OPPORTUNITIES FOR INCORPORATING GEOGRAPHY INTO THE RIVER BASIN MANAGEMENT

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Abstract
Geography in Slovenia is not sufficiently involved in the management of river basins, since it has not won its place in the interdisciplinary education of water managers and has also not been sufficiently present in practice. We designed a model of geographical approach to integrated management of water resources which is presented on the example of the Sotla river basin. We considered the river basin with its inner diversity and heterogeneity as a basic spatial unit of management. To realize our commitments to the environment we need their spatial placement that can be offered by geography. This approach would be a supplement to present sustainable strategies of water management and it could be applied into practice by appropriate study programmes in geography.

Key words: geography, river basin, Slovenia, Sotla river basin, water management

MOŽNOSTI VKLJUČEVANJA GEOGRAFIJE V UPRAVLJANJE POREČIJ

Izvleček
Geografija v Sloveniji ni zadostno vključena v upravljanje porečij, saj si ni izborila mesta v interdisciplinarnem izobraževanju upravljavcev voda, pa tudi v praksi ni dovolj prisotna. Oblikovali smo geografski pristop celostnega upravljanja vodnih virov in ga predstavili na primeru porečja Sotle. Za uresničevanje obveznosti do okolja je potrebna njihova prostorska umeščenost, ki jo lahko ponudi geografija. Pristop bi lahko bil dopolnilo sedanjim trajnostnim strategijam upravljanja voda, v prakso pa ga je mogoče aplicirati z ustreznimi študijskimi programi geografije.

Ključne besede: geografija, porečje, Slovenija, porečje Sotle, upravljanje voda

1. INTRODUCTION

According to European Water Framework Directive (European Parliament and Council), the EU countries need to achieve the sustainable management of water resources by 2015 and prevent further worsening of conditions. In Slovenia, intensive discussions about the importance of sustainable water planning in the watersheds of the Danube and the Adriatic Sea started in 2002 after the introduction of Water Act. In this country, water management is still sector-based and as such it does not bring wholesome solutions that would consider all elements of the environment. Geography is not sufficiently involved in the management of water resources and it has not fought its place in the interdisciplinary education of water managers. It is also not sufficiently present in practice – in local communities and municipalities. Governmental and managing organisations still do not pay enough attention to the innovative and integral ideas of geographical science.

However, we have to expose important geographical contribution to the development of the methodology for sustainable water resources management in Slovenia. Brečko Grubar (2007) suggests methodological approach of geographical study of sustainable management of water resources, which is based on DPSIR (Driving forces–Pressures–State–Impacts–Responses) model approach, on the integral geographical model of study of the environment and its components, and on the model of environmental vulnerability. Bricelj (2007) exposes the identification of dominant regional hydrogeographical characteristics as basic for geographical concepts of the water management in Slovenia. Namely, regional and local differences in water quantity of individual Slovenian regions are obvious. Šterbenk (2009) studies the role of water resources in the sustainable development of Šalek Valley and its periphery. Frantar (2011) pays the attention to geoinformation design of driving forces research in watersheds. Based on the theoretically identified driving forces and the concept of the French model NOPOLU, he used geoinformation technologies to establish the Slovenian model for research of driving forces in watersheds.

Our intention was to contribute to the efforts for geography to take part in the wholesome river basin management. Therefore, we designed a model of geographical approach to integrated management of water resources which is demonstrated concretely on the example of the Sotla river. Geographical approach with the emphasis on the spatial aspect would be a supplement to existing strategies of river basin management.

Many authors consider water management as very complex process and this is the reason why social studies, also geography, should be included in this process. Lawson (2007) finds that across the decades geographers have been concerned with questions of our ethical responsibilities to care. So it seems that care is nothing new in geography. Armstrong (2006) studies the ethical starting points in water use and he noticed the development of 'water ethic'. The 'water ethic' also supports the programme of the European Water Framework Directive in aiming for 'good ecological status' for all water bodies. Blackstock and Carter (2007) are convinced that the implementation of the European Water Framework Directive will challenge traditional single discipline or single issue approaches to form new 'sustainability science' with interdisciplinary, place-centred, multi-scale, collaborative and problem-oriented approach. Authors conclude that geographers are ideally placed to make such a transition happen. Watson et al. (2007) find that integrated water management is, to a large extent, influenced by geography in the sense that prevailing political, ideological, legal, institutional, cultural, economic and environmental conditions create the opportunities and constraints for policy development and implementation. Berndtsson et al. (2005) express criticism to the educational system. They believe it is possible to avoid inefficient water management by educating highly-competent professionals that would be able to face present and future water issues. Those authors emphasise specific requirements to improve the educational curricula of future water engineers: multidisciplinary skills, communication skills, training skills, societal aspect and ethical aspect.

