otpadom u kojem postojeća velika infrastruktura neće diktirati način rada, već biti integralni skup velikih i malih sustava Promoting and introducing green infrastructure and on site infrastructure through construction laws and other provisions adopted at national, regional and local level / Promicanje i uvođenje zelene infrastrukture i infrastrukture na mjestu nastanka kroz propise o gradnji i ostale propise od strane državne, regionalne i lokalne vlasti Physical plans and projects should provide for soil infiltration of rainwater on and alongside public spaces / Prostorni planovi i projekti moraju omogućavati čim veću infiltraciju oborinskih voda u tlo na i uz javne površine | <ul style="list-style-type: none"> Preserving resources / Očuvanje resursa Anaerobic digestion of separately collected black water produces biogas, less sludge and does not remove nutrients (nitrogen and phosphorus), so that effluent may be used in agriculture in place of artificial fertilizer / Anaerobnom digestijom odvojeno prikupljene crne vode dobiva se energent bioplina, proizvodi se manja količina mulja, te se ne uklanjaju hranjive tvari (dušik i fosfor), pa se effluent može koristiti u poljoprivredi umjesto umjetnog gnojiva In addition to proven environmental benefits and economising the valuable resources, new quality, mainly local workposts are thus created, private sector is stimulated, thereby achieving the overall long-and short-term economic benefit / Pored dokazanih ekoloških koristi i štednje vrijednih resursa doprinosi se otvaranju novih kvalitetnih, uglavnom lokalnih radnih mjesta, potiče privatni sektor, čime se sveukupno postiže dugoročna i kratkoročna ekonomska korist Operations of utilities sector in line with green economy would significantly reduce the burden on taxpayers for new infrastructure and the liability for “externalized” environmental damage / Poslovanje komunalnog sektora u skladu sa zelenom ekonomijom bi značajno smanjilo doprinos poreznih obveznika za novu infrastrukturu i odgovornost za “eksternaliziranu” štetu za okoliš |

- companies wish to shift the burden of financing the maintenance of environmental infrastructure to local authorities, thereby influencing the technical concept,
- bulk of investment is borne by citizens and not by economic operators – polluters.

Here are the challenges:

- availability of financial resources for centralized wastewater and waste management systems results

in insufficient research of decentralized and less costly waste management systems,

- there exists no forum where interested entities may agree the investments of common interest.

Costs of utility infrastructure maintenance are high. Problems are as follows:

- the project is conceived outside the utility, it is elaborated by external design office, and in completed state it is simply delivered to the utility for maintenance,

Table 3. Application of the model with regard to organization of utilities**Tablica 3.** Primjena modela u odnosu na ustroj komunalnih tvrtki

| Possible solutions / Moguća rješenja | Concrete measures / Konkretno mjere | Economic benefits / Ekonomska korist |
|---|---|---|
| <ul style="list-style-type: none"> Public authority should keep majority share and voting right in the utility / Javna vlast mora zadržati većinski udio u kapitalu i odlučivanju u komunalnoj tvrtki Municipal utilities, owners' or employees' cooperatives, community-utility partnerships and other forms of public-public partnerships / Gradska komunalna poduzeća, kooperative korisnika, radničke kooperative, partnerstva zajednica-komunalna tvrtka i drugi oblici javno-javnih partnerstava Public sector as contracting authority in public procurement contracts where private capital is supplier of goods, provider of services or contractor / Javni sektor kao naručitelj u ugovorima o javnoj nabavi u kojima je privatni sektor podugovaratelj, odnosno isporučitelj Professional and technical capacity of smaller local communities and small-size utilities should be achieved through public-public partnerships / Stručnu i tehničku osposobljenost malih jedinica lokalne samouprave i manjih komunalnih tvrtki treba postići javno-javnim partnerstvima A need to create a management model which pursues a balance between market competitiveness and interests of all citizens at local community level / Potreba stvaranja modela upravljačkog sustava koji teži ravnoteži između zahtjeva tržišne konkurentnosti i interesa svih građana na razini lokalne zajednice | <ul style="list-style-type: none"> Corporate company model commonplace in Croatia which is an appropriate solution in utilities sector should be adapted so that the users also become co-owners and property managers / U Hrvatskoj uobičajen poslovni model korporativno uređene komunalne tvrtke koji je primjereno rješenje u predmetnoj djelatnosti i upravljački model centralnog planiranja (u smislu lokalne vlasti) treba prilagoditi na način da korisnici budu suvlasnici i upravljači imovinom Development costs may be financed by issuing shares, that is by partial privatization in $\leq 49\%$ portion by sale of shares to employees, citizens users and other natural and legal persons / Troškovi razvoja se mogu financirati izdavanjem dionica, tj. djelomičnom privatizacijom u udjelu $\leq 49\%$ prodajom dionica zaposlenicima, građanima korisnicima i ostalim fizičkim i pravnim osobama Public-public partnerships in utilities sector with domestic and foreign utilities / Javno-javna partnerstva u komunalnom sektoru sa domaćim i inozemnih komunalnim tvrtkama In Croatia, local administrations should collaborate with other municipalities and make use of their good practice, invest in education of own employees and citizens and set an example in upgrading the environment with goodwill and non-sizeable financing / U Hrvatskoj bi lokalne uprave trebale surađivati s drugim općinama i gradovima i koristiti njihove primjere dobre prakse, ulagati u edukaciju vlastitih zaposlenika i građana te dati primjer kako se uz dobru volju i manja financijska sredstava može znatno unaprijediti stanje u okolišu | <ul style="list-style-type: none"> Preserving overall economic value of resource / Očuvanje ukupne ekonomske vrijednosti resursa Financing development / Financiranje razvoja |

- as a result of non availability of alternatives and true feasibility study elaborated in the interest of end user, and not of the financier, true cost of investment, and particularly that of maintenance is not known.

Here are the challenges:

- perceiving long-term maintenance costs,
- sound cooperation at county level would outperform compulsory amassing of operations under current law.

