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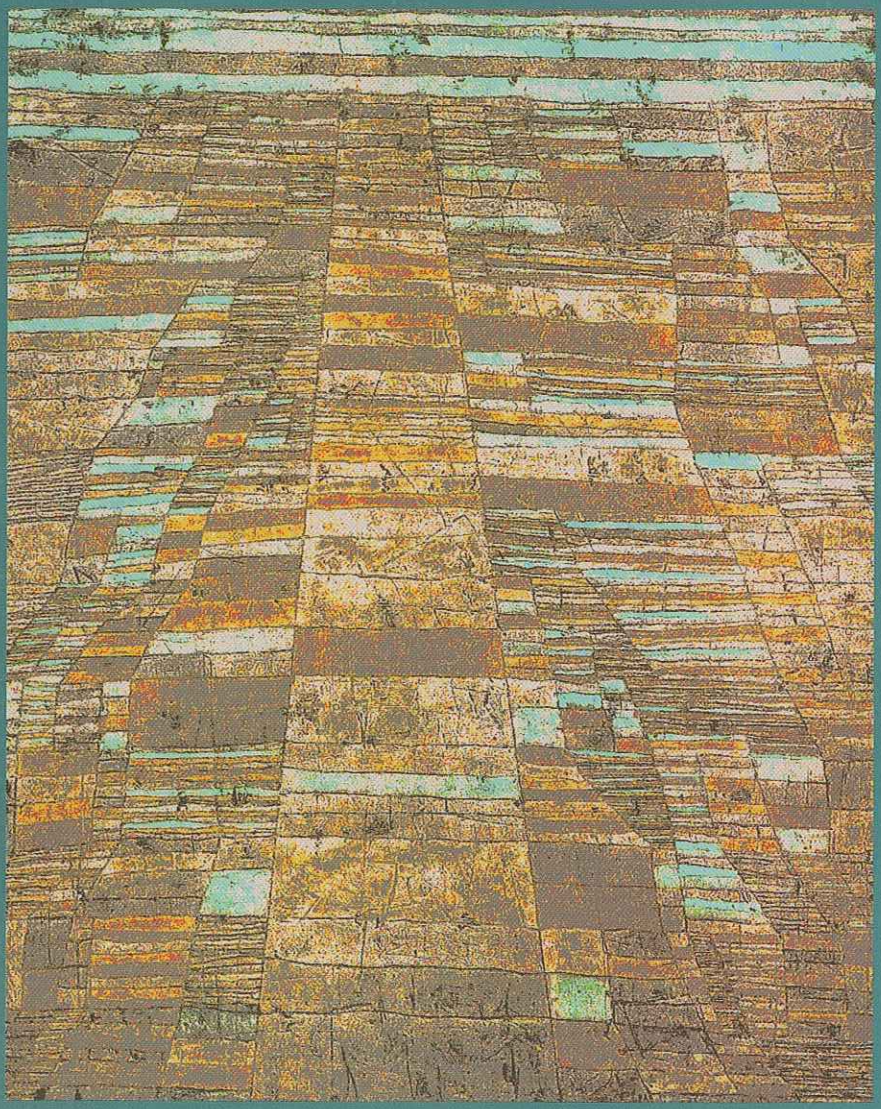

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SCOPE AND AIMS

The review is concerned with a multi-disciplinary approach to spatial, regional and urban planning and architecture, as well as with various aspects of land use, including housing, environment and related themes and topics. It attempts to contribute to better theoretical understanding of a new spatial development processes and to improve the practice in the field.

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Igor Marić, Director

ADDRESS

Institute of Architecture and Urban & Spatial Planning of Serbia, IAUS
"Spatium"
Serbia, 11000 Belgrade, Bulevar kralja Aleksandra 73/II,
tel: (381 11) 3370-091
fax: (381 11) 3370-203,
e-mail: iaus@EUnet.rs, web address: www.iaus.ac.rs

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EDITORIAL

Dear readers,

As previously announced, this issue of the International Journal „Spatium“ is also a thematic one with the majority of papers covering certain aspects of „Sustainable spatial (territorial) development“. These aspects address natural conditions, e.g. climate changes and challenging task of integrating climate change adaptation policies in spatial planning, the role of water storage reservoirs and sustainable water supply systems, mineral resources' use and issues of harmonisation between spatial plans for the mining areas with other strategic documents, as well as national or specific (transport system) indicators for monitoring and evaluation of the outcomes of spatial planning, and application of new methods in modelling spatial distribution of population.

This issue also contains few articles covering other (miscellaneous) themes and topics of academic relevance, such as the customary rules in construction of wine cellars, use of wood as an element of facade covering, and environmental impacts of foreign direct investments.

Editor-in-Chief

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INTEGRATING CLIMATE CHANGE ADAPTATION POLICIES IN SPATIAL DEVELOPMENT PLANNING IN SERBIA - - A CHALLENGING TASK AHEAD

Nada Lazarević Bajec[1], University of Belgrade, Faculty of Architecture, Belgrade, Serbia

Climate change adaptation policies integration process adds a new dimension to spatial planning. National planninng systems need to be reviewed for their capability to incorporate new procedures and implementation tools with a view to upgrading general efficacy of public response to climate change.

The Spatial Plan of the Republic of Serbia (SPRS) adopted in October 2010 devotes special attention to issues of climate change, mitigation and particularly adaptation. This paper argues that regional level of governance is key to considering climate change vulnerability and setting a framework for specific actions on the local level. In the absence of the regional level, great responsibility is on the national planning level to lay out detailed guidelines and regulations as a guidance for spatial planning practice.

What problems may be expected in the SPRS implementation with respect to climate change adaptation? How the adaptation policies adopted in the plan will be integrated into subordinate plans, regional and local? What limitations will the overall system face in policy harmonization? Although this brief paper cannot answer all of these questions, it will try to explain them and indicate the necessary transformations to the planning system to be discussed in the coming period.

***Key words:** Climate change, Adaptation, Spatial Plan of the Republic of Serbia, Planning system in Serbia, Regulations*

INTRODUCTION: FROM MITIGATION TO ADAPTATION

While climate change causes, trends and scenarios may be debated, the number of climate change related tragic events in Europe has reportedly doubled in the 1990s compared to the previous decade, leading to severe economic and social consequences (EEA, 2004). The most pessimistic scenario projects temperature rise about 4.0°C (best estimate for a "high scenario") with a likely range between 2.4 to 6.4°C (°C at 2090-2099 relative to 1980-1999) (IPCC, 2007).

Climate projections for South East Europe show that this region is particularly sensitive to climate variability (IPCC, 2007; CEPS, 2008). In some parts of South East Europe precipitation has decreased by up to 20%. Projections are uncertain, but the researches indicate that Serbia belongs to areas highly vulnerable to climate change (UNECE, 2007). Mean annual air temperature in Serbia exhibits a rising trend and forecasts project sharp drop in precipitation during summer and intensified droughts (Spatial Plan of the Republic of Serbia, 2010).

The emphasis placed on mitigation in combating climate change has recently started to shift toward adaptation, under a broad consensus in sustainable development policies that adaptation to climate change is necessary and urgent (EEA, 2006). Adaptation is defined as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2001: 72). Climate change adaptation (hereinafter CCA) includes "actions taken by governments including legislation, regulations and incentives to mandate or facilitate changes in socio-economic systems aimed at reducing vulnerability to climate change, including climate variability and extremes" (Burton et al., 2002:146).

A bulk of documents produced worldwide and in Europe emphasize that while adaptation cannot prevent climate change consequences, it can alleviate them (IPCC 2007; Stern 2006). Under its climate change policy, the EU has adopted the Green Paper on adapting to climate change. The document pays special attention to adaptation, defined as "reducing the risk and damage from current and future harmful impacts cost-effectively or exploiting potential benefits" (EC, 2007a, 3). Its importance is also recognized by the Copenhagen Accord (2009), which is keen to support the research on possible adaptation actions.

The research supporting adaptation policies is

[1] Bulevar kralja Aleksandra 73/II, 11 000 Beograd, Serbia
jbajec@eunet.rs

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growing (Klein and Tol, 1997, Burton et al., 2002, Eggenberger and Partidário, 2000, Füssel, 2007). According to Klein et al., it is no longer a question whether to mitigate climate change or to adapt to it. Both mitigation and adaptation are essential in reducing the risks of climate change (Klein, Schipper and Dessai, 2005) and they are assured a prominent place in sectoral policies, particularly the ones integrated in spatial planning. At the same time, however, it is noted that insufficient attention is paid to consideration of operationalization mechanisms. Therefore, the EC Green Paper on adapting to climate change (2007) stresses that programs and projects adopted under the Cohesion Fund, Regional Development Fund, pre-accession instruments, Trans-European Networks Programmes, and infrastructure measures under the Rural Development Fund need to ensure that climate change considerations are adequately incorporated into these important funding streams.

Materials prepared for the Cancun Summit (2010) place equal emphasis on mitigation and adaptation. "Parties have emphasized that adaptation and mitigation need to be accorded the same level of importance. Adaptation does not replace mitigation of greenhouse gas emissions. On the contrary, both adaptation and mitigation need to be pursued in parallel during the same period of time, thus complementing each other, and they need to be implemented through sufficient financing and appropriate technology" (UNFCCC, Fact sheet, 2010).

In an effort to combine both types of policies, researches seek an optimal mix of adaptation and mitigation. The policies are tightly interwoven and "the greater the effectiveness of adaptation in reducing vulnerability to climate change, the less will be the urgency to reduce emissions of greenhouse gasses"(Burton et al., 2002).

However, despite the researchers' claims that mitigation and adaptation policies are connected and that sole reliance on adaptation may accelerate climate change, it seems that in research and policy formulation these two areas need to be separated. The researches point out to the problems and limitations in efficiency and effectiveness of the synergy for different scenarios of climate and socio-economic change. This primarily concerns the complexity of institutional setup and incorporation of adaptation and mitigation policies into sectoral policies and linking them with financial instruments. It is a very challenging process: "Striking the balance will be particularly challenging because of some unique characteristics of the problem; long time horizons; non-linear and irreversible effects; the global nature of the problem; social, economic, and geographic differences amongst affected parties; and the fact that institutions needed to address the issue have only partially been formed" (Klein et al., 2005: 583).

UNDP has developed Adaptation Policy Frameworks for Climate Change underpinned by four major principles that provide a basis for integrated climate change adaptation action:

- Adaptation to short-term climate variability and extreme events serves as a starting point for reducing vulnerability to longer-term climate change;
- Adaptation occurs at different levels in society, including the local level;
- Adaptation policy and measures should be assessed in a development context; and
- The adaptation strategy and the stakeholder process by which it is implemented are equally important (UNDP, 2004).

Particularly pertinent for climate change adaptation is vulnerability of the planning system, one of its focal points, which is why it is crucial that planning reviews institutional capacities in formulation of policies, legislation, strategies and programmes, local actors' capacities to implement them, capacities for striking a consensus between competing interests, compiling information and knowledge, as well as monitoring and evaluation capabilities (Haanpää and Peltonen, 2007: 5).

Spatial planning and climate change adaptation

The awareness of the need to incorporate climate change adaptation into spatial planning has developed over more than a decade. Natural hazards and risks have been associated with climate change since the 90s. A range of measures and tools have been developed, closely tying climate change area with other economic, social and environmental objectives, struggling with all the difficulties of balancing conflicting objectives characteristic of spatial planning.

Numerous documents and guidelines are available advising on how to incorporate hazards and risks in spatial planning on a global, European and national scale (UNFCCC, 2008; 2010; UNDP 2004; EC, 1999; ESDP, 1999; EC, 2004, 2006, 2007a, 2007b, 2009). Given that uncertainties and growing natural hazards associated with climate change call for concerted management, it is emphasized that hazard mitigation has to be incorporated into spatial planning and management on a transnational, national, regional and local scale to effectively save human life, settlements and infrastructure (UNISDR, 2004).

Spatial planning plays an important role in the implementation of climate change adaptation measures and policies, and in this sense it is urged to broaden the scope of all plans and programmes with potential effects on risk and vulnerability (EC, 2003; EC 2007b). The issues of the character of planning, types of measures and cooperation with other sectors are raised (e.g. integrating land use planning and water resources management in support of risk mitigation) and, particularly, the need for stronger integration with civil protection measures (Peltonen, 2006). In that sense, climate change adaptation should become an integral part of the planning process, similarly for example to the way in which environmental impact assessment is today integrated into all strategic plans and projects.

What is new?

Spatial planning has always attached great weight to the issue of adjustment to climate factors. What is new in adaptation to climate factors? Several aspects have considerably changed the situation: unprecedented climate conditions that will soon affect many regions; expected future unprecedented rate of change necessitating urgent action; and also, unprecedented knowledge as a basis for understanding causes and effects and forecasting future trends, thus enabling informed action. Spatial planning is faced with the need to change traditional methodology and develop a new one able to cope with the uncertainties of global climate change dynamic, include new actors who so far never considered climate hazard issues in their decisions and refine innovative measures that will most effectively respond to challenges (Füssel, 2007: 268).

As a form of public climate change adaptation policy, spatial planning is guided by four key objectives: increasing robustness of infrastructures; increasing flexibility and adaptability of vulnerable managed systems; reversing trends that increase vulnerability; and improving awareness and preparedness (Klein and Tol, 1997). In order to meet these objectives it is necessary to identify appropriate adaptation variables against which adaptation options can be assessed; determine priority sectors, regions and locations for adaptation investment; facilitate adaptive capacity-building processes; establish

possible inter-institutional coordination; and assist in the estimation of the costs and benefits of adaptation measures (UNFCCC, 2010: 60).

Context

Climate change adaptation policies depend on the specific context in which adaptation is considered. Given the difference in contexts, it is impossible to apply a uniform approach in the assessment, planning and implementation of adaptation measures. "There is no 'one size fits all' with adaptation. Each adaptation action is different, and depends on the level(s), sector(s), support (financial, technological, capacity-building, educational) and stakeholders involved" (UNFCCC, 2010:51). It follows that in each specific case different methodological approaches need to be thought through, to enable adequate insights and assessments of geographic, social and institutional vulnerability.

Füssel indicates key aspects of adaptation which need to be looked into in concrete spatial planning situations: establishing climate-sensitive domains; the types of average climate hazard situations, climate variability, and climate extremes; predictability of climatic changes that are in some aspects associated with more and in others with less uncertainty; defining adaptation purpose – autonomous vs. planned adaptation; timing – reactive vs. proactive/anticipatory planning with different planning horizons; familiarizing with non-climate factors that vary across regions – economic, social and cultural factors and stakeholders – individuals, groups and institutions in private and public sectors on different hierarchical levels. The form of adaptation involves a broad range of measures facilitating implementation through effective risk mitigation actions – technical, legal, educational (Füssel, 2007: 267).

Approaches

Two approaches may be distinguished in spatial planning, relying on different aspects of adaptation, primarily the plan's horizon, available data and their reliability. On the one hand, there is *the hazards-based approach* that relies on probabilistic information on the events themselves, suitable for long-term planning since it builds awareness about the problem and enables identification of priorities. The underlying assumption is that the existing risks are effectively controlled and that climate scenarios, enabling reliable projections of future climate impacts, are defined. On the other hand, *the vulnerability based approach* that relies on understanding and mitigating vulnerabilities, rather then scenarios and precise projections, requires better understanding of the context. It is most suitable in circumstances where the existing risks are inadequately managed, posing great uncertainties with regard to future climate impacts, where climate and other factors are firmly intertwined, primarily in short-term planning with limited funding. Developing countries often resort to policies focused on short-term improvements through management of existing climate-sensitive risks which at the same time try to cover a range of possible climate projections (Füssel, 2007:271). In this way reduction of vulnerability does not require accurate predictions, but relies on understanding the context of the problem, which makes it more comprehensible to all relevant stakeholders (Peltonenet et al., 2005:1).

Hazards are considered based on information about highly vulnerable areas. In the context of new planning for large-scale development areas microclimatic conditions are monitored and defined on an ongoing basis, and zoning is reexamined according to degree of risk (floods, droughts, heightened risk of erosion and similar), areas requiring special protection measures are identified (e.g. flood management, water retention areas, flood dams etc.), hazard protection regulations are specified in building regulation plans, prevention of heat islands is ensured in densely built-up areas, securing green areas of sufficient size, etc. "Management measures include structural and nonstructural measures to avoid (risk prevention) or limit (risk mitigation and preparedness) adverse effects of hazards such as early warning systems, socio-environmental safety nets and risk-sharing mechanisms such as insurance" (UNFCCC, 2008).

Risk-based climate change adaptation calls for new planning approaches. Since hazard probability cannot be precisely determined, instead of relying on past experience (which is typically the case) planning needs to involve all interested stakeholders in the assessment of hazard probability and types of measures to be undertaken. In cases of conflict of interests, binding decisions should be corroborated by well-founded expert opinions. On the basis of expert assessment, hazard zones and risk plans are identified and incorporated into land use planning. Risk areas most often extend over local community boundaries. Documents and researches indicate that these assessments are most effectively conducted on the regional level, where it is also possible to strike an equitable trade-off between costs and benefits.

Adaptation underpinned by vulnerability assessment enables linking of planning and management. Trans-sectoral approach in considering environmental requirements enables integral assessment of the environmental effects of planned activities and points to limitations with regard to certain forms of land use. Spatial planning has a very important role in preparing for long-term changes, so it is necessary to explore possible innovations to the planning system, process and work method which could provide more adequate responses.

Coordination

Inter-sectoral coordination

Contemporary spatial planning calls for integration of adaptation options across economic sectors and at different levels and defining of programs and projects that will reconcile stakeholders' needs and create multi-sectoral partnership necessary for plans implementation. The ways and means of adaptation need to be assessed in the light of their combined impact, identifying potential conflicts and linking them with social and economic determinants of vulnerability in a development context. "This means that the questions of *who* adapts and *how* become of central importance" (Peltonen et al., 2005:6). Emphasis is thus placed on development of legal and institutional frameworks to enhance cross-sectoral collaboration on adaptation.

Despite a clear need for holistic understanding on the issue of adaptation, cross-sectoral approach encounters numerous difficulties, primarily in dealing with organization of competences that favors sectoral approach, and trying to identify effects across sectors and sectoral adaptation responses. In order to overcome the divisions, an assessment method needs to be established that would take into account the interrelation of measures, assess their combined effects and recognize potential conflicts (Cassar et al., 2007:3).

Experience and knowledge about adaptation is upgraded across a range of agencies and actors. The precondition for effective planning is that clearly defined public participation procedures and collaborative planning methods are incorporated into the risk-based planning process. An important role is played by the private sector: "The specific expertise of the private sector, its capacity to innovate and produce new technologies for adaptation, and its financial leverage can form an important part in the multi-sectoral partnership that is required for planning and implementation of adaptation. "...Businesses are undertaking a large range of ongoing practices in a range of sectors, that they are carrying out as part of

their strategic business practices that enhance adaptive capacity and expand the coping range of communities" (UNFCCC, 2010:51).

Coordination of different planning levels

With a view to reduce vulnerability, it is recommended that climate change adaptation is integrated into and coordinated across all levels of spatial planning. Adger et al. (2005:79) deem that "All dimensions of adaptation can be implemented at any scale", however, given that spatial distribution of impacts and social distribution of resilience and adaptive capacity are local issues (regions and local communities) the plans need to be harmonized across levels and at the same time partially binding, so as to allow flexible application on lower levels. "Understanding adaptation therefore requires consideration not only of different scales of human action, but also of the social construction of appropriate scales by institutions to further their own aims" (Adger et al., 2005:80). In carrying out complex adaptation policies responsibilities for action need to be specified for a range of actors, the state, region, local communities, starting from strategic to urban land use plans, which also calls for corresponding decision-making freedom (e.g. assessment of relationship between plans, which aim to provide guidance, and binding regulations).

Adaptation policies and planned actions are underpinned by global and national policy frameworks, as well as national adaptation strategies and plans. Over the last decade, in many countries around the world and especially in the EU, climate change adaptation policies on the national level have been defined or prepared in the form of a comprehensive national adaptation policy which also considers the impact of climate change on spatial planning and adaptation responses. (National Adaptation Strategies adopted for example in the UK, 2010, Denmark, 2008, Hungary, 2008, Portugal, 2006, Spain, 2006, Finland, 2005, etc. see National Adaptation Strategies, European Environment Agency).

Although plans are capable of identifying climate related hazards and risks and areas at risk on different levels, experiences of many countries have shown that climate-related hazards and risks are best identified and monitored on the regional level. Regional strategic plans provide a link between national adaptation strategies and spatial planning that is supposed to guide lower levels on how to incorporate climate change measures and tools in their plans, i.e. formulate plans and projects that will reduce vulnerability of local communities. These plans are based on regional climate change studies which lay basic criteria for impact assessment.

In policy coordination, special emphasis should be placed on the links between adaptation problem and land use objectives and coordination of development objectives. Peltonen et al. (2005:27) offer an example of a paradigm promoted in the Finland's National Adaptation Strategy - concentrating development within the current urban structure. Debates on this policy have demonstrated that such orientation is hindering the provision of safe and good quality living environments, since densely populated urban areas pose challenges to adaptation.

Effectiveness

Effectiveness is the key objective of planners' actions addressing climate change adaptation. Spatial planning is effective only if its actions contribute to reducing climate change impact, i.e. mitigate risks and enhance safety. However, limitations should also be kept in mind. Adger et al. (2005) point out several aspects that cause difficulties in assessing effectiveness. "First, there may be uncertainty over how a particular adaptation option will work even under defined conditions. ...Second, the effectiveness of an adaptation option introduced by an organization may be reliant on actions taken by others... Third, the effectiveness of an adaptation action may depend on the future — unknown — state of the world... Fourth, whilst an adaptation measure may be effective in reducing the impacts of climate change or increasing opportunities in one location or time period, it may increase pressures "downstream", or lessen the abilities of others to adapt to climate change" (2005:81).

With a broad range of economic, social, political and environmental circumstances affecting the effectiveness of climate change adaptation planning, no general rules apply. Decision-making is located depending on the decision-making and implementing agent: national, regional or local authorities, communities, groups or individuals. It also depends on available knowledge and tools as well as the timing and time horizon of the adaptation action (UNFCCC, 2010:52).

On the one hand, according to Adger et al., sustainability of adaptation measures depends on different adaptive capacities of a variety of stakeholders, while on the other, this very heterogeneity of stakeholders' capacities, benefits and objectives may pose a limitation. Therefore, division of responsibilities, with clearly defined roles of different public and private sector stakeholders who take part in adaptation segment of spatial planning through legislation and guidance would have to take into account their capacities and resources. This also includes specifying procedures that link climate change and its impacts to the planning processes and practice.

Central to adaptation planning is the assessment that has shifted from science-driven assessments to policy-driven assessments. According to Adger et al. (2005:80) "Adaptation to climate change ... can be evaluated through generic principles of policy appraisal seeking to promote equitable, effective, efficient and legitimate action harmonious with wider sustainability". Focusing on the use of adaptation assessments for adaptation planning and policy-making, Fussel stresses that the purpose of assessment is "identifying options to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency and feasibility" and gives an overview of recommendations and guidance formulated to this aim by numerous international and national organizations (Fussel, 2007:271.) However, guidance and planning principles remain the subject for further research and verification.

Integration of climate change adaptation issue into spatial planning is very complex. Many current researches claim that risk-based planning instruments are poorly developed even in developed countries and usually boil down to hazard maps. In order to assess the adequacy of spatial planning response to adaptation, we need to start from the research and assessment of vulnerability on the one hand and the response provided by the existing policies on the other. Research findings may help toward gradual change and adjustment of existing competences, procedures, planning forms and tools, including legislative and financial ones.

INTEGRATING CLIMATE CHANGE ADAPTATION POLICIES IN SPATIAL DEVELOPMENT PLANNING IN SERBIA

In this part we tackle some aspects of the problem of integration of climate change adaptation policies in spatial planning in Serbia. The integration overview should serve as a starting point, "adaptation baseline" (Burton, et al. 2002:157) against which policies and improvements are proposed and contemplated, based on identified gaps and resource needs, and which helps to establish what hinders adoption and what are the reasons behind it. However, we are not aware of any such analysis. Therefore, our considerations

are based on the recently adopted Spatial Plan of the Republic of Serbia from 2010 to 2020 (The Law on Spatial Plan of the Republic of Serbia from 2010 to 2020, hereinafter referred to as the SPRS). The SPRS, as the first strategic and development spatial plan that includes climate change adaptation issues, is underpinned by previously adopted environmental documents, particularly the National Sustainable Development Strategy of the Republic of Serbia (2008) and The Action Plan for the implementation of the National Sustainable Development Strategy for the Period 2009 – 2017 (2009). The Spatial Plan provides an exhaustive overview of problems in the area and climate change adaptation policies, so its analysis can give an insight into the current state of planning in Serbia and indicate necessary changes to the spatial planning system that would more adequately respond to climate change adaptation problem. In that sense of particular interest are the problems related to integration and operationalization of general policies, decision-making levels, vertical and horizontal coordination, participation of relevant stakeholders, capacity for implementation, monitoring and enforcement (Vujošević, 2004).

Recognizing key problems from the standpoint of climate change adaptation, the SPRS places an emphasis on:

– lack of adequate support for implementation of multidisciplinary research programs on climate change impact, vulnerability and adaptation options;

– absence of a special state program to address climate change problems;

– limited financial support for building capacity (systemic, institutional and individual), education, training and informing (SPRS:118).

The Republic of Serbia "so far had no clearly defined policy for protection from natural hazards, and the problem was addressed either by sectoral studies on specific types of hazards or as an integral part of various planning documents." In linking CCA goals with hazard protection measures, it is stressed that in order to proceed with adequate integration on all levels and in all stages of planning – "an acceptable level of risk from natural and technological hazards needs to be identified and the system of preventive, organizational and other measures employed to prevent their occurrence and/or reduce hazards effects to an acceptable level" (SPRS 2.6. Natural and Technological Hazards, 2010:146)

Policy Implementation

Clearly, climate change adaptation topic intertwines vertical and horizontal planning levels. In a top-down and bottom-up decision-making concept the key role in the EU countries is played by the national level hand in hand with the local, with a view to creating a conducive environment for joint (collective) action (Dasí, 2006). Nationally made decisions are binding and represent the starting point for the regional and local level. Hence, the form and the exactness with which the decisions are formulated and suitability for their use on lower decision-making levels seem to be of crucial importance.

Key weaknesses and problems associated with strategic planning practice do not concern so much strategy conceptualization and development, as does the implementation process. Researches point out the fact that a bulk of strategies fail to be implemented exactly because of the difficulties arising in realization (Mintzberg,1994). The problem on the one hand lies in the absence of a clear methodology that would enable the understanding of strategy implementation, while on the other, as in Serbia's case, striking discrepancies in the systemic framework, undeveloped institutions, procedures and relationships and outdated methodologies also pose an obstacle.

Although the basis of the planning system in Serbia is hierarchical and assumes that national policies and measures are transferred to lower levels (the Law on Planning and Construction, 2009, hereinafter referred to as the LPC), difficulties are encountered in concrete planning practice. A myriad of reasons account for that, from financial, through institutional and staff limitations, to lack of knowledge and readiness to reflect numerous new challenges in the planning process. All this makes salient problems related to vertical coordination in directing spatial development. We find the main problem in the fact that the system fails to define clearly the dynamic aspect, i.e. does not really answer the question of harmonization of non-flexible, biding documents. It is very important to establish clear links between policies on the same and different levels of governance because even the best proved strategy on one level can limit adaptation options on other levels. It follows that adjustment procedures need to be embedded into the system, carefully linking binding policies and measures and modes of their adjustment in a changing environment.

Integration of CCA issues in local plans, i.e. planned elaboration of policies outlined in the SPRS is foreseen through development of regional plans and spatial plans for special purposes (they are developed and adopted on national level as there is no regional administrative level in Serbia). In addition, policy implementation is envisaged through drafting of development and regulatory planning documents that fall under the remit of local government units, namely spatial plans of local government units and urban plans (SPRS in the section 1.1. Requirements and Guidelines for Planned Elaboration, 2010:337).

Emphasis on CCA integration implies vertical and horizontal harmonization of policies and measures, in line with the principles set out in the LPC, 2009, *3. Principles of Development and Use of Space* which likewise underlines that the principles also include the instruments for implementation. How is this reflected in reality in Serbia?

Vertical Integration

Vertical integration implies coordination between plans on different levels of governance. That means that the national spatial plan lays out responsibilities and guidelines for planned elaboration in subordinate plans – "general and sectoral plans, strategies and programs on regional and area level and priorities under development." Although the SPRS presents the basic goals, principles and priorities, the Program for the Implementation of the SPRS has yet to be developed (SPRS, Requirements and Guidelines for Planned Elaboration, 2010:337).

A problem may arise in relation to a wide range of the SPRS's operative goals which encompass all aspects of climate change related activities (see: Operative Goals, SPRS, 2010:118 -119) while remaining silent on the modes of their local implementation. An extensive range of competences related to SPRS operationalization is transferred to the local level. Problems in the area of climate change, particularly those related to adaptation, are largely unfamiliar in local planning. There is no adaptation strategy, despite a multitude of general and sectoral national strategies and a variety of underlying methodologies, with barely any mutual coordination. Some problems may be expected in integration of general policies into local plans, for example when cities set out to define sustainability standards tailored to the local level. Given the available financial and staff resources, it is questionable whether the cities and local communities will generally be able to innovate the planning methodology, which is one of the important themes underlined by the SPRS. Since this activity has yet to take off, it is

unclear how a new generation of regional and local plans through which the SPRS is to be implemented and whose development starts immediately upon the plan adoption (2010) (SPRS IX Toward Plan Realization, 2010:337) is going to operationalize and elaborate the SPRS policies (Vujošević, 2004).

Local planning, defined as a very complex activity, will not have sufficient input to reduce vulnerability locally. Despite a very prominent role assigned to sustainability issues in the SPRS and other strategic documents, there are no clear criteria, measures, regulations to facilitate the job of local stakeholders. The fact is that there is no adaptation strategy currently available, while it remains to be seen how the SPRS Implementation Program (under preparation) will address all open issues.