Local community or public plays an important role in wholesome river basin management. Water management plan should summarise basic proposals, opinions and initiatives and also the report on how the designer of that plan takes public comments into consideration (Decree on the detailed content and method of drawing up a water management plan, 2006). Downs and Gregory (2004) report on significant progress in public environmental awareness and in the increased popularity of river preservation and protection. In discussion about deliberative process for urban river restoration, Petts (2007) emphasises the importance of public engagement because public participants represent and reflect the broad range of interests and perspectives in the areas. Responsible public participation in water management could be increased by qualifying the water professionals that will possess good communication skills for popularising to general public and will respect ethical aspect to provide information about the risk and uncertainties in the short and long terms of water projects (Berndtsson et al., 2005).

2. SUSTAINABLE STRATEGIES FOR INTEGRATED MANAGEMENT OF WATER RESOURCES

Methodology of geographical approach to integrated management of water resources considers already established sustainable strategies, e.g. River Basin Management Plans (hereinafter RBMP), Integrated Water Resources Management (IWRM) or Integrated Water Management (IWM), and ecoremediation as examples of synthesis approaches to management of river basins. River Basin Management Plans are based on Water Framework Directive and are prepared by EU countries for particular river basins or watersheds. Water Framework Directive also promotes RBMP as a planning tool of contemporary integrated water management. In Slovenia, two river basin districts were delineated: the Danube River Basin District (part of it is the Sotla river basin), and the Adriatic Sea River Basin District. Consequently, in Slovenia two RBMP are under preparation. The concept of integrated preparation of RBMP determines, among other, the collaboration of scientific fields. However, geography is not one of the selected fields, which points to the lack of its involvement in contemporary management processes. Regarding the specifics and variety of Slovenian landscape, we need an in-depth spatial aspect to manage water resources. That kind of aspect could be provided by geography because of its multi-layer and integral landscape research. Thus, geography needs to be incorporated into the systems of river basin management.

Integrated water management, supported by Global Water Partnership, is one of the core sustainable development categories of the modern society (Bizjak, 2008). Watson, Walker and Medd (2007) argue that there is still very little agreement regarding what IWM actually means in practice. Considering geographical approach to integrated water management it is essential for a geographer to connect with several groups of stakeholders: authorities, administrations, sectors, public, other professional and research institutions, local governments, broad public, individuals and other stakeholders.

Third sustainable strategy – ecoremediation is about adjusting the measures to the properties and functioning of river basin or ecosystems, protecting and spreading of natural ecosystems and at the same time enabling human activities in the area (Vrhovšek and Vovk Korže, 2007). Basic functions of ecoremediation are significant buffer, self-purifying and habitat features. In case of flowing waters, these functions are demonstrated by water retention, increase of self-purifying abilities and restoration of water and riparian habitats. In nature, this role is played by pools, rapids, sandbanks, riverbeds overgrown with water vegetation, braided channels, dykes and riparian vegetation. It is therefore essential to preserve and recreate them. The increasing threats to water environment and high-cost improvement procedures encourage the development of new ecoremediation procedures. Here, we could emphasise vegetation purifying plants, vegetation belts and creation or restoration of wetlands and pools.

3. THE ADVANTAGES OF GEOGRAPHICAL APPROACH TO INTEGRATED MANAGEMENT OF WATER RESOURCES

Using the geographical approach, we need to monitor environmental status and plan the protection or restoration measures in an integrated way. Clear spatial determination of measures taken and public participation are fundamental for achieving practical results. Water Directive is based on river basin or watershed (Carter, 2007). Present river interventions displayed several mistakes or narrow technical thinking about the so-called river management since they were not based on integration. In frame of geographical approach, we consider river basin as a basic managing unit. Owing to its inner diversity and homogeneity, we divided it into particular hydrographical areas. When designing hydrographical areas, we considered spatial units of 4th level, determined by Environmental Agency of the Republic of Slovenia (EIONET in Slovenia, 2012). Such division originates from hydrogeographical study orientation and is necessary to define hydrogeographical differences among the parts of the river basin and to better determine the management measures.

4. USING GEOGRAPHICAL APPROACH OF INTEGRATED MANAGEMENT OF WATER RESOURCES IN THE SOTLA RIVER BASIN

The Sotla river basin is located on the margins of Pannonian plain and it spreads from north to south along the border between Slovenia and Croatia. It is one of the largest Slovenian river basins and is exceptionally asymmetric since most of the tributaries are on Slovenian side in the upper and middle course. The total area of river basin is 583,8 km^2 and 81.7% of it belongs to Slovenia. The basin is characteristic for its fan-branching and is therefore more exposed to floods.