Application of the model with regard to sustainability of investment in utilities sector and maintenance of the infrastructure is shown in Table 4.

Unsustainability is expressed as the difference between the actual price of the utility service and a rate that itself is often unjust. Here are the problems:

- price of utility service is not yet based on the analysis of actual costs,
- low unit price stimulates higher consumption of a resource, and higher one also affects those who save.

The challenges are:

- economic sustainability,
- fairness in setting the price of utility services,

Table 4. Applying the model with regard to sustainability of investments and maintenance of infrastructure in utilities sector**Tablica 4.** Primjena modela u odnosu na održivost investicija u komunalnom sektoru i održavanje komunalne infrastrukture.

| Investments / Investicije | |
|--------------------------------------|---|
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> • Integrated resource management / Integralno gospodarenje resursima • Scarcity of funds or prevailing crisis combined with obligation to implement ecological solutions may be stimulative for engineering new concepts in utility service management / Nedostatak financijskih sredstava, odnosno kriza uz istovremenu obvezu oživotvorenja ekoloških rješenja može biti poticajna za osmišljanje novih koncepcija u komunalnom gospodarenju |
| Concrete measures / Konkretna mjere | <ul style="list-style-type: none"> • Utilities infrastructure should be designed so that waste is not waste, but resource / Komunalnu infrastrukturu projektirati tako da otpad nije otpad, već resurs • Adopting and implementing of the previously repeatedly announced Regulation on the methodology of preparing and evaluating the design of investment projects in the area of public procurement / Donošenje i primjena u Hrvatskoj višekratno najavljivane Uredbe o metodologiji pripreme i ocjeni izvedbi investicijskih projekata u području javne nabave. • Introduce alternative wastewater treatment technologies which among other things take into account phased construction which renders possible adjusting the capacity with demand, avoiding the costs of system over-dimensioning, and ultimately deferring capital expenditures / Uvoditi alternativne tehnologije pročišćavanja otpadnih voda koje između ostalog uzimaju u obzir etapnost izgradnje, te omogućava usklađivanje kapaciteta sa potražnjom, izbjegavaju se troškovi predimenzioniranja sustava, a što je najvažnije odgađaju se kapitalni rashodi. • Setting up a body for managing property-infrastructure of the municipality which should consist of the representatives from various departments of local administration, representatives of utilities, elected officials and the public / Ustanoviti tijelo za upravljanje imovinom-infrastrukturom općine ili grada koje mora uključivati predstavnike iz različitih odjela unutar lokalne uprave, predstavnike komunalne tvrtke, izabrane dužnosnike i javnost. • Enacting the rules on wastewater for smaller agglomerations / Donijeti pravila za otpadne vode za manje aglomeracije. |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> • Maximising net revenue from recovered resources, thereby minimising the costs for taxpayers / Maksimiziranje neto prihoda iz uporabljenih resursa, čime se minimiziraju troškovi za porezne obveznike • Saving and investing in the most optimum environmental technology means economic benefit for the community / Uštede i ulaganje u najoptimalniju tehnologiju zaštite okoliša znači ekonomsku korist za zajednicu • Sound ecology may be based solely on sound economy and vice versa / Zdrava se ekologija može temeljiti samo na zdravoj ekonomiji i obrnuto |
| Maintenance / Održavanje | |
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> • Staff in the utilities should be the main technical consultant for municipalities, driver and creator of utility infrastructure projects / Stručne službe u komunalnim tvrtkama bi morale gradovima i općinama služiti kao glavni tehnički savjetodavac, pokretač i kreator projekata komunalne infrastrukture |
| Concrete measures / Konkretna mjere | <ul style="list-style-type: none"> • Improving human resource capacity of utilities by recruiting highly qualified persons, whereby the service of highest complexity, that of creating and control would be undertaken in-house, and that of lower complexity would be outsourced / Unapređenje kadrovske strukture komunalnih tvrtki zapošljavanjem većeg broja visokoobrazovanih ljudi, čime bi se usluga najviše razine, a to je razina kreiranja i kontrole, obavljala u kući, a ona niže razine bi se mogla pribavljati izvana. • Promoting the inter-municipal cooperation / Promicanje međuopćinske suradnje. |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> • Attention concentrated on the costs of maintenance of long-term investment, and not on initial investment only / Pozornost usmjerena na troškove održavanja dugoročne investicije, a ne samo na početna ulaganja |

especially water which is the asset of common interest,

- interest of water suppliers for high consumption rate is not aligned with ecological or social imperative for conservation or saving ,
- current consumers should not bear in entirety the costs to be borne by future consumers.

Application of the model with regard to utility cost and rate is shown in Table 5.

6.3. Modelling technical and administrative solutions

Technical solutions for decentralised and sustainable water systems which may replace or complement present infrastructure do exist. Here are the problems:

- since the water market is highly regulated, there are numerous obstacles to adopting decentralized infrastructure for water, storm water and wastewater,

Table 5. Application of the model with regard to utility rate**Tablica 5.** Primjena modela u odnosu na cijenu komunalne usluge

| Possible solutions / Moguća rješenja | Concrete measures / Konkretna mjera | Economic benefits / Ekonomska korist |
|--|--|---|
| <ul style="list-style-type: none"> • True cost accounting / Stvarno računovodstvo (bilanciranje) troškova • Public entities should set an example in water saving / Javni subjekti trebaju služiti kao primjer štednje vode • Facilitating and stimulating disposal of minimum quantities of waste / Stvaranje uvjeta za i stimuliranje građana da odlažu minimalne količine otpada | <ul style="list-style-type: none"> • Analysis of actual costs should be a guideline when making decisions on capital investments / Kod donošenja odluka o ulaganjima rukovoditi se analizom stvarnih troškova. • In fixing prices of water it is necessary to resort to block tariff as the only environmentally friendly approach. Minimum quantities required should be acceptable at very low rate in order to take account of the needs of the most impoverished categories of population. / U određivanju cijene vode za korisnike potrebno je pribjegavati blok tarifi kao jedinom za okoliš prihvatljivom pristupu. Minimalne potrebe pak moraju biti dostupne po izrazito niskoj stopi, kako bi se vodilo računa o potrebama najsiromašnijih slojeva stanovništva. • Charging for collection and disposal of waste based on volume whereby citizens-users should be provided with separate containers for different kinds of waste within reasonable distance. / Naplata odvoza i zbrinjavanja otpada prema obujmu s time da se građanima-potrošačima osigura da na razumnoj udaljenosti postoje odvojene posude za različite vrste otpada. | <ul style="list-style-type: none"> • Balancing rates and cost / Izjednačenje naknade i cijene koštanja • System should be efficient, characterized by pronounced social sensitivity as it provides basic services to everyone / Sustav mora biti učinkovit uz naglašen element socijalne osjetljivosti jer svima pruža osnovne usluge |