It is characteristic of all developing countries, and Serbia is no exception, that best results are achieved on the national, systemic level, where there is knowledge of the problems and awareness on the need for adaptation, while this knowledge is inadequately transferred to the local level. The problem that deserves particular attention with CCA in its inception stage only, but nevertheless as a matter of urgency, is how to formulate policies and regulations to make them accessible and operative on the local level.

Stakeholders in spatial and urban planning on the local level typically have very limited knowledge on climate change and adaptation options. Their perspective of the problem is usually limited, neglecting complex topics and failing to take into account all the requirements of CCA. Another problem burdening local level is relatively short mandate of elected decision-makers, which diminishes their interest in long-term effects of planning (Wilson, 2006). Particularly troublesome is local plans financing. In circumstances when averagely one third of municipality income originates from the republic level in the form of state transfers, as government controls share of wages tax, while property tax account for the rest, planning will unavoidably rely on private investors, which may have adverse effects on sustainable development and climate change adaptation in particular.

While complex social and economic situation in Serbia is particularly manifested on the local level, one may expect that the debates on climate change adaptation modalities will involve mainly scientific and research community, as well as politicians, on the national level. In recognizing capacity building needs, primarily on the national level, the SPRS emphasizes the expectation for "...ongoing improvement of knowledge and technologies and strengthening capacities in the area of climate change in the European integration process." It foresees the advancement of national institutions responsible for climate change issues (Republic Hydrometeorological Service, Environment Protection Agency, Environment Protection Fund, and also strengthening of the Sub-regional Climate Change Center, hosted by the Republic of Serbia) (SPRS, 2010:21). Although the plan also envisages general enhancement of problem understanding "among decision-makers, relevant stakeholders and wider public", there is no clear policy on how to carry out this type of activity locally. Other measures may need to be considered to this aim: regulations and guidelines to support local planning.

Horizontal coordination

Horizontal coordination is also the LPC (2009) requirement and it primarily "implies linking with adjacent territories during planning, in order to resolve common functions and interests". However, the second part of the definition - "as well as the networking and participation of all those involved in spatial development of the public and civil sectors, and citizens" (3. Principles of Development and Use of Space, Article 3) failed to clearly pinpoint the problem of sectoral harmonization.

Strong sectoral policies tend to make horizontal coordination much harder to achieve than vertical. Eggenberger and Partidário (2000) identify different aspects of coordination as a prerequisite for integration: substantive, methodological, procedural, institutional and political.

Climate change adaptation lays groundwork for assuring development conditions, provided that relevant changes are made to numerous sectoral strategies, plans and projects. Horizontal policy integration (in the context of sustainable development) implies commonly understood and balancing economic, social and environmental interests and policies in a way that trade-offs (or negative effects) between them are minimized and synergies (or win-win opportunities) maximized. Realization of horizontal integration goal that the SPRS insists upon is by no means a simple activity, as pointed out by many researchers, and calls for a range of strategic tools and a complex institutional setting (Berger and Steurer, 2009).

The solution for better horizontal as well as vertical coordination would probably be to develop the national Climate Change Adaptation Strategy that could contribute to better definition of series of problems and ensure that local authorities will have to give priority to CCA issues. It can also provide the broad extent of the options and instruments for effective policy making across different geographical administrative boarders, departments and sectoral interests (Campbell, 2006). Targeted incorporation of CCA into legislation in key areas should also be considered. Tools need to be developed on the national level that could serve as specific guidance for operationalization of goals and for resolving conflicts that may arise in harmonization of planning decisions locally (fiscal incentives and sanctions, monitoring mechanisms that enforce the effective implementation of climate sensitive proposals, advices on better practice, etc).

Regional Planning Level

All research into CCA policies' position in spatial planning assigns central importance to regional level. It is on this level that long-term spatial planning for sustainability and climate change adaptation takes place (Glasson, 2004). It may also play mediating role between national and local levels of governance, provide an insight into regional vulnerability to climate change and support adequate informing on, for example, advantages and risks in land use, and where regional administrative level of governance is in place, it may provide a link between environmental and economic concerns (Peltonen, 2006).

However, the SPRS states that "Regional development and the issue of regional organization of the Republic of Serbia have never been adequately positioned in the hierarchy of country's development goals" (SPRS, 2010:54). While the position of regional level of governance in Serbia still remains unclear, the issue of representation of regional, amid national and local interests, will probably be regulated in the coming period. From the standpoint of climate change adaptation, it seems justified to insist on setting up and strengthening institutional organization that would promote regional approach, i.e. strengthen horizontal connections and cooperation between local units. That way, regional planning level could more adequately and systematically incorporate CCA issues and provide better local planning framework.

In a still uncertain institutional setting, the SPRS section *Toward Plan Realization* (2010:338) stresses: "Planned elaboration of the Spatial Plan of the Republic of Serbia 2010 - 2020 sets a requirement for development of regional spatial plans for all regions and areas in the Republic of Serbia, as a

priority activity to be carried out by the end of 2012, i.e. before the completion of the first implementation stage of this spatial plan by 2014" (p. 338) Despite the SPRS's commendable clear commitment, doubts remain as to whether the plans in the given institutional setting, adopted without precise information and defined regulatory basis, will be able to assess vulnerability and formulate policies to overcome the existing sectoral discrepancies.

Regulations

Problems that will likely occur in the SPRS implementation in CCA area stem from the fact that Serbia's planning system has not yet conformed to the changes in the social-economic system, from plans to regulations-driven development. Even after two rounds of changes to the planning system in 2003 and 2009, there is still no law on planning regulation. There is awareness of this problem in the SPRS, and the section *Key measures and tools needed for climate protection and climate change risk management in the Republic of Serbia* particularly stresses the need for development of legal tools and advancement of "standard methods and guidance for applying climate data and information in planning and design." In addition, the section *Natural and technological hazards*: *Operative objectives of protection against natural and technological hazards* points to the need "to harmonize national regulations in the area of natural and technological hazards management with the EU legislation". It is further underlined that it is "...necessary to adopt a strategy for integral protection from natural and technological hazards in the coming period, which in addition to appropriate planning and other necessary measures and tools, has to be supported by adequate legal, *spatial-planning urban and technical regulations, especially with regard to policy of land use, construction of buildings and technical infrastructure*." (SPRS, 2010:148) [italics added].

The Adaptation Green Paper emphasizes the need to incorporate CCA in amendments to the existing and drafting of new legislation (EC, 2007a). Effective implementation and monitoring of achievement of adaptation objectives calls for clear guidance, so priority in the coming period should be the research into the possibilities of integration of these regulations into the spatial planning system of Serbia.

In bringing together different sectors and necessitating formulation of very clear measures and tools, the need for climate change adaptation seems to provide an opportunity for thorough reexamination and changes to the Serbia's planning system, from plan - oriented approach to elaboration of regulations. This could be a decisive step toward aligning with the planning systems of developed European countries.

CONCLUSION

A number of tasks lie ahead in integration of CCA policies into spatial planning: enhancing capabilities of adjustment to climate change, alleviating potential damage and addressing adverse spatial consequences. The fulfillment of these tasks requires identification of appropriate adaptation variables and criteria against which adaptation options can be assessed: prioritize sectors, regions and locations for adaptation investment; facilitate adaptive capacity-building processes; establish possible inter-institutional coordination; build resilience and assist in the estimation of the costs and benefits of adaptation measures. These tasks are a requirement under ratified international conventions.

Spatial planning has a very important role in addressing the causes and impacts of climate change and preparing different concepts of spatial development. Therefore it is necessary to explore possible innovations to the planning system, process and work method which could provide more adequate responses beyond mere inclusion of the CCA as a policy principle. The CCA problem asks for more fundamental changes in the traditional planning methodology. On the one hand, particular emphasis should be placed on better problem definition in connection with land use objectives, while on the other, greater collaboration between planners and other actors involved in the assessment of hazard probability and choice of measures should be established in order to mobilize all available resources to achieve policy objectives.

Adaptation policies are formulated across a range of policy domains. In a still unfledged institutional setting in Serbia, policies in many sectors have yet to be developed and mutually aligned. The SPRS, as an integral spatial development strategic document, makes an effort to formulate policies and integrate them in spatial planning. This undoubtedly entails a host of difficulties. Serbia has not yet developed adaptation assessment methods and tools, and lacks adequate legislative and regulatory framework for promotion of adaptive friendly action, as well as procedures for aligning the interests of stakeholders, including the ones from the private sector. Likewise, policies could not have been corroborated by an analysis of the current state of integration against which possible improvements, resource gaps and needs are generally weighted. Such an analysis could have cast a light on difficulties hindering adoption and reasons behind them.

Policies and priorities, as well as detailed guidance and regulations on adaptation have yet to be formulated, and substantial progress is expected in this area. Adaptation planning process involves a range of time-scales and levels and sectors, all of which will require ongoing amendments and adjustments to the planning documents which are the basis of Serbia's spatial development. Their rigidness accounts for the hierarchical and mandatory nature of the system which makes adding new input, knowledge and sectoral policies a daunting task. Therefore, in this paper we urge for the review of vulnerability of the planning system and exploring possibilities for its transformation so that it can adjust to the changing conditions and engage on adaptive actions. A shift in emphasis from plan - to regulation - driven development would contribute to a much more flexible system, susceptible to change and adjustments, which is of crucial importance for integration of CCA and many other policies faced with uncertainty.

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WATER STORAGE RESERVOIRS AND THEIR ROLE IN THE DEVELOPMENT, UTILIZATION AND PROTECTION OF CATCHMENT

Branislav Đorđević[1], Belgrade, Serbia
Tina Dašić, University of Belgrade, Faculty of Civil Engineering, Belgrade, Serbia

Reasons why water storage reservoirs are necessary in accordance with the sustainable development strategy are described in the paper. The main positive and negative impacts of reservoirs on the environment are analyzed. The most important are: the improvement of hydrological regimes (decreasing maximal and increasing minimal flows), the creation of optimal water management, utilization and protection of water, and the creation of better conditions for river and coastal ecosystems. Negative impacts and measures for its mitigation or elimination are also analyzed. The conclusion is that water storage reservoirs can be harmoniously incorporated into the environment. Serbia has a limited number of locations suitable for the construction of reservoirs, therefore it is necessary to retain these areas for storage in regional development plans and other legal acts.

***Key words:** water storage reservoirs, water as a resource, utilization of water, water protection, ecological aspects, social impacts, environment*

INTRODUCTION

In Master Plans of all levels, two space users have special priority: mines, especially surface exploitation ones, and water resources systems. These users have very specific requirements in terms of location, as their resources are located in specific and limited areas. Therefore the structures for their exploitation must be at those exact locations. If the locations are not reserved on time and secured for that specific use, they can be permanently lost. This is why these two users must prepare studies and designs, and precisely define the areas necessary for the realization of future systems.

Strategic development plans in the water remit are defined in the Water Master Plan of the Republic Serbia and Water Master Plans of specific catchment areas. The Water Master Plan of the Republic of Serbia, completed in 2001, outlines the strategic development in this area (Maksin-Mićić et al., 2009). Locations for the realization of water resource systems can be defined on the basis of this document. After analyzing the strategic results of Water Master Plans a few important conclusions can be pointed out (Đorđević, 2002b): (a) contrary to previous opinions, Serbia lacks domestic water resources, (b) spatial and temporal distribution of water resources is unfavorable from the aspect of its utilization and protection, (c) Serbia is poor in water resources of high quality – high quality resources must be protected now so they could be used in the future, (d) future water demand can be met only with the realization of numerous water storage reservoirs, and their purpose will be the improvement of irregular water regimes. A general conclusion would be that complex problems of utilization, water protection and regulation will be solved only as part of integral systems, harmoniously incorporated in the environment and with planned measures for rationalization. Systems will be wider, better connected, with more goals in the area of utilization, regulation and water protection, and with higher required reliability. These objectives, especially the ones referring to higher reliability of water supply, flood protection and improvement of water regimes, cannot be accomplished without water storage reservoirs. These facts were also well known to ancient civilizations. Water storage reservoirs were built more than 4000 years ago. All developed civilizations based their progress and flourishment on the development of water resource systems, and the decline of each civilization began with neglecting and ruining these systems.

In recent times water storage reservoirs have become the bone of contention, supposedly because they have a negative impact on the surrounding area and the environment. This is an incorrect assumption! The main purpose of this article is to emphasize the following: (a) Integral water resource systems, with water storage reservoirs as their important part, are a key element for the regulation and protection of the area (water supply, sanitary settlements, flood protection, improvement of river banks, protection of catchments areas, improvement of conditions

[1] Bul. kralja Aleksandra 73/I, 11 000 Beograd, Serbia
branko@grf.rs

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for better urban prosperity of settlements, etc.), (b) water storage reservoir redistributes water on time and over the given area in the best possible manner for the environment. By adequate management they can increase water regimes downstream from a dam or gate. This is of particular importance in low flow periods. In this way the actual concept of water protection is achieved: implementation of water resource management to help the eco-system and preserve biodiversity in the best possible way.

In the process of water storage evaluation a few facts should be taken into account. Firstly, ***development or stagnation of water resources directly affects the conditions and development of all other systems***. This is why it can be stated that the development of water resource systems act as an "engine of prosperity" for the development of all other systems. Some countries find their way out of great economic crises through the realization of complex systems in the water remit, especially the realization of water storage reservoirs (American "New Deal", polders, water storage reservoirs in Spain, Iran, Turkey, China, South Africa, etc.). It is well known that investment in water resources and hydro energy cannot fall through, and these are investments that start up different industries of a country.

Secondly, in line with the basic principles of maintenance development, there is a very strong connection between development and environmental protection (Vujošević, M., 2004). This is pointed out in a well-known document: *The Report of the World Commission on Environment and Development (1987).* A summary of this document in only a few sentences would read: "*Development should be relived. Poverty decreases the possibility to wisely use resources and increase impact on the environment...Economic and ecological goals (objectives) are interdependent*"[2]. Or, even shorter: ***environment cannot be properly protected without adequate economical development***. And economic development is not possible without adequate water resource systems, with water storage reservoirs as their key element.

Thirdly, when analyzing the environmental impact of water storage reservoirs some important categories of impacts must be considered: (1) soil as an area and resource, (2) water as a resource and biotope, (3) air as an area that should be protected, (4) pollution with solid waste, (5) pollution with liquid waste, (6) thermal pollution, (7) noise as a form of air pollution, (8) radiation, (9) impact on biocenosis, (10) aesthetic of the landscape. All alternatives should be compared and evaluated, including the "do nothing" choice, which often has a negative impact on the environment (considering the stated ten impacts). If all defined impact categories are analyzed, hydroelectric power plants – as a renewable and clean energy source – have an incomparable advantage over all other energy sources (Đorđević, 2001b).

WHY ARE WATER STORAGE RESERVOIRS NECESSARY?

There are numerous reasons why water storage reservoirs are a necessary element of water resource systems in Serbia. The most important ones are stated below:

- Temporal distribution of water flow in rivers is irregular. Lots of rivers have torrent type flow. Very often 60–70% of summary annual water discharge runs in a short flood period, succeeded with long dry periods. The average annual flow of all domestic waterways in Serbia is around 509 m^3/s. In a low flow period it decreases ten times and stands at around 50 m^3/s. This is insufficient even for ecological needs of the water ecosystem. The relation between the minimum monthly discharge with the occurrence probability of 95% and the maximum annual discharges with the occurrence probability of 1% are often greater than 1:1000. Variation coefficients of annual discharges are also high ($C_v > 0.5$ for many rivers in Serbia), indicating a variation of mean annual discharges, which are usually higher than 3:1. An analysis of the coefficient of autocorrelation of annual discharges and spectral functions of those values indicates one unfavorable phenomenon: accumulation of dry years creating one long dry period, when discharges are very low on all rivers (catchments) and all water users are endangered, as well as the rivers as ecosystems. These extremely dry periods affect a broader region and without water storage reservoirs it would be impossible to provide water for normal human activities (settlements and economy). These low flow periods are detrimental for river flora and fauna. The only way to mitigate it is to discharge water from water storage reservoirs in the upstream part of the river.

- This area is also characterized by extreme spatial irregularity. Specific water flows of domestic waterways vary in a wide range, from only around 1 $L/s \cdot km^2$, to over 50 $L/s \cdot km^2$ in the area of the Dinarides. The lowest specific flows are in the lowland areas with the highest density of population and with fertile land which should be intensively irrigated. Taking all this into account, it can be concluded that water storage reservoirs are the only structures that can deal with temporal and spatial water irregularities. Without them it would be impossible to transfer water from the water source area to the consumer area.

- Around 2/3 of underground water in Serbia is in river alluvium, meaning that the quantity and quality of this water directly depends on the river flow. That is the reason why settlements supplied with water from wells in the river alluvium have huge problems with water supply. Many settlements (Vranje, Kruševac, Kragujevac, Užice, Čačak, Aleksinac, Leskovac etc.) changed their water supply systems from groundwater to more reliable supply – from water storage reservoirs. The source of the water supply system for Belgrade has changed in a similar manner. Water demand could not be satisfied from wells near the two large rivers, so the source was changed, and it now uses the water from Sava Lake – a special form of water storage reservoir.

- There is an important difference between the two categories of water: water existing in catchment areas and water that can be treated as a water resource. An imperceptible difference between these categories can lead to serious errors in the evaluation of water resources of some catchment areas or regions. ***Water existing*** in the area/catchment (V) is exclusively a geophysical category, and it can be defined as: $V = \langle L,Q,K \rangle$, with the matrix structure defining location (L), quantity (Q) and quality (K) of water (Đorđević, 1990). ***Water resource*** (VR) is a social, economic and ecological category, because beside the previously mentioned three attributes, it also has to possess another very important one – the existence of conditions for catching, utilization and protection of water (US). This means that when defining the water resource matrix, the structure of the "existing water" has to be enlarged with the conditions for utilization (Đorđević, 1996), and it can be defined by the relation:

$$VR = \langle\langle V,US \rangle\rangle \qquad (1)$$

Based on the same system logics, ***water demand*** in an area/catchment can be defined

[2] "The goal of sustainability requires that all countries rethink their policies and actions with respect to their impact on world ecology and economic development. Critical objectives in this process include:
- Reviving growth. Poverty reduces peoples' capacity to use resources wisely and intensifies pressures on the environment. The stagnant or declining economic growth trends of this decade must be reversed, especially in developing countries, where the links between economic growth, elevation of poverty, and improvement of environmental conditions are most apparent.
- Ecological and economic concerns are interdependent. Therefore the environment and economy must be integrated in the decision making process from the very start, not just to protect the environment but also to promote long-term economic and social development."

("Our Common Future – Sustainable Development", The Report of the World Commission on Environment and Development, 1987)

by the matrix $V_z = \langle L_z, Q_z, K_z \rangle$, with L_z – the location where water is demanded, the required quantity Q_z and demanded water quality K_z. Now, the planning of water resources systems can be presented by the logical structure S:

$$S: V \xrightarrow{US} VR \xrightarrow{VS,U} V_z \qquad (2)$$

Relation (2) means that water existing in the catchment (defined by the matrix V) can be considered as a resource only after we have included utilization conditions (US). Through the appropriate water resource system (VS) and appropriate management (U) it can be transformed into a matrix structure of water demand (V_z).

Conditions for water utilization (US) are of multidimensional structure, with many components on which the realization of water utilization depends. In each water resource alternative certain conditions have to be analyzed: geotechnical conditions (GU), hydrotechnical conditions (HU), economic conditions (EU), conditions of interaction with social and urban environment (SU), interactions with cultural-historical and other properties (KU), conditions for environmental protection (ZU) and conditions that result from international obligations (MU). US can be decomposed into the following structure:

$$US = \langle\langle\, GU, HU, EU, SU, KU, ZU, MU \,\rangle\rangle \qquad (3)$$

Some parameters in equation (3) can be defined with appropriate quantitative or qualitative valuations. With these parameters we can emphasize impracticability or practicability only under particular circumstances of water utilization in an area. If only one of the mentioned parameters in the matrix (3) is given a value defining the impracticability of the design for water utilization (for example GU=0, because a karstified valley cannot provide water tightness), the entire design becomes impracticable because an appropriate water resources system (VS), necessary for the transformation from "existing water" into "water demand" (equation (2)) cannot be achieved. In this case, water existing in the area cannot be considered as a water resource and it should not be taken into account for future use. Because of all the abovementioned reasons, real water resources are considerably lower than those estimated by analyzing the water existing in the catchment area, or analytically:

$$VR << V \qquad (4)$$

Equation (4) is simple, but fundamentally important. The fact that the quantity of water that can be defined as a water resource is much lower than the water existing in the catchment area (sign <<) is the main reason for misunderstandings between the public and designers. Usualy, public opinion about water is much more optimistic. This is why the broader public does not understand that key elements for water utilization are water storage reservoirs.

• ***Reliability of water delivery*** is the main reason why water storage reservoirs have become such an important element in water supply systems. The expansion of settlements into the large urban centers requires an increase in the reliability of water supply. Presently, reliability of water supply systems is required to be over 97%. Lack of water in big cities with high-rise buildings and a high concentration of population, without a stable and secured water supply source, is one of the most serious issues that can occur. The situation is similar when it comes to providing water for technological needs for heavy industry and thermal power plants, where the required level of water supply reliability exceeds 97%. This is the result of a close interrelationship between production processes and integration in one unique production circle, where failure of one basic capacity affects other production processes in a chain reaction, thus practically affecting the entire production circle. It is for these very reasons that water storage reservoirs are absolutely necessary: only water storage reservoirs with a large relative volume can provide high reliability of water supply for settlements and technological systems. Analyses performed with simulated synthetic series of flows with different stochastic characteristics (Đorđević, 1990) indicate one typical relation: for flow series with stochastic parameters close to those common for rivers in our country (variation coefficient Cv=0.5, relation between coefficients of asymmetry and variation $C_s/C_v = 2$, autocorrelation coefficient of annual flows r=0.3), if the required relative water supply is $\alpha = 0.7$ (delivered quantity of water is 70% of average multiyear flow), then an increase of reliability from P=80% to P=90% requires an increase of the water storage volume 2.5 times higher! In order to achieve higher reliability, the situation is even more drastic: an increase of reliability from P=90% to P=97% requires an increase of water storage volume of 2.2 times. An enormous increase of the necessary water storage volume implies a higher price for increased water supply reliability. However, the reliability of around P=97% is within the range of system saturation, and further increases of reliability practically cannot be realized without system of reservoirs with multiyear regulation.

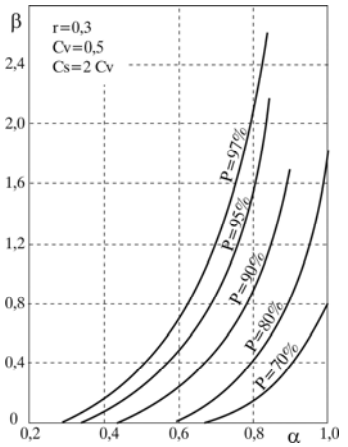

Figure 1. Relation between relative water storage volume, relative water supply and reliability $\beta = \beta(\alpha, P)$

• Requirements in the area of flood protection are more severe (strict) and often cannot be met without active use of water storage reservoirs. Namely, modern flood protection systems require a high protection level (for example protection from flood water with occurrence probability of 1%). Such demands can be met only with a combination of passive protection measures (linear systems – embankments and regulatory works) and active measures. Active protection measures imply a mitigation of flood water especially in reserved areas (volumes) of multipurpose reservoirs, but also influence the entire reservoir volume – very efficient for this purpose. A high level of protection for settlements with urban parts entirely defined in relation to the river cannot be accomplished without active retention effects of a water storage reservoir. One of the examples is Leskovac, a town reliably protected only after the water storage reservoir Barje on the Veternica River has been completed. Another example is the town of Skoplje, for which the required high level of protection (P ~ 0.3%) was accomplished after completing the water storage reservoir Kozjak on the Treska River. A similar situation can be observed in numerous other towns in the world. Fast urban development was realized after managing flood water in reservoirs in the catchment area. The Seine River used to flood Paris until its flood water was mitigated by a water storage reservoir.

Figure 2. Center of Paris (Rue de Lion) during a flood in 1910 before the realization of reservoirs on the River Seine catchment area

• Water quality protection, one of the primary objectives of an organized society, can be accomplished only by one or all of the following actions (measures): (a) technological, (b) water resources and (c) organizational-economical measures. Water resource measures become the crucial protection measures as without them it is almost impossible to accomplish the required high quality levels in rivers, especially during low flow periods. These measures take into account the so called improvement of low flows by discharging water during low flow periods. During this period, river biocenosis and ichtiofauna are endangered as a result of a synergetic influence of several ecological factors, each of them near its pessimum (simultaneous effects of low flow, high temperature and low concentration of dissolved oxygen in the water). If under such conditions water can be discharged from the water storage reservoir, water of high quality, desired temperature, with a high concentration of dissolved oxygen – water quality can be managed and maintained within the boundaries suitable for the survival of river biocenosis. To accomplish this, structures for discharging guarantied ecological flow are built as selective inlets, with the possibility of taking water from the layer with the most suitable temperature (Figure 4). It is an active way to utilize thermal stratification of a lake. This way, water storage reservoirs become an irreplaceable element for water quality protection. They are also the only protection activity in incidental situations, when the designed discharge of quality water can mitigate dangerous consequences of those incidents.

• The recent electric energy situation in the world has been guiding energy development in the direction of complete utilization of hydro potential, as a renewable and ecologically one of the cleanest sources of energy. Such a situation is the result of several facts. (a) The rise of fossil fuel prices makes energy from thermal plants more expensive. In addition, conditions for the control of GHG (green houses gasses) are stricter which, increases the price of thermal plants. (b) The criteria for nuclear power plants are even stricter in all countries; in some they are even forbidden, so that an imbalance between a demand for and supply of energy becomes more pronounced (severe). (c) The criteria for economic utilization of hydro potential have also changed. As a result of the soaring prices of fossil fuels and energy from thermal plants, coefficients of HPP (hydro power plants) energy value increase (Đorđević, 1980, 2001c). This is why some HPPs previously judged as economically unfavorable, have become economically viable when compared to TPPs (thermal power plants). The criteria for economic acceptability for HPP are quite simple: it suffices that the energy price of some HPP is lower than the energy price of the highest price TPP that will be ejected from the system. (d) Building huge aggregates in TPPs increases the problem of providing the spinning reserve capacity and stand-by reserve. Hydropower plants are the most favorable type of plants for providing both reserves, because of its mobility and for operational reasons. (e) An electric power system with more HPPs is economically more stable (Dašić, Đorđević, 2008) (f) Complex water utilization in multipurpose systems enables the utilization of a part of the potential that would be too expensive in one purpose systems. (g) Technological prosperity in equipment production, especially different types of Tubular turbines, enables the utilization of small gross head, on the alluvial rivers, previously impossible to utilize by classical Kaplan turbines. This part of hydro energy potential was not utilized, although it passed into the category of economical potential (Đorđević, 2003).

From the above it can be concluded that the construction of water storage reservoirs continues to be the most instrumental part in the development of electric systems.

• The struggle for food becomes the struggle for irrigation of agricultural land, at least of the highest quality land. However, even in the fertile valley of large rivers (Velika and Zapadna Morava Rivers) there are no conditions for mass irrigation by river water in natural conditions. The reason, as previously mentioned, is the irregular flow distribution – there is not enough water during the periods when intensive irrigation is necessary. The river flow on the Velika Morava drops to below 30 m^3/s, which is hardly enough for the ecological survival of river during low flow periods. This is why irrigation cannot be achieved without seasonal replenishment of water flow from water storage reservoirs.

POSITIVE IMPACTS OF WATER STORAGE RESERVOIRS

From the previous part of the article a number of positive impacts can be perceived. They indicate that water storage reservoirs are irreplaceable structures for human survival. As ecological impact of water storage reservoirs is often a subject of discussion, their role from the environmental point of view will be discussed. It should be analyzed comprehensively, in time and space in which their entire impact must be evaluated. Only the most important positive ecological impacts, crucial for water storage reservoir valuation, are discussed.

• Healthy drinking water is provided, waterborne epidemics are prevented – an important ecological impact.

• Production of hydro energy – ecologically the cleanest form of energy – decreases pollution with solid, liquid, gas, thermal and radioactive waste from alternative thermal and nuclear power plants (these should not be built at the expense of hydro power plants).

• Production of food is intensive in the irrigation condition. This is one of the most important ecological impacts. At the same time, ecological pressure on lower quality land is weaker and it can be used for reforestation and other purposes.

• Flood water flows are decreased and flood risk is smaller. Human population is free of the fear of floods, but the environment is also protected from floods which can easily be termed one of the biggest environmental catastrophes.

• River flows increase in the warm part of the year (improvement of low flows), when conditions for the survival of biocenoses in the river are limited as a result of the synergetic influence of low flows, high temperature and a low concentration of dissolved oxygen.

• A water regime becomes managed: low flows can be increased and flood water decreased, with a positive impact on the ecological state downstream from the reservoir. With better water regimes, the regulation and organization of river bank settlements (which previously suffered from floods and low flows) can come down to river banks and incorporate them in the urban city framework. River regulation through populated areas should be done on the bases of natural regulations – one of the most important measures for harmonious incorporation and arrangement of river banks as part of the settlements.

• The construction of water storage reservoirs is accompanied by anti erosion works, especially the rehabilitation of erosion areas of I and II category (excessive and strong erosion). Biological protection measures are particularly important (reforestation, restoration of degraded forests, drainage of meadows, etc.) and are an ecologically important contribution to the eco-environment of the area.

• The construction of water storage reservoirs is always followed by improved sanitary arrangement, sewerage system and wastewater treatment plants, to protect the reservoir and the river from the process of eutrophication. These water quality protection measures are financed from dam and reservoir designs.

• Finally, large water storage reservoirs create favorable conditions for tourism and recreational valorization of the area.