The Sotla river basin consists of five hydrographical areas: the Sotla–Rogatec (upper course of the Sotla till the confluence with Mestinjščica river), the Mestinjščica river basin, the Sotla–Podčetrtek (central part of the river basin till the confluence with Bistrica river) the Bistrica river basin and the Sotla–Bizeljsko (lower part of the Sotla river basin) (Figure 1).

Original environmental status of the Sotla river basin displays the rich diversity of surface waters (rivers, streams, standing waters) and ground waters (springs, mineral and thermal waters). Agricultural areas and settlements represent significant pressures on the Sotla river and its tributaries (in 2012, Rogaška Slatina had 5105 inhabitants and Šmarje pri Jelšah 1765). Disperse settlement pattern, industry and tourism infrastructure also affect the river basin.

Hydrological properties display high vulnerability of the Sotla river and its tributaries according to its specific run-off (16 $l/s/km^2$ in the lower section of the Sotla river), mean annual discharge (9 m^3/s in the lower part of the Sotla river) and mean minimum discharge (0.9 m^3/s in the lower part of the Sotla river). Hrvatin (1998) classifies the Sotla's river discharge regime as fed by rainfall and snowmelt. In the Sotla river basin, there is a trend of gradual decrease in mean annual precipitation and increase in mean annual air temperature. This leads to diminishing of water resources. According to water balance for 1971–2000, Slovenia has enough water on the average; however, some months are critical, also in the Sotla river basin (Surface streams …, 2012). These months are usually at the end of summer when there is a lack of precipitation accompanied by high temperatures. In general, the streams in the Sotla river basin are in natural and slightly or moderately modified state and this is why the riverbed is quite naturally preserved. Existing regulations are outdated. The biggest issue in the Sotla river basin is significant pollution in the upper part. Chemical status of the Sotla in Rogaška Slatina is bad but, since 2005, it is improving gradually in the lower section.

The Sotla's flow was dammed in 1980 in its narrow part in Vonarje and about 6 km long Vonarje artificial lake was created. The intention was to retain high water and to provide drinking water for the area. Unfortunately, water quality was poor because of low discharge and municipal sewage water, so the dam had to be removed after eight years. Today, the lake is dry most of the year and its existence depends on hydrological situation. It is used for high-water retention. However, there have been some ideas about the restoration of the Vonarje lake but water quality should be much better for a project like that.

We examined original environmental status of the river basin by an integrated geographical model used for studying the environment and its components. Integrated geographical model was previously transformed from basic methodological model DPSIR (Driving forces–Pressures–States–Impacts–Responses) because several geographical studies were centred on the consequences of pollution (Plut, 2004). Integrated geographical model for studying the environment and its components includes six groups of indicators:

- factors of impacts on water resources;

- impacts on water resources and their vulnerability;
- present conditions and ambitions for water quality;
- impacts on water quality;
- political response;
- basic geographical properties of river basin.

Figure 1: The Sotla river basin
Slika 1: Porečje reke Sotle

The last group of indicators was added with purpose to present landscape diversity of the river basin, e.g. annual precipitation and its distribution, riverbed gradient, amount of water and similar. The use of GIS programme tool enabled a more effective search for the connections among the landscape elements and thus improved the quality of designed measures.

People have always studied landscape with the help of simple models as maps and globes. During the last 30 years it has become possible to enter these models into computers which then lead to the development of geographical information systems (Ormsby et al., 2004). We used Esri ArcView 9 computer programme tools and digital spatial data from various Slovenian institutions such as Environmental Agency of the Republic of Slovenia, Geological Institute of Slovenia, Hidrosvet, Institute for Water of the Republic of Slovenia, Ministry of Agriculture, Forestry and Food, and Statistical Office of the Republic of Slovenia. We adjusted the collected data to our needs. This means that we, for example, used a scale with 4 levels instead of 7 to study hydromorphological quality of surface flowing waters. We are well aware that we can qualify only a part of properties and processes in nature and, therefore, we create simplifications and this is why the quantified demonstrations include some unreality uncertainties.

Determining the aims for river basin management also means the determining of global aims that manage human co-habitation with waters. We have studied legal foundations that are essential for planning and implementing the measures of water management. Based on that, we determined the aims of water protection, management and use. We were especially interested in EU legislation, international conventions, national regulations, cross-border agreements and municipal decrees. Due to the exceptionalities of Slovenian environment (small country, great landscape diversity and well-preserved water resources), we need to view EU regulations from specific aspect. National regulations should be updated regularly; they would have to include clearly defined cross-sector river basin management and consider local particularities.