- educational programmes involve mainly conventional sanitation or end-of-pipe solutions,
- making decisions concerning sanitation is based on present net value of the investment, operating and maintenance cost, while social, environmental, technical, and health aspect and long-term resources management are not considered, especially not in their integrated interaction.

Challenges are specified hereinbelow:

- decentralized systems lead to renewal and preservation of ecosystem services, save energy, produce energy and nutrients, create green spaces, improve air quality, restore urban streams and ecosystems and contribute to opening green workplaces,
- the problem is not of a technical nature, but that of management,
- investing of an individual in ecology.

Modelling the technical and management solutions with regard to water systems is shown in Table 6.

As regards municipal waste, it is necessary to achieve sustainability in waste production and waste management. Here are the problems:

- solid waste is characterised by pronounced externalization of costs borne by local communities or consumers,
- technical solutions and research are concentrated on high-tech hardware for processing large amounts of waste.

Here are the challenges:

- consumers are still not provided with alternative option to select products which generate significantly lesser quantity of waste,
- designing innovations in the systems of collection or creation of waste, that is in the waste management "software",
- reducing pressure on the environment, stimulating local production and minimising transport costs.

Modelling the sustainability in waste management is shown in Table 7.

Table 6. Modelling the technical and management solutions for water systems

Tablica 6. Model tehničko-upravljačkih rješenja u odnosu na vodne sustave

| Possible solutions / Moguća rješenja | Concrete measures / Konkretno mjere | Economic benefits / Ekonomska korist |
|---|---|--|
| <ul style="list-style-type: none"> Centralized management of decentralized water systems by including on-site systems into an integrated management programme with regard to operation, maintenance and control, as regulated for centralized sanitation systems / Centralizirano upravljanje decentraliziranim vodnim sustavima uključivanjem malih sustava u integralni program upravljanja u pogledu njihova rada, održavanja i nadzora, na način kako je to uređeno za centralizirane sustave odvodnje | <ul style="list-style-type: none"> Establishing management systems for decentralized systems / Ustrojiti sustave upravljanja decentraliziranim sustavima. Combining old centralized infrastructure and multiple decentralized plants in the community / Infrastruktura treba biti kombinacija stare centralizirane infrastrukture i višestrukih decentraliziranih uređaja u naselju. Designing and manufacturing of modular prefabricated devices for decentralized treatment / Projektiranje i proizvodnja modularnih prefabriciranih uređaja za decentraliziranu obradu. Including sustainable sanitation in educational programmes and awareness raising programmes / Obrazovnim ciklusima i razvijanjem svijesti obuhvatiti održivu sanitaciju. | <ul style="list-style-type: none"> Lower capital and maintenance costs and costs for collection and transfer of wastewater / Niži kapitalni izdaci i izdaci za održavanje, te troškovi prikupljanja i prijenosa otpadne vode Ecological sanitation where wastewater system constitutes a subgroup of natural systems, and not its alternative / Ekološka sanitacija u kojoj sustav otpadnih voda čini podskup prirodnih sustava, a ne alternativu Costs of decentralized systems are substantially lower compared to centralized system, but their structure is such that share of public expenditure diminishes, and expenditure of private household increases in comparison with conventional sanitation / Troškovi decentraliziranog sustava u odnosu na centraliziran znatno su niži, ali njihova struktura je takva da se smanjuje udio javnog izdatka, a povećava izdatak kućanstva, u odnosu na konvencionalnu sanitaciju Reduction of prices of on-site systems in mass production / Pad cijene individualnih sustava u masovnoj proizvodnji Lesser energy if use is made of solar energy in treatment process / Manja količina energije ako se koristi sunčeva energija u procesu obrade Investing in sustainability (still being far below the true economic costs of unsustainable way of life) / Ulaganje u održivost (koje je još uvijek daleko ispod stvarnih ekonomskih troškova neodrživog načina života) |

6.4. Some aspects of utility service management in the European Union

One of the problems within the European Union is unbalanced standards of various Members States with regard to sanitation. Namely, the European Directive prescribes fixed technical solutions which are not appropriate for all the circumstances and are costly, and the challenge is to solve the problems of less developed Member States and smaller communities throughout the European Union. Another marked problem is the

still inadequate emphasis on preventing the generation of waste or conservation of resources in the European Union. Problems are the following:

- inability to agree on target waste prevention levels,
- majority of the new and many old Member States rely on landfilling,
- redefining incineration in recovery in the most recent directive negates the effect of incinerators on climate and pollution and is not conducive to recycling.