NEGATIVE IMPACTS OF WATER STORAGE RESERVOIRS AND MEASURES FOR THEIR MAINTENANCE

The construction of each water storage reservoir is followed by certain negative impacts. Most of these negative impacts could be maintained, mitigated or completely eliminated by adequate design solutions. The most important negative impacts are the following:

- On the riparian area as a result of changed groundwater regimes. This impact is especially visible at reservoirs on alluvial rivers, with low riparian area. It can be successfully neutralized by constructing a suitable drainage system. These systems become an inseparable part of the area and enable the management of groundwater regimes – maintenance of groundwater levels within the defined boundaries appropriate for urban systems and agricultural production. These systems can be of two purposes – drainage and irrigation, when a negative impact transforms into a positive one. It was performed in the riparian area of the HPP Đerdap, and the same principles of managing groundwater regimes are planned for the riparian area of the Velika Morava River, Mačva and Semberija after the construction of integral systems on the Morava and Drina Rivers.

- Reservoir sedimentation as a result of disturbed regimes of deposit flow is a negative impact that cannot be neutralized, but can be mitigated and maintained by adequate anti erosion works and a selection of adequate discharge objects.

- The change of ecological factors can jeopardize the survival and development of some biocenoses in the backwater zone. Altered water regimes in backwater zones bring about changes in the living conditions for biocenoses in that zone. Conditions for the development of reobionits – species adapted to living in fast-flowing waters – change very unfavorably. Survival of these species can be secured if some parts of the river, out from the backwater zones, remain in their natural condition.

- Dams are barriers for fish migration. This negative impact can be successfully overcome if special structures for fish migration are provided. For lower barriers – fish paths, and for higher ones – fish navigation lock and fish elevators. In some cases, disturbance in fish reproduction can be solved by special spawning zones in backwater.

- Eutrophication of lakes is one of the serious problems causing water quality degradation if protection measures are not implemented. These negative impacts can be neutralized and controlled if control of inflow water quality is performed. There are mathematical models for predicting water quality. These models, with appropriate research studies, can predict the changes of water quality. This enables the designer to make some changes in reservoir design and to predict adequate protection measures (Dašić, Đorđević, 2009). There are numerous examples of successful revitalization of reservoirs in an advanced phase of eutrophication and water quality degradation. Reservoirs were returned to oligotrophic state by adequate measures of nutrient income, especially of phosphorus. This means that water storage reservoirs can maintain ecologically favorable quality conditions by adequate protection measures.

- A change of aesthetic values of some spatial natural characteristic. Some reservoirs, especially the ones in deep gorges, after their formation turn into a different kind of biotope and can be experienced as a different aesthetic ambience. This change cannot be mitigated, and this is the most important problem facing the construction of some very attractive water resource systems in canyon parts of some rivers (Tara, Morača, Studenica). But, this new aesthetic view is not unpleasant, moreover, for many people it is of special aesthetic value. This is a matter of personal experience of some elements in space. It can be demonstrated by the fact that most of the time, the biggest problem after filling the reservoir is how to prevent the construction of settlements on its coastal areas.

- A change of microclimate conditions in the narrow zone around the reservoir is another impact. Analyses performed over recent years in a number of countries indicate that microclimate changes are of a much lesser degree than previously thought. The case of the Studenica River reservoir, for which the most detailed analysis were conducted, indicates that all impacts in terms of temperature and humidity were negligibly small and measurable only in the distance of 600 m to 800 m from the reservoir coast.

- Oscillations of reservoir water level have certain negative impacts. One is aesthetic, because bare coasts in backwater zones are an unpleasant sight. The second impact is ecological: fluctuations of water levels can cause the destruction of fish spawn laid in the shallow zones. The third is from the point of view of tourist and recreational usage of the reservoir: lowering water levels decreases the possibility for its exploitation. These negative impacts cannot be neutralized, but can be alleviated if an additional criterion is implemented in management rules – the criterion for maintaining water level in some periods of the year (periods of fish spawning, summer when the reservoir is used for recreation and tourism). Furthermore, in numerous cases, especially in the case of reservoirs for hydro energy production, reservoirs are full and levels are stable during that period of the year.

- Altered water regimes downstream from the dam and its impact on biocenoses is another important effect. It can be neutralized by designing adequate guarantied ecological flow. The methodology for defining guarantied ecological flow in Serbia already exists (Đorđević, Dašić, 2007). According to this methodology, downstream parts of the river are permanently maintained in the state needed for undisturbed development of the aquatic ecosystem. During certain periods of the year, intentional additional discharge from the reservoir may create conditions better than the natural ones (without the reservoir).

DESIGN MEASURES FOR INTEGRATION (FITTING) OF RESERVOIRS IN THE ENVIRONMENT

From the master planning point of view, a wider question is asked: can water storage reservoirs be harmoniously incorporated into social and ecological environment with adequate design and management measures? The answer is affirmative and some of the measures will be tabled.

- Reservoir parameters, especially water levels, should be defined in line with the ecological criteria, considering the behavior of the reservoir as a biotope in the period of exploitation. Dispositions with wide shallow zones should be avoided, because such reservoirs are very prone to the development of submerged plants and intense eutrophication processes in the lake.

- Design of all infrastructure of the system (dam, intakes, valves, powerhouse etc.) should be architecturally implemented and horticulturally enhanced in such a way that they fit into the environment as harmoniously as possible. On rivers with special ambience values, all of these structures, except dams, can be placed underground. An example of a harmonious integration of a dam into the ambience is the Marathon Dam which supplies water to Athens.

Figure 3. Marathon Dam for water supply of Athens

• Excavations and borrow pits should be subsequently submerged, or, if impossible, later on shaped and "cured" by biological measures, or even used for the improvement of ambience values.

• Each water resource design has to be accompanied by detailed ichthyological studies, which should define if there is a need to incorporate structures for providing fish migration (fish paths, navigation locks and elevators). Water storage reservoirs are a new aquatic biotope in which the desired development of fish population can be realized by anthropologically guided successions. In line with this fact, all activities on stocking the reservoir with fish and the disposition of structures for fish protection should be planned.

• The dynamics of the first filling of the reservoir should be planned and performed in line with ecological demands. Submerged areas of the reservoir should be carefully cleaned just before the filling to avoid unfavorable effects of the eutrophication process.

• The design of outlets (capacity, number of inlets, elevation etc.) should respond to ecological requirements. To provide the best quality of guarantied ecological flow – structures for discharging the flow should be designed as a selective intake structure with a possibility to manage the quantity and quality of discharged water. Discharged water should be accommodated to the needs of downstream biocenoses (discharge from the adequate water level, the one most appropriate for the specific development phase of downstream biocenoses, Figure 4)[3]. Valves have to be of regulatory type to enable water flow management. Dispositions and types should also envisage the best possible aeration of the stream (the best are Howler-Bunger valves, Figure 5) to enable the control of the oxygen content in water. Summary: outlets should be designed in such a way as to enable the management of the temperature and oxygen regimes downstream from the dam.

[3] Function of the outlet must be adjusted to temperature constant according to which the product of temperature (t) and time (v) of the development of fish spawn until the hatching is constant: v×t=const. For example, temperature constant for trout is v×t=410, meaning that at the temperature of 2 °C smaller fish (subyearlings) hatches after 205 days, at the temperature of 5 °C after 82 days and at the temperature of 10 °C it lasts only 41 days. This means that proper management of water temperature discharged from the reservoir through selective intake from the most appropriate level can accelerate the development of fish populations, in line with the objectives of anthropogenic guided successions.

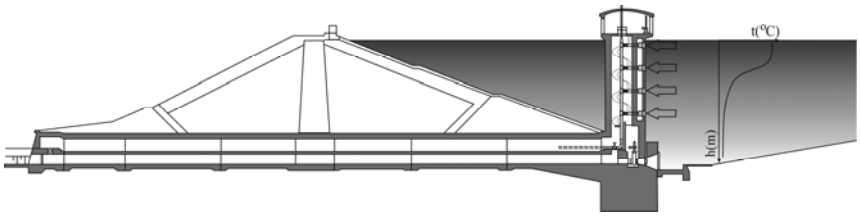

Figure 4. Discharge of guarantied ecological flow from adequate water level

Figure 5. Howler-Bunger valve

• Bottom outlets should be of a high discharge capacity to allow pre-emptying of the reservoir for efficient mitigation of flood waves.

• Groundwater levels in affected land should be controlled by drainage systems, which should be designed as management systems to enable better water regimes than those in natural conditions. These systems should also be adapted to water resources and ecological objectives (irrigation, touristic valorization of the area). A good example of such a system is the design of Srebrno Jezero Lake on the Danube River, as a part of the protection of the riparian area of HPP Đerdap, which became a popular tourist and recreational centre thanks to managed water regimes. Systems for the protection of riparian areas should be designed as multipurpose systems, so that they can be used for drainage as well as for irrigation, control of salt regimes, etc.

• Antierosion protection of the reservoir should be considered as a wider measure of catchment area cultivation. Particularly important are biological measures (afforestation, drainage of pastures). It should be treated not only as an ecological parameter, but also as a stabilizing economical parameter for the survival of people on catchment areas with poor soil quality.

• Water level management should be adapted to ecological and tourist requirements. For example, maintaining stable water levels in the periods of fish spawning to prevent the destruction of fish spawn laid in shallow zones, or maintaining stable water levels during the summer in the reservoirs used for tourism purposes.

• All biological interventions in the system (afforestation, stocking reservoir with fish) should be carried out only after detailed ecological studies, to prevent destabilization of the already established ecological equilibrium.

• Guarantied ecological flow should be defined in line with ecological requirements, considering it as dynamic category. It should be adaptable to the stage of development of a biotope downstream from the dam (discharging more water in a warmer part of the year, Đorđević and Dašić, 2000).

• To maintain reservoir water quality at the best possible level, the quality of inflow water should be protected. Adequate observation of reservoir water quality, with mathematical models for water quality prediction, enables the prediction of processes of degrading water quality. In this case certain measures for water quality protection could be undertaken.

• Envisage protective forest corridors in the areas of new reservoirs for the migration of animals and to provide safe crossing over the water barrage.

• Hydraulic engineering structures in towns and settlements should be planned with special care, from the viewpoint of harmonious functional and aesthetical incorporation into the urban framework. Reservoirs constructed in populated areas should be utilized for a harmonious connection of settlements and the body of water (examples are some parts of Belgrade, which are urbanisticaly adequately connected with the Sava and the Danube – these rivers are part of the Đerdap reservoir, Kladovo, Golubac, Bečej in central parts of these towns).

CONCLUSION

Summarizing water resources, the economic, social and other aspects of water storage reservoirs, it can be concluded that there is an unambiguously clear answer to the question of whether they should be built. They have to be built because economic and social progress and even the survival of the civilization depends on water storage reservoirs. The main question to be asked is the following: what protection measures should be implemented to

harmoniously incorporate water storage reservoirs into the environment. Harmonious integration of reservoirs into the environment is not a technical matter. It was pointed out that technically, the majority of negative impacts can be neutralized, mitigated or compensated, and some of the other components of eco-system (environment), in the process of building water storage reservoirs, significantly improved. In addition to past experiences, the criteria for developing an optimum solution must be extended to include optimizations of economics, of the technical know-how, and only elements necessary for the system's functionality should be built. Now, optimization of integral solutions must be performed, with a complex structure of objectives, in which the technical solution is reached by defining sets of social, economical, ecological, urban and other objectives, criteria and constraints. Future water resource systems should be built only as part of integral systems, meaning that complex solutions are optimally incorporated into the requirements of other users of space.

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SUSTAINABLE WATER SUPPLY SYSTEMS IN INDIA - - THE ROLE OF FINANCIAL INSTITUTIONS AND ETHICAL PERSPECTIVE

Krishne Gowda[1], University of Mysore, Urban and Regional Planning Institute of Development Studies, Mysore, India
Ravishankar Doddaswamy, Housing & Urban Development Corporation Ltd., Mumbai, India

Water is a scarce resource and an important basic necessity for the human survival. The quantity of potable water on earth is limited and its availability per person is reducing day by day due to increase in global population and damage to environment. Though water available in nature is free, sizeable investment is needed in order to supply water to the people at their doorsteps with required quality. This paper deals with the role of financial institutions in the balanced distribution of water for the public, the related problems with various regulatory instruments, and ethical perspectives for efficient utilization of this scarce resource through internal control aimed at long term sustainability.

***Key words:** water scarcity, sustainable development, financial and institutional reforms, liberalization, privatization and globalization*

INTRODUCTION

Water is one of the scarce resources in the world which is a basic necessity for the human survival. The entire global renewable water resources are estimated at around 41 trillion m^3. Accordingly, the per capita availability of water is about 7000 m^3. In spite of this fact, the world population is threatened by water scarcity in the next two decades. Hence serious effort is required to protect the existing water resources and utilize them efficiently in order to meet the growing demand.

Historically the rise and fall of civilizations and their economic prosperity have been centered on access to water and its utilization. Due to the increase in population, the per capita availability of water is declining. If the existing resources are not consumed properly, the human population on earth, which has more than doubled from 2.5 billion in 1950 to 6 billion in the year 2000, will be seriously threatened and deprived. The population is expected to grow to the extent of 10 billion by the year 2050, and this is a cause for serious concern.

India receives 4000 billion m^3 of rainfall annually. Only one-third is used and the remaining part drains into the sea. Fresh water availability is estimated to be around 1700 m^3 per person. However, in certain regions such as Kannyakumari, and Kutch, the per capita availability is less than 500 m^3. The availability of water below 1000 m^3 per person is termed a **Water Scarcity**.

It is forecast that by the year 2025 the human population will reach the level of 9 billion and 2/3 of the population will be living under **Water Stress**. In India, the main use of water remains to be in agriculture. Robert Walker, CEO of Seven Trent, says that "There is enough water for everybody in the world but only if we change the way we manage it".

According to a study conducted by Cohen, the carrying capacity of the planet earth is about 20 to 30 billion humans. Hence, there seems to be no need to get alarmed with the current trend, provided corrective measures are taken for the effective and efficient utilization of resources (Rao, 2000). Another important issue is the over exploitation of ground water, which is increasing very rapidly.

SUSTAINABILITY

The concept of **Sustainable Development (SD)** was first defined in 1987 in the WCED report titled "Our Common Future", popularly called "Brundtland Report", as follows:

"Sustainable Development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

FAO states:

"Sustainable Development is a development which is environmentally non-degrading, technically appropriate, economically viable and socially acceptable".

Sustainable Development is a dynamic, balanced and adoptive evolutionary process in the use of natural resources. The principle underlying natural resources harnessing is that it should not be used at a rate beyond its **"Regenerative Capacity"**. In its broadest sense the strategy of SD aims to promote harmony between human beings on the one hand and nature on the other. The primary objective is to provide lasting and secure livelihood that minimizes resource depletion, environmental degradation, cultural disruption and social instability. The world has faced great challenges during the past decades, which has showed that the development based only on the economic indicators is not possible. The new ethics of sustainable development requires fresh approach to water resources management (Trajković, 2004).

A sustainable society cannot be achieved without fundamental changes in our basic

[1] Manasagangotri, Mysore-570006, India
krishnegowda@hotmail.com

thinking encompassing ethical values, moral intuitions and religious beliefs. The integrity of the life support system for maximizing future options includes enabling current and future generations to achieve economic and social improvement while maintaining: Cultural Diversity, Biogeochemical Integrity and Biological Diversity. The various constraints hindering sustainable water use are:

– Financial difficulties;
– Institutional problems;
– Lack of skilled human resources;
– Inadequate inter-sector coordination;
– Weak political commitment;
– Insufficient community involvement;
– Untimely intervention in operation and maintenance;
– Deteriorating water quality;
– Insufficient information and communication;
– Discharge of untreated effluent to water bodies and soil.

An attempt is made here to provide an account of the efforts made in India to tackle financial and institutional reforms, to emphasize the need to bring in the ethical perspective, and to draw attention to the major culprit i.e. the human being, for ignoring the norms of sustainable consumption pattern and holistic life style.

IMPACT OF WATER POLLUTION

There are many critical interrelationships between **environment and poverty. One of the well documented is the link between the environment and the health of poor people.** Polluted water and air are the major contributors to diarrhea and respiratory infections, the two most frequent causes of death among poor children.

A study for 144 water and sanitation projects found that improved water and sanitation services were associated with a median 22% reduction in the incidence of diarrhea and 65% in deaths caused by diarrhea. In addition, the improved excreta disposal and hand washing can reduce under-five mortality rates by 60% and cases of schistosomiasis by 29% and trachoma by 27–50%. Other analyses have found significant relationships between air quality and health.

These critical relationships between the environment and health highlight the importance of cross-sector work to alleviate poverty.

Both natural chemical substances in drinking water and those occurring due to human intervention adversely affect health. A variety of acute and chronic health hazards have been reported. Actual risks are determined by the types of chemicals and their concentration in drinking water.

Several diseases such as diarrhea, hepatitis (jaundice), etc. have been linked to the human contact with polluted water. The World Bank and WHO have estimated that in India, 21% of all communicable diseases (11.5% of all diseases) are water related. It is estimated that very year in India 1.5 million children under 5 years of age die of water related diseases and that the country loses over 200 million man-days (Mord, Goi. 1993). About 30 million DALYs are lost each year in India due to poor water quality, sanitation and hygiene (IDR, 1999–2000).

Disability Adjusted Life Year (DALY) is a quantitative measure that integrates premature deaths and temporary disability. Using the Human Capital Approach, the statistical value of one DALY is equal to the annual average productivity of an Indian worker. Considering average per capita Gross Domestic Product (GDP) of US$ 240, the annual loss of 30.5 million DALYs works out to be **US$ 7.2 billion**. The country should be willing to spend that much annually to provide clean drinking water to all.

The major sources of Water Pollution are:

– Domestic Waste Water;
– Industrial Waste Water;
– Agriculture Run-off.

It is estimated that domestic and municipal effluents constitute 75% of India's waste water, but waste water treatment facilities are grossly inadequate.

ROLE OF FINANCIAL SECTOR FOR SUSTAINABLE DEVELOPMENT

Financial Institutions play the role of an intermediary between borrowers (Providers of Service and goods) and lenders. The aim of this intermediary function is to bring together and coordinate savings and investments. As the financial intermediary between entities in the market, financial institutions play an important role serving:

– **Investors:** By channeling the investment needed to achieve future and needed development.
– **Innovators:** By developing innovative financial products to encourage resource conservation and effective delivery mechanisms with the needed liquidity.
– **Valuers:** By pricing risks and estimating returns for companies, projects etc.
– **Power to Stakeholders:** As stakeholders and lenders to exercise considerable influence over the management of companies to achieve the intended objective.

Thus, if financial institutions are to integrate environment considerations into their decision making process, they need to be convinced that they are not only profitable in the narrow sense, but are sufficiently important to merit their attention. Here, the relationship between environmental performance and financial performance and overall sustainability is quite important. The corporate social responsibility plays an important role in order to introduce discipline in this sector. The coordination between interfacing institutions has to be developed and ensured.

Public awareness, as well as active participation of the public in the decision making process during development and enforcement of legislation are necessary for sustainable water management (Branković, Trajković, 2007).

A number of approaches may be used to encourage financial institutions to factor in the environment in their business, and examine the available opportunities to contribute towards sustainable development:

– High level initiatives, involving commitments from the senior management at financial institutions can encourage organizations to consider environmental issues;
– High profile financial organizations, particularly those that are public institutions, can be pioneering and normative. In this context, the role of development banks is quite significant;
– Businesses that are concerned about the environment and wish to ensure that financial institutions are supportive of their actions can engage in a constructive dialogue explaining their actions forcefully and persuasively to institutions; and
– The public sector can encourage financial markets to factor in environmental issues by structuring its policy development to cooperate with the financial markets. Fiscal incentives and benefits can help a lot in this regard.
– Concessions may be offered to projects which are more environmentally friendly than others. Green area ratio, use of solar power, water recycling etc.

Two major financial institutions involved in financing water supply schemes in India are LIC and HUDCO.

a. Life Insurance Corporation of India (LIC) has lent about US$ 0.5 billion so far for the implementation of water supply projects through the state water supply utilities.

b. Housing and Urban Development Corporation Ltd. (HUDCO) set up a separate wing viz. Urban Infrastructure Finance Wing (UIFW) in HUDCO in 1989 to cater to the growing demand for urban infrastructure services. One of the main sectors receiving assistance is water supply. HUDCO has so far sanctioned more than 400 schemes with a loan amount of US$ 2 billion.

While granting loans to various agencies, HUDCO introduced certain norms in this sector to make it sustainable, such as:

Concept of cost recovery: In order to bring in more investment for the water supply sector it is essential to make the project financially viable and hence serious attempts are required to recover the cost from the project itself as much as possible. The concept of cost recovery can be broadly classified into 3 categories, namely:

- **Category I:** Where beneficiaries are identifiable and the benefits accrued to each beneficiary can be quantified – the examples are telescopic rates for water supply and electricity and cross subsidy for public transport – higher levels of consumption entailing higher levels of charges.
- **Category II:** Where beneficiaries are identifiable but the benefits accrued to each beneficiary are not directly quantifiable – indirect methods of estimating the benefits accrued to various beneficiaries; e.g. flat rate charge as a bulk cost to local bodies in accordance with their size. These local bodies are expected to augment resources over time and thus become able to meet these obligations.
- **Category III:** Where it is difficult to identify individual beneficiaries as well as to quantify the benefits accrued to the individuals or the groups of beneficiaries – the example under this category is the bulk supply in water-scarce areas.

In some of the schemes where new areas were included for water supply, a lump sum connection charge ranging from US$ 20 to US$ 100 was collected directly from the beneficiary households which in turn helped to reduce the cost of borrowing.

Water kiosks with meter system were introduced instead of public stand posts and the responsibility for operation and maintenance was placed on the beneficiary communities. Metering is encouraged to bring in accountability.

In cases where the target group is below the poverty line and the group members find it difficult to pay the water fee, the expenditure is reimbursed by the respective local bodies from the common fund by means of cross subsidization.

WATER SUPPLY SECTOR IN INDIA

Following the independence, the water supply system has been primarily managed by Public Works Department/Public Health Engineering Department under direct responsibility of the respective state government. In some cases the respective local bodies are in charge of the drinking water supply in their jurisdiction. However, in order to attract investment to this sector to implement the projects efficiently, State Water Supply and Sewerage Boards/ Authorities were created in 1970s. Though this facility has succeeded in implementing many water supply and sewerage schemes, due to the poor cost recovery these institutions have accumulated huge losses.

In the era of LPG (Liberalization, Privatization and Globalization), the water sector has also received a lot of attention and accordingly, water sector commercialization has been gaining popularity. The bottled drinking water has already become a commercial venture and people have accepted to pay to an extent of Rs.10 per liter or more for quality drinking water.

Though water available in nature is free, to the process of bringing this water to the people at their homes requires pumping the water from its natural level, transmitting it through pipes, storing it in ground level/high level reservoirs and supplying it through distribution networks. All this, requires capital investment, in addition to the recurring expenditure for power, chemicals, operational maintenance, salary and wages and revenue recovery.

Although the cost of ONE cubic meter (1 m^3) of water is about US$ 0.05 to US$ 0.15, the prevailing water tariff in India as of recently varies from US$ 0.05 to US$ 0.2 per m^3. Hence, there is an implicit loss for water supply institutions. This is why the authorities were advised to increase the tariff to the cost recovery level. However, considering the socio-economic situation, and the impact of health expenditure related to the supply of polluted/untreated water to the under privileged, the government is subsidizing this amount as a social commitment. *People are ready to pay US$ 0.2 for 1 lit of bottled water but are not willing to pay US$ 0.2 for 1000 lit (1 m^3) of water being supplied directly to their home from public authorities.* This distorted thinking has to be solved through social education, efficiency, and ethics on the part of officials and other authorities.

Various organizational structures responsible for water supply and sewerage are as follows:

a. One Single Institution for Entire State

Kerala Water Authority (KWA) is responsible for water supply and sewerage projects for the entire state both in urban and rural areas. KWA is the only agency which takes up the project from research, planning, execution, and maintenance to the revenue recovery from the public.

b. Separate Institution for Metro & Other Local bodies

In the State of Karnataka, Urban Water Supply and Sewerage Board (KUWSSB) is responsible for the water supply drainage schemes in all urban local bodies, while Bangalore Water Supply and Sewerage Board (BWSSB) is the implementing authority for Bangalore City. Rural Water Supply schemes are implemented by the Public Health Engineering Department through *Zillah Panchayat*.

c. Single Co-coordinating Agency

In the State of Maharashtra, Maharashtra Jeevan Pradhikaran (MJP) is responsible for implementing water supply projects as a nodal agency. After implementation, the responsibility for the plant is transferred to the local bodies in term of operation & maintenance and tariff collection.

Water Tariff and its Applicability: (An Example)

In case of a medium water supply system used to serve a population of 10,000 with an average supply level and 100-litre per capita per day (lpcd), the total requirement of water is 1 million liter per day (mld) (1000 m^3). If the required capital investment is about US$ 0.2 million for 1 mld, the capital investment required for 1 m^3 works out to be US$ 200 /-. Considering that the project lifetime is 20 years and cost of funding is about 10%, the debt servicing obligations work out to be Rs 3.3 per m^3 (Rs 1 equals US$ 0.02) in order to recover capital investment. Apart from this, the operation and maintenance costs, such as

labor, chemicals and power, turn out to be about US$ 0.1 to 0.2 depending on various local conditions. Hence, the cost of production of 1 m^3 of water varies from US$ 0.1 to 0.3, the average being US$ 0.2 per m^3.

Normally, the water tariff is traditionally classified into 3 categories viz:

a. Domestic (80%);

b. Commercial (15%);

c. Industrial (5%).

Companies are forced to recover the cost of O & M for domestic supply and the cost of commercial and cost plus from the industrial category of uses.

REFORMS IN THE SECTOR

In order to provide basic facilities in urban areas, Rakesh Mohan's Committee constituted by the Government of India estimated that the investment required for the next 10 years is about US$ 50 billion. However, the availability of resources is far below the requirements which is why the private participation in infrastructure sector was initiated on a large scale.

The private sector investment requires a well articulated and implementable state sector institutional and policy framework which, underpinned by relevant laws, would pave the way for systemic reforms. Radical reform of the Urban Water Supply and Sanitation (WSS) sector is urgently needed to:

• Boost economic growth and the well-being of the urban population, especially the 70 million poor people living in urban areas

• Create the institutional and policy framework that can attract the level of public and private investments needed to fill the growing gap between the demand and supply for modern infrastructure services in a sustainable manner. The main point of reform is to ensure, at least in a progressive manner, the principle of collecting due user charges enabling cross subsidization.

The Government of India, Ministry of Urban Development and Poverty Alleviation (MoUD & PA) developed public private partnership guidelines (PPP) to encourage private investment for promoting drinking water supply. In conformity with the 74th Constitutional Amendment, urban local bodies shall be responsible for water supply and sanitation.

a. Management Options for Private Sector Investment

– **Service Contracts** – Asset remains with the local body, only operation is contracted;

Table 1. Water tariff in various states per kilolitre

State	Domestic Monthly	Rate per m^3 (in US$), Based on Metering			
		Domestic	Commercial	Industrial	Street Taps
Kerala	0.6	0.1 to 0.2	0.2	0.3 to 0.4	16/year
Karnataka	0.9	NA	-	-	-
Tamil Nadu	NA	-	-	-	-
Andhra Pradesh	1	0.07 to 0.11	0.2	0.3	NA
Maharashtra	1	0.07 to 0.15			NA
Mumbai	NA	0.07	0.5	0.35	NA

Table 2. Management options for private sector investment

Options	Advantages	Limitations
Service Contracts	Quick Gain in Operational Efficiency, Simpler to process and re-tender	Town retains all commercial & investment risks
Management Contracts	Gains in Managerial Efficiency, Simpler to Tender	Lack of Strong sustained private incentives, City retains risks
Lease	Larger Operational Efficiency Gains	City retains investment risk & needs supervision
Concession	Efficiency Gain in O&M and Asset Management	Complex Tendering Process, Needs steady commitment & strong regulatory capacity

– **Management Contracts** – Asset remains with the local body, Operation and Maintenance of a part/entire system is contracted with the option of revenue recovery;

– **Lease** – Asset is leased out to private party;

– **Concession** – Entire revenue is collected by a private party and a concession is provided.

b. Derivatives of Public Sector Participation

BT – Build and Transfer

BOO – Build Own and Operate

BOT – Build Own and Transfer

BLT – Build Lease and Transfer

BTO – Build Transfer and Operate

RLT – Rehabilitate Lease and Transfer

BOOT – Build Own Operate and Transfer

BOLT – Build Own Lease and Transfer

DBFOT – Design Build Finance Operate and Transfer

Important points to be considered while opting for private sector involvement are:

– Careful drafting of agreements;

– Adequate foreclosure provisions;

– Clearly specified ownership and concession clauses;

– Measures for damage redress due to non-compliance and deficiency regarding agreed service.

ETHICAL PERSPECTIVE

In spite of various financial arrangements, technical advancement and management options, a majority of people are still deprived of basic necessities due to various reasons. The cost of projects has increased due to corrupt practices and service delivery mechanisms become biased against the poor.

a. Transparency International estimates that every year about US$ 400 billion is lost world wide for paying bribes related to the goods and services provided by the government.