Integrated management of river basins in Slovenia will come to life much easier when the regions will be established. Then, numerous competences will move from state to regional authorities. In an integrated management of river basin we need to deal with local specifics and our starting point should not be only well-being of the state but also of an individual. Since municipalities should play an important role in preparing management plans, we have also studied municipal regulations. We found that municipalities do have many commitments toward the environment and water resources since they approve municipal programmes of environment protection, determine the land use and conditions for locating the interventions in the area.

Programme of measures taken within river basin management was based on original environmental status and management aims. Original environmental status is the actual status of different geographical parameters in the area, e.g. water quality, use of riparian land and so on. Management aims define what the status should be like. Since this status is often not satisfactory, it should be improved by the measures within management. Measures are actual solutions to achieve goals and to preserve or improve the status. When defining the actual measures, we applied the connatural ecoremediation approach, own understanding of river basin issues, legal foundations, professionals' opinions and also some properties of integrated river basin management.

Quantification of original environmental status of the river basin is related to the measures in a way that it defines satisfactory or not satisfactory status of geographical parameters and at the same time, the need to implement measures to achieve the aims. The aims and measures refer to protection, management and use of water. Measures of river basin management are measurable with the indicators of aim achievement that are mostly quantitatively defined. Quantification of indicators is based on our judgement about the possibility for implementation of the measures and aim achieving. This should be implemented till 2015.

Measures of river basin management were defined by main spatial factors which is evident from Table 1. A combination of all main spatial factors for particular measure stands

Table 1: Examples of some measures and main spatial factors in river basin management
Preglednica 1: Primeri nekaterih ukrepov in poglavitnih prostorskih dejavnikov upravljanja porečij

	Measures	**Main spatial factors**
Water protection	Creating ponds, pools and wetlands for natural retention of water	• land use (meadows and pastures, moor grasslands, wetlands) • soil types (riparian soils, gleysol soils)
	Constructed wetlands	• inflows and outflows of standing waters • industrial facilities • tourist facilities • large settlements • areas of disperse settlements
	Preserving and creating protective vegetation belts	• intensive agricultural land along the rivers and its tributaries (borders of fields and meadows in a belt 30 metres from the river bank)
Water management	Revitalisation of regulated riverbeds	• regulated riverbeds (slightly to significantly alternated streams) • water dams
	Improvement of critical erosion in riverbeds	• buildings in a 10 m belt on each side of the riverbed
Land use of riparian areas	Limiting the plantation method of farming and encouraging the ploughing transversally to the slope; supplementing farming by growing industrial hemp; growing reed	• areas of intensive farming (meadows and fields) • plains with riparian and gleysol soils
	Planting willows along the streams and rivers	• riparian and gleysol soils, infertile areas • 30 m belt along the river bank • land use: meadows, pastures, moor grassland, overgrown areas, areas of trees and bushes, wetlands

for its placement. For example, ponds, pools and wetlands are created for natural retention of water and their creation is determined by two main spatial factors: soil type and land use (to be precise, meadows and pastures, moor grasslands, wetlands and the areas of riparian and gleysol soils). The areas of preservation and creation of vegetation belts are defined by intensive land use and the location along the rivers and their tributaries. Spatial aspect gives water managers some spatially-defined guidelines and thus enables more effective management of river basins.