Table 7. Modelling the sustainability in waste management**Tablica 7.** Model održivosti u gospodarenju otpadom

| Possible solutions / Moguća rješenja | Concrete measures / Konkretna mjera | Economic benefits / Ekonomska korist |
|---|--|--|
| <ul style="list-style-type: none"> Internalizing the costs of solid waste / Internaliziranje troškova krutog otpada Dematerialization and detoxification of economic activities / Dematerijalizacija i detoksifikacija gospodarskih aktivnosti Sustainable waste management systems which are in itself labour-intensive / Održivi sustavi gospodarenja otpadom su i radno intenzivni Zero waste strategy in which production and consumption are an integral part of a cycle / Strategija nula otpada u kojoj su proizvodnja i potrošnja sastavni dijelovi ciklusa Reduction at source as a proactive method, as opposed to reactive methods of materials management after it was produced – recycling, composting, recovery, disposal / Smanjenje na izvoru je proaktivna metoda, za razliku od reaktivnih metoda gospodarenja materijalom nakon što je proizveden – recikliranje, kompostiranje, uporaba, odlaganje Extended producer liability / Proširena odgovornost proizvođača Pay-as-you-throw (PAYT) as a provisional solution pending effective application of zero waste, reduction at source and extended producer liability which should be applied integrally / Plati koliko baciš (PAYT) kao prelazno rješenje ka nula otpada, smanjenju na izvoru i proširenoj odgovornosti proizvođača, koje sve treba primjenjivati integralno Any residue waste should be treated as close as possible to the place where it was generated / Preostali otpad dokle god postoji treba obrađivati čim bliže mjestu nastanka | <ul style="list-style-type: none"> Promoting arrangements where waste is not produced / Promicanje sustava u kojima se ne proizvodi otpad. Charges to be based on PAYT principle / Sustav naplate koji se temelji na načelu plati koliko baciš. Reshaping the product with regard to durability, reparability, reuse and recycling / Preoblikovanje proizvoda u pogledu trajnosti, mogućnosti popravaka, mogućnost ponovne uporabe i recikliranja. Consumers should be provided with alternatives to stimulate them to minimise waste or purchase products that are less harmful for the environment / Potrošači moraju imati na raspolaganju alternative kako bi ih se potaklo da minimiziraju otpad ili kupe proizvode koji su manje štetni za okoliš. Prescribing by law the obligation to integrate life cycle assessment in development stages of products, giving consideration to waste management issues at design stages / Propisati obvezu ugradnje procjene životnog vijeka u razvojne stadije proizvoda i razmatranje pitanja gospodarenja otpadom u stadijima projektiranja. Establishing standards for the entire waste management sector / Ustrojiti standarde za cjelokupnu granu gospodarenja otpadom. Implementing the programme of reduction at source by local authorities in their own premises and facilities, at the level of economic operators and other entities, and at the level of population in general / Oživotvorenje programa smanjenja na izvoru od strane lokalnih vlasti u vlastitim uredima i objektima, na razini poslovnih i drugih subjekata i općenito na razini stanovništva. Waste scavenging to be restricted to specific locations, ensuring that scavengers operate in safe conditions / Prebiranje otpada ograničiti na posebne lokacije i osigurati da prebirači rade u sigurnim uvjetima. | <ul style="list-style-type: none"> In true cost accounting market price will have to cover full costs of environmental degradation and effects on public health with regard to mining materials, processing, manufacturing, transport and disposal of a product / U računovodstvu stvarnih troškova će tržišna cijena morati obuhvatiti pune troškove propadanja okoliša i učinke na ljudsko zdravlje u vezi s vađenjem materijala, prerade, izrade, prijevoza i zbrinjavanja proizvoda Reduction at source is not simple to quantify since it is difficult to measure what has not been produced / Smanjenje na izvoru nije jednostavno kvantificirati jer se teško mjeri ono što nije proizvedeno Transferring liability for products management at the end of life cycle on producer, that is the product user, thus embodying the polluter pays principle / Prebacivanje odgovornosti za gospodarenje proizvodima na kraju vijeka na proizvođača, tj korisnika proizvoda, čime se utjelovljuje načelo onečišćivač plaća Economic benefit for health care, disability and other compulsory and voluntary funds resulting from reduced risk of death, disability and medical treatment inflicted by improper generation and management of waste / Ekonomska korist zdravstvenih, invalidskih i drugih obveznih i dobrovoljnih fondova uslijed smanjenja rizika od smrti, invaliditeta i liječenja uzrokovanih neprimjerenom proizvodnjom otpada i načinom gospodarenja otpadom |

Table 8. Aspects of the model relevant to utility service management in the European Union**Tablica 8.** Aspekti modela koji se odnose na komunalno gospodarenje u Europskoj uniji

| Unbalanced standards of various EU Members States regarding sanitation / Neuravnoteženost standarda različitih zemalja članica Europske unije u odvodnji | |
|---|--|
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> Applying the principle of best available technology that is feasible economically / Primjenjivati načelo najbolje dostupne tehnologije koja je ekonomski opravdana |
| Concrete measures / Konkretna mjera | <ul style="list-style-type: none"> Applying in utility service management the basic BAT principle as in IPPC Directive regulating industrial environment, but also the experience of Baltic Sea regional agreement, especially for sanitation of smaller agglomerations the impact of which is not negligible, particularly when considering pollution and eutrophication of the sea / U komunalnom gospodarstvu primjenjivati temeljno načelo najbolje dostupne tehnologije kao u IPPC direktivi koja regulira industrijski okoliš, ali i iskustvo regionalnog Sporazuma o Baltičkom moru, posebno za rješavanje sanitacije manjih naselja čiji utjecaj nije zanemariv, naročito kada je u pitanju onečišćenje i eutrofikacija mora Giving particular attention to smaller agglomerations in terms of both legislation and financing / U zakonodavnom i financijskom smislu posvetiti pažnju manjim naseljima |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Financially optimum solutions for new Members States, small agglomerations and unsewered areas / Financijski optimalnija rješenja za nove države članice, mala naselja i sva mjesta gdje odvodnja nije riješena na konvencionalan način |
| Inadequate emphasis on preventing waste generation or preserving resources in the European Union / Premali naglasak na sprječavanje stvaranje otpada, odnosno na očuvanje resursa u Europskoj uniji | |
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> Joint decision making in which public interest holds higher priority with regard to national interests / Suodlučivanje u kojem se javni interes pretpostavlja nacionalnim interesima |
| Concrete measures / Konkretna mjera | <ul style="list-style-type: none"> Building public awareness concerning the unsustainability of established waste management patterns / Izgraditi javnu svijest o neodrživosti uhodanih obrazaca postupanja s otpadom. Enhancing the role of European Parliament with regard to the Commission within the European Union and reducing the role of interest groups in comitology in the decision making process / Unutar Europske unije povećati ulogu Europskog parlamenta u odnosu na Komisiju, te umanjiti ulogu interesnih grupacija u komitologiji u postupku donošenja odluka. |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Preserving resources: raw materials, energy, nature, soil, water, air / Očuvanje resursa: sirovine, energija, priroda, tlo, voda, more, zrak |

Therefore the challenge is to harmonise legislation with the principles of sustainable development.