The ethical practices are a means to achieve distributive justice through co-operation. Business is primarily concerned with the material things and gains. Ethics, on the other hand, are concerned with intangible things and attitudes. The World Bank defines corruption as "the use of public office for private profit". The corruption has been broadly classified into honest corruption and dishonest corruption. Thailand, which has practiced honest corruption collapsed in 1997 amidst the South East Asian crisis, which validated the old saying "Honesty is the best policy". Corruption occurs every where, in Japan, USA,

Table 3.The milestones of holistic human development

Sl. No.	Positive, Desirable Human Development	Negative, Undesirable Human Development
1	Infant growth values	Spoilt child
2	Youth education empowerment	Illiterate, Ill-trained
3.	Judicious economic enterprise	Unemployment, Crime
4.	Divine family	Broken family
5.	Unification with nature	Environment destruction
6.	Work for benefit of present and future generation	Global destruction
7.	Community and world as a family	Individualistic, greedy, corrupt
8.	Cosmic harmony, enlightenment	Annihilation of human race

Russia, South Asia etc, but South Asian corruption had four characteristics that make it far more damaging than the others (HDR- UNDP, 1999):

- Corruption at the top – which distorts the fundamental decision about development priorities, policies and projects;
- Due to the corruption in the region, the investment in domestic production gets reduced substantially;
- Corruption leads to promotion (not prison!) of a few individuals and the public is deprived and discomfited;
- Mainly poor people are affected and they are the worst sufferers; and
- Corruption tends to transform public resources into private wealth.

b. Spending on Defense and Poverty: About US$ 900 billion per year is spent on defense, compared to only US$ 60 billion for foreign aids. Mr. James Wolfensohn, President of The World Bank, stated that "Investing money into the root cause of poverty may help prevent conflicts and if US$ 900 billion spent on this cause, not even US$ 50 billion is required for defense". It is stated that the expenditure on USA-Iraq war is about US$ 200 billion, which is sufficient to provide both shelter and water supply for the entire poor population of India!

Science and technology are solely concerned with man's victories over external nature, the material world. Ethics and morals are related to the life within. Science and technology have helped man to progress merely by controlling external nature. The more basic task is to control the "Inner Nature", rise above the animal instinct and reach human excellence. Man's true enemy is within himself. Obsessive concern with ever higher "Consumption Standards" in the name of higher living standards is a kind of psychological infection that is now being transmitted across the globe (Chakrabarthy, 2001).

In view of the above, it is essential to introduce the ethical perspective into our day-to-day management, to moderate the consumption pattern and to have a sustainable peace-loving society. The investment required for defense and wastage of money through corrupt practices can be reduced to a great extent and the saved resources can be used for developmental work. Hence it is very important to understand the real human development and focus on these issues while formulating new projects and policies.

SUMMARY AND RECOMMENDATIONS

Mahtma Gandhi once said that **"Mother Earth has sufficient resources for everyone's needs but not greed"**. This is all the more applicable in the 21st century, because even though man has created sufficient wealth through technical & scientific innovations, only 20% of the overall population is enjoying 80% of the resources. The challenge of the current century is to innovate mechanisms to make these resources available to all the people with the aim to reduce tension and bring in peace and harmony. Most of the corrupt practices happen because of lack of understanding of real human growth and triggering of selfish instincts in human beings. In respect of water supply schemes, the following recommendations are made:

- Community participation should be encouraged for the formulation, operation and maintenance of water supply projects;
- Dividing the water supply system similar to the electricity system viz. separation of production, transmission and distribution. Inciting competitive tendering process to implement projects in a time bound manner;
- Introducing computerization of billing and flexible billing mechanism;
- Introducing rewards and punishment for the efficient usage and wastage;
- Developing awareness programs to treat water "as scarce commodity" and inculcating the habit of proactive compliance;
- Proper participatory systems should be brought in to reduce wastages of water in the irrigation sector as well as the uncontrolled pollution by over usage of fertilizers and pesticides which pollute the fresh water bodies;
- In situ wastewater treatment methodologies should be used based on local conditions for treating domestic sewage before discharging to fresh water bodies;
- Rainwater harvesting should be encouraged in all areas to store fresh water;
- Developing basic awareness on the limitation of natural resources on earth;
- Creating awareness regarding the balance of inner growth and material comfort (i.e. the concept of high-level thinking and simple living) for the overall sustainable development.

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THE USE OF MINERAL RESOURCES AND ISSUES OF HARMONISATION BETWEEN SPATIAL PLANS FOR THE MINING AREAS IN SERBIA WITH OTHER STRATEGIC DOCUMENTS

Jasna Petrić[1], Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
Jasmina Đurđević, Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia

Growing development needs and requirements for mineral resources endorsed by the contemporary society reopen the issues of mineral resources finitude and effects that mineral industry imposes on the global scene. Mining is certainly among the activities which raise numerous environmental and social concerns being enhanced by continuous demand for new exploitation areas. Experience supports the need for continuous process of planning in the mining areas and development of extensive research, both fundamental and applied. With particular focus on spatial plans for the mining areas in Serbia, this paper addresses current mining regulatory framework and issue of harmonisation between spatial plans for the mining areas with other pertinent strategic documents on environmental and social protection. Regardless they have been prescriptive or legally binding, fundamental principles of these strategic documents serve as guidance towards sustainable development in the mining sector under the new institutional, organisation and economic settings.

Key words: ***mineral resources, spatial planning, Serbia, environmental and social protection, strategic documents.***

INTRODUCTION

Mineral resources' use is an integral part and one of the key premises of development worldwide. With population growth and increase in society's development needs, the requirements for minerals have grown and diversified. Despite certain opposing views, mineral resources are *conditio sine qua non* of the contemporary production. These 'stock resources' are claimed to be exhaustible or finite, which means that their present (excessive) use may affect their availability in the future. There are views that mineral resources (excluding those which are used for the energy production) are not necessarily exhaustible if there is a potential for their recycling or successive use in exploitation, primarily concerning the ores with less abundant contents. However, the attempts to recycle or substitute mineral resources based on their multiple use will only prolong the period till their lack reoccurs and becomes reopened issue in the future. In any case, having that mining has followed and is likely to pursue with the role of a vital companion for the development of a society, actors involved in planning and exploitation of the mineral resources should seek for a balance between maximising the economic use of these resources with minimum degradation to the environment, and minimum of adverse social impacts.

In opposite to other types of development activities, mineral industry is rather location dependent, i.e. mineral resources can be produced only in places where they are naturally deposited. Yet, the actual activation of a potential location for these resources' exploitation depends on a number of conditions - economic, environmental as well as the social ones.

Spatial planning in the mining areas is faced with numerous issues, such as: dynamic spatial changes, large scope of degradation of natural and man-made environment as the implication of physical interventions, socio-economic impacts, etc. Therefore, planning in large mining basins requires certain adjustments of current institutional organisation, normative regulations, standards, methods, approach, dynamics and other planning aspects. Special concern relates to strategic documents which contain guidelines on environmental protection and social stability through mining development projects. Implementation of planning concepts for the mining areas should thus be appropriately harmonised with pertinent strategic documents which are the part and parcel of international standards and practices.

[1] Bulevar kralja Aleksandra 73/II, 11 000 Beograd, Serbia
jasna@iaus.ac.rs

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MINERAL SECTOR OUTLOOK – THE WORLD AND EUROPEAN COUNTRIES PERSPECTIVE

Mineral resources' exploitation (mineral industry) is placed at one of the key positions among the strategic economic activities. Across the World, on the annual basis, there are approximately 23 billion t of mineral resources that are exploited, out of which 18 billion t are of solid nature and 5 billion t are oil and gas (Vujić *et al.*, 2009:5). The structure of a solid mineral resources' use reflects that the non-metallic ones account for the largest part (12.0 billion t per annum), followed by the coal exploitation (3.5 billion t per annum) and metallic mineral resources exploitation (2.5 billion t per annum). There are over 50,000 mines around the world in which approximately 200 types of mineral resources are in use (ibid.).

Distribution and availability of mineral resources is quite uneven. The majority of mineral deposits (around 80%) is located in few countries only. For example, the United States, Canada and Australia are among the countries with major mineral production due to good or excellent geological predisposition[2]. Analogy can be noticed with the mineral resources applied for energy production having that over 2/3 of the world known fossil energy resources are located in 3 countries only (USA, Russia and China) (Spasić, Vujošević, 2009:152). For example, the coal reserves are widely dispersed, but the major deposits of the northern hemisphere are mainly situated between latitudes of 35 and 50 degrees. It has been estimated that 95.8% of the total coal reserves are located in 15 countries only (Maksimović *et al*., 2010). The reserves of coal in Europe are estimated on 71 billion t of hard coal whereas the reserves of lignite and brown coal are estimated on 75 billion t (EURACOAL, 2009). As for the matter of coal production at the European coal market (EU-27 countries), in 2008 out of 422.3 million t of lignite which was produced in EU-27 countries, Germany had by far the largest share (175.3 million t), followed by Greece, Poland, Czech Republic, Romania, Bulgaria, Hungary, Slovak Republic and Slovenia (Zeković, 2010:3). Poland is the greatest producer of hard coal among the EU-27 countries (83.4 million t out of 148.3 million t produced in 2008 in the EU), and it is followed by Germany, UK, Czech Republic, Spain, Bulgaria and Romania (EURACOAL, 2009).

With current level of exploitation, world production of hard coal is foreseeable for the next 160 years and of lignite for the next 460 years. Although production of coal increases, it is estimated that in the next 30 years only 25% of the presently known reserves of coal will be exhausted, which is respectively much lower in comparison to the exhaustion of current reserves of oil (84%) or gas (64%) (Maksimović *et al*., 2010:234).

Potentials and use of mineral resources in Serbia

Although there is a relatively spread public belief on the abundance of mineral resources in Serbia, which is based on the Middle age mining legacy, the present facts highly challenge this notion. Serbia has certain resources of strategic colour metals and coals for energy production (lignite), which could be to some extent comparatively better ranked at the European level (Radević, 1997:167). Economic and technology status of the mineral resources production in Serbia has been stagnating for a number of decades. On the other hand, an increasing need for mineral resources' consumption and the drop in their average content in ores have influenced a change in their way of exploitation. Surface exploitation is the dominant way of extracting solid mineral resources in all countries. In comparison to the world's 65-70% of solid mineral resources production based on surface exploitation, this share is even more emphasised in Serbia (95%) (Vujić *et al.*, 2009:5).

Surface exploitation in Serbia features lignite production, as well as the production of non-metallic mineral resources, production of copper, silver and gold, whereas the ores of lead, zinc, antimony and other higher caloric coals (brown and hard coal) are produced by underground exploitation. It is estimated that in Serbia some 100 km^2 of land surfaces have been engaged so far for the mining purposes, and that future may bring to several times multiplication of the needed territorial encompass for this activity if it is to be uninterruptedly performed (Spasić, Jokić, 1998:4).

Lignite, as one of the key mineral and thermal energy resources of Serbia takes in 96.8% of the country's total geological reserves of coal. Without considering the coal reserves of Kosovo and Metohija, the total balance reserves of coal in the rest of Serbia are estimated on 1.0 billion t of equivalent coal, or 0.34% of the world balance reserves (Maksimović *et al*., 2010:230). Out of these reserves, which are expressed in equivalent coal, Kolubara lignite basin comprises 15.4%, Kostolac 8.7%, Sjenica 1.3% and Kovin basin 2.5% (ibid.:231). Kosovo-Metohija basin with more than 67% of the total geological reserves of lignite in the Republic of Serbia represents the major energy potential but is not in use by Serbia which does not have access to these reserves after the year 1999 and the UN Resolution 1244. A long-term concept of energy development in Serbia until the year 2020 presumes an increase of lignite production from the current 37 million t per year to 50 million t per year, where the major pressure on production increase will be put on Kolubara lignite basin (Spasić, Vujošević, 2009:153).

The largest proportion of lignite produced in Serbia (93%) is used by thermal power plants for the electric energy production and 7% is used by other consumers (Maksimović *et al*., 2010:236). Lignite is therefore a foundation of the energy sector in Serbia and its present reserves allow long-term production of energy in thermal power plants. According to the Strategy of energy development in Serbia until 2015 (*Strategija razvoja energetike Srbije do 2015. godine*), the priority in energy sector development is based on modernisation and restructuring of production and processing of coal with aim to increase competitiveness as well as to fully acknowledge the ecological principles, i.e. to apply ecologically clean effective technologies.

SPATIAL PLANNING OF THE MINING AREAS IN SERBIA

As it was previously discussed, the energy potential of strategic significance for Serbia is represented by its large lignite basins. With that in view, lignite exploitation requires coordination at several planning levels (national, regional and local). Intensive development of surface exploitation, as well as of facilities for lignite transformation, dynamic spatial changes, and large scope of degradation of natural and man-made environment, created a framework of specific conditions and challenges for spatial planning in the large lignite basins. Surface exploitation brings to certain ecological problems, but it is contestable whether this type of solid mineral resources' extraction is much more condemned for the 'negative' effects than it truly imposes them. The main reason for a negative public opinion is caused by embedded visual impression of surface mines (disintegration of solid rocks, occupation of productive land, degradation of forests, etc.). At the same time it is commonly neglected the fact that this is a 'temporary condition' in the area where the mining works take place, and that with adequate planning and proper ways of technical and biological recultivation, degraded space can be effectively restored,

[2] The United States is a net importer of minerals while Canada and Australia export more than they consume.

with a number of successful international examples in support of this assertion.

Nowadays, planned coordination of a long-term development, including a subsequent regeneration of the degraded space in the large mining basins, is no longer a possibility but a necessity. Planning and regeneration in the mining basins require adjustments to the institutional setup, legal framework and relevant strategic documents. At the same time, spatial planning in the large mining basins is determined by: structural spatial changes, integral as well as the regional planning approach, information base, reconciliation of development conflicts, recultivation, long-term forecasts, etc. (Spasić *et al*., 2007, Spasić *et al*., 2009a).

Due to the nature of spatial changes which are caused by surface mining, planning in the mining areas is faced with a number of specific development, environmental, social and spatial conflicts and limitations. Planning experience from the mining areas around the world may serve as a pointer but could not be directly translated to the Serbian practice. Therefore, an extensive research, both general (fundamental) and specific (applied), is needed in support of planning activity in the mining areas. Fundamental research relates to the state-of-the-art technologies and analyses of long-term environmental implications. Applied research in this field considers structural spatial changes, socio-economic implications, possibilities for revitalisation of damaged areas, and the environmental as well as the quality of life improvements in the mining activity's immediate zone of influence. The experience confirms that research and planning process for the mining areas should be a continuous one, encompassing forecasts and development solutions for the various time horizons: long-term (20-50 years), medium-term (5-10 years), short-term (1-5 years), and operative (2-12 months) (Spasić *et al*., 2007:79).

Within the scope of integral and regional approaches, the strategic planning in large mining basins is founded on long-term forecasts (and research). Newly opened pits are typically planned for the period of 25-30 years, where the process of preparation, including a design, takes around 10 years. The accompanying so-called negative externalities, e.g. land acquisition, resettlement of population, change in the water regimes, environmental degradation, etc. are exhibited on a long-term basis (ibid.:74).

Apart from time dynamics, large mining basins are also qualified by the spatial dynamics, which is determined by continuous demand for the new exploitation areas. The requirements to expand a territorial encompass for the mining activity as well as the need to involve comprehensive development imply that the strategic planning framework in the mining basins is implemented through plans of smaller territorial entities, as well as through medium-term and short-term plans and programs that are in accordance with the general planning framework, i.e. with higher order spatial plans.

Specific targets of comprehensive planning in the mining areas involve: dissemination of scientific research results and their inclusion in development concepts; optimisation and guidance to the resettlement process; optimisation of transport facilities; utilisation of water resources and agricultural land; ecological and physical conditions for revitalisation of degraded soil; protection and preservation of natural and cultural heritage, etc.

Implementation of planning concepts, goals and solutions for the mining areas includes a range of measures and coordinated activities, e.g. improvements and adjustments to normative regulations; sustainable development; monitoring and provision of a continuous planning process; and permanent institutional support from the national, regional and local levels.

MINING REGULATORY FRAMEWORK AND PERTINENT STRATEGIC DOCUMENTS

Current international law adopts a non-interventionist approach to the mining sector, which presumes that nation-States have sovereignty over their own natural resources. State ownership over mineral resources is reflected in national legal framework. However, nation-States could disclaim a part of their sovereign rights 'through long-term practice of legal customs, through the development of general principles of a legal nature, through treaties and other binding legal agreements, and through judicial decisions' (Buergenthal & Maier, 1990:19, Guruswamy & Hendricks, 1997:15), all of which constitute a part of the international law.

Mining legislation incorporates a number of different laws which relate to regulations for environment, land, water, etc. In majority of countries, the Mining Law[3] is a key regulatory instrument for exploitation of mineral resources, and it defines both rights and obligations of stakeholders in this field (Petrić *et al.*, 2009).

Transition of the mining industry from public to the private sector re-opens an issue of legal framework adjustments in this sphere which would respond to the new economic conditions. As Otto (1996) observes, in the period 1985-1996, over 90 nations either completely changed their mineral sector laws or they have significantly altered them by amendments. This number is now probably much bigger since in the last 15 years a number of former communist countries also changed their old mining regulations. On the other hand, Serbia has not till now updated its mining law with adjustments to the market economy. Its legal framework in this field is based on the Mining Law from 1995 which was amended several times until 2009, and on the Law on geological research (1995). Planning in the large mining basins in Serbia is also treated according to the Law on planning and construction (2009), and Regulation on contents, method and procedure of developing a planning document (2010), in reference to development of 'spatial plans of the special purpose areas'. Mining sector is also partly covered by other laws referring to the energy sector development, water management, agriculture, environment, expropriation, etc. Still, many related issues which concern population resettlement, social issues, property regulation, recultivation of the damaged soil, liability, etc. have not been covered by the current legislation (Spasić *et al.*, 2009b:176).

Other strategic documents which are relevant to the mining sector in Serbia are the *National Strategy of Sustainable Development* (Nacionalna strategija održivog razvoja, 2008) with chapter on mineral resources - primarily the part on coal and fossil fuels, and the *Strategy on sustainable use of natural resources of Serbia* with partial strategy dedicated to mineral resources, latter still not being completed (Tošović, 2010:418). Goals in the sector of fossil fuels which feature the *National Strategy of Sustainable Development* are: optimum long-term energy efficiency through exploitation of non-renewable natural resources with least environmental degradation and impact on human health; exploration of new mines and sustainable use of non-renewable natural resources; application of modern methods for exploration of oil and gas – application of BAT (Best Available Techniques) for disposal of waste material; substitution of fossil fuels by the renewable energy sources with special economic incentives, etc. (Nacionalna strategija održivog razvoja, 2008:93).

Strategic documents on environmental issues related to the mining sector

Intensive exploitation of mineral resources causes the significant spatial transformation

[3] A comprehensive international law on mining has not been set up.

processes, as well as ecosystem changes and environmental degradation. Some recent global surveys show that environmental concerns (40%) continue to raise the most evident sustainable development alarm for the mining industry, being followed by social concerns (28%) (Opinion poll, 2010). Mining is certainly among the activities which has an intensive effect on the environment, both from the aspect of the mineral resources' exhaustion and from the aspect of environmental degradation and extensive pollution. On top of that, the public and most of all the environmentalists' perception of the mining industry is typically featured by the negative image created by immediate visual impacts of a large scale open-pit extraction.

Knowing that the location of mining facilities is conditioned by the imperatives of geology and that mines are linked to specific sites, the environmental effects of this activity tend to be governed by site-specific factors (Wälde, 1992). With intention to integrate regulations of the Mining Law and Law on Environmental Protection, a large number of countries prescribe special guidelines on environmental protection for mining. Those guidelines are typically a part of the Law on Environmental Protection referring to the following aspects: Environmental Impact Assessment; Socio-Economic Impact Assessment; environmental management plan; environmental monitoring programme; environmental audits and reports; recultivation programme; mine closure; compensation; costs and financial aspects. Some other issues, e.g. water usage, waste disposal, air pollution and control of hazard substances are typically regulated by other specific laws.

Responsibilities of the mining sector towards environment are governed by actions in the international forum and these actions are channelled via certain conventions and strategies, e.g. Stockholm Declaration on the Human Environment (1972); Rio Declaration on Environment and Development (1992); Kyoto Protocol (1997); Johannesburg Declaration from the World Summit on Sustainable Development (2002), just to name a few.

Principles of direct relevance for the mining activity, which are stated in these documents, underline the following obligations: non-renewable resources should be used and protected in a way to provide the benefit of present as well as of future generations; identification and prevention of environmental risks require application of adequate technology and research; for mitigation of effects that climate changes put on sustainable economic development it is most necessary to apply the concept of 'precautionary approach'; the emphasis should be made on co-operation through various types of arrangements and trans-boundary movements to prevent, control, reduce and eliminate adverse environmental effects. Still, such treaty obligations apply to the signatory countries only, forming the boundaries on their general applicability.

Serbia has ratified 64 international conventions in the sphere of environmental protection (ratifications which are taken over as responsibilities of a successive country), whereas ratification of other international conventions in this sphere is in the course (Petrić *et al.*, 2009).

In relation to the mining-energy sector, the country's priority in the forthcoming period is the implementation of the SEE Energy Community Treaty which was signed in 2005 in Athens between the European Community on the one side and the countries of south-eastern Europe including Serbia, on the other side. The Contract was enacted in Serbia in 2006 by the Law on ratification of Energy Community Treaty SEE (2006). As Gavrić et al. (2009) notice, the Energy Community Treaty foresees a gradual but comprehensive application of *Acquis Communataire Environment* by the year 2017, which is related to the energy and mining sector of activities. These obligations include: implementation of the Directive 2001/80/EC of the European Parliament dated 23rd October 2003 on the limitation of emissions of certain pollutants into the air from large combustion plants and Council Directive 79/409/EEC of 2nd April 1979; implementation of Council Directive 85/337/EEC of 27th June 1985 on the assessment of the effects of certain public and private projects on the environment, with modifications and amendments from the Council Directive 97/11/EC of 3rd March 1997 and the Directive 2003/35/EC of the European Parliament of 26th May 2003; and implementation of Council Directive 79/409/ EEC of 2nd April 1979 on the conservation of wild birds (Article 4 (2)).

For Serbia as a non-annex country, the policy of the EU which defines responsibility to reduce CO_2 emissions by 20% until 2020 does not impose any direct responsibilities, but it entitles Serbia to fully participate as a signatory of the Energy Community Treaty (ibid.:29). With present global concern on the climate changes and with the insight on the mining-energy industry being one of the most carbon-intensive sectors influencing these changes, Serbia is directed to implementation of the UN Framework Convention on Climate Changes, ratified by the State Union Serbia and Montenegro in 2001. Implementation of this convention should at least cover the preparation of the inventory of greenhouse gases and reporting on emissions. As an important step towards adjustments with 'green' regulation, and as the opening possibility for application of clean development mechanisms (CDM projects), Serbia ratified the Kyoto Protocol in 2007. However, it should be stressed that in terms of taking in responsibilities of quantified reduction of GHG emission in relatively short term, Serbia as a non-annex country may face difficulties if it doesn't obtain a significant technical and technological support.

Strategic documents on socioeconomic issues related to the mining sector

Involuntary resettlement is among the most delicate issues accompanying large-scale development projects including those relating to lignite and energy production (Petrić, 2005). Displacement of people from their traditional residential place implies not only the change of their actual physical environment, but also the change of their social and cultural settings. In this case, the social relationships, people's needs, values, customs, and attitudes are typically faced with major changes due to the new physical and social circumstances which demand certain adaptations. Although planning for resettlement which is induced by large-scale mining projects in Serbia has not been of a very long tradition (it goes back to the beginning of 1980s), the local experience confirms that the process of people's adjustments to the resettlement will be more successful if they are properly and timely informed on: development goals; dynamics of the exploitation area's expansion; dynamics of planned resettlement for a certain time ahead; resettlement conditions; options for compensation of the property loss; etc. (Spasić, 1998).

Ideally, the resettlement process should result in rehabilitation of the previous socioeconomic status of the affected people/community. Yet this goal is often out of reach, not to mention that it is much less likely to achieve the improved position of a community after its resettlement in comparison to the position it had before the process started. Basically, the paradox is that development process embedded in the mining activity goes hand in hand with the risk of impoverishment of population that has to resettle because of the mining activity's expansion.

Even though development induced displacement is not a new thing, it was long the case that policies or guidelines on involuntary resettlement have been missing. For example,

the state would typically deal with the legal process of expropriation with outlined compensation mechanisms but without further consideration of resettlement in the ways that would prevent impoverishment.

Starting from the early 1970s, in response to consequences of social impacts of various development projects including the ones related to the mining sector, much interest has been raised over development of the Social Impact Assessment (SIA). There are many definitions of SIA but in general SIA is a methodology or instrument which is performed for assessing the social impacts of planned interventions or events, and for development of strategies for the ongoing monitoring and management of those impacts (Vanclay, 2003:6). The key objective of undertaking SIA is to provide that local communities are not being threatened and that they can achieve sustainable benefits from development activities such as mining projects. Instead of being merely concerned with the identification and/or amelioration of unintended/adverse social consequences, the objective of SIA is to take the proactive stance for ensuring better development outcomes, especially in terms of minimising the costs of development activity borne by people. SIA is not yet a part of particular legislation at the EU level although in the last couple of years the Impact Assessments in general are getting in focus of attention (Jokić, Petovar, 2010). In Australia, for example, SIA for mine development purposes has already become a standard practice being integrated in the country's legislation system. Experience shows that SIA should be used to promote sustainability both for the mining company and the affected people, and it should be a process of navigation rather than prediction. One can distinguish two different approaches in performing SIA - 'technical' and 'participative' one. As Lahiri-Dutt *et al.* (2008:13) point out 'the technical approach to SIA treats social impacts in the same way as environmental impacts, without particular attention to public participation, whereas the participative SIA acknowledges that local people know more about their own lives and things that would matter to them in the future than outside experts or mining company staff'. Participative SIA involves community representatives in the ongoing monitoring and evaluation of activities featuring the whole mining project – from its initiation till the mine closure. Hence, community is actively participating in the dialogue with development proponents throughout whole mining project's lifecycle giving community a chance to have a say in management and mitigation of impacts.

Although in Serbia the resettlement plans are included in the planning process for the mining/energy development, the participative SIA is still lacking. This is not surprising having that the sole interest of development proponents is oriented towards the easiest, simplest and cheapest way to resettle local population (land occupiers, affected people) in order to provide undisturbed mining activity. Instead, more attention needs to be paid to social stability of mining development projects, including prediction of likely impacts and community's response to them, and early assessment of benefits that local population could achieve out of these projects (Jokić, Petovar, 2010).

CONCLUSIONS – THE WAY FORWARD IN IMPLEMENTING NECESSARY ADJUSTMENTS

Knowing that Serbia highly depends on lignite as the key (strategic) resource for energy production, it is not likely that the country would opt for future decrease in its exploitation. Coal production and prospective activation of new open pits, as well as development of mining-energy systems in the mining basins in general require steering through coordinated planning actions. Spatial planning of the mining areas in Serbia develops under the circumstances of legislation reforms, endorsement and preparation of strategic/development documents as a way of necessary adjustments to the EU standards particularly in the sphere of environmental protection. The goal is to achieve sustainable development of the energy sector within new institutional, organisation and economic settings (Spasić *et al.*, 2009c).

Implementation of standards for environmental and social protection through plans for the mining sector development in Serbia is exposed to two types of challenges. First one is the focus on competitiveness growth and wish to sustain economic development versus environmental and social equation, and the second one is adaptation to externally suggested standards to local conditions, institutional and legal framework. Easy solution to this inherent tension could not be seen except if some kind of 'double' standards is applied on the global scene. Developed World would thus be subjected to strict standards given in the pertinent strategic documents on environmental and social protection within mining activity, whereas developing countries such as Serbia would have less restrictive global minimum standards which will gradually evolve depending on the obtained technical and technological support.

Regardless they have been prescriptive or legally binding, the following fundamental principles consisted in various strategic documents should serve as guidelines for adjustment of planning process in the mining areas:

- Identification of environmental management priorities, early and comprehensive environmental impact assessment, pollution control and other steps for prevention and mitigation of negative effects;
- Awareness on the SIA importance which should be conducted right from the start of the mining project;
- Identification of environmental responsibilities both in the mining sector and at the highest national levels of management and decision-making;
- Provision of real participation and dialogue with communities affected by the mining activity, as well as with other stakeholders involved in social and environmental aspects of the mining activity;
- Application of modern technologies for environmental protection in all phases of mining activity and the emphasis on appropriate technology transfer which would mitigate negative environmental impacts that mining may impose; and
- Development of infrastructure, information system and capacity building for environmental management through mining activity.

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NATIONAL INDICATORS FOR EVALUATING THE OUTCOME OF REINVENTING SPATIAL PLANNING IN SERBIA

Omiljena Dželebdžić[1], Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
Dragana Bazik, University of Belgrade, Faculty of Architecture, Belgrade, Serbia

This paper is a follow-up to a research in the domain of theorizing planning practice and practising spatial planning theoretical approaches in the context of information-isation, globalisation and EU-isation. The theoretical framework contemplates the meaning of the spatial concept that is grounded in the duality of the information phenomenon and contemporary expression of the space notion, as a way of reinventing spatial planning. The operational framework discuses the spatial planning practice in Serbia through a brief explanation of applied methodology for identifying a suitable indicator set proposed for the implementation monitoring of the Spatial Plan of the Republic of Serbia 2010-2020. The national indicators set represents a theoretical model of knowledge for evaluating relational outcomes of spatial development complexity, and its spatial-temporal character represents a way of practising theoretical approaches as monitoring tools for spatial planning within the limits of the present regulatory system in Serbia.

***Key words:** information phenomenon, relational space, spatial planning indicators*

CONSIDERATION FRAMEWORK: NETWORK SOCIETY AND EUROPEAN INTEGRATION

Is it possible to timely recognize future changes? Are we prepared to respond to these changes? Could we implement theoretical and academic research in spatial planning strategies and how could we insure their application in professional practice? What do space and territory mean under the Globalisation and Europeanization? Without attempting to give final answers, this paper underlines the significance of these questions in the context of growing development and impact of Information and Communications Technologies (ICT) that has changed many elements of the way we work and live. The globalisation and "information-isation" created a highly dynamic, competitive and complex environment of a network society. Qualitative location factors have become more important and the ICT can play a key role in increasing the attractiveness of place and space in terms of liveability, accessibility, e-services, e-quality, e-work, and e-mobility. These changes create challenges to spatial and urban planners who need to understand and anticipate them and adjust their traditional view of planning and planning instruments. Simultaneously, Europeanization creates new geographies and governance trends that require the adoption and reinvention of spatial planning in theory and practice.