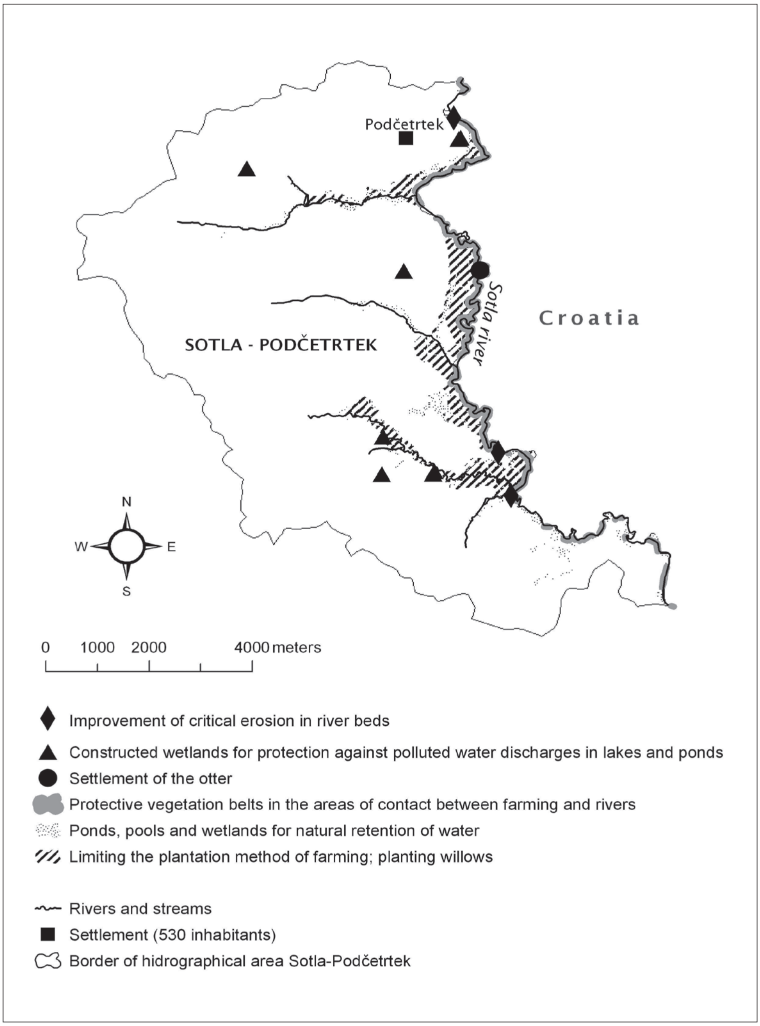
5. IMPLEMENTATION OF ENVIRONMENTAL GOALS IN THE SOTLA RIVER BASIN

The aims of river basin management are the protection, management and use of water and other aims related to some specific properties of the river basin (e.g. border location, rich biodiversity), to the importance of environmental education, qualifications, awareness and public participation in integrated water management. Generally, we can understand from legal foundations that countries and also municipalities do have a lot of commitments to the environment and water resources. It is indisputable that Slovenia will not be able to realize the main aim of Water Directive – good status of all waters, also surface waters, by 2015. Failing to achieve the environmental aims is in most cases the result of sector approach. A total evaluation of possibility for meeting environmental aims was made for the Sotla and its tributaries by Institute for Water of the Republic of Slovenia. Hydrographical area of the Sotla–Rogatec will definitely not be able to meet environmental aims, while they might not be met in the Sotla–Podčetrtek and the Sotla–Bizeljsko. In the Mestinjščica and the Bistrica areas the environmental aims could be met. River status is the worst in the upper course of the Sotla river (Globevnik, 2006). To sum up, the status is poor and the aims will not be met. An important step towards more effective meeting of aims would be active cross-sector cooperation for better management of river basins. It should not be solely on the state level, but also on the level of river basins and its parts with active participation of municipalities. To implement numerous commitments to the environment we need to understand their spatial placement, which is provided by geographical approach to river basin management.

6. ADVANTAGES OF USING THE GEOGRAPHICAL APPROACH IN INTEGRATED PLANNING OF RIVER BASIN MANAGEMENT – AN EXAMPLE OF THE SOTLA RIVER BASIN

We describe spatial aspect of managing the Sotla river basin for all hydrographical areas within the basin. Because of clarity, the cartography is made for smaller area, namely for hydrographical area of the Sotla–Podčetrtek (Figure 2). When determining the spatial aspect of managing the basin, we considered that the areas of meadows, pastures, moor grasslands and wetlands that coincide with riparian or clay soils naturally retain water. Therefore, those areas should be maintained and preserved. Constructed wetlands should be built to clean standing waters, wastewaters in the areas of dense and disperse population and wastewaters from tourist and industrial facilities. Preserving and creating vegetation belts is necessary in the areas of contact between farming and rivers and also on areas where two allotments meet. We recommend additional monitoring of river quality on the Bistrica river since there is no regular monitoring and it is the second largest tributary of the Sotla river. We also propose monitoring for the Mestinjščica river, because it drains waters from densely populated areas with 200 inhabitants per km^2.

Figure 2: Spatial determination of some measures for protection and regulation of water and riparian areas in hydrographical area of the Sotla–Podčetrtek
Slika 2: Prostorska opredelitev nekaterih ukrepov varstva in urejanja voda ter obvodnega prostora v hidrografskem območja Sotla-Podčetrtek



To settle the otter in the area again we need to preserve and restore natural water and riparian ecosystems of Bistrica and Sotla rivers in its middle course. Revitalisation of regulated riverbed is necessary in all streams with moderately up to significantly alternated level, while dam of the Vonarje lake requires improvement. We also need to pay attention to erosion hazard, especially on the contact of building areas and meanders along the Sotla, the Mestinjščica and the Bistrica rivers. To diminish negative influences of intensive farming on riparian land, we suggest mitigation measures such as changing field into meadows and introducing stockbreeding, limiting plantation method of farming, growing industrial hemp, ploughing transversally to the slope and growing reeds. Industrial hemp is appropriate for crops rotation on wetlands and it can be used for oil, cosmetic substances, animal feed and fibres. By ploughing transversally to the slope, we can prevent direct draining of crop sprays into rivers and we can also diminish the erosion. Reeds are a great source of biomass that can be used for heating, construction material or for restoring cultural landscape and animal shelters.