Major problems dealt with by the model with regard to utility service management in the European Union are presented in Table 8.

6.5. Utility services management model in the Republic of Croatia

Although less than half of the population in Croatia is provided with connection to sewerage, decision makers seek the solution for leaking cesspits (especially in karst soil), for household sewers connected to storm water sewers and ultimately for polluting waters and the sea, solely in conventional municipal sewer networks which when and if completed are often not functional owing to a low connecting rate of the users. Here are the problems:

- Croatian regulations stipulate compulsory connecting to the sewage system although the network is not adequately developed and, with regard to the amount of investment, it is difficult to expect that it will soon cover the entire territory,
- the problem of wastewater in unsewered areas is not dealt with systematically and appropriate potential solutions are deemed temporary and are always based on discharge into water recipient or on transport of the contents of cesspit or septic tank to the site of central treatment/discharge into water,
- very small portion of wastewaters undergoes secondary treatment,
- transferring wastewaters from urban fringe to its centre or coastline area is an unnecessary and harmful centralization of sanitation system,
- discharging wastewater directly into the sea via bypasses,

- vulnerability of karst and coastal ecosystems,
- discharge of sanitary waters into storm water sewers,
- landfilling the sludge,
- leaking septic systems,
- using high-quality drinking water from local sources for all purposes,
- squeezing as many houses and parking lots as possible on a tract of coastal land results in impermeability of surfaces.

Here are the challenges:

- Croatia is characterized by small communities and a dispersed population and many so-called small polluters, whereby karst soil occupies almost one half of its area,
- costly tourist service may get along solely with the provision of top-quality environmental protection, especially with regard to wastewaters,
- on-site systems which would treat wastewater to higher levels of quality and ensure multifold water use are completely neglected within the meaning of legislation and quite unknown among the public.

The issues of wastewater management in Croatian utilities sector examined in the model are presented in Table 9.

Generation of municipal waste in Croatia is on the rise, and little is recovered and recycled. Here are the problems:

- bulk of municipal waste ends up on landfills,
- separate collection of biodegradable municipal waste is not sufficiently developed,
- preparations for construction of new county landfills run slowly and lack integrated approach,
- charging on the basis of quantity of waste is being introduced under the pressure of new regulations, although the quality of its implementation is questionable.

Here are the challenges:

- county landfills, the preparation for construction whereof is characterized by constant postponements shall result in unaltered continuation of landfilling at another site and at higher price,
- high rates for waste disposal necessary for repayment for oversized investment will further burden local authorities that will have no alternative for disposal left as they are not adequately prepared for it and waste is likely to end up at illegal dump sites,

The issues of waste management in Croatia considered in the model are presented in Table 10.

Aligning of legislation concerning utilities sector on the occasion of accession of Croatia to the European Union is currently in course, facing the following problems:

- conditions placed before the candidate state constitute a significant economic burden, while their efficiency may be questionable,
- the practice confirms that some standards apply to big European states, and others apply to “new entries”, and very often the acting of a certain entity in the mother country differs from that in another Member State, and especially the non-member state.

With regard to challenges, the *acquis* is a result of the various conflicting interests of Member States often having a very low common denominator, with numerous derogations and deferrals with regard to implementing the regulations in particular states. The European Union specifies equal rights for all member states, but in reality the influence of certain founding and/or major Member States differs from that of smaller ones. Therefore the implementation of certain rules is quite diverse across Member States.

By accessing the European Union, the Republic of Croatia also assumed significant liabilities with regard to environmental protection. Here are the problems:

- international development institutions which finance utilities infrastructure by granting long-term loans unfortunately do not always adhere to the principle of best available technology, disregarding its duration, efficiency and environmental features, and at times they themselves become actors of the deals that disrupt sustainability,
- projects that are proposed are frequently irrationally expensive, they are of a conventional type while other available technical solutions that would be more appropriate both in water and waste sector are not taken into consideration to a sufficient extent,
- embarking on costly projects that are currently unsustainable puts the burden on population and subsequent to big initial investments, challenges the feasibility of project completion.

Here are the challenges:

- the investments designated for protecting the environment in the Republic of Croatia, especially in its near-accession to the European Union, undervalue Croatian specific features and are not feasible for the national economy,
- operators in transition country hold all the responsibility for poor utility service management model and for bad technical design since international financiers do not rectify the model and the design in the interest of national environment, but work in the interest of their own profitability,

Table 9. Wastewater management model in Croatian utilities sector**Tablica 9.** Model komunalnog gospodarenja u sektoru odvodnje u Hrvatskoj