The actual demand of ICT development is to achieve the distribution and aggregation of knowledge between relevant survey fields, thus enabling a comprehensive investigation of: (i) real spatial complexity; (ii) existing processes; (iii) prognostic changes; and (iv) decision-making efficiency (Bazik, Dželebdžić, 1997). The main factor for computer progress is component and network development, as well as standard interface implementation. This permits integrate projects and resolves the problem of separate/sector approach and the "closed information system" concept. Traditional elaboration of spatial and environmental problems, by analyzing activities and land use within the concept of functionally-formed treatment of the physical space, has been predominantly rejected, either in the context of information requirement complexity, or in the context of current ICT potential.

On the other hand, borderless Europe "faces a moment of transformation" as it is underlined in the document "EUROPE 2020 – European strategy for smart, sustainable and inclusive growth" (CEC, 2010). It puts forward three mutually reinforcing priorities: (a) smart growth: developing an economy based on knowledge and innovation; (b) sustainable growth: promoting a more resource efficient, greener and more competitive economy; and (c) inclusive growth: fostering a high-employment economy delivering social and territorial cohesion. Sustainable development is still based on three major principles: (i) inter-generational equity (principle of futurity); (ii) intra-generational equity (the principle of social justice); and (iii) the principle of transfrontier responsibility or inter-country borderless accountability (Selman, 1995). The implication of these statements is often in stark contrast with the traditional concept of bounded space under the jurisdiction of an authority with territorial and functional

[1] Bulevar kralja Aleksandra 73/II, 11 000 Beograd, Serbia
omiljena@iaus.ac.rs

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synchrony. "The idea of the nation-state having complete control over its territory may have to be consigned to history" (Waterhout *et al*., 2009). The focus of the planning approach is moved from the quantitative approach of capacity and representation, through land-use, to the *quality* of life in relation to the level of pollution, safety and health of inhabitants, and work conditions or aesthetic standards from a global to a local scale and vice versa. Of particular importance is the "recognition that sustainable development strategies are as much a journey as a specific destination and, in their implementation, process may be as important as the product" (Selman, 1995).

Spatial planning in Europe needs to adapt fundamentally to the new circumstances because of the emerging European territorial cohesion policy (CEC 2008), which alongside with other EU sector policies may change the conditions for local planning practices. By "theorizing practice and practising theory" (Boelens, 2010) all stakeholders responsible for spatial development in Serbia should be prepared for new conditions while following basic principles for inclusion in the European integration process. Researchers and academics can play a crucial role in these processes "by analysing and reflecting upon current practices, by comparing them nationally and internationally, by seeking innovative ways and modes within the limits of present regulatory systems" and by preparing existing professional practitioners and students "analytically, as well as in terms of designer and communicative skills" (Waterhout *et al*., 2009) through joint studies or lifelong learning programmes.

The discussion will now consider the following: (a) the theoretical framework of meaning spatial concept that is grounded in the duality of information phenomenon and contemporary expression of the space notion; and (b) the operational framework of spatial planning practice in Serbia through an analysis of the national indicators set as a model of knowledge for evaluating relational complexity outcomes of spatial development.[2]

DUALITY OF SYSTEM AND PROCESS

The Third technological revolution unrestrainedly produces different changes by technical and technological innovations. They reflect the transformation of communication patterns and knowledge configurations and network connectivity. The ICT ensure progress of the planning process and research for the future, and many developed countries have decades of experience with its implementation. Technological changes might be an element of long-term and balanced spatial development on condition that new power concentration centres are not produced, more specifically, the nucleus of producing and distribution of knowledge, technical skill and a life style for the rest of the world. One of the positive implications of information technology development (computer science and telecommunications combined) is the improvement of information transfer by removing distances in space and time, that is, by developing an informatics infrastructure. An "open possibility for everyone" would help in eliminating privileges and in exceeding a marginal position of some areas that consider a new dimension for upgrading spatial planning and design processes. At the same time, informatics infrastructure represents a precondition for the implementation of a sustainable development concept that initiates the achievement of an appropriate quality of life for contemporary and future generations as the dominant development intention. The improvement of knowledge is the way to quality; distribution of information is the way to improve the knowledge; and the informatics infrastructure is an efficient way for the distribution and accumulation of knowledge. Moreover, the informatics infrastructure is treated as a new element of spatial planning and design process that is added to the existing infrastructure potential of space.

Phenomenon of information

Information science theory interprets the information phenomenon as *an information system* that is realized, now being realized or may be realized, in some information *process.* In this case the term *information system* does not have the usual meaning of a system for collecting and processing data, but it means that the information phenomenon already represents a system as a group of elements connected by interrelations and can be considered as a whole. Information is a system of possibilities and potential in some proposed situation or time and public knowledge presentation is single and partial realization of some possibilities that predict the information system. Thus, the public knowledge presentation *(information process)* is separated as reality or existing fact, and the information *(information system)* is contemplated as a hypothetical product (Bazik, 1996).

According to the information science theory, there are three different and irreducible explorations of the information:

a) information as a knowledge resource that exists in a text, or a document, or a message – information is created by data processing, or by increasing knowledge through communication, or by a facts exchange process with the intention of increasing the knowledge. In the context of spatial planning, it is not appropriate to equate information with data and facts. Every space and place has specific spatial and temporal features and it could not be categorized within a fixed and static common group of data;

b) information as a new form of knowledge and it is no more text implication – it is a logical and semantic issue, a new form of knowledge that is present parallel to existing messages, documents and facts. Subjective assessment is crucial for information consolidation and validation. The number and different features of stakeholders in the spatial planning process with a different role, power, motivation, interest, interesting, cognitive potential or background knowledge, is very hard to operationalize; and

c) information as a model of knowledge that represents the key notion of information science and signifies hypothetical construction that interprets different real/practical objects as books, documents, plans, messages, news or data (Šereš, 1977). Information as a hypothetical construction enables the understanding of experiential phenomenon by fixing invariable features of communication process. Information permanence could be described with entities from information process/reality. In the domain of spatial planning, this information concept creates two key possibilities: (i) to analyze a transmission and transformation of knowledge as a physical entity that contains certain, not exact or fixed, news, messages, data, facts or theories; and (ii) to analyze the knowledge interchange through presentation or organization of some cognitive content separately of users demand and cognitive capacity.

Relevant data and information selection is grounded in the aforementioned theoretical exploration of the information phenomenon: (a) raw data as a result of some inventory and has its exact meaning, but only in relation with other data could it develop and get full significance; (b) aggregated raw data as statistical information of distribution with different data relations and meaning that request additionally explanations; and (c) indicator as a complex information about some phenomena or appearances that could not be measured alone, or cannot be directly seen. They are based on data, but ideally add value to data by expressing them in a way which

[2] The theoretical and operational frameworks considered in this paper are the results of authors' contributions within the COST 358 research team (D.Bazik) and the SPRS 2010-2020 planners team (O.Dželebdžić) during the last two years.

is more understandable and more relevant to the user, regarding the indicator's capability to represent a wider context than the data regarded separately.

Indicators are a standard spatial planning tool in all planning process segments, from the spatial plan production, through its evaluation, implementation and monitoring. Besides that, indicators are one of the basic supports of the theoretical and methodological spatial planning framework. The practicability of indicator development is grounded in the normative and directing character of spatial plan documents. Accordingly, the main purposes of spatial planning indicators could be a basic tool: (a) for better coordination of spatial planning proposals with well-timed digression mark; (b) for explanation of trends and progress of development; (c) for recognition of regional disparities and other spatial analyses; (d) for environment and social assessment analysis; (e) for analytical framework of region and urban typologies; (f) for providing relevant and precise information on benefits or disadvantages of planning proposals to decision-makers, stakeholders, investors and the local community; and generally (g) for creating a basic information set of existing living quality, quality of the environment and its development level. Only a part of all the uses of indicators in spatial planning process is presented here (Dželebdžić, 2002). Contemplation of comprehensive indicators would demonstrate their contribution to the advancement of spatial planning practice through decision objectivity, reliability of the evaluation process and monitoring efficiency.

To respond to the abovementioned tasks, indicators have to be: explicitly defined within the context of a phenomenon expected to be explained; correlated with the basic dynamics and changes within a context towards objectives achievement; and clearly correlated with concrete policies intentions (Bracken, 1981). Accordingly, indicators assortment should be highly selective and oriented towards the key phenomena within the spatial system and not too overloaded with information and data. The indicators of spatial development should also be based on the integral spatial planning methodology directed towards the general idea of sustainability.

It can be said that spatial inventory provides data, analysis of data provides statistics, and interpretation of statistics relations provides indicator as a model of expert knowledge that helps to inform different stakeholders about the information process in reality. The robustness of that information process increases with the new ICT potential in: (a) establishing consistent data relationship, with more complex opportunities in perceiving space entities and their relations, as well as recording changes and updating all data bases across analytical procedures; (b) processing multi-criteria analyses and examination of different scenarios of the spatial physical structure, functions and organization in future; (c) simulating spatial changes and processes, and comparing more variants of activities on territory; and (d) new modelling methods in particular planning phases, land use, environmental assessments, etc.

Contemporary strategic spatial planning and sustainability pattern both request appropriate contemplation of the information phenomenon as a model of knowledge. In the planning and management of the development process this means: not only the service for making plans or a tool for the implementation of plans, but rather a fundamental and socially verified resource of sustainable development. As the process of accomplishing life quality for contemporary and future generations, development integrates the cognition, communication and information activities. The quality is reached by comprehension and articulation of knowledge – *cognitive activity*; knowledge is increased by transmission and distribution – *communication activity*; and knowledge selection and accumulation is a precondition of balanced and sustainable development – *information activity* (Bazik, Dželebdžić, 1997). This means that adequate use of information technology represents a basic element for improving the information function of reinventing strategic spatial planning within the planning outcome framework.

The world information processes that represent information function of spatial planning are founded in the development of a Global Spatial Data Infrastructure (GSDI) through technical developments in the geographic information systems (GIS). A recent key development was achieved in GIS servers: the role of GIS servers in managing GI knowledge (maps, data, 3D visualization, and models) on the Web; and GIS servers as a platform for building and integrating server-based applications for other geoclients or Web services. Simultaneously with the adoption of the directive of the Infrastructure for Spatial Information in Europe (INSPIRE), the EU took a unique approach to developing its spatial data infrastructure as a contemporary and holistic information process in Europe. The Directive covers a wide range of domains – in total 34 spatial data themes, and requests emerging technical architecture for spatial data, services, and metadata, as well as adequate strategies and challenges for providing access to "harmonized data" across Europe. At the national scale in Europe, there is a concept of the National Spatial Data Infrastructure (NSDI) that represents a national information process that would be both a base and a goal for developing a national spatial information market. It will minimize the transaction cost for the provision and use of spatial information, which will in turn lead to a dramatically increase in usage. Spatial information is regarded as an economic asset, integrated into value chains, which is produced and traded. This will not only enhance the spatial information market, but also all sectors of economy which depend on the availability of reliable spatial information resources (Bazik, 2008). Market mechanisms would be used to coordinate the supply and demand of spatial information products.

Relational space as a model of knowledge

The consideration of the 'space' notion is different according to technological change, to the communication technology that has a serious impact on space-temporal change and to the connectivity. In everyday communication, the notion of 'space' can have multiple meanings – 'physical', 'virtual', 'personal', 'material', 'mental' or 'cosmic' – that interpret its complexity and ambiguity.

The classic view of space as '*absolute*' considers the pre-existing space of Newton and Descartes that could be measured and calculated. Space and time are treated separately. For David Harvey, the absolute space is geometrically the space of Euclid and therefore the space of all manner of 2D cadastral mapping and engineering practices (Castree et al., 2006).

The Modern Period considered the notion space as '*relative*' space in keeping with Einstein's theory and non-Euclidean geometry. Space and time are integrated as the notions space-time or space-temporal, and depend on the observer's movement and preferences. Relative space is physical, real, material, divided, functional, autonomous, positional, measurable, typological, ordered and 3D visualized (Metapolis dictionary, 2000). Comparisons between different space-temporal frameworks can illuminate the problems of political choice, such as a space-temporal conflict of financial flows and ecological processes that might be disrupted.

The accelerated science and ICT development contribute to the new interpretation of the notion of 'space' according to achievements of new mathematics and physics. In the present age, the notion of space is considered as '*relational*' space that exists as a relationship in or internal to process. Relationship/interaction created in process is space-temporal defined

and it is impossible to separate space from time. Relational space is real, as well as informational, virtual and digital. Relational space is operative, reactive, tactical and topological, with synergy and 4D attributes for decision combinations in dynamic systems. It is not simple to measure and quantify the relational space, but it could be considered by an aesthetic criterion and quality evaluations through a new mathematical theory and modular dynamic models.

In his consideration of the notion of space, carried out in 1979, David Harvey underlined that those different human practices create and make use of different conceptualizations of space. Nearly thirty years later, he confirmed this position in his paper *Space as a Keyword* (Castree et al., 2006). The *absolute* space concept may be adequate for issues of property boundaries and border determinations, but their placement on the property market depends on *relative* space in correlation with location position, functionality and equipment, or on *relational* space that considers the relationship and information of financial and energy flows as well as the compatibility with personal vision, spatial understanding and aesthetic criteria of process participant (Bazik, 2008). Accordingly, relational space is a hypothetical construct and could be considered as a model of knowledge separately from its emitter or receiver.

Despite these different spatial concepts, the relational approach becomes, especially at the academic level, more widespread and acceptable in the domain of theory and practice of architecture and urban and spatial planning. It may be suggested to consider the relationships and processes with a new mathematical apparatus and technological potential instead of objects and forms (Bazik, 2010). Uncertainty of future development and confronted views of the limits of new technology suggest caution in elaboration of possible implication, as well as careful definition of aspects of future development and the characteristics of planning in future, from the position of spatial organization and use. One of the most significant objectives of development is continuous growth of knowledge, and most importantly, or still equal to natural or artificial resourses, potential of development might be the possibility of knowledge interchange and access to it. The knowledge does not decrease by use; it becomes greater. To transmit knowledge to someone does not mean that it is no longer in our possession. It incorporates the increasing conviction that the information is development resourse as a precondition of scientific, technical and technologic development. Cognitive and communicative activities of the spatial planning process represent accepted and conventional dimensions of the mentioned concept (Agenda 21, European Urban Charter, Habitat Agenda, Millennium Development Goals, Europe 2020, etc.). We do not consider them as constants and already we contemplate them as variables that depend on the knowledge interchange process itself. Relations between cognitive, communicative and information activity of the spatial planning process are not rigid (Bazik, Dželebdžić, 1997). The development of every activity will be enhanced by its interrelation improvement. Consequently, we recognize that the promotion of the knowledge interchange process contributes to appropriate contemplation of the spatial planning outcome framework.

Current ideas about geographical and spatial economic processes can be grouped under the label of 'relational space and place' (Waterhout et al., 2009). We are witnesses of a diffusion of wireless communication networks around the world, which is taking place faster than any other communication technology to date. Communication is at the heart of human activity in all spheres of life, and the advent of this technology, allowing multimodal communication from anywhere to anywhere where there is appropriate infrastructure, raises a wide range of new patterns of behaviour and of fundamental changes in the existing ones (Castells et al., 2007). Consequently, the production of space and place is increasingly understood as a result of a complex interplay of multiple socio-economic processes taking place at multiple and overlapping scales. In this view, the concepts of spatiality and territorialisation are seen from a relational perspective, putting emphasis on fluidity, reflexivity, connectivity, multiplicity and polyvocality (Graham & Healey, 1999; Healey, 2007; Davoudi & Strange, 2009). A place thus could have multiplex-meaning and mixed-uses for different stakeholders and at different spatial scales. Brenner (1999) underlines that in Western states with open economies "(t)he boundary separating spatial scales is … becoming so blurred that it may be increasingly appropriate to conceive the scalar organization of contemporary capitalism as a continuum of glocalised interaction".

Table 1. Types of space

Types of space	Described by Harvey	Metapolis dictionary	Expressed examples
Absolute	concrete, material, fixed, bounded, territorialisation, space of Euclid;	geometrical, measurable, calculable;	blueprint plans, private property, cadastral maps, 2D; **data**
Relative	multiple geometrics, frame dependent, variety of choice;	physical, real, functional, positional, autonomous, divided, typological;	transport networks, water infrastructure, grid, 3D; **statistics**
Relational	complex, in process, socially constructed, space-time, convergence;	informational, virtual, model of knowledge, tactical, topological;	network society, space of flow, dynamic, 4D. **indicators**

(Adapted from Harvey, 2006 and Metapolis dictionary, 2000)

TOWARD A REINVENTED SPATIAL PLANNING PRACTICE IN SERBIA

The former conceptualisation of spatial planning in Serbia was rooted in a rational comprehensive tradition and was too rigidly structured to solve fast and basic changes in socially unstable conditions. The ongoing "information-isation" and "EU-isation" of the Serbian society create new dynamic and more complex environment for spatial planning reinvent. The fact that different sectors require different periods of time to be transformed implies that the process of comprehensive planning has to be fundamentally reformed. In the period of post-socialist transition there is a need for a new approach that will respond to changed conditions: free market, privatization and political pluralism. There are generally two concepts of change: (i) complete reform of the planning system; and (ii) the step by step approach. The first alternative means the transplantation of sophisticated planning systems from a European country which requires developed institutional network working on its own. The step by step approach seems much more appropriate. Problems could be solved one by one, measure by measure, in an adequate order, with a purpose to fill the gap between theory and practice (Boelens, 2010). The aforementioned relational planning approach, grounded in the duality of system and process, performs the theoretical framework for further consideration of the step

by step reinvention of Serbia's spatial planning practice. The focal point of discussion is the conceptualization of national indicators that generate spatial planning outcome framework. The new context for this "practising theory" consideration could be recognized in two main aspects:

a) Redefining the role of the nation-state that the borderless EU has limited and transferred decision-making powers: The Council Regulation for Structural Funds 2007–2013 (Council Regulation (EC) No 1083/2006 from 11 July 2006) emphasises the need for enhancing the efficiency of regional policy and the requirements of studies, data and observation of regional development trends. "Community knowledge on regions and larger territories promoting a European perspective/context in policy development is gaining importance, both for European and regional competitiveness, as well as for the fulfilment of the Lisbon objectives and for ensuring Community aims of cohesion" (ESPON, 2010). The academic capacity for applied research and studies on territorial development issues will be further strengthened in Europe. Reinforcing regional policies in light of the challenges facing European territorial cohesion means the strategic objective of meeting the policy demand for data, information and evidence through the delivery of the applied research and studies results.

The Spatial Plan of the Republic of Serbia 2010-2020 (SPRS) defines "the integration of Serbia in the wider surroundings and achieving sustainable development by defining, encouraging and harmonizing modalities of international/regional cooperation and applying international strategic documents" as the basic goal. Deferent global conventions, international agreements and programs, as Conventions on Climate Change, on Biodiversity or on Wetlands, could provide valuable support at the thematic level. Linkages with these mechanisms are encouraged to orient and empower various processes of regional co-operation. In the Guiding Principles for Sustainable Spatial Development of the European Continent (CEMAT, 2000), nine types of European regions (including: mountain regions, eurocorridors, urban area, rural area) are considered, with framework of spatial development measures for each of them. Accordingly, in December 2010, the European Commission adopted the EU Strategy for the Danube Region. This is a comprehensive Strategy, covering several Community policies and targeting a 'macro-region' that covers parts of eight EU countries and six non-EU countries, including Serbia. European territorial cooperation and cohesion contribute to the "shaping of soft spaces, fuzzy borders and borderlands" (Allmendinger, Haughton, 2009) as a new set of relationships that is spatial planning responsibility.

b) The second contextual aspect is transferring decision-making powers to different levels and stakeholders. The SPRS emphasizes that "the spatial development of Serbia will present a continual responsibility for all stakeholders, namely (i) authorities and competent institutions on all levels; (ii) public and private sector which will, by their activities, exert influence on spatial development and its elements, and (iii) spatial planners, town planners, engineers and other experts whose activities will influence changes in space, that is, the quality of changes in certain municipalities, districts or regions" (SPRS, 2010). The experience of European planning practice recognized the need for multi-level governance and rescaling of governance that takes various directions: 'downscaling' of the state and 'upscaling' of municipalities. It requires spatial planning to adopt bottom-up approaches also. "Likewise, private stakeholders and investors are gaining on importance as financers, designers and implementers of planning objectives. Meanwhile, citizens and interest groups increasingly challenge the legitimacy of planning interventions" (Waterhout et al., 2009).

These two aspects point out the real world complexity that theoretical planning framework should adopt. Relational approach to spatial planning, with appropriate mathematical apparatus and ICT tools, offers new possibilities for it. The focal points are transferred from objects in isolation to their relations and from arrangements on the surface to element interactions. Consequently, visualization by a traditional map with two-dimensional space could not be sufficient to reflect the relational complexity of multi-scalar and space-temporal planning entities.

Spatial planning outcome framework of Serbia

Although plan-making still seems the dominant mode of planning, "the planning system is now more than ever concerned with promoting the role of planning as a coordinator, integrator and mediator of spatial dimensions of wider policy streams". That generates new challenges: "how to improve the traditional indicator framework from a static set of indicator values into a more dynamic and discursive framework" (RTPI, 2008) that would be understandable, measurable, comparable and recognizable as spatial planning output and outcome set for different spatial scale and timeframe; and how to develop a monitoring system for spatial development strategies that could properly reflect spatial planning outcomes in complexity of integrating multi-spatial levels and cross-sectoral policies?

The object-oriented approach adopted in the Spatial Plan of the Republic of Serbia emphasizes the linkage among key objectives of policies, strategic targets, outcomes and output indicators. Process delivery objectives, targets and indicators are used to measure the implementation of planning policies. In addition, indicators are used to help measure outcomes and in assisting the understanding of the evolving context in which the planning strategy operates. The identification and specification of indicators which in an adequate and characteristic way describe the spatial development of Serbia is a precondition for establishing the basis for continual monitoring of the spatial development of Serbia (SPRS, 2010). One of the main challenges is defining a limited number of indicators through the Program of Implementation of the Spatial Plan of Serbia, which will cover a broad range of topics, including the accepted determination that indicators must be harmonized with available and accessible data bases and directed towards five main objectives of Serbia's spatial development. Such indicators must fulfil the main planning requirements regarding quality, relevance, long-term monitoring, spatial multi-level and covering broadness. An important recommendation is that the selected indicators should correspond to indicators for monitoring the European territory in the framework of the European Spatial Planning Observatory Network (ESPON).

The mission of the European Spatial Planning Observatory Network (ESPON) Programme is to support policy development in relation to the EU Cohesion Policy. It does this by providing evidence and knowledge about European territorial structures, trends, perspectives and policy impacts which enable comparisons of regions and cities and which support the understanding of European territorial diversity. The current policy debate at a European level is focusing on three main avenues: (i) implementation of the new treaty goal of territorial cohesion; (ii) contribution of cohesion policy measures to "Europe 2020" (Strategy of Smart, Sustainable and Inclusive Growth within Europe); and (iii) the content of an EU Cohesion Policy after 2013.

Spatial development monitoring has to accomplish simultaneously two information requests for: (a) data and information set for spatial analyses; and (b) information about main development trends and about policies evaluation. In both information requests there

exists a difference between information sets for: (i) comprehensive spatial development monitoring; and (ii) focused spatial monitoring that is policies-oriented (ESPON, 2006). Consequently, there are two indicator levels for monitoring that are conceptualized in the Spatial Plan of the Republic of Serbia:

1) The first one generates the "spatial planning outcome framework" for comprehensive spatial development monitoring which contains a limited set of quality expectations derived from the objectives of planning as operational targets. Theoretical conceptualization of the spatial planning "outcome" could be established by treating the information phenomenon as a 'model of knowledge' within a relational planning approach in a 'relational' space context.

2) The second one is the "spatial planning output framework" for focused spatial and policies-oriented monitoring that consists of relevant features which could be measured and quantified. They are recognized in theoretical consideration of 'knowledge form' and 'semantic meaning' of knowledge, as well as in the domain of 'absolute' and 'relative' space.

'Spatial Planning Outcome Framework' should be observed as territoriality of "the combined effects on socio-demographic, economic and environmental changes brought about by the planning system and other forces that seek to achieve sustainable development" (RTPI, 2008). The aforementioned complexity of multi-level governance and variations in sectoral priorities influences the assessment and measurement of spatial planning outcomes. The hierarchy of planning outcomes could further be considered by introducing the spatial scale. The planning outcomes of one spatial scale may consist of various outputs at another. For instance, regional strategies seeking to facilitate 'sustainable economic growth' will require a series of localized outputs in the form of land being made available, etc. Similarly, a series of regional outputs may constitute the outcome at the national level.

Simultaneously, relational planning accepts the notion of relational space that exists as a relationship in or internal to process. Relationship/interaction created in the process is space-temporal defined and it is impossible to separate space from time. Concerning that, it is important to establish the appropriate timeframe to ascertain different policy outcomes and to assess changes in processes. In the Spatial Plan of the Republic of Serbia (2010) it is highlighted that spatial planning takes two to three years to see some immediate effect of the policy and at least five or more years to measure any medium to long term effect of spatial planning policies. Spatial planning involves complex stakeholders and a network of activities with different outcomes and different rates of change. At the same time, a clear articulation of what outcome framework means and whether it is equivalent to the measurement of the strategic and longer-term impacts in the EU framework, represent a key requirement of the spatial planning outcome framework.

Continuous monitoring of spatial development is the main tool for policy makers and their assessment of recent development trends, as well as for scanning problems and creating action plans. In regard to this, it is important for the outcome and output framework conceptualization to reflect the integrated multi-level and cross-sectoral spatial development policies.

Spatial planning output: National indicators of Serbia

The main objectives of Serbia's spatial development are: (1) more even-balanced regional development and improved social cohesion; (2) regional competitiveness and accessibility; (3) sustainable use of natural resources and protected and improved environment; (4) protection and sustainable use of natural and cultural heritage and landscape; and (5) functional integration in the broader surroundings. They perform a general concept of spatial development in Serbia, through qualitative, rather than quantitative, information set that has to be operationalized for further spatial monitoring. The first level of main objectives operationalization represents the 'spatial outcome framework' with 37 quality expectations for phenomena that cannot be directly seen, but reflect the territorial policies concept that is of great significance for decisions-makers, for example the concept of polycentric development, urban-rural partnership, or concept of accessibility in general. The second level performs output indicators that are measurable and quantitative. On the one side, output indicators could form, at both regional and local levels, a strategic overview of the different functions served by output and outcome indicators in monitoring spatial planning strategies. On the other side, spatial planning process efficiency and effectiveness is seen as being central to the delivery of the visions of sustainable development and greater 'liveability'. This means that the ability of plans to be flexible and adaptable and to contribute to the achievement of these wider outcomes has to be assessed through an operational set of output indicators.

The new performance framework of spatial planning output in Serbia proposed a radical reduction of national indicators to a set of 106 indicators that are outcome-oriented (Table 2).

Spatial planning outcome and output indicators set in Serbia are a result of multi-level selection process. The proposed indicator set needs to be accurate, reliable and feasible, with possibilities for the implementation of policies and spatial problem solving. The criteria for the evaluation of output framework are as follows: (i) connection with objectives and priorities of strategic spatial development of Serbia; (ii) reliable measuring possibilities; (iii) durability; (iv) relevance to space creation, use and management; (iv) collected on a regular basis by statistical data sources and (v) synchronized with ESPON indicators. The following list of main indicators (Table 2) is the first proposal of adequate indicators set for spatial observation and it represents the possibilities for and challenges of future spatial monitoring in Serbia. The main structural characteristic of the indicator set is the separate overview of spatial development goals as spatial planning outcome, and the concentration on the limited number of indicators as spatial planning output. Consequently, the monitoring of SPRS implementation could be based on the objective-oriented measurement. It means that the entire outcome and output sets of indicators need to be flexible and adaptable relationally to the changes of goals, policies and new knowledge of specific and relevant spatial questions.

Main indicators proposal is the starting framework for developing the second level of a spatial monitoring system that includes additional indicators relevant for detailed analysis and thematic researches. The recognition of territorial disparities, trends and their relation with territorial policies goals, as well as efficient measurement of the goals realisation, could be done only with continuous monitoring. Further research on the detailed concepts of the monitoring system model should involve three different hierarchy levels: (1) a main indicators list or an outcome list that is on the top system level with its spatial strategic function based on the goal-oriented approach; (2) the second level consists of additional indicators for different spatial areas that are more detailed according to requests of sectoral policies and area users which need more specialized observation of it; and (3) the third level consists of thematic indicators set with very detailed content of considering field or regional and local specifications.