These mitigation measures are intended for the areas where riparian and clay soils coincide with farming land. Planting willows is an opportunity to revive basketry as a landscape property and additional income of farmers. We suggest it on the areas along the Sotla, the Bistrica and the Mestinjščica rivers where riparian and clay soils coincide with one of the following land uses: fields, meadows, moor grasslands, areas in overgrowing, individual trees and bushes, wetlands. Integrated planning of river basin management needs to involve all key economic sectors such as farming, industry, tourism, settlements, regional development, as well as sectors and organisations from environmental management and protection and all those that could influence the integrated water management.

7. THE NEED FOR MODERNISING GEOGRAPHICAL STUDY PROGRAMMES WITH CONTENT FOR INTEGRATED RIVER BASIN MANAGEMENT

Geographical approach to integrated planning of river basin management could be applied to practice by designing and introducing appropriate geographical study programmes. In Slovenia, study of geography has not paid special attention to river basin management or water resources so far. With modernised new study programmes, we are making a giant leap forward. Here, we emphasise a new Ph.D. study programme Sustainable development with ecoremediations at the University of Maribor which aims to educate top professionals for implementation of sustainable development in practice.

The aim is to qualify high-skilled professionals that will recognise environmental challenges in the development of municipalities and regions. They will have an integrated approach to the environment and development and will be able to plan the development of local communities with public participation for they will understand that educating public is a key element of local development (Vovk Korže et al., 2008). With this programme, students acquire general competences, for example the ability of aim-oriented communication within the field and with other fields, locally or internationally. Other competences are qualifications for leading projects or organisations, ability of cooperating in modernising and developing the legislation and organising or leading research activities in Slovenia or abroad. Students acquire subject-specific competences, for example understanding of sustainability from environmental, economic and social aspect. They learn about project work in ecoremediation and understand the importance of protected and ecologically important areas as region's potential.

There are twelve study subjects of the above mentioned study programme and they are important for education of connatural management of water and other environmental components. The subjects are:

- Ecoremediations;
- Environmental aspects of sustainable development;
- Economic aspects of sustainable development;
- Social aspects of sustainable development;
- Environmental aims and ecoremediations;
- Sustainable development in local communities;
- Sustainable development in protected and ecologically important areas;
- Informing public for sustainable development;
- Project planning of ecoremediations;
- E-environmental information about ecoremediation;
- Environmental informing and life-long learning for sustainable development, and
- Environmental sociology.

Among the aims we need to emphasise are those where students learn about the old methods of ecoremediation and their transfer to present time for preventing and diminishing the consequences of pollution. Students also identify the consequences of shifting the gravity from economic growth to costs reduction which will become the leading driving force of the economy. They learn about designing local environmental protection programmes and gain knowledge and skills for recognising the environment as an ambient for healthy life. Among the foreseen study results we need to emphasise the possibility of recognising the specific issues in the environment and the ability of selecting and using the appropriate type of ecoremediation, integral thinking and interdisciplinary work approach, understanding modern environment-friendly technology and the evaluation of balance between spatial intervention and environment protection (Vovk Korže et al., 2008).

8. DILEMMAS OF IMPLEMENTING GEOGRAPHICAL APPROACH TO THE INTEGRATED PLANNING OF RIVER BASIN MANAGEMENT

When designing the methodology for geographical approach, we started from the belief that geography could contribute significantly to the prevention-based planning of connatural spatial and regional development. Geography's advantage is in its multi-layer and integrated studying of specifics and differences of Slovenian landscape and regions and in in-depth spatial aspect of river basin management.

When determining the spatial aspect of the Sotla river, we established that the model we designed is deficient since it could define measures in a more concrete spatial way. Hydrographical areas are namely relatively large regions – in the river basin of the Sotla river they measure from 61 to 134 km^2. This deficiency could be limited by dividing the river basin in small homogenous units. These units could be landscape-ecological ones or based on settlement pattern or other factor. Studying the river basin with landscape-ecological units is based on key natural landscape-creating factors and it includes a lot of ecosystem components (Špes et al., 2002). Landscape-ecological units are the connections of various ecotypes, for example riverbeds, floodplains, alluvial plains above the floods and similar. The focus is on the elements that influence the living world more significantly and also influence human actions and land use, e.g. relief or geology and soils.

When implementing Water Directive in Slovenia, we need to view the EU regulations from the aspect that takes into account the characteristics of Slovenia. Therefore, the aims of river basin management should be adjusted to our small country with great landscape diversity and quite well preserved water wealth. There still remains a dilemma whether geography will stay out of the approaches to water management or not. Therefore, we appeal to flexible and up-to-date national regulations which should include clearly defined cross-sector management of water resources.