| Possible solutions / Moguća rješenja | Concrete measures / Konkretna mjera | Economic benefits / Ekonomska korist |
|--|--|---|
| <ul style="list-style-type: none"> Introducing on-site systems for wastewater treatment, provided designing, organisation and financing of the training, proper operation and maintenance thereof is regulated / Uvoditi male sustave za obradu otpadnih voda s time da se regulira njihovo projektiranje, organizacija i financiranje obuke, pravilan rad i održavanje State agencies should exercise permanent control of the performance of on-site wastewater systems, issue the operating permits and certify those who perform maintenance of such systems / Državne agencije trebaju vršiti stalni nadzor nad učinkom malih sustava obrade otpadnih voda na mjestu nastanka, izdavati dozvole za rad vlasnicima sustava i certifikate onima koji održavaju takve sustave Existing utilities should expand their activity from mere transport of the contents of cesspits to central discharge point or treatment plant to systematic recording and maintenance and coordinating the dissemination of on-site systems / Postojeće komunalne tvrtke trebaju proširiti svoju djelatnost sa jednostavnog odvođenja sadržaja sabirnih jama na centralni ispušni uređaj na sustavno evidentiranje i održavanje, te koordiniranje uvođenja malih sustava Requirements for wastewater treatment should be specified as maximum annual discharge of nutrients / Zahtjevi za obradom otpadne vode navesti u obliku najvišeg dozvoljenog godišnjeg ispuštanja hranjive tvari | <ul style="list-style-type: none"> Stimulating on-site wastewater systems by environmental authorities in Croatia, not as an interim solution but also as an alternative to conventional centralized systems for appropriate layouts of the community or buildings in the community, and for complementing the centralized systems / Poticanje u Hrvatskoj malih sustava za obradu otpadne vode na mjestu nastanka od strane ekoloških vlasti i to ne kao privremena rješenja, već i kao alternative za konvencionalne centralizirane sustave kod odgovarajućeg položaja naselja ili zgrada unutar naselja, te nadopuna centraliziranim sustavima. Gathering data and keeping centralized records of decentralized systems, specifying essential information on the system / Prikupiti i voditi centraliziranu evidenciju decentraliziranih sustava, uz navođenje bitnih podataka o sustavu. Prescribing the best available technology or specified performance for new systems, use and maintenance according to manufacturer's instructions and regulations, and accessibility of the data on treatment systems and their performance to the public / Propisati da novi sustavi budu ili najbolje dostupne tehnologije ili propisanog učinka, da se sustav koristi i održava prema uputama proizvođača i propisima, te da podaci o sustavima obrade i njihov učinak budu opće dostupni. Producing and publishing the manual for on-site wastewater treatment / Izrada i izdavanje priručnika za obradu otpadnih voda na mjestu nastanka. Competent bodies should specify requirements for effluents, draw up and publish the flow-chart of a procedure for selecting the sanitation system and publish the data on best available technology for on-site systems / Nadležna tijela trebaju propisati uvjete za efluente, izraditi i objaviti hodogram postupaka za izbor sustava odvodnje, te objavljivati podatke o izboru najbolje dostupne tehnologije za male sustave. Area where ecological sanitation issues are dealt with should be kept to a minimum in scale, and waste should be diluted to least possible extent / Područje u kojem se rješavaju problemi ekološke odvodnje treba zadržati unutar najmanjeg moguće prostora, a otpad razblaživati čim manje. Stimulating reuse of water for purposes other than drinking / Poticati ponovnu upotrebu vode za namjene koje nisu voda za piće. Regulating the issues of supervision / Urediti pitanje nadzora. | <ul style="list-style-type: none"> Conservation of resources: water, the sea, air, soil, nature, energy, raw materials / Očuvanje resursa: voda, more, zrak, tlo, priroda, energija, sirovine Lower investment and maintenance costs / Manji troškovi ulaganja i održavanja Economic benefit from high employment rate / Gospodarska korist od većeg zapošljavanja Stimulating the production sector / Stimuliranje proizvodnog sektora |

Table 10. Utility service management in waste sector**Tablica 10.** Model komunalnog gospodarenja u sektoru otpada

| | |
|--------------------------------------|---|
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> Investing sustainably on a small scale, in minimum capacity necessary / Ulaganje na održiv način i na čim manjem prostoru, minimalno potrebnog kapaciteta |
| Concrete measures / Ekonomska korist | <ul style="list-style-type: none"> Stimulating separate collection and in situ composting or collecting and separating on the very landfills with treatment of biodegradable portion of waste using recognized techniques, thus obtaining materials and energy through recovery / Poticati odvojeno sakupljanje i in situ kompostiranje, odnosno sakupljanje, te izdvajanje na samim deponijima i obradu biorazgradljivog dijela otpada priznatim tehnologijama, uz dobivanje materije i energije oporabom The cities themselves must conceive the most efficient method of collecting waste on their territory with a view to reducing the quantity of waste transported to the landfill, whether by separate collecting using bags of various colours, or collecting waste from door to door, or similar, and the method of educating citizens on the necessity of proper waste handling / Gradovi i općine moraju sami osmisliti na koji način je na njihovom području najučinkovitije sakupljati otpad za smanjenje količine otpada koja se odvozi na deponij, hoće li primjerice koristiti model odvojenog sakupljanja putem vrećica različitih boja, hoće li sakupljati otpad od vrata do vrata ili slično, te na koji način će educirati građane o nužnosti pravilnog postupanja otpadom Local communities should set up the centres for recycling and reuse where citizens could bring in such materials and goods and take out free of charge those they need for reuse / Lokalne zajednice bi trebale postaviti centre za reciklažu i ponovnu uporabu gdje bi građani mogli donijeti takve materijale i uzeti s tog mjesta besplatno one koji su im potrebni za ponovno korištenje. A body exercising control should also have the powers / Onaj tko obavlja nadzor mora imati ovlaštenja |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Conservation of resources: raw materials, energy, nature, soil, water, the sea, air / Očuvanje resursa: sirovine, energija, priroda, tlo, voda, more, zrak Higher employment rate / Veće zapošljavanje |

- aligning with the *acquis* in reality entails not only the change of legal framework, but also of the pattern of behaviour in implementing the internationally agreed standards which represent a compromise between various interests.

The issue of aligning legislation with the *acquis* examined by the model is dealt with in Table 11.

A further problem is insufficiently transparent spending and the efficiency of use of funds by government institutions. Here are the problems:

- institutionally defined and monopolist role of the company "Croatian Waters" which collects statutory fees and distributes the funds thus collected following own criteria, may not be considered a successful bureaucratic arrangement which fulfils efficiency requirements,
- parafiscal levies and fees paid in favour of "Croatian Waters" as an entity responsible for water management activity among other things substantially increase the price of each cubic meter of water consumed and/or burden the payers,
- clear competence of the Environmental Protection and Energy Efficiency Fund in collecting the funds, but unclear in its distribution, thus reducing its credibility.