Table 2. Summary of key indicators proposed for monitoring spatial development in Serbia

Objectives	Outcomes/Targets	Output/Indicators
1. MORE EVEN-BALANCED REGIONAL DEVELOPMENT AND IMPROVED SOCIAL COHESION		
Sustainable demographic development		
	Balanced distribution of population	1. Population density* (critical mass) 2. Migratory balance*
	Improving/maintaining the demographic structure	3. Share of population by broad age group* 4. Fertility rate*
Improving social and economic cohesion		
	Improving the education level of population	5. Population by the highest education level attained*
	Reducing the number of the unemployed	6. Unemployment rate, below 25 years*
	Improving spatial balance of the education level among the employed	7. Employed persons by the highest education level*
	Securing equal opportunities on the labour market	8. Part-time employment 9. Employment rate of elderly workers
	Provision of housing security	10. Number of social (non-profit) dwellings by the number of households in the social housing programme
Reducing social exclusion and poverty		
	Available labour force and employment	11. Activity rate of male/female population (15-64 years)* 12. Employment rate 13. Rate of increase of economically active persons in relation to persons with income of their own and dependants
	Reducing regional economic disparities	14. Rank-size index by GDP
	Achieving spatial balance distribution of wealth:	
	- Maintaining a mix of social groups and preventing social segregation in a community	15. Gini index of household incomes+
	- Decreasing gaps in the purchasing power of population	16. Regional Price Index+ 17. Proportion of households with a standard of living below the poverty line
	- Ensuring maximum involvement of regional resources by using them efficiently	18. Unemployment rate* 19. Long-term unemployment* 20. Share of jobless households+
Sustainable settlement structures		
	Polycentrism of the urban system	21. Rank size rule (by population) 22. Primacy Rate* 23. GDP per capita as a % of EU15 average 24. Isochronous accessibility of services of general interest at a regional level 25. Average travel time to the three closest regional cities+
	Sustainable settlement structures (urban-rural relations)	26. Demographic trend in urban areas compared to rural areas+ 27. Volume of commuting 28. Proportion of long-distance commuters+
Balanced spatial organization of public services		
	Improving accessibility to public services	29. Accessibility to central places by public transport (including: accessibility by railway)* 30. Number and proportion of population without access to primary healthcare
Improving access to infrastructure and information		
	Providing equal accessibility in the space	31. Potential multimodal accessibility to the population*
	Providing a basic level of sustainable mobility to people who do not have or do not drive a car	32. Proportion of population living within 30-minute isochrones from the railway station+
	Increasing water management infrastructure in settlements	33. Share of a settlement (% of households) connected to the public water supply network 34. Share of a settlement (% of households) connected to the sewage system
	Improving electric power network in settlements	35. Share of a settlement (% of households) connected to the electricity network of high supply functional reliability level
	Improving access to ICT	36. Share of households with Internet access+
Territorially responsible governance		
	Improving transparency of territorial administration	37. Corruption perception index
	Providing public participation in governance activities	38. Public participation in activities of the civil sector
2. REGIONAL COMPETITIVENESS AND ACCESSIBILITY		
	Economic strengths and dynamics	39. GDP per capita* 40. GDP per capita in PPS* 41. Correlation of GDP growth and employment rate in a specific region 42. Annual GDP growth rate per capita* 43. Import-Export ratio at a regional level 44. Share of exports in GDP
	Diversity of regional economies	45. Employment by economic activity* 46. Share of agriculture, forestry and fishery in regional added value* 47. Share of technological manufacturing industries in the regional added value* 48. Share of financial and business services in the regional added value* 49. Share of administration, education, health and social services in the regional added value*

Objectives	Outcomes/Targets	Output/Indicators
	Improving the technological level of regional economies (the aspect of innovation and know-how technology in the economy)	50. Number of enterprises in innovation+ 51. R&D personal % of total employment* 52. Employed in high-tech sector* 53. Gross domestic expenditure on R&D as percentage of GDP* 54. Access to broadband systems 55. Energy intensities by industries+
	Sources of global competitiveness	56. Foreign direct investment inflows in the regions 57. Investment rate+ 58. Number of multinational companies in the region 59. Employed in foreign firms in total employment in the region 60. Share of foreign firms in total export by region
	Competitiveness of labour force	61. Labour productivity+ 62. Labour costs*
3. SUSTAINABLE USE OF NATURAL RESOURCES AND PROTECTED AND IMPROVED ENVIRONMENT		
	Preservation of natural resources	63. Land use (agriculture land, forest land, built land, water area) (CORINE) 64. Share of organic/controlled production area in utilised agricultural area 65. Quality of river water (quality index) 66. Quality of groundwater 67. Specific consumption of water in the settlements (litres per day per person) 68. Portion of piped water lost before reaching consumers 69. Ratio of renewable and non-renewable energy sources in total energy consumption
	Rational land use	70. Fragmentation index* 71. Land consumption by transport infrastructure+ 72. Urban growth – urban sprawl (2010–2015–2020) 73. Share of urban fabric in total area+ 74. Share of artificial area in total area+ 75. Illegal construction in zones of water sources 76. Number/surface of brownfield sites
	Reducing environmental impact of transport and sustainable use of energy	77. Intensity of traffic to the transport network sections 78. Modal split passenger transport+ 79. Renewable energy in total energy production+ 80. Energy consumption by source and type of users+
	Healthy environment and prevention of hazards	81. Share of population living in areas exposed to permanent or frequent excessive air pollution 82. Housing (% of population) around high pollution areas from industry, mining, power plants
	Prevention of natural disasters	83. Housing settlements in areas with potential risk from flooding (CORINE)* 84. Settlements in earthquake risk zones 85. Housing settlements in areas with potential risk from landslides
	Reduction of waste, increasing recycling	86. Municipal waste+ 87. Share of municipal waste collected by utility services (% households) 88. Generation of industrial waste (t/year, ha) 89. Share of the total amount of waste that is recycled
4. PROTECTION AND SUSTAINABLE USE OF NATURAL AND CULTURAL HERITAGE AND LANDSCAPE		
	Limiting the reduction of nature areas – protection of natural habitats and preservation of biodiversity	90. Formation and development of natural landscapes 91. Protected nature areas+
	Maintaining cultural markers and preserving the specific character of the landscape	92. Protected cultural assets* 93. Cultural heritage proposed for protection 94. Identified landscapes
	Improving regional potential for tourism and creative industries	95. Tourist accommodation in rural households 96. Arrivals and overnight stays of tourists per year 97. Galleries and sale points for traditional handicraft and artwork
5. FUNCTIONAL INTEGRATION IN THE BROADER SURROUNDINGS		
	Participation in cross-border and interregional co-operation programmes and projects	98. Number of projects with international participation per municipality 99. Membership in international organizations and co-operation networks
	Trade links with neighbouring countries	100. Trade exchange per capita with neighbouring countries 101. Share of trade exchange with neighbouring countries in total foreign trade 102. Passenger and freight traffic between river ports 103. Container traffic (in river ports)
	Permeability of borders	104. Density of road and railway crossings per segment of the border area 105. Weekly return flights to European MEGA areas 106. Travel time by car to MEGAs and transnational FUAs areas (weighted according to the importance of FUAs)
		Note: Corresponding with routing (*) and wish (+) indicator of ESPON

CONCLUSION REMARKS

The planning as an activity seeks to improve social and environmental well-being in a "real world" of diverse peoples who interconnect in complex and unpredictable ways with place and space. Planners need to recognize the multiple dimensions of such relations and pursue actions that promote sustainable outcomes. It could be termed "holistic or comprehensive sensibility, a faculty capable of grasping the broader context of a problem whilst selecting specific aspects and actions to guide current action" (Healey, 2009). On the other side, Information-isation, Globalisation and EU-isation create new behaviour patterns within the network society of the 21st century. These two sides point out the real world complexity that spatial planning framework should adopt. Relational approach to spatial planning, with appropriate mathematical apparatus and ICT tools, offers new possibilities for it. The focal points are transferred from objects in isolation to their relations and from arrangements on the surface to element interactions. This means that no single territory can be treated as an island which develops in isolation without coordinating activities, networking and cooperating. The purpose and mode of the European spatial planning/territorial cohesion policy are thus encapsulated in three 'Cs': cohesion, coherence, cooperation (Faludi, 2009a). Going beyond economic and social cohesion, territorial cohesion includes all sector policies in a comprehensive approach to reinventing spatial planning. Macro-regional strategies for the Danube River Basin represent examples of cross-border, pan-European and transnational planning that require collaboration and "(a)n intergovernmental approach and as such form pointers to the future… What is needed is a dynamic understanding of EU governance; of the role of territory; and of spatial planning/territorial cohesion policy… The story of the European spatial planning/territorial cohesion policy, too, is full of tailor-made arrangements… So we need to re-think the governance for 'soft' spaces. 'Soft' territorial governance requires well known tools like spatial analysis and strategies, or visions, but no longer exclusively for local, regional or national jurisdictions. Rather, there can and should be many strategies for the many spaces into which the world is splintering" (Faludi, 2009b).

The operational framework of this paper discusses the spatial planning practice in Serbia through a brief explanation of applied methodology for the identification of a suitable indicator set proposed in the Spatial Plan of the Republic of Serbia before 2020 (SPRS). The national indicators set represents a theoretical model of knowledge for measuring relational outcomes of spatial development complexity, and its spatial-temporal character represents a way of practising theoretical approaches to spatial planning within the limits of the present regulatory system in Serbia. The abovementioned key indicator set proposal should be considered as the first step toward more sophisticated spatial monitoring in Serbia. Key indicators will be especially tested in the development process of the spatial monitoring system in order to create territorial policies grounded in the continuous development trends evaluation. There is an expectation that selection of other indicators based on the proposed key indicators, filtered by the criteria of spatial relevance and regional and temporal accessibility could check reviewing possibilities of spatial development observing. This selection will get a form of a periodical report in the future. By focusing on the timeframe of analysis, indicators can be seen as static or dynamic. "A snapshot of the statistical value at a particular point of time will produce static indicators, whereas examining the variations of values over two different points of time will provide dynamic measures of change. It is then possible to conceptualize a hierarchy of outcomes along the time axis" (RTPI, 2008). This concept will be the central point of further research in the implementation of Serbia's key indicators.

Following the basic principles for inclusion in the European integration process, it is necessary to achieve the goal of territorial cohesion and harmonious territorial development. "Territorial cohesion refers to a situation whereby policies to reduce disparities, enhance competitiveness and promote sustainability acquire added value by forming coherent packages, taking account of where they take effect, the specific opportunities and constraints there, now and in the future. Territorial cohesion policy refers to measures promoting good territorial governance with the aim of achieving coherence as described. European territorial cohesion policy more in particular refers to such measures taken by EU institutions" (Faludi, 2009b). ESPON (European Spatial Planning Observatory Network) provides "comparable information, evidence, analyses and scenarios on territorial dynamics and revealing territorial capital and potentials for the development of regions and larger territories contributing to European competitiveness, territorial cooperation and a sustainable and balanced development" (ESPON, 2010). Besides the significances of numerous researches within ESPON Programme, there is a need for continuous contribution in this field at Serbia's national level, in the programme of the National Spatial Data Infrastructure (NSDI) development, if it is possible, as well as within activities of the Serbian spatial plans implementation. EUROSTAT methodology for collecting, storage and processing data should be the common statistical methodology with the aim of enabling data comparisons.

Soft spaces, fuzzy borders and borderlands request a research into how can the regulatory planning system be made more flexible in order to provide room for informal, unexpected, complex associational and across time and place moving spatial planning exercises. It means that spatial planning needs to be in interrelation, or sensitive, to the particular times and places rather than to generalized theories or accepted methodological protocols. According to Boelens (2009), while the debate on the significance of relational geography has influenced how planners plan, it has failed to change, in a meaningful way, what planners plan. More case studies (Healey 2007; Davoudi and Strange 2009) show that planners experience great difficulty with imagining the complexity of space and place in relational ways. "One reason for this is the lack of suitable data describing the characteristics of a place and the intricate ways of how it is linked to its wider surroundings. Evidence about geographical processes, to underpin powerful concepts and strategies, may well become one of the most sought after issues in tomorrow's strategic spatial planning" (Waterhout et al., 2009) and the conceptualization of national indicators for evaluating outcomes of reinventing spatial planning in Serbia represents new steps in Serbia's "theorizing practices and practiced theories" approach.

Is it possible to timely recognize future changes? Are we prepared to respond to these changes? Could we implement theoretical and academic research in spatial planning strategies and how could we insure their application in professional practice? What do space and territory mean under Globalisation and Europeanization? This paper discussed those questions without giving concrete answers, but with the intention to give directions, or initiations, for further research into the spatial planning theory and practice in Serbia.

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DESCRIPTION OF THE NEW MEMBER STATES TRANSPORT SYSTEM IN AN ERA OF CONVERGENCE - DEVELOPMENT OF AN INDICATOR SYSTEM

Nikolaos Gavanas[1], Aristotle University of Thessaloniki (A.U.Th), School of Technology, Department of Civil Engineering, Transport Engineering Laboratory, Thessaloniki, Greece
Magda Pitsiava, Aristotle University of Thessaloniki (A.U.Th), School of Technology, Department of Civil Engineering, Transport Engineering Laboratory, Thessaloniki, Greece

The recent enlargement of the European Union (EU) towards East Europe and the Balkans provides a common policy framework towards the promotion of socio-economic convergence of the 12 new member-states to the EU emphasizing the role of the transportation system. A system of indicators is developed in this paper in order to describe the new member-states' transportation system in relation to the area's socio-economic characteristics by comparing them to the transportation and socio-economic profile of the 15 pre-enlargement member-states. The analysis indicates relatively low levels of mobility for the study area combined with social and economic disparities. It also highlights a series of prospects that could contribute decisively towards the achievement of socio-economic convergence. Based on the experience gained by the development and application of the indicator system, the paper concludes with a series of propositions in order to enhance its contribution for the description of the features and the assessment of the impacts from the development of the new member-states' transport system.

Key words: ***transportation, system of indicators, European enlargement, spatial integration, socio-economic convergence***

INTRODUCTION

After a long preparative period, in 2004 the countries: Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia and in 2007 Bulgaria and Romania accessed the European Union. At present, Croatia, Iceland, FYROM and Turkey are candidate member-states and Albania, Bosnia-Herzegovina, Montenegro and Serbia are potential candidates. After the accession of all the above countries the whole of South-East Europe will become part of the EU.

The recent political instability in South-East Europe obstructed socio - economic development, thus resulting to significant differentiation compared to the EU standards (Directorate General for Economic and Financial Affairs, 2005). Nowadays, an external obstacle is added to the process of convergence: the deficiency of the international economic system that has particularly affected the less developed economies within the EU. Since the late 90s, a series of European policy documents such as: the European Spatial Development Perspective (Commission of the European Communities, 1999), the White Paper for the EU Transport Policy and mid-term review (Commission of the European Communities, 2001 and 2006), the Communication for the "Enlargement strategy and main challenges" (Commission of the European Communities, 2007) and the Green Paper on Territorial Cohesion (Commission of the European Communities, 2008) refer to the "peripheral" position of South-East Europe and the need of improving accessibility and mobility conditions in order to achieve spatial integration and socio-economic cohesion (Vickerman et al., 1997 and Pitsiava, 2007). According to the cohesion policies, the development of transport infrastructure, such as the Trans-European Transport Networks, the strengthening of the transport market's competitiveness, the update of management methods and the application of new technologies and innovative techniques (Commission of the European Communities, 2001 and 2008) are highlighted as main contributors. Due to the complexity of the interaction between socio-economic and transport development (Rodrigue et al., 2009), it is argued that the improvement of the transport system would lead to socio-economic cohesion only if it corresponds to the true mobility needs of the peripheral economy and population (Peters, 2003, Vickerman, 2003 and Black, 2000).

In this context, the objective of the paper is the assessment of the new member-states' transportation system and its interaction with the socio-economic development in relation to the process of convergence within the EU.

[1] Thessaloniki, 54124, Greece, ngavanas@civil.auth.gr

For this purpose, an indicator system, connecting transport and basic socio-economic characteristics was developed and applied. The results from the application of the indicator system are discussed in order to identify the milestones and prospects that are determinant for the achievement of socio-economic convergence. The specific value added by this research is the formulation of the framework for the development of an integrated indicator system that combines transport, socio-economic, spatial and environmental indicators to support transport policy and investment decisions.

DEVELOPMENT OF THE INDICATOR SYSTEM

Scope and requirements

The use of indicators for research and planning purposes is common worldwide as they comprise useful tools for the simplified analysis of complicated data allowing the monitoring of features through time and the assessment of problems and future trends (Stead and Rienstra, 1999). An overview of the main systems of transport indicators used by international organizations comprises: UN CSD, World Bank Headline, Eurostat database, European Environmental Agency TERM and CSI indicators and ESPON indicators. The main indicator systems currently in use for the assessment of transportation features in SE Europe are: SEETO (South-East Europe Transport Observatory) Evaluation/Monitoring Indicators, referring to the candidate and potential candidate EU member-states in the area, and Egnatia Observatory, monitoring the spatial and environmental impacts of the Egnatia motorway in Greece.

In general, the development of the appropriate system of indicators is a complicated process that must ensure the alignment with the objectives of the research at all stages. In order to maintain an adequate level of explanatory power, the construction of the appropriate indicator system should fulfill the criteria of compatibility with the related features allowing the synthetic and comparative analysis and the access to reliable and adequate sources of primary data. In addition, the overall methodological approach for the development and application of the indicator system must be precise allowing updates and adjustments (Sustainable Transportation Indicators Subcommittee of the Transportation Research Board, 2008).

The system of indicators developed in the current research fully exploits the significant background of the main transport indicator systems mentioned above, taking into account the requirements for the credibility of used sources and the compatibility of data as well as the specific characteristics of the study area. Thus the produced indicator system provides a dynamic tool for the monitoring of the study area's transportation profile that can be periodically updated. Furthermore, the structure of the indicator system allows a cross-scientific approach with the addition of complementary groups of indicators from related scientific fields, in order to acquire the integrated impact assessment of the transport system, as described in the final section of the paper.

Area of application

The area of application of the indicator system comprises the 12 new member-states of the EU after the enlargements in the period 2003-2007: Bulgaria (BG), Cyprus (CY), Czech Republic (CZ), Estonia (EE), Latvia (LV), Lithuania (LT), Hungary (HU), Malta (MT), Poland (PL), Romania (RO), Slovakia (SK) and Slovenia (SI) (Figure 1). The paper especially focuses on the new member-states of South-East Europe which, although presenting differentiations concerning their socio-economic and transport features, they meanwhile present certain similarities referring to both their socio-economic profile and the spatial structure of the transport network (Petrakos and Economou, 2002).

Until the end of the 80s the new member-states of SE Europe were explicitly related to the "Eastern European" financial and socio-political zone of influence. Moreover in the end of the previous century civil warfare, internal socio-political disputes and the embroilment of external factors changed the wider area resulting to territorial fragmentation not only among the countries of the examined region but also between this region and the European Union (Kafkalas, 2007). In the same period, the countries of Central Europe (that comprise the "core" of EU) are developing as an integrated spatial entity supported by common policies for social welfare and economic competitiveness.

Description of the indicator system

The methodological approach of the indicator system is based on the experience gained by the involvement in the following European Research Programmes: "European Space and Territorial Integration Alternatives Spatial Planning Observatory Network in South East Europe - ESTIA SPOSE" (INTERREGIIB CADSES), "Spatial Impacts of Multimodal Corridor Development in Gateway Areas: Italy-Greece-Turkey-SIMCODE: IGT" (INTERREGIIIB ARCHIMED) and "South Eastern Mediterranean Spatial Observatory Network-SEMSON" (INTERREGIIIB ARCHIMED).

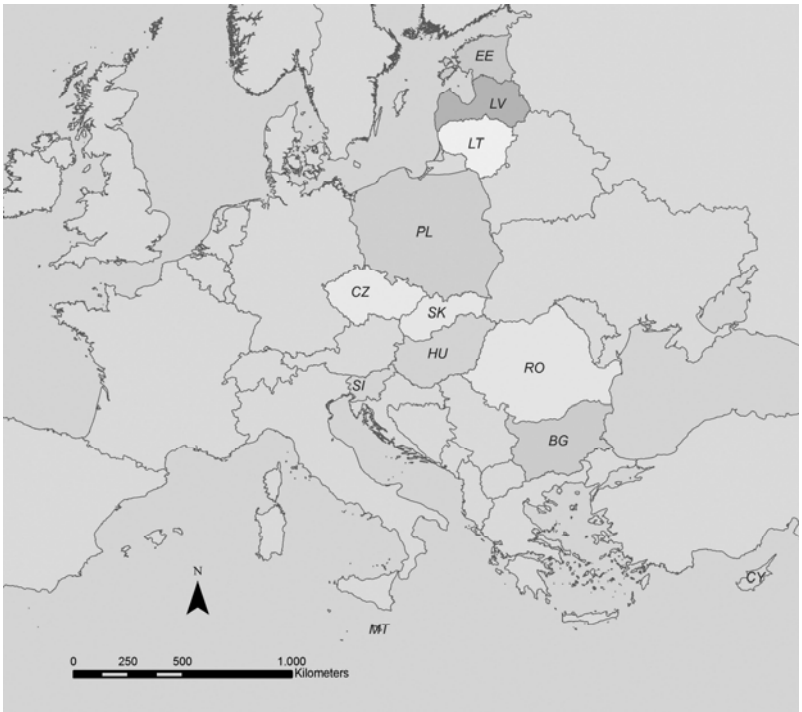

Fig. 1: The area of application (NMS), Source: Own elaboration

The selection of the appropriate spatial level of the indicators was made taking into consideration the allowance of vertical and horizontal comparisons, the analyses of special issues and the data availability. The spatial reference of the indicator system refers to i) the national level (for each of the 12 new member-states) and ii) the level of the following Geographic Entities: The group of the 12 new member-states (NMS), the group of the 15 pre-enlargement member states (EU15) and the total of the EU (EU27). The values of indicators for the three Geographic Entities are given either as average values or as sums.

The proposed system consists of 60 indicators divided into four Thematic Fields: i) main Socio-Economic Profile (SE-P), ii) Transport Economic Performance (T-EP), iii) Transport Infrastructure (T-Inf) and iv) Transport Operation (T-Op) indicators. In Table 1 there is a combined presentation of the SE-P and T-EP indicators aiming at the investigation of the share of transport section in the general socio-economic performance.

The T-Inf and T-Op indicators are summarized in Tables 2 and 3 respectively, where the symbol (×) shows the specific transport system that the indicator refers to. For the needs of the current study some new indicators, which are indicated by the symbol (*), are introduced in order to investigate the level of mobility of the new member-states in relation to the European Union's transport features.

According to their importance for the assessment of the research objectives, the indicators are further categorized into Core and Other. Furthermore, some indicators have a dynamic (Dyn) time reference and some refer to the most recent available data (Stat). Metadata for each indicator are included in properly produced technical reports (Table 4).

The following were used as main sources for the calculation of the proposed indicators: the Eurostat Database, the NACE reports, the "Panorama of Transport" (Commission of the European Communities, 2009), the "TEN-T Priority axes and projects" (Commission of the European Communities, 2005), the EU Labour Force annual Surveys, the CIA-The World Factbook, the National Reports of SEMSON Research Programme and the national statistical services of each member-state. Data was processed using MS Access and SQL programming. Charts and diagrams were produced using MS Excel and maps were designed in ArcMap.

Table 1. Combined presentation of SE-P and T-EP indicators

Main Socio-economic Profile (SE-P)	Transport Economic Performance (T-EP)
Total population *(inhabitants)*	
Density of population *(inhabitants/km²)*	
Gross Domestic Product (GDP) per capita *(PPS)*	
Gross Added Value (GAV) per capita *(€/person)*	Share of GAV in the transport, commerce and communications sector *(%)*
Number of employed *(1000 persons)*	Share of employed in the transport, commerce and communications sector *(%)*
Percentage of employed in the total of active population *(%)* [1]	

[1] *Active population is considered the population of more than 15 years of age (Romans and Preclin, 2008)*

Table 2. Summarized presentation of T-Inf indicators

Transport Infrastructure (T-Inf)	Transport system						
	Road		*Rail*		*Inland waterways*	*Maritime*	*Air*
	Motor ways	Other roads	Total	Electrified	Total	Total	Total
Length of network *(km)*	×	×	×	×	×		
Density per population *(km/10000 inh)*	×		×		×		
Density per surface *(km/100 km²)*	×		×		×		
Number of main terminals [2]						×	×
Distribution of TEN-T priority projects*	×		×	×	×	×	×

[2] *As main ports and airports are considered the group of ports or airports that handle at least the 80% of the total annual freight or passenger volume serviced by the county's seaport or airport network respectively (Commission of the European Communities, 2009)*

Table 3. Summarized presentation of T-Op indicators

Transport Operation (T-Op)	Transport System				
	Road	*Rail*	*Inland waterways*	*Maritime*	*Air*
Total passenger volume *(10^6 pas-km)*	×	×			
Share of road passenger volume by passenger cars *(%)*	×				
Passenger transport at national level *(10^6 pas)*	×	×		×	×
Passenger transport at international level *(10^6 pas)*	×	×		×	×
Share of international passenger transport between EU members* *(%)*	×	×		×	×
Modal split of passenger transport *(%)*	×	×			
Total freight volume *(10^6 ton-km)*	×	×	×		
Freight transport at national level *(10^6 ton)*	×	×	×	×	×
Freight transport at international level *(10^6 ton)*	×	×	×	×	×
Share of international freight transport between EU members* *(%)*	×	×	×	×	×
Modal split of freight transport *(%)*	×	×	×		
Transportation of containers *(10^3 TEUs)*				×	

Table 4. Example of an Indicator Technical Report

Thematic Field: T-Inf	*Name:* Distribution of TEN-T priority projects			
Description:	The number of priority projects (axes) of Trans-European Transport Network whose segments are located in a new member-state			
Gravity: Other	*Time Reference:* Stat		*Unit:* number of projects	
Objective:	The number of TEN-T axes that intersect a country reveal the importance of the country's transport network to the Trans-European network and the availability of international accesses.			
Sources: CEC, 2005	*Comments:* When an axis intersects more than one of the new member-states, the axis is counted as many times as the number of intersected new member-states.			

ASSESSMENT OF THE INDICATOR SYSTEM AND DISCUSSION OF THE MAIN RESULTS

General rules for the calculation and presentation of the indicators

Due to the indicator system's vast size, the most significant indicators for the purpose of this research are presented in the form of tables, charts and maps referring to either comprehensive results for each of the NMS countries or to the Geographic Entities (NMS, EU15 and EU27). Additional information from the elaboration of the rest of indicators is also given in order to support the conclusions extracted from the above.

It should be pointed here that for the purpose of diminishing mistakes and incompatibilities, the average and sum values of indicators referring to the Geographic Entities were calculated from data referring to each member-state. In case that there is no data or there is absence of the specific transport mode in a certain member-state, this member-state is not taken into account in the calculation of the above values. For example, in the calculation of the average and sum values of the indicators: "Number of main seaports" and "Maritime freight transport" for the Geographic Entities NMS and EU27 the Czech Republic is not taken into account because it does not have a seaport network.

The most recent data for each country is available in the indicator system's database. However in the process of the comparative and synthetic analysis the time reference of each indicator is adapted accordingly to ensure compatibility between data for countries and Geographic Entities. Finally, it should be noticed that separate information for Greece is given as it is the only EU15 member-state in South-East Europe.

Socio-economic profile and the economic performance of the transport sector

The results from the combined elaboration of the SE-P and T-EP indicators are discussed in the current section.

Demographic features

In 2006 the population of the NMS countries (103,420,194 inhabitants) comprised the 21% of the total population of the European Union, with the population of Poland and Romania being the highest and close to the EU15 average. During the decade 1998-2008 a decrease of 2% in the total number of inhabitants was observed mainly due to the labor immigration out of some of the weaker economies of South-East Europe.

The Czech Republic, Poland, Slovakia and Hungary have the highest population density per surface, which is close to the EU15 average (118.24 inhabitants/km^2), while Latvia, Lithuania and Bulgaria are the most underpopulated countries in the study area.

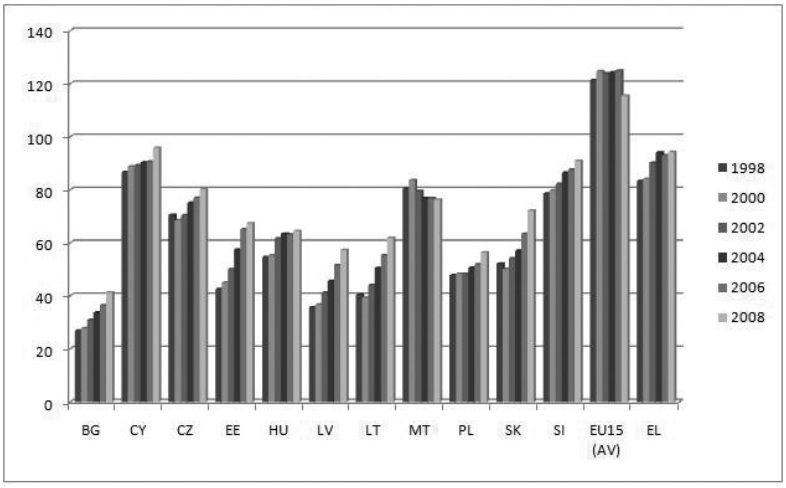

Figure 2: GDP for each NMS country and the EU15 averag, Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_databas,e accessed 23th Apr 2010) and own elaboration

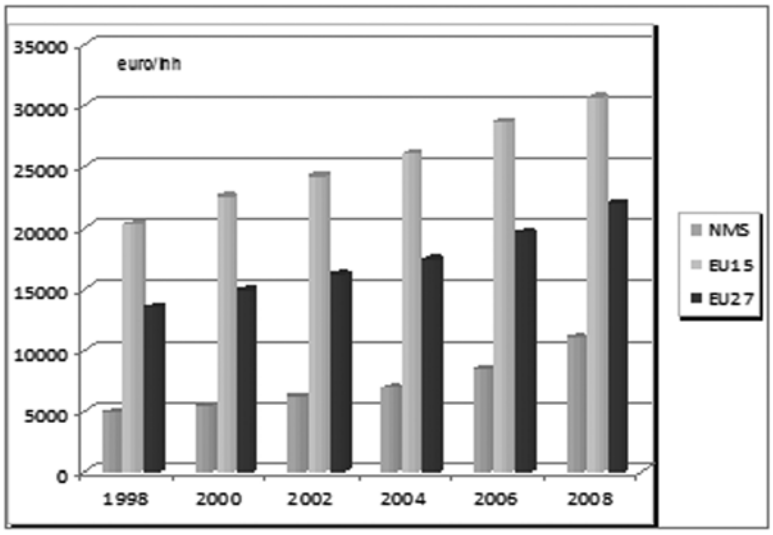

Figure 3: Average GAV for NMS, EU15 and EU27, Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database accessed 23th Apr 2010) and own elaboration

Economic performance

The Gross Domestic Product[2] per capita in the study area during the period 1998-2008 presents an increase for the majority of the examined countries with the average GDP of the NMS for 2008 corresponding to the 60% of the average EU15 value. It is also observed that Slovenia and Cyprus[3] have the highest values of GDP and close to the value of Greece (EL), while the GDP of Latvia, Lithuania, Estonia and Bulgaria is the lowest (Figure 2). Furthermore during the same period the average Gross Added Value (GAV) for the NMS countries increased significantly comprising in 2008 the 36% of the EU15 average (Figure 3).