To be realistic, numerous aims of Water Directive will not be met by 2015. One of the basic reasons is in the fact that local communities do not actively participate in planning of water management. In our opinion, integrated river basin management could come to life with the introduction of regions, since the region will receive more competences for water management. Integrated river basin management is namely not about the well-being of a state; it is mostly about regional and local community and about individuals. We believe that municipalities should accept more detailed water management plans for particular water types or for particular water management issues, since this is determined by Water Act (2002). The municipalities should encourage cross-sector cooperation with economy sectors and also sectors of water management, environment protection and nature preservation, as well as with all sectors and organisations that could have the impact on water management. Generally speaking, we established that municipalities do have many commitments to the environment and water resources, but to meet them they need spatial placement which is provided by geographical approach.

When planning the river basin management using geographical information system, as in our case, the quality of spatial placement of measures greatly depends on the existence, up-to-dateness and precision of digital data about the original environmental status. We think that the existing state digital spatial data could not be used in small river basins or its parts because of data's imprecision. This holds especially true for data on impact factors and impacts on water resources. This is why we suggest that data on local level should be supplemented with field work and interviewing of the locals, where geography again plays a crucial role.

We need to specify in detail the measures to include schools into river basin management, since students could become, with the help of their mentors, the creators of local management plans. When searching for content and forms of development, local knowledge and values play an important role, which is also defined by Aarhus Convention. Here, geography teacher possesses extreme power.

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MOŽNOSTI VKLJUČEVANJA GEOGRAFIJE V UPRAVLJANJE POREČIJ

Povzetek

Glede na določila evropske Vodne direktive je potrebno v državah članicah Evropske unije do leta 2015 doseči trajnostno usmerjeno upravljanje vodnih virov. V Sloveniji imamo še vedno sektorsko zasnovano upravljanje voda, ki ne prinaša celostnih rešitev, ki bi celostno obravnavale vse sestavine okolja. Geografska stroka ni zadovoljivo vključena v upravljanje vodnih virov in si ni izborila mesta v interdisciplinarnem izobraževanju upravljavcev voda (npr. hidrotehnikov, krajinskih arhitektov, prostorskih načrtovalcev itd.). Geografska stroka tudi ni dovolj prisotna v praksi (v lokalnih skupnostih, občinah itd.), s strani vladnih in upravljavskih organizacij pa je zaznati pomanjkanje posluha za njene inovativne rešitve.

Geografija je integralno usmerjena veda, saj je po številnih definicijah njen osnovni predmet večplastno preučevanje pokrajine, zaradi česar lahko pomembno prispeva k preventivno zasnovanemu načrtovanju sonaravnega prostorskega in regionalnega razvoja. Z namenom predvideti pot, da se geografija vključi v celostno upravljanje porečij, smo ob-

likovali model geografskega pristopa in ga konkretneje prikazali na primeru porečja Sotle. Pri tem smo upoštevali že uveljavljene strategije celostnega upravljanja vodnih virov, kot so priprava načrtov upravljanja voda (River Basin Management Plans), integralno upravljanje z vodnimi viri (Integrated Water Resources Management) in ekoremediacije.

Vodna direktiva temelji na porečju oziroma povodju, saj so dosedanji posegi v vodotoke pokazali mnogo napak ozkega tehničnega razmišljanja o t.i. urejanju vodotokov, ki niso bili zasnovani celostno. Zato smo v okviru geografskega pristopa upoštevali porečje kot osnovno prostorsko enoto upravljanja, zaradi notranje raznolikosti in heterogenosti pa smo ga razdelili na posamezna hidrografska območja. Porečje Sotle, ki leži na obrobju panonskega sveta, se vleče v smeri sever–jug ob slovensko-hrvaški meji. Je izrazito asimetrično, saj pretežni del sotelskih pritokov pripada slovenski strani, in sicer zgornjemu in srednjemu toku reke. Površina celotnega porečja Sotle znaša 583,8 km^2, od tega leži 81,7 % v Sloveniji. Porečje Sotle sestavlja pet hidrografskih območij, in sicer Sotla–Rogatec (zgornji del porečja Sotle do izliva Mestinjščice), Mestinjščica (porečje Mestinjščice), Sotla–Podčetrtek (srednji del porečja Sotle do izliva Bistrice), Bistrica (porečje Bistrice) in Sotla–Bizeljsko (spodnji del porečja Sotle).