Here are the challenges:

- plurifunctional character of the utilities is an advantage, especially in smaller agglomerations,
- decentralized decision making on the use of funds collected, which is proportional recovery of funds collected from a certain area.

Furthermore, the public has no confidence in environmental data provided, in the operation of inspection services that turn a deaf ear to problems reported and in the fact that its participation is not just the cover for arrangements already agreed. Main problems are:

- unprofessional and inefficient functioning of institutions
- users often have no influence in decision making on capital expenditures in utilities infrastructure.

Here are the challenges:

- participation of the public and the stakeholders is crucial for sound implementation of environmental projects,
- domestic environmental associations gather enviable number of environmental experts, and this very fact speaks for itself, namely that official policy deviates considerably from orientation to sustainable development.

Moreover, integration of environment into educational programmes is insufficient. The problem is that

Table 11. Model for aligning Croatian legislation with the *acquis* with regard to resulting liabilities**Tablica 11.** Model za usklađenje hrvatskih propisa s pravnom stečevinom Europske unije obzirom na troškovne obveze

| Legislation / Zakonodavstvo | |
|--------------------------------------|---|
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> Protecting own interests during negotiation stage with the European Union in the area of utility services management, in a manner practiced by Member States of the European Union / U fazi pregovaranja s Europskom unijom za područje komunalnog gospodarstva štititi vlastite interese kao što to štite i države članice Europske unije |
| Concrete measures / Konkretna mjera | <ul style="list-style-type: none"> Conceiving for Croatia the most optimum and most cost-effective utility services management model and defining it in negotiations in an argued manner / Osmisliti za Hrvatsku najoptimalniji i najisplativiji model komunalnog gospodarenja i argumentirano ga obraniti u pregovorima |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Costs of aligning legislation with the <i>acquis</i> borne not only by the accessing member state, but also by the European Union which expands its economic influence / Troškovi usklađivanja propisa s Europskom unijom ne mogu biti samo trošak države pristupnice, već i Europske unije koja širi svoj ekonomski utjecaj |
| Liabilities / Troškovne obveze | |
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> International financial organisations should grant support to projects that are sustainable and which provide for their phased completion and putting in operation (decentralized systems) and those that are more oriented to methods and less on the plants (zero waste, waste prevention, recycling) / Međunarodne financijske organizacije bi morale podržavati projekte koji su održivi i koji omogućavaju njihovo fazno dovršenje i stavljanje u pogon (decentralizirani sustavi), odnosno sustavi koji su više usmjereni na metode nego na postrojenje (nula otpada, sprječavanje, recikliranje) In environmental projects public procurement should be given priority with regard to public-private partnerships / U projektima zaštite okoliša treba javnoj nabavi dati prednost u odnosu na javno-privatna partnerstva |
| Concrete measures / Konkretna mjera | <ul style="list-style-type: none"> Applying less costly and more environmentally friendly technologies / Primjena manje skupih i za okoliš prihvatljivijih tehnologija Drawing up a long-term cost analysis of applying concrete measures for assuming the responsibility for efficient environmental protection / Izraditi dugoročni troškovni pregled primjene konkretnih mjera za preuzimanje obveza učinkovite zaštite okoliša |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Preserving national resources and standard of population / Očuvanje nacionalnih bogatstava i standarda stanovništva |

understanding environment by the few is insufficient for its protection. The challenge is for holders of elementary and medium schooling and teachers of young citizens and users of environmental and utility services to be ecologically educated so as to be able to teach children thereof.

Last but not least, major problem of Croatian society is corruption because:

- it disrupts democracy, degrades the environment, damages economy, undermines confidence in functioning of the rule of law,
- the presence of corruption in Croatia is particularly pronounced in judiciary, that being particularly dangerous for business and environment, while other significant possible source of corruption are small municipalities which are financially dependent on the state and state agencies.

The challenge is openness, public character, transparency of procedures and clear criteria.

Tables 12 and 13 present the aforementioned social issues which are of significance for the environmental

governance model based on waste and water utility service management.

7. Conclusion

The author has on the basis of literature sources, interviews with stakeholders in the environmental and utilities sectors, own years-long work experience in utilities sector, and by conducting survey among the utilities in the Republic of Croatia derived the model of environmental governance based on waste and water utility service management which specifies a number of issues and measures to be undertaken for the utilities sector to be in function of environmental protection [15].

It is the target that is achievable in a process that is complex, but unavoidable. First of all, it is necessary to regulate gradually at local level rainwater harvesting and its use for particular purposes, and the obligation to separate at source or grant concrete incentives therefor in the transitional period. Alternative wastewater treatment technologies should be widely introduced, not only as

Table 12. Transparency, public character and education as essential components of the environmental governance model**Tablica 12.** Transparentnost, javnost i obrazovanje kao bitne sastavnice u modelu upravljanja zaštitom okoliša