As far as the share of GAV for the Transport, Commerce and Communication sector is concerned, an increase was observed in the NMS during the period 1998-2002 followed by a relative decrease after the enlargement due to the development of other economic sectors. In 2008 it was more than 25% of the total GAV and 10% higher than the EU27 average, a fact that indicates the serious importance of the transport sector for the new member-states. In Figure 4 there is a presentation of the GAV shares weighted by the GAV value for each NMS country.

[2] GDP is measured in Purchase Power Standards in relation to the EU27 average (100 PPS)

[3] The economies of Slovenia and Cyprus are traditionally linked with Central European member-states

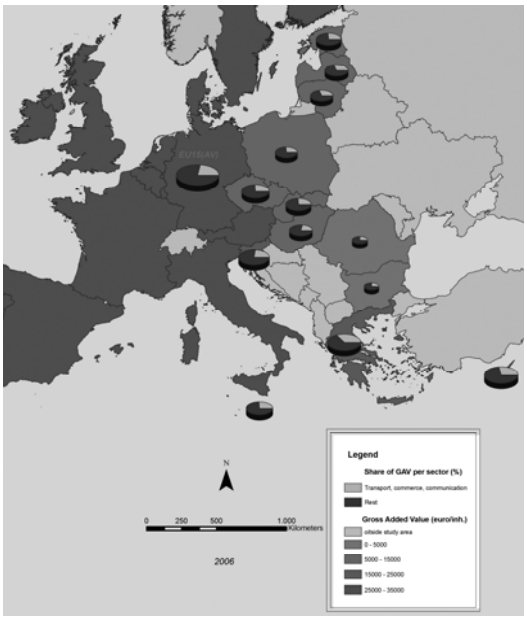

Figure 4: Share of GAV for the Transport, Commerce and Communication sector for the NMS countries and the EU15 average Reference year: 2006, Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/ portal/statistics/search_database accessed 23th Apr 2010) and own elaboration

Labor market

In 2008 there were a total of 44,685,300 employed persons in the NMS comprising the 20% of the EU labor market (Figure 5). This value represents the 53.5% of the active population in the NMS countries, while the corresponding average value for EU15 is 56.5%. The above comparison combined with the low GDP per capita for the study area indicates a differentiation between the NMS and EU15 countries concerning social opportunities and welfare.

On the other hand, the share of the total employed persons in the Transport, Commerce and Communications sector, which presents small variations through time, is higher in the new member-states than in the EU15 countries. In specific its value for 2006 was 7.03% for the NMS in comparison to 5.98% for EU15, highlighting the role of transportation for the social welfare of the NMS.

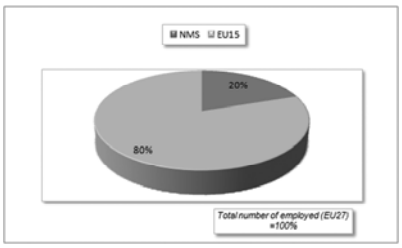

Figure 5: Distribution of the EU labor market between NMS and EU1, Reference year: 2008 Source: Eurostat (http://epp.eurostat.ec .europa.eu/portal/page/portal/labour_market accessed 23th Apr 2010),EU Labour Force Survey (http://circa.europa.eu/irc/dsis/employment/info/ data/eu_lfs/index.htm accessed 20th May 2010) and own elaboration

Infrastructure of the multimodal transport network

The following section comprises an analysis of the results from the elaboration of the T-Inf indicators.

Land transport network

It can be noticed in Table 5 that the length of motorways in the NMS increased more than 25% during the period 1998-2004 corresponding to the 8.5% of the EU15 total length of motorways in 2004. During the specific period there was a slight decrease in the length of the NMS railways and inland waterways, while at the same time there was a 20% increase in the length of the corresponding networks for EU15 (Table 5). The absence of high speed rail in South-East Europe should also be noticed.

From the elaboration of network density indicators for 2002 it resulted that the average density of the NMS railway network per population and per surface is higher than the EU15 average values (Figure 6). The highest density per surface was observed in the Czech Republic (20.93 km/100 km^2), Hungary (13.69 km/100 km^2) and Poland (13.02 km/ 100 km^2)

Table 5: Length of the land transport network by category in the NMS and EU15 countries

Entity	Land Transport Network				
	Road		*Rail*		*Inland waterways*
	Motorways	Other roads	Total	Electrified	Total
Average length *(km)*					
NMS	380.62	85,849.11	10,726.14	5,358.17	1,096.45
EU15	4,489.8	-	21,565.96	-	4,354.57
Change of length during the period: 1998-2004 *(%)*					
NMS	27	15	-8	-3	-2
EU15	29	-	22	-	23
Distribution of length *(%) EU27=100%*					
NMS	6	30	33	30	26
EU15	94	70	67	70	74

Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/ portal/statistics/search_database accessed 23th Apr 2010) and own elaboration

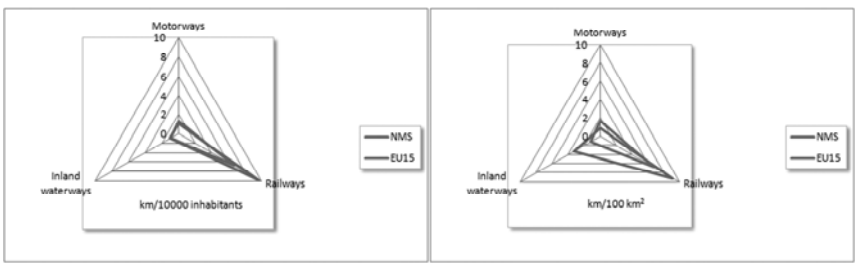

Figure 6: Density per population and surface for the land transport network in the NMS and EU15 Reference year: 2002 Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_ database accessed 24th Apr 2010), Commission of the European Communities, 2009 and own elaboration

and the lowest in Estonia (3.46 km/100 km^2) and Lithuania (3.42 km/ 100 km^2). On the other hand, the inland waterway network of the NMS is located mainly along the river axes of Hungary, Poland and Romania (78% of the total length of the NMS inland waterway network).

Main seaport and airport terminals

The structure of the seaport network depends on geographical conditions, economic activity and the complementarities between land and maritime corridors of freight transport (Rodrigue, et al., 2009). On the other hand, in most cases the airport network is strongly connected to large urban centers fulfilling the needs for long distance passenger transport (Bowen and Rodrigue, 2009).

In the NMS both maritime and air transport infrastructure is very poor. In specific, the number of main seaports in the new member-states varies from 1 to 6, while the average number for the pre-enlargement member-states (with access to the sea) is 23 main seaports. As far as the airport network is concerned, the greatest share of airborne traffic is managed by a small number of main terminals (1 to 8 per country) in the NMS whereas the average number of main airports in the EU15 is 16.

Trans-European transport network

As it is presented in Table 6, the number of TEN-T priority projects is equally distributed between the NMS countries in relation to the available transport modes. Priority is given to the railway network and the motorways of the sea.

Features of transport demand

The main results from the assessment of the T-Op indicators are presented in the following.

Passenger and freight transportation

The demand for passenger and freight transport in the new member-states is presented in brief in Table 7, which provides a comparative analysis of the volumes transported by each mode at the national and the international level by the NMS and EU15 countries. In addition the share of international (passenger and freight) volumes transported between EU member-states is presented in order to investigate the connections between the new member-states and the rest of the European countries.

The above Table shows that, apart from rail freight transportation, both passenger and freight volumes of the NMS are much lower than those of EU15. In addition the transported volumes between the NMS and the other EU countries vary depending on the location of each country in relation to the rest of Europe, the level of accessibility towards the European corridors as well as the socio-economic factors that favor the enhancement of certain transport connections.

Land transport operation

Since the enlargement, a significant increase in the freight volumes transported by road is observed for the NMS, with Poland taking a great share (about 40%) of the total road tone-kilometers. The transportation of passengers by road is also increasing in the majority of the new member-states. The private car is dominant in passenger transportation and its share of the total passenger-kilometers traveled by road varies from 80.96% (Latvia) to 91.74% (Lithuania). The above trend of increasing road transport, mainly due to the undergoing period of economic development, is opposite to the principles of sustainable mobility where a more balanced use of alternative transport modes is suggested.

On the other hand, the conditions for rail transport are less favorable. There is no significant increase in freight volumes transported by rail with the average value of tone-kilometers in the NMS corresponding to the 86% of the EU average. Meanwhile, despite the extended railway network, the lack of modernized infrastructure results to very low numbers of passenger movements.

The inland waterways of the NMS, due to the obsolete infrastructure and the limited international connections, do not take a significant share of freight transport. In 2006, an average task of $1{,}882.5 \cdot 10^6$ ton-kilometers were transported by the new member-states, corresponding only to 8.9% of the mean value for EU15. A significant share of the NMS total ton-kilometers was transported by the inland waterways of Romania mostly at the national level.

Table 6: Distribution of TEN-T projects per transport mode among the NMS countries

New Member States	Motorway	Railway axis	Inland waterway	Motorway of the Sea	Total
Bulgaria	1	1	1	1	4
Cyprus				1	1
Czech Republic	1	2			3
Estonia		1		1	2
Hungary	1	2	1		4
Latvia		1		1	2
Lithuania		1		1	2
Malta				1	1
Poland	1	1		1	3
Romania			1	1	2
Slovakia	1	2	1		4
Slovenia		1		1	2
Total	5	12	4	9	30

Source: Commission of the European Communities, 2005 and own elaboration

Table 7: Comparative analysis for passenger and freight transport in NMS and EU15

Type of transport	Entity	Transport System				
		Road	*Rail*	*Inland waterways*	*Maritime*	*Air*
National level						
Passenger *(10^6 pas)*	NMS	-	81.29	0	3.58	0.19
	EU15	-	445.21	0	17.01	11.82
Freight *(10^6 ton)*	NMS	211.06	40.13	5.11	0.34	0
	EU15	918.20	41.25	43.31	27.21	0.05
International level						
Passenger *(10^6 pas)*	NMS	-	1.12	0	2.73	5.09
	EU15	-	6.45	0	13.39	56.73
Freight *(10^6 ton)*	NMS	15.48	31.47	3.06	29.23	0.03
	EU15	40.98	25.20	85.37	219.52	0.85
Share of international transport between EU members						
Passenger *(%)*	NMS	-	60.74	-	98.89	54.97
	EU15	-	89.80	-	79.97	55.14
Freight *(%)*	NMS	88.16	68.22	-	54.22	52.55
	EU15	94.53	67.00	-	39.68	22.21

Reference year: 2006, Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database accessed 24th Apr 2010) Commission of the European Communities, 2009 and own elaboration

From the modal split of land transport modes in the NMS and EU15, it can be noticed the important role of rail transport and the limited share of inland waterways for the study area in relation to the EU15 countries, where the railways and inland waterways present similar shares. For the whole of EU the dominance of road transport is eminent for the movements of both passengers and goods (Figure 7).

Maritime and air transport operation

Maritime passenger transport is generally limited in the EU, apart from the member-states connected to national or international short-sea shipping axes. In the NMS freight transport by sea at the national and international level is also limited. In 2006 the average international freight volume handled by the new member-states' seaport network comprised only the 20.6% of the EU mean value ($141.67 \cdot 10^6$ tons). The most significant freight volumes at the international level are handled by the seaports of Latvia, Poland and Estonia (in the Baltic Sea) as well as Romania (in the Black Sea). Furthermore, as it can be concluded by Figure 8, the seaports of the new member-states handle a limited amount of containers (TEUs) in comparison to the EU15 average.

Moreover during the last decade the "opening" of the air transport market throughout Europe has led to the steady increase of passenger traffic. In the first two years since the enlargement (2004-2006) the international passenger volumes transported by the NMS airport network increased significantly but still remained much lower than the EU15 average. The airports of Poland and the Czech Republic present the highest international air passenger traffic among the new member-states. The passenger traffic at the national level and the overall freight and mail volumes transported by the airports of the new member-states are also very low in comparison to the rest of the EU and especially the "core" member-states of Central Europe.

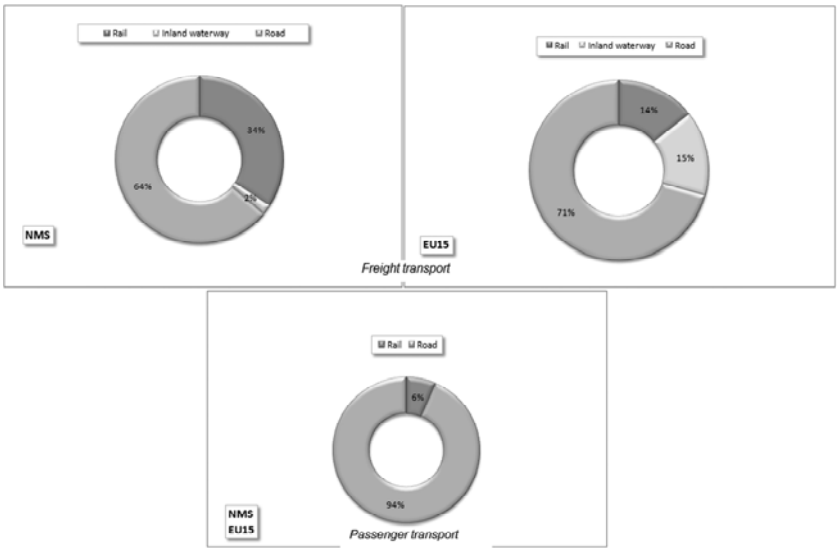

Figure 7: Modal split of land transport modes for the NMS and EU15 countries (passenger and freight transport), Reference year: 2006, Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database accessed 24th Apr 2010), Commission of the European Communities, 2009 and own elaboration

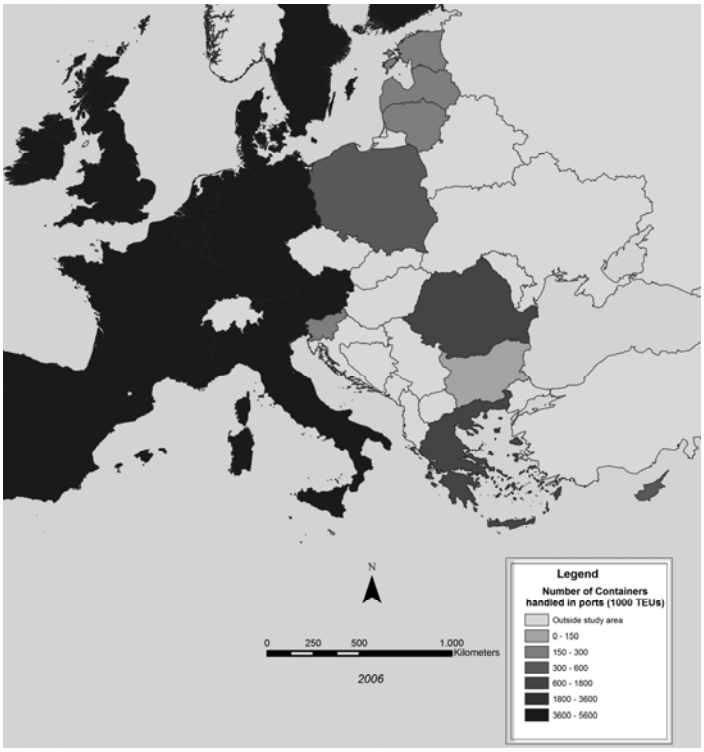

Figure 8: Number of containers handled in the NMS countries and EU15 average, Reference year: 2006, Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database accessed 24th Apr 2010) and own elaboration

CONCLUSIVE REMARKS

Concerning the NMS transport system

The synthetic analysis of the results from the application of the indicator system allows the extraction of some useful conclusions concerning the development of the NMS transport system and its contribution to the process of socio-economic convergence with the European Union.

The transport infrastructure and the mobility levels for both passenger and freight movements in the NMS are in most cases below the EU average in terms of quality and quantity. However, the transport sector plays a significant role for the economic development and the social welfare of the new member-states. Moreover, there are certain competitive advantages for the NMS transport system that could act as contributors towards socio-economic development and convergence with the European Union:

- *High density of the railway network*, which can be upgraded in terms of services and infra-structure (e.g high speed rail) aiming at the attraction of higher passenger volumes while complementarity of rail freight transport with the seaport network should be promoted.
- *Strengthening of the EU Motorways of the Sea* through the seaport network of the new member-states in the Baltic, Adriatic and Mediterranean Sea and the provision of maritime accesses to the Black Sea through the seaports of Romania and Bulgaria.

• *Enhancement of competitiveness in the EU transport sector*, as certain new member-states develop gradually into "key-players" for road and rail freight transport.

Concerning the indicator system

It is evident from the above that the proposed indicator system provides a coherent description of the current situation and the development of the NMS transport system in an era of convergence with the EU permitting meanwhile the update of data for future applications. In order to enhance the above advantages it is proposed the periodical application of the indicator system (at the end of the current programming period and every two years).

Towards this purpose, the adoption of a cross-scientific approach is also proposed, with the addition of a series of indicators from different scientific fields. In specific, the detailed assessment of the interaction between transport features and socio-economic development can be managed by the addition of a larger number of selected socio-economic indicators while the introduction of a series of environmental impact indicators can contribute to the examination of sustainable mobility aspects, which comprise a main priority of the European policies for socio-economic convergence and territorial cohesion (Foutakis and Thoidou, 2009). The cross-examination of these indicators with the indicators of transport infrastructure and transport demand and the synthetic analysis of the results can provide useful data to support decision making mechanisms of transport planning and management authorities and the stakeholders of the private sector at the national and European level.

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MODELLING THE SPATIAL DISTRIBUTION OF VOJVODINA'S POPULATION BY USING DASYMETRIC METHOD

Nikola Krunić[1], Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia
Branislav Bajat, University of Belgrade, Faculty of Civil Engineering, Institute for Geodesy and Geoinformatics, Belgrade, Serbia
Milan Kilibarda, University of Belgrade, Faculty of Civil Engineering, Institute for Geodesy and Geoinformatics, Belgrade, Serbia
Dragutin Tošić, University of Belgrade, Faculty of Geography, Belgrade, Serbia

Cartographic presentation of heterogeneity/homogeneity in the spatial distribution of population is still a major problem in modern geography, and other geo-sciences as well. The traditional method of thematic or choropleth mapping rarely gives satisfactory results. This paper analyzes the applicability of dasymetric mapping method for the modelling of spatial distribution of population. Although it is a relatively old method, it becomes widely used following the development of computer technology, GIS and satellite imagery, and its applicability is increasing in social, economic and other sciences and disciplines. After showing the basis and development of dasymetric mapping, the authors present possible application of this method in the population distribution modelling of Vojvodina.

Key words: *dasymetric mapping, population distribution, spatial planning, Vojvodina.*

INTRODUCTION

The traditional choropleth map creates an impression of uniform distribution of a phenomenon in space, although it most often varies in the specific geographic area. Thus, the boundaries of spatial units affect abrupt changes in values of the mapped phenomenon. In order to solve this problem, it is necessary to create the new, so-called *statistical surfaces*, which model the space heterogeneity, thus simulating variations of the observed phenomenon in the specific geographic area. To achieve greater precision in distributing the phenomenon, additional/ancillary data (predictors) are used, namely, spatial relationships between the data and variables are to be determined.

One of the approaches in solving this problem is a dasymetric mapping method by which the distribution of modelled space into zones of higher degree of homogeneity is made, whereby the variations in statistical surfaces are more realistically depicted with the support of additional variables and their mutual relationships. Mennis (2003) defined the dasymetric mapping as a process of spatial data distribution (deaggregation) by smaller and, for the analysis, more suitable spatial units using additional/ancillary data in order to make the population distribution or other spatial phenomena in a more refined way. Although it is most frequently used to model distribution of population, the dasymetric mapping may also, theoretically, be used in deaggregation of any quantitative variable dependent on geographical/spatial units, such as statistical and territorial political units of various hierarchical level (from the census round, statistical settlement, district, and region), but also in deaggregation of geographic entity with specific ecological features such as, for example, flood-prone areas.

Although used for more than two centuries, dasymetric mapping method has still not been standardized like other thematic mapping methods, due to which it is to great extent subjective and without consistent criteria. The most often quoted excuse for this is that the method of making the dasymetric map is rather complicated, that the data used are relatively difficult to obtain, and that the method is also technologically demanding as it employs significant computer resources (Maantay *et al.*, 2007). So far, in Serbia, this method has not been used in demographic studies or somewhere else in thematic cartography.

BASIS AND DEVELOPMENT OF THE DASYMETRY

George Julius Poulett Scrope used rudimental dasymetric technique in 1833 for mapping the population density in various parts of the world. The Russian geographer Semenov-Tyan-Shansky, who described the method in the year 1911 and whose map showing the distribution of population of the European Russia was published in the year 1923, has often been cited as the first author of dasymetric map. However, John Kirtland Wright was the first to describe the method in English language (1936) and explain the origin of the word *dasymetry* as *density measuring*. It his

[1] Bulevar kralja Aleksandra 73/II, 11 000 Beograd, Serbia
nikola@iaus.ac.rs

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paper, he indicated the advantages of dasymetric thematic or choropleth map over the standard one. Although the choropleth mapping was carried out a whole century before Wright, the coined word choropleth denoting the value-by-area method (Jarcho, 1973; Maantay *et al*., 2007) was attributed to him.

The choropleth method is simple to use, easy to read and understand, thus most commonly used in demographic and socio-economic analyses, where the statistical data are related (uniformly distributed) to spatial/territorial units. The major drawback is a so-called MAUP (Modifiable Areal Unit Problem) problem emerging when the results of spatial analysis are substantially changed due to the change of boundaries of mapped units or levels of statistical data aggregation.

In this paper, further evolution of dasymetric mapping is shown through the development of the method, techniques and use of ancillary data (Maantay *et al*., 2007).

DASYMETRIC MAPPING METHOD

Although the final aim of dasymetric mapping is to obtain a map which would in a most realistic way depict spatial distribution of population, its implementation methodology is based on a variety of concepts. Summary of concepts on which dasymetric mapping is based are given below.

Areal Interpolation. Areal interpolation method is defined as data transfer from the so-called source (spatial) unit to the target unit. The ratio of the variable's value to surface area of the spatial unit is determined under assumption that phenomenon is spatially-homogeneous. The obtained ratio is assigned to the target unit, and the variable's value is determined in relation to its surface area. This method is most often used in measuring the population density. Indeed, the major drawback is precisely in the assumption that phenomenon is spatially-homogeneous on the entire area of the spatial unit.

Binary model - Filtered Areal Weighting. This method is based on areal weighting coefficient added to ancillary data, thus obtaining a new layer used as a filter or mask. These filter/mask data are most often the land use/land cover data obtained by remote sensing, that indicate inhabited and uninhabited land areas (therefore the name „binary model"). Through applying the filters/masks, the population data are distributed by spatial units belonging to the category of inhabited land area. However, the model has two key drawbacks. First, the model still assumes a homogenous population density within inhabited areas. Second, the fact that uninhabited areas still have certain population is neglected. Through further improvement of the method, a essentially refine model has been used, whereby more realistic data have been obtained.

Utilisation of land use and land cover data as ancillary predictors. The possibilities provided by the use of ancillary data in defining spatial distribution of population have been indicated already in the previous model. These data are obtained either from the data in vector format, e.g. CORINE, (Bielecka, 2005), or from raster data, such as satellite and orthophoto images (Mennis, 2003; Sleeter, 2004). Drawbacks in implementation of these data have also been indicated, primarily those related to prices and time required for their collection, volume of raster data and difficulties in their processing, as well as difficulties in separating inhabited from uninhabited areas.

Three-Class Method and Limiting Variable Method. Both approaches represent further improvement of binary method. Through the three-class method, based on land use categories, a percentage share of class is assigned to the total population counts in the given area (the known example is that the class of urban land is assigned e.g. 70%, agricultural/forest/non-urban land is assigned 20%, while 10% belongs to forest land (Eicher and Brewer, 2001). Indeed, the percentage share is determined on a case-by-case basis and by expert knowledge. It has been noticeable that this method still „suffers" from the problem of separating urban areas from other areas, as well as that it homogenizes density within classes.

The limiting variable method differs from the previous method therein the maximum probable population density value for the class is assigned to each class. When the modelled density value exceeds the limit value, the population is distributed into other classes. Nevertheless, the problem of heterogeneity in population distribution within the classes is not solved. Furthermore, the procedure of determining the limiting variable itself may lead to wrong limit values, thus significantly influencing the results of mapping. (Mennis, Hultgren, 2005).

Image Texture Analysis Method. Population distribution modeling is carried out using high resolution satellite images, thus determining the ratio between the population densities according to census data and raster texture. Spatial units thus obtained are called homogeneous urban patches (HUP) and are determined by image analysis through which the differences between these patches are maximized, while differences within each patch are minimized. Albeit this method has demonstrated high correlation between the modelled density and image texture, it is still barely efficient for implementation in practice.

Statistical Approach – Regression Analysis. Some authors have used statistical techniques in dasymetric approach, such as areal patch-point interpolation or regression analysis of correlation between population density and land use (Bielecka, 2005).

Heuristic Sampling Method. Mennis (2003) used the combination of dasymetric mapping, advanced three-class method and empirical sampling based on satellite images to model the population distribution independently of data from spatial/statistical units. Population within group of block was classified into individual grid cells based on two factors: a) relative difference in population density regarding to rank of urbanization (low, high, non-urbanised), and b) the proportion of urban area in the total surface area of the block group. This method, although significantly improving the previous models, revealed certain drawbacks in implementation for the densely inhabited urban areas, which makes its implementation in planning and analyses impossible. Variations within block groups may not be adequately perceived by using this method.

Kernel Density Surface from Population-Weighted Census Centroids. Numerous variations of surface-generating methods are used to model a population layer by kernel density. Rather than mapping population by zones, by spatial units of the statistical services (census/statistical units), this method entails creating a vector layer of population density by interpolating the population number within enumeration district - (ED) centroid, often used for representing census data in the United Kingdom (Martin, 2006). A kernel window is moved over the cells contained in these centroids, and the population number at each centroid is distributed to the cells in the kernel window by a distance-decay model. An early iteration of this method had the drawback that the total surface population number by cells was not always identical to the population counts in the census data. This drawback was overcome by distributing the population number to cells within the centroid's original zonal boundaries, thus highlighting the pycnophylactic property of the method[2].

[2] The pycnophylactic method means that, after reaggregation, modelled values have the same values as initial/original value (Tobler, 1979).

Use of Other Types of Ancillary Data - Street-weighted Interpolation. Realizing that the use of other types of ancillary data, such as those on land use and others, did not offer the possibility for sufficiently precise population density modelling, particularly in densely populated urban areas, some researchers (as stated by Maantay *et al*., 2007) used in their studies the street network data to determine interpolation weighting coefficient. By comparing the obtained results with the areal-weighted coefficients, they found that the applied method was better and that, in modelling the total population number, yielded by 20% more precise results.

Cadastral-based expert dasymetric system - CEDS. Maantay *et al.* (2007) used cadastral data as predictors for large-scale dasymetric mapping. The expert system was used to select which cadastral data, as ancillary variables, would best depict the true population number. Modelled population always retained its pycnophylactic property, this being rarely achieved by the previous methods. According to the authors, the greatest advantage of the CEDS method was that it could make high resolution population distribution in densely urbanized and heterogeneously inhabited urban blocks with high precision. The techniques implied the use of data on housing zones and housing units, with the support of tax data, by parcels. Selection between housing zones and housing units was made by the expert system. The results were checked against the census data and other dasymetric techniques in order to improve the method.

Despite the utilized dasymetric model, the reliability of obtained results depends most of all on the lineage and quality of input spatial data and GIS layers (Joksić and Bajat, 2004).

Global databases on dasymetric mapping - based population distribution

Mapping the spatial population distribution is today increasingly implemented in a number of projects and researches at the global level. One of such examples is a LandScan database which has been developed by the Oak Ridge National Laboratory (ORNL) within the Global Population Project for the needs of assessing the population vulnerability after disastrous events at the global level (Dobson *et al*., 2000). The LandScan database is a dasymetric model of population distribution in a grid format, based on available census data for each country, where the population distribution probability for each grid cell (size 1×1 km) is calculated based on parameters, such as purpose of the land use, slope of the terrain, vicinity of communications, night light, etc.

The Special Report on Emission Scenarios (SRES) is a similar project showing the assessment of spatial distribution of population for the period 1990-2100 (Bengtsson *et al*., 2006). This map is a long-term projection of world population for the needs of projects related to climate change and water resources assessment. A database of similar purpose is the Gridded Population of the World version 3 (GPWv3) of resolution of 2.5 minutes by geographic coordinates (e.g. latitude-longitude) based on projection of population for 2015 (Balk and Yetman, 2004). It is very important to underline that all of these mentioned databases are available on the Internet (*open-access*).

DASYMETRIC MAPPING OF VOJVODINA

The dasymetric method was used to model spatial distribution of population of Vojvodina aiming at obtaining statistical surfaces which would more convincingly show heterogeneity/homogeneity of the Province's population density. The obtained statistical surfaces were additionally used to model differences between the so-called „daily" and „night" population. The counts of „night" population in this model was equal to the population counts registered by their place of residence. The „daily" population is the population who usually stay in the settlement during working days, made up of enumerated population to/from which daily migratory population (workers and pupils/students) is added/deduced, depending on whether the settlement is of migratory character or immigration character. The layers from the 2000 CORINE database were used as ancillary data.

The Autonomous Province of Vojvodina is located in the northern part of the Republic Serbia and occupies an area of 21,506 km^2, or somewhat more than 25% of the territory of Serbia. It has population of 2,031,992 (according to the 2002 Census, about 27% of the total population of the country, excluding the data for Kosovo and Metohija), with population density of approximately 94 people per km^2. Administratively, it consists of seven districts comprising of 45 municipalities/cities. The territory of Vojvodina is comprised of 449 cadastral municipalities with 467 settlements, out of which 48 are urban ones, while other settlements are mainly rural, and more rarely the mixed ones (according to the methodology of the Republic of Serbia Statistical Office – RZS).