Izhodiščno okoljsko stanje porečja smo preučili z integralnim geografskim modelom preučevanja okolja in okoljskih sestavin ter z ArcGIS programskim orodjem. Integralni geografski model je bil že pred tem preoblikovan iz osnovnega metodološkega modela DPSIR (Driving forces–Pressures–States–Impacts–Responses), in sicer zaradi osredotočenosti številnih geografskih prostorskih raziskav na posledice onesnaževanja okolja. Integralni geografski model preučevanja okolja in okoljskih sestavin vključuje šest skupin kazalcev, in sicer dejavnike pritiskov na vodne vire, pritiske na vodne vire in ranljivost vodnih virov, stanje in težnje kakovosti vodnih virov, vplive kakovosti vodnih virov in odzive politik. Za prikaz pokrajinske raznolikosti smo dodali še osnovne geografske značilnosti porečja. Uporaba ArcGIS programskega orodja nam je omogočila učinkovitejše ugotavljanje povezav med pokrajinskimi sestavinami ter posledično kvalitetnejše oblikovanje ukrepov.

Opredelitev ciljev upravljanja porečij pomeni opredelitev globalnih ciljev, ki urejajo sobivanje človeka z vodami. Preučili smo pravne podlage, ki so pomembne za načrtovanje in izvajanje ukrepov upravljanja porečja ter na osnovi tega opredelili cilje varstva, urejanja in rabe voda. Program ukrepov upravljanja porečja smo opredelili na osnovi izhodiščnega okoljskega stanja in ciljev upravljanja porečja. Če povzamemo, pomeni izhodiščno okoljsko stanje dejansko stanje, ki v porečju obstaja za različne geografske parametre (npr. kakovost vodnih virov, raba obvodnih zemljišč itd.), cilji pa narekujejo, kakšno naj bi to stanje bilo. Ker stanje velikokrat ni zadovoljivo, naj bi se to izboljšalo z ukrepi upravljanja porečja. Ukrepi torej pomenijo konkretne rešitve za uresničitev ciljev in za ohranjanje oziroma izboljšanje stanja. Pri določanju konkretnih ukrepov upravljanja porečja smo črpali iz sonaravnega ekoremediacijskega pristopa, iz lastnega poznavanja problematike upravljanja porečij, iz pravnih podlag s področij voda in okolja, iz mnenj okoljskih strokovnjakov ter iz nekaterih značilnosti integralnega upravljanja voda. Ukrepe upravljanja porečij smo opredelili s poglavitnimi prostorskimi dejavniki. Kombinacija vseh poglavitnih prostorskih dejavnikov za določen ukrep pomeni njegovo prostorsko umestitev.

Geografski pristop k celostnemu načrtovanju upravljanja porečij je mogoče aplicirati v prakso z oblikovanjem in uvedbo ustreznih študijskih programov geografije. V Sloveniji študij geografije do sedaj ni posvečal posebne pozornosti upravljanju porečij oziroma vodnih virov, medtem ko je bil z novimi študijskimi programi narejen velik korak naprej. Izpostavljamo nov doktorski študijski program Trajnostni razvoj z ekoremediacijami na Filozofski fakulteti Univerze v Mariboru, ki ima za temeljne cilje izobraziti vrhunske strokovnjake za implementacijo trajnostnega razvoja v praksi, izobraziti vrhunski kader, ki bo usposobljen za prepoznavanje okoljskih izzivov v razvoju občin in regij, razviti strokovnjake s celovitim pogledom na okolje in razvoj, usposobiti strokovnjake za načrtovanje razvoja lokalnih skupnosti glede na okoljske cilje skupaj z javnostjo ter prepoznati izobraževanje javnosti kot temeljni element razvoja lokalnih skupnosti.

Pri opredeljevanju prostorskega vidika upravljanja porečja Sotle smo ugotovili, da je model, ki smo ga oblikovali, pomanjkljiv v segmentu premalo konkretnega prostorskega opredeljevanja ukrepov. Namreč, tudi hidrografska območja predstavljajo relativno velike regije – v porečju Sotle od 61 do 134 km^2. Pomanjkljivost bi lahko odpravili z obravnavanjem porečja po manjših homogenih enotah, bodisi po pokrajinskoekoloških enotah, bodisi po takšnih enotah, ki temeljijo na poselitvenem vzorcu ali na katerem drugem dejavniku.

Menimo, da je potrebno v Sloveniji pri procesu implementacije Vodne direktive gledati na določila Evropske unije z zornega kota, ki upošteva posebnosti slovenskega ozemlja, ter cilje upravljanja porečij prilagoditi majhnosti države, pa vendar veliki pokrajinski raznolikosti in pestrosti ter dokaj ohranjenemu vodnemu bogastvu. Dilema je tudi, ali bo geografija še naprej ostala izven pristopov upravljanja z vodami. Zato apeliramo na fleksibilnost nacionalnih predpisov, saj bi jih bilo potrebno sproti posodabljati in v njih jasno opredeliti medsektorsko upravljanje vodnih virov.