| | |
|--|---|
| Insufficient transparency of spending and efficiency in using funds by state institutions / Nedovoljno transparentno trošenje i učinkovitost korištenja sredstava od strane državnih institucija | |
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> The provision of current law categorizing public water supply and public sewage and wastewater treatment (the so-called supra-communal activities) as water management activity, removing those from water utility sector, designating Croatian Waters as responsible entity therefor, should be thoroughly re-examined / Odredbu važećeg zakona da djelatnost javne vodoopskrbe i javne odvodnje i pročišćavanja otpadnih voda (tzv. nadkomunalne djelatnosti) prenese iz vodnokomunalnog u nadležnost vodnog gospodarstva čije su Hrvatske vode nositelj treba pomno preispitati Option of amassing water utilities should be considered from case to case / Mogućnost okrupnjavanja vodnih komunalnih tvrtki treba razmatrati od slučaja do slučaja |
| Concrete measures / Konkretno mjere | <ul style="list-style-type: none"> Conceiving the mechanisms of independent and efficient control of spending / Osmisliti mehanizme nezavisnog i učinkovitog nadzora trošenja sredstava. International institutions should rethink the selection of partners for utility projects / Međunarodne institucije trebaju preispitati odabir partnera za komunalne projekte. Producing integral analysis of economic benefit for the entire community / Sačiniti sveobuhvatnu analizu ekonomske koristi za čitavu zajednicu. |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Actual investing in environmental protection / Stvarno ulaganje u očuvanje okoliša |
| Public has no confidence in institutions / Javnost nema povjerenje u institucije | |
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> Active involvement, interactive participation, adhering to, considering and respecting the interests, objectives and requests of the citizen / Aktivno uključivanje, interaktivno sudjelovanje i pri tome poštivanje, uvažavanje i cjenjenje interesa, ciljeva i zahtjeva građana |
| Concrete measures / Konkretno mjere | <ul style="list-style-type: none"> Honourable, qualified, independent human resource in institutions / Pošten, stručan, autonoman ljudski resurs u institucijama. Speeding up court proceedings in ecology cases, reducing the costs of such proceeding, ensure that prevention interim measures are issued without delay, in which case additional qualifications of participants in the proceedings is necessary in order to provide for efficient hearing of evidence / U odnosu na ekološke sporove potrebno je ubrzati trajanje ekoloških postupaka, smanjiti troškove tog postupka, omogućiti bez odgađanja izdavanje privremenih mjera sprječavanja onečišćenja, kod čega je potrebna je dodatna obučenos sudionika postupaka kako bi se omogućio učinkovit dokazni postupak. |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Incomplete information and fictitious public participation in decision making represent economic loss for the community / Nepotpune informacije i fiktivno sudjelovanje javnosti kod donošenja odluka su u ekonomskoj analizi materijalni gubitak zajednice |
| Insufficient integration of the environment in educational curricula / Nedovoljna integriranost okoliša u nastavne programe | |
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> Universities which train the teaching staff must integrate environment into their curricula / Fakulteti koji školuju nastavni kadar moraju okoliš integrirati u sve svoje nastavne programe Engineers, economists, physicians, lawyers, agronomists, foresters, and all those who in their work apply environmental aspects in practicing their own profession must create and preserve interdisciplinary professional knowledge basis / Inženjeri, ekonomisti, liječnici, pravnici, agronomi, šumari, veterinari, odnosno svi oni koji u svojem radu primjenjuju aspekte okoliša u bavljenju vlastitom strukom, moraju stvoriti i imati multidisciplinarnu stručnu osnovu |
| Concrete measures / Konkretno mjere | <ul style="list-style-type: none"> Developing environmental awareness as an integral part of schooling system and education of the population / Razvijanje svijesti o okolišu kao integralni dio školskog sustava i edukacije stanovništva. |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Investment into raising environmental awareness is an investment which pays off in the future / Ulaganje u razvijanje svijesti o okolišu je investicija isplativa u budućnost |

interim solutions, taking into account phased construction which renders possible adjusting the capacity to demand, avoiding the costs of system over-dimensioning, thus ultimately deferring capital expenditures.

Infrastructure should be a combination of the old centralized infrastructure and multiple decentralized plants in the community.

Table 13. Corruption and environment**Tablica 13.** Korupcija i zaštita okoliša

| | |
|--------------------------------------|--|
| Possible solutions / Moguća rješenja | <ul style="list-style-type: none"> In order to achieve environmental protection, the judiciary, as well as all other central and local authorities, must be incorruptible, and judicial rulings should be made within reasonable time period / Da bi se mogla postići zaštita okoliša, tijela središnje i lokalne vlasti - u prvom redu pravosuđe - moraju biti nekorumpirani, a sudske odluke moraju se donositi u povoljnom roku |
| Concrete measures / Konkretna mjere | <ul style="list-style-type: none"> Developing civil society, raising professional standards, and stimulating community protection bodies / Razvijanje civilnog društva, podizanje profesionalnih standarda, te poticanje tijela zaštite zajednice. Publishing instructions on the availability and use of national and international funds for environmental projects, and simplifying the procedures without diminishing criteria / Objavljivati upute o dostupnosti i korištenju državnih i međunarodnih fondova za okolišne projekte, te pojednostaviti postupke bez ublažavanja kriterija. Budget revenues at local level should in the first place come from local taxes and compensations, and not by transferring revenues from citizens and economic operators first to central government which then distributes political favours to regional or local level / Proračunski prihod bi na lokalnoj razini trebao biti osiguran u prvom redu iz lokalnih poreza i naknada, a ne time da se prihodi građana i poduzeća prvo transferiraju centralnoj vladi, nakon čega ona dijeli političke "milosti" na regionalnu ili lokalnu razinu. Re-examining the possibility of improving access to judiciary, and – considering its significance of the community – of setting up new mechanisms such as ombudsman for utilities sector / Preispitati mogućnosti poboljšanja pristupa pravosuđu, te - zbog važnosti za zajednicu - i ustroja novih mehanizama poput pravobraniteljstva za djelatnost komunalnog gospodarstva. |
| Economic benefit / Ekonomska korist | <ul style="list-style-type: none"> Efficiency of the rule of law and anti-corruption bodies represent economic benefit for the community / Učinkovitost pravne države i tijela za borbu protiv korupcije predstavljaju ekonomsku korist zajednice Financing on grounds of successful confiscation of illegally acquired proceeds / Financiranje s naslova uspješne konfiskacije nezakonito stečene dobiti |

It is necessary to build public awareness concerning unsustainability of established waste management patterns.

Therefore communal infrastructure should be designed so that waste is not waste, but resource, charges should be based on the pay-as-you-throw principle; systems where waste is not produced should be promoted and products should be reshaped with regard to durability, reparability, reuse and recycling. Main guideline in making decisions on investments should be the analysis of actual costs.

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