In Vojvodina, out of 912,000 active population, 227,162 are daily migrants, or about 25% (*Table 1*); 159,862 (70,4%) are employed daily migrants, while 67,300 (29,3%) are students and pupils. 72,840 of daily migrants (32,1%) are from urban settlements, while 154,322, or almost 68%, from other settlements, which is typical for urban system in which central positions dominate. According to place of

*Table 1. Daily migrants in 2002**

		Total	Employed	Work in		Total no. of pupils and students	Pupils	Students	Go to schools in	
				other settlement in the same municipality	other municipality and the R. Serbia				other settlement in the same municipality	other municipality and the R. Serbia
Vojvodina	ttl	227,162	159,862	103,250	55,303	67,300	45,940	21,360	30,929	35,810
	%	100	70.37	64.59	34.59	29.63	68.26	31.74	45.96	54.04
Urban settlements	ttl	72,840	47.615	23,440	23,589	25,225	11,233	13,992	5,548	19,421
	%	32.07	65,37	49.23	49.54	34.63	44.53	55.47	21.99	78.01
Other settlements	ttl	154,322	112,247	79,810	31,714	42,075	34,707	7,368	25,381	16,389
	%	67.93	72,74	71.10	28.25	62.52	82.49	17.51	60.32	39.68

**data on migrants from categories: "in other republic or foreign country" as well as "unknown", have not been taken into consideration, the total of 1309 inhabitants.*

migration, and at the level of the entire Province, migrations within municipality dominate, where about 2/3 of daily migrants move into other municipalities. As for urban settlements, however, the same share of daily migrants move within municipalities and into work centres in other municipalities. As for other settlements, local work centres dominate, where about 71% of workers move within municipality. This indicates that there is a formed hierarchy in the work center network of Vojvodina. Daily commuting creates specific spatial forms and relations between centres known as „Daily urban systems". These systems become very important issue in the spatial planning (Tošić *et al.*, 2009).

The share of pupils and students in daily migrations is about 30% (68% pupils, 32% students). Here, the difference between urban and other settlements is also pronounced: for urban settlements, the number of pupils and students is approximately the same (46% and 54% respectively), while for other settlements, the share of pupils is dominant compared to the share of students (82.5% and 17.5% respectively). The analogy in place of migration is also pronounced, where, similar to workers, the pupils and students from urban settlements more commonly migrate into other municipal/urban centres (22% and 78% respectively), while those from other settlements opt more for municipal/urban central settlements (60%:40%).

Used data and software

The population count by settlements on the territory of Vojvodina, according to the data of 2002 Census (RZS, 2004), was used as an basic data. The data used here were from the 2002 Census, obtained by the new census methodology which, compared to previous one, did not include the population who stayed abroad longer than 1 year, but enumerated foreign citizen who lived and worked in Vojvodina longer that 1 year. The Table 2 shows the population count obtained both by previous and by new methodology, for Vojvodina as a whole, as well as for its districts of Bačka, Banat and Srem.

The number of workers – daily migrants in 2002, according to unpublished RZS data, was used to determine the number of the so-called „daily population". Using the overview of the number of population who move to/from settlements, the total number of population who move between the settlements was determined. By adding to or deducting from the number of permanent population, the number of „daily" population was determined for each settlement. In this paper, students (most commonly the secondary school ones, and more rarely university students) who migrate daily, were taken as permanent population for the sake of trial model simplicity, although their share was not small (comments given in Table 1). The Table 3 shows the ratio of number of daily to number of night population for some typical urban and other settlements.

Table 2: Comparative overview of the 2002 Census population count by previous and new census methodology

Region	2002 Census population numbers, by new census methodology	2002 Census population numbers, by previous census methodology	Difference in population number	Change index
Vojvodina	2,031,992	2,098,779	-66,787	96.8
Bačka	1,079,889	1,108,339	-28,450	97.4
Banat	616,202	642,733	-26,531	95.9
Srem	335,901	347,707	-11,806	96.6

Table 3: Comparative overview of daily/night population for some typical settlements

Settlement	City/municipality	Settlement type	Number of night population	Number of daily population	Change	Change index
Novi Sad	Novi Sad	urban	191,405	221,765	30,360	115.9
Kać	Novi Sad	other	11,166	8,945	-2,221	80.1
Sombor	Sombor	urban	51,471	55,878	4,407	108.6
Čonoplja	Sombor	other	4,359	4,019	-340	92.2
Kikinda	Kikinda	urban	41,935	46,435	4,500	110.7
Mokrin	Kikinda	other	5,918	5,026	-892	84.9

Table 4: CORINE land use classes and one possibility of the assessed percentage value of representation of the number of „night" and „daily" population

Class code	Class name	Percentage of night population	Percentage of daily population
112	Discontinuous urban fabric	87	75
121	Industrial or commercial units	8	15
122	Road and rail networks and associated land	3	2
123	Port areas	1	2
131	Mineral extraction sites	0	1
141	Green urban areas	0	1
142	Sport and leisure facilities	0	1
221	Vineyards	0	1
222	Fruit trees and berry plantations	0	1
243	Land principally occupied by agriculture	0	1
	All other categories	0	0
	Total	100	100

For the basic spatial surface of dasymetric modelling, a polygonal overview of cadastral municipality boundaries was used for the territory of Vojvodina as a whole, the total of 447 units. Each cadastral municipality was assigned the data on permanent number of population, number of workers moving into settlements, number of workers moving from the settlements, and number of daily population. Given that the number of cadastral municipalities and statistical settlements did not coincide in about 20 cases (there are 467 settlements), it was necessary to distribute statistical data by cadastral municipalities.

The land use data according to the 2000 CORINE were used as predictors. The subjectively assessed percentage values of the number of represented population were assigned to the land use classes. The land use classes, different values in percentage representation of population were given, to obtain a model of daily oscillations in population number. Table 4 shows percentage representation of population number by land use classes.

The ArcGIS ArcEditor 9x software was used to model data and create maps. The procedures are very simple to perform and mainly based on traditional GIS overlaying analyses.

RESULTS AND DISCUSSIONS

The map of spatial distribution of Vojvodina's population was made by the use of dasymetric mapping. In this paper, a very simple dasymetric method was used with the CORINE land use data as main predictor. Percentage values of population share by land use classes were given arbitrarily. The obtained results were in direct correlation with predictors, while the obtained

values of assessed population were in direct function of subjectively determined percentage values of representation, so that they could be significantly manipulated during analysis. The goal of further investigations of the model, as well as for its improvement in local theory and practice should be the adjustment of the initial model in order to eliminate, or minimize, the subjectivity and uncertainty in modelling.

However, the most important contribution to making the dasymetric map of Vojvodina is a complete change in visualization of demographic phenomena in the specific geo-space, compared to traditional choropleth maps. Dasymetric mapping essentially alters perception of researchers and analysts. The long-established perception of the conception of population density is also changing, because modelled values obtained by dasymetric method indicate much greater values per surface unit, as well as their greater non-uniformity. For the sake of example, the population density in Novi Sad reaches more than 7,000 people/km^2, or more than 70 people/ha, which is many times greater value than a common conception of about 450 people/km^2 (when total population of the city and its total surface area are considered). Functional relationships and inter-dependence in the settlement network (at regional and sub-regional level), on the one hand, and functioning of the city as a work centre (of spatial distribution of functions within the settlement itself), on the other hand, was indicated by modelling daily population oscillations between and within settlements.

Figure 1 shows the traditional choropleth map of population density and, in parallel, the spatial distribution of settlements, i.e. urbanized areas. Figures 2 and 3 show differences between the population density interpreted by choroplet and dasymetric maps of the citiy of Novi Sad and municipality of Kikinda. Attention is drawn to differences in modelling the population density between city/municipal centres and surrounding settlements, as well as to the differences occurring within the city/municipal centre itself (between industrial and sport-recreation surfaces, and other city tissues).

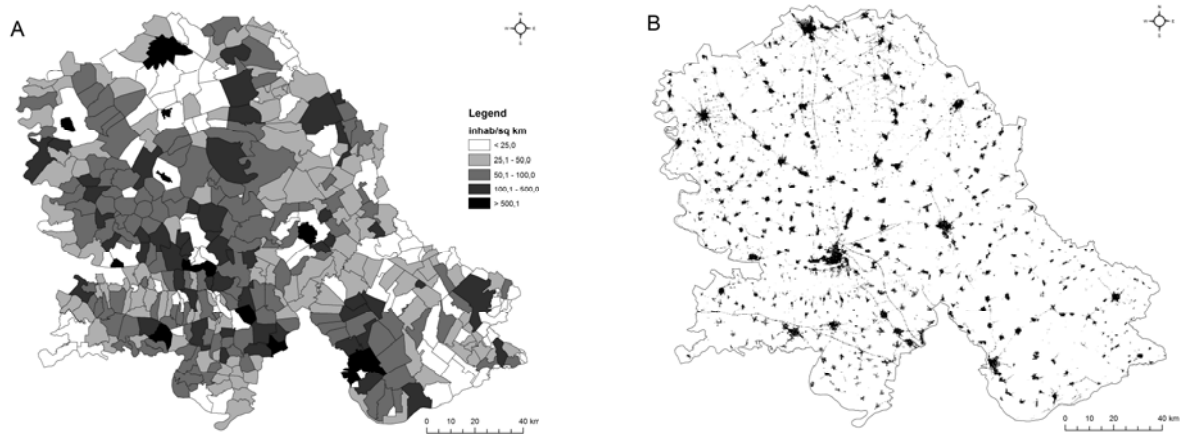

Figure 1. Example of the choropleth map (A) of the population density of Vojvodina (2002) and spatial distribution of urbanized areas (B) (CORINE, 2010)

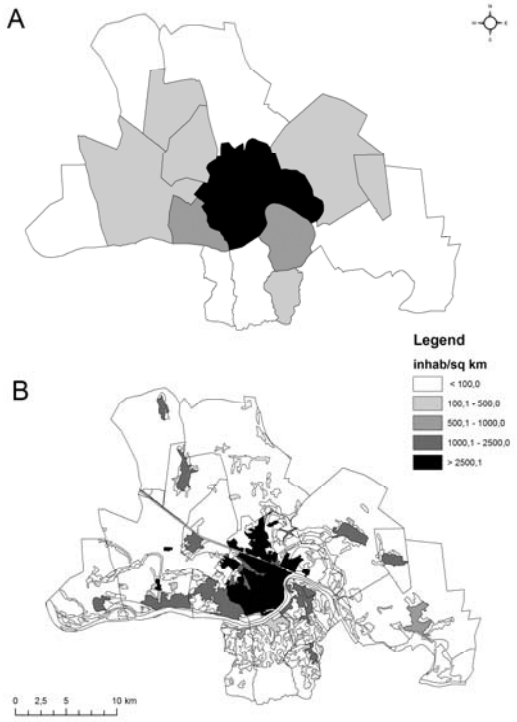

Figure 2. Choroplet (A) and dasymetric map (B) of population density of the city of Novi Sad

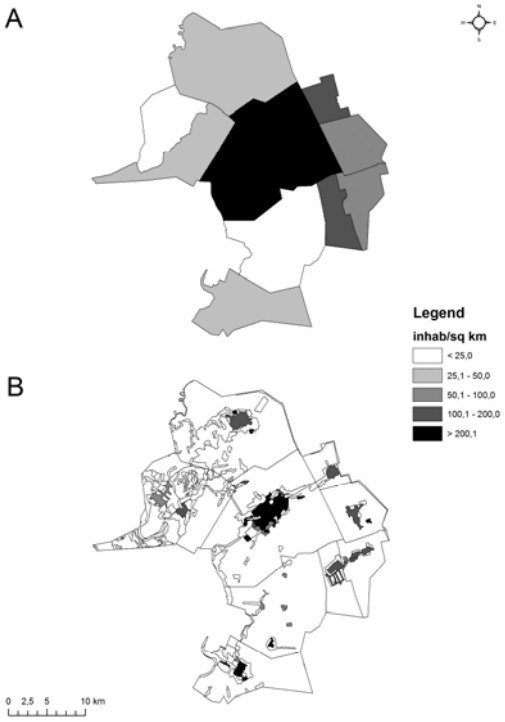

Figure 3. Choroplet (A) and dasymetric map (B) of population density of the Kikinda Municipality

CONCLUSIVE CONSIDERATIONS

Rapid development of computer technology, advanced GIS software tools, availability of satellite images, and other data obtained by remote sensing in the last twenty years, have increased scientist's and researcher's interest in dasymetric mapping method. In this paper, the advantages of this method compared to traditional choropleth method were indicated.

Dasymetric modelling was developed through two general approaches. The first approach was used for population distribution using statistical data on bigger territorial units (from the level of settlements and municipalities) which were then distributed by specific local phenomena of population density, the so-called downscaling. This analytical approach is more suitable for modelling the (sub)regional and higher-level territories. The second approach of conditionally deductive character was used for modelling the population number/density based on assessed (or empirically determined) values in the smallest considered spatial units (e.g. block in the settlement), followed by „aggregation of" such phenomena thus producing the total population number, the so-called upscaling. This approach is more suitable for local analysis in densely - populated urban settings.

Common feature for both approaches is the use of predictors, which make analytical process become more complex, but substantially influencing its precision and quality. However, while using predictors, the detail quality and degree of spatial generalization, particularly of grid data, must be taken in account, as well as conditional time-agreement of data. This means that grid predictors of rough resolution are not used for local analysis, and that older satellite images are not to be used for modelling the new statistical data, etc.

There are wide and significant possibilities for using the dasymetric modelling of spatial distribution of population, i.e. population density, primarily for analyses and projections in spatial and urban planning, assessment of vulnerability in emergency situations, environmental protection, socio-economic disciplines, etc.

The example shown in this paper represents an initial analysis, as well as illustration of possibilities offered by dasymetric modelling at the regional level and in strategic planning. The advantages were proven, but also the drawbacks of the method, primarily reflected in subjectivity of analysts while selecting predictors and assessing the percentage representation. In this context, the previous empirical investigations would be of importance. In addition to further engagement in improving the dasymetric modelling, we expect an increasing interest of other researchers in this method, whereby the detail quality would be improved, while the method itself would be used in other scientific disciplines and practice, particularly in socio-economic research.

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CUSTOMARY RULES OF THE RAJAC WINE CELLARS CONSTRUCTION

Đorđe Alfirević[1], Belgrade, Serbia

This paper considers the possibility of implementing the customary rules of construction and organization of the Rajac wine cellars, as well as whether and to what extent they have been implemented so far. Wine cellars of the village of Rajac are a unique example of ethno-architecture in the Republic of Serbia and its surrounding. They are under the protection regime as a rare spatial cultural-historical entity, i.e. cultural property of exceptional importance to Serbia.

The paper analyzes various elements of spatial development and structure, as well as specific characteristics of construction carried out by migrant workers. Considering that customary rules of construction are found in some other complexes of folk architecture in the immediate and broader surrounding of the Republic of Serbia (Korčula, Dubrovnik and Ilok in the Republic of Croatia), it has been indicated, based on comparative analysis, that it is possible that the same rules as those implemented during the foundation and development of the Rajac wine cellars have also been implemented later during their renovation by introducing new architectural principles through characteristic way of construction of Macedonian craftsmen-builders – migrant workers.

***Key words:** customary rules, Rajac wine cellars, migrant workers, cultural heritage*

INTRODUCTION

The phenomenon of spontaneity, a specific characteristic for the past time settlements, which could "at first sight" be explained as a complex of architectural structures emerging without any regularity or order in the time when there were no written rules able to define these relationships in more specific way, is nevertheless characterized by certain regularities, both in terms of structure and organization of settlements oriented towards their surrounding and natural conditions, as well as in terms of architecture.

These regularities could be explained by the so far insufficiently investigated notion of customary rules of construction often found in folk architecture.

Customary rules of construction represent a set of organizational and aesthetic principles, as well as principles of construction that have been passed on orally amongst people and implemented in founding and developing settlement in times when no written laws existed which would specify these relationships in more detail.

The emergence of customary rules may be compared with rules of construction existing in statutes of towns on the Adriatic coast (Korčula, Dubrovnik, Šibenik), which date back from the 13th century, and which were based on tradition of local customs and modified Roman law (Karač, Braun, 2000).

One of the first town statutes in immediate surroundings, which has also regulated the construction, is the Statute of Korčula (1214). It has been observed that customary rules, such as the "right to share a wall" and the "right to access", mentioned in the Statute and recognized in the organization and development of the town of Korčula, have also been implemented in the construction of the Rajac wine cellars.

It is almost certain that customary rules have originally been orally passed on amongst people, to be later, in economic and cultural development of certain towns, recorded in a form of statute, which has been a common and practically only form of a privileged communal legislation (Karač, Braun, 2000).

This conclusion may be supported by the fact that there is a great similarity amongst the rules of construction of towns having statutes and rules of construction, which may be recognized in "spontaneously emerged" settlements.

The two most often ways in which the customary rules were in the past passed on from one community to the other were: a) migrations of population, and b) activity of craftsmen-builders.

During this period, craftsmen who worked as migrant workers have often brought their families with them, so that sometimes they would settle permanently in the place in which they have worked. Thus, they passed down their tradition in building to native inhabitants (Kirovska, 1981).

From this aspect, the possibility that the customary rules have been implemented in the organization and/or development of the Rajac wine cellars, and if so, in which form and way, will be considered further in this paper.

RAJAC WINE CELLARS

Position, origin and development

The Rajac wine cellars are situated in Negotinska krajina, a wine-growing region in the eastern part of the Republic of Serbia, 22 km south of the town of Negotin.

[1] Pariske komune 8/22, 11 070 Novi Beograd, Serbia
djordje.alfirevic@gmail.com

Fig. 1. Location of Rajac wine cellars

It is unknown when the first forms of wine cellars have emerged in Negotinska krajina, although it is known, based on archaeological researches carried out in Prahovo and Gamzigrad, that wine-growing tradition in this region is very old and dates back from the period of Roman Empire (Maslovarić, 1969). It is also assumed that the first wine cellars in Negotinska krajina have been built by mountain peasants who in their village areas have not had suitable conditions for growing wine grapes (Pantelić, 1960).

Furthermore, the wine cellars were built in the neighboring regions (Sikole, Bratujevac, Štubik) suitable for growing wine grapes. Just like most of the forms of folk architecture, these wine cellars were built as log cabins with stone cellars, since timber was abundant in these regions. An example of the cellar built in this way is preserved in Atenica near Kraljevo.

In the mid 19th century (1858), in the period when grapes growing developed in Negotinska krajina, emerged the first forms of stone wine cellars (Rajac, Rogljevo and Smedovac), suitable for better and modern wine preserving (Žikić, Đorđević, 1999).

Compared to other wine cellar groups in the surrounding, only Rajac wine cellars are completely built of chipped stone, while those in Rogljevo and Smedovac are built using post and petrail system on a stone base.

Fig. 2. Rajac wine cellars

The aforementioned examples show how much the Rajac wine cellars are different compared to wine cellars in the surrounding areas. There is a similarity amongst the Rajac wine cellars and Rogljevo ones in terms of choice of material and methods of construction. However, by their spatial organization and truly beautiful craftsmanship, the Rajac wine cellars are outstanding compared to those of Rogljevo, thus being the unique examples of folk architecture.

Position and structure

Location outside the village

Wine cellars of the Rajac village are situated on the boarder of geomorphologic surfaces, on the edge of a plateau above the village at the distance of 500-1000 m. Building wine cellars on the hill above the village may be considered as being justified in terms of hygienic conditions, which is also in line with the folk saying that wine-growing requires cleanliness and quietness (Žikić, Đorđević, 1999).

Good aeration of the place in which the Rajac wine cellars are situated, which is exposed to winds all the year round, as well as clean air and environment, but also their distance from stable smell and other unpleasant smells, represent an elementary condition for wine care, since wine easily absorbs odors from its environment (Lajković, 1997).

Compared to other wine cellar groups in the surrounding, the Smedovac wine cellars, which are integrated into the village structure and the Rogljevo ones which are adjacent to the village, the Rajac wine cellars are situated outside the village as spatially and functionally

Fig. 3. Location outside the village

independent entity.

Wine cellars located in the vicinity of vineyards

One of the most important preconditions for greater efficiency of technological grape processing process (grape processing and quick start of fermentation) is that wine cellars should be located in vicinity of vineyards.

Considering that in the past the houses in Serbia were built of more moderate materials (wattle-and-daub huts, post and petrail type huts), often without sufficient space for grape processing and wine storage, building the wine cellars near vineyards was considered to be justifiable, particularly because there was the possibility for engaging watchmen who lived in the complex and who were given certain compensation (in wine) for keeping guard of wine and wine cellars (Pantelić, 1960).

Other examples of wine cellars in Negotinska krajina also indicate this important principle, particularly the wine cellars situated far from their villages. The inhabitants of these villages built wine cellars in places with favorable conditions for grape growing, although they were tens of kilometers far from their villages[2], so for them they were a temporary place to stay, store their tools and keep the products which they later brought to the village.

Vineyards have often been far from their homes and they have had to go on foot for even several hours to their vineyards, thus they could not go to work in vineyards and afterwards return to village in the same day (Pantelić, 1960).

Just like for other wine cellars in surroundings, it has been of crucial importance for Rajac wine cellars to be in vicinity of vineyards. The Rajac wine cellars are situated at the very edge of escarpment and are surrounded by vineyards from several sides.

Fertile land used as a buildable land

Rationality of the Rajac attitude is to great extent reflected in the fact that the first wine cellars have been located and built on a barren land remaining after the fertile land has been used for planting grapevines. Fertile land and vineyards have been "a sacred thing not to be touched", which directly influenced the way in which wine cellars have been grouped, as well as their additional densification.

Similar examples of structure densification are found with fortress towns – bastides, once surrounded by fortified walls. This principle in a similar form has been implemented in the Rajac wine cellars, because the development and widening of the complex has been conditioned by surrounding fertile land, which has been preserved.

Dense structures, as a way of preserving the fertile land in immediate surrounding of the settlement, are found in other vineyard regions in surrounding. The examples of Grožnjan and Motovun in Istria are well-known examples, where the settlements have been developed by grouping structures on the hill above vineyards.

[2] Wine cellars near Rogljevo and Smedovac are partially or completely integrated into the village structure, while Štubik and Glogovac wine cellars are 15-30 km far from villages.

By analyzing the structure of the Rajac wine cellars, the differences in density, structure and position of wine cellars in relation to vineyards may be observed. These differences occurred between the zone with oldest wine cellars and zone with wine cellars that have been built later. It is evident that a part of common land, which were barren and originally envisaged for building the wine cellars, were used over time, while the bordering parts of vineyard parcels have been used only later.

Wine cellars as a market place

Once, the owners of wine cellars used to spend most of the day in vineyards in production or wine cellars dealing with wine care. In the past, there were butcher's shops which were usually open during the vintage, when the wine cellars were the busiest. Likewise the comparison of wine cellars with the "čaršija" (Turkish word for market place) may often be heard (Lutovac, 1959).

The distribution of the widening at the junctions has also enabled trading activity associated with wine cellars (Stefanović, 2004). Several hundreds of people used to gather in the complex during the vintage and at the time when new wine was brought in wine cellars. Thus, during that period, the entire public life took place there.

However, no content of similar character is present in the complex today, since the wine production is at the quantitatively much lower level than it was at that time. Nevertheless, the recent reconstruction of old wine cellars into the "Sveti Trifun" Inn raises hopes that something has still remained.

Adjusting wine cellars to the terrain topography

One of the important architectural principles that guided local architects in founding original complex of wine cellars is a principle of respecting the terrain topography.

Since the Rajac wine cellars are situated on the hillside of Beli breg, on a gentle slope of southern orientation, the inclination of the terrain has enabled the wine cellars to be positioned and built in dense and elongated groups, which are at some places dug into the ground.

Building the wine cellars in clusters and belts following terrain contours provided easier access for loaded horses or horse-drawn carts to wine cellars due to more gentle street slope.

Wine cellars were built in continuous rows, one next to the other, thus forming the streets. In such rows, the roofs leant on each other or became as one, so that several wine cellars were, so to say, under one roof. Today, only some older houses are found in such sequence (Pantelić, 1960).

Building and grouping structures according to the terrain topography is an old customary rule of spatial organization and development of settlements, which may be found throughout the territory of the Republic of Serbia, and even in surrounding regions. This indicates the logics of development which is reflected in the respect and adjustment of buildings to the existing characteristics of the terrain.

Ownership and parceling

When Velika Hoča was inhabited, the villagers of Rajac divided the land among themselves in equal parts, so that connection between the size and shape of parcels and dealing of villagers with the same kind of production may be observed. The original parcels were narrow, vertical to the direction of terrain contours and very elongated, which provided suitable conditions for planting the vineyards and for grape growing.

Ownership over land was important only for arable land, because the inhabitants made a living from it. Wells, surrounding forests and stone pits for extracting stone for building the wine cellars were shared, and there was no question whose it was. Barren land was not divided among themselves, but used by all as a common good for building the first wine cellars and local cemetery (Žikić, Đorđević, 1999).

Wine cellars have been erected on barren land and at the end of vineyard parcels, so that the process of their parceling out took place only later after the settlement was formed.

There has been an old story amongst the villagers that the first wine cellars had a similar disposition, as well as houses in the village (referring to the vicinity of family and neighborly wine cellars), and that this principle was also respected in dividing the parcels amongst themselves, this could also partially explain the implementation of the "right to share a wall" in certain parts of the complex, while in other parts the wine cellars were built as detached structures.

Gathering place of villagers

The villagers of Rajac had a custom to gather in the center of the complex, where since ancient times there was a space like a 'gathering place" with inscription, which was used as a place where they gathered during festivities, „slava“ (Serbian family or village/ town feast in honor of their Patron Saint) and for negotiating business.

The gathering place has been gradually formed around the old mulberry tree already during the original foundation of the settlement, since the remaining part of the slope has been used for building the wine cellars.

The vintage has usually begun on the Day of the Cross (27th September), regardless of whether the grapes have ripen or not. Nobody could enter the vineyard and start the vintage on that day. This old custom meant to prevent causing the damage to vineyards by uncontrolled vintage. The custom has been strictly observed since ancient times (Maslovarić, 1969).

Grouping the wine cellars in clusters and rows

The dominant way of grouping the Rajac wine cellars are clusters and rows. The reasons which influenced the commitment to organize wine cellars into separate, dense groups are the following:

a) Keeping guard of vineyards and wine in cellars was resolved by engaging the watchman who lived in the complex (Pantelić, 1960).

b) Tendency to save arable land, which has over time resulted in densification of the settlement.

Wine cellars in Negotinska Krajina were built at small distance from each other, while some were even adjacent, so they looked like being built in a row. A narrow alleyway was left between wine cellars, so that there were no fenced courtyards and regulated access roads (Findrik, 1994).

Accessibility – the right to access

The "right to access" is one of the customary rules of construction that probably influenced the incoherent structure of the settlement to the greatest extent.

Basic element regulating the position of some wine cellar is the possibility of free access. A lot of care has been taken to prevent the deterioration of relationships between neighbors by building the wine cellar, precisely by blocking or narrowing the access to the wine cellar. Since the first wine cellars have been erected on common land, everyone has had the right to his own wine cellar. A minimum width of the alleyway between wine cellars had to be such as to provide free access of loaded horses or horse-drawn carts to the wine cellar entrance.

The land on which wine cellars have been erected has been in the ownership of the municipality in which they have been located, so that any villager could build a wine cellar in a suitable place, provided that he/she should not obstruct any alleyway or access (Pantelić, 1960).

Design and the way of construction

One-storey houses

Wine cellar interior is often a single space of irregular shape, which is directly conditioned by building the cellars in an incoherent structure.

Smaller wine cellars have been of approximate size 4×4 m, while bigger (less often) ones, about 3,5×7 m and usually with two rooms (Žikić, Đorđević, 1999). Spatial organization of wine cellars is simple, with barrels placed along both sides of the cellar and a working space in the center.

Half dug-in cellars

The back side of most wine cellars is dug into the ground, with floors that are lower than the street level (50cm in average), and with a few descending stairs at the entrance. The floor is made mainly of raw earth (and less often paved with bricks) in order to maintain proper humidity level in the cellar.

By building on the slope and lowering the wine cellar floor below the street level, the wine cellars is sometimes even up to 2 m dug into the ground. By half-digging the wine cellars, an access from two levels is provided: a) from the level of entry doors, through which equipment is brought in and the wine cellar entered; and b) through openings at higher level of the wall opposite the entrance, through which the grapes are brought in.

Outdoor staircases

There are very few one-storey buildings with wine cellars in the Rajac complex owned mainly by affluent persons. Aiming at optimal usage of interiors of buildings with wine cellars and more directly connecting the ground floor with the first floor, the outdoor staircases are built along exterior walls not to prevent passing of horse-drawn carts.

The staircases are made of wood and such placed to provide an easy access to the first floor, but without narrowing the alleyway leading to neighboring wine cellars.

Fig. 4. Outdoor staircase

The staircases are always built as outdoor staircases, skillfully taking advantage of the terrain inclination in order to be shorter, particularly because the cellar had to be dug into the ground (Stanisavljević, 1989).

Due to their outdoor stone staircases and specific way of building stone stairs, the Rajac wine cellars are often compared to Dalmatian coastal towns (Croatia).

Entrance on the corner

An unusual element often found in the Rajac wine cellars is an entry door on the corner.

Fig. 5. Entrance on the corner

Similar example of the entrance on the corner is found with dwelling houses in the south of Serbia, the Republic of Macedonia, and immediate surroundings, particularly on the entrance from thresholds or small hallways to some of the rooms.

Taking into account that entrance to rooms in dwelling houses has been considered in the similar way as the entrance into wine cellars, it may be assumed that the Rajac wine cellars have been considered not only as a complex, but also as a space in a big house.

The position of the door on the corner provides the possibility of viewing the whole room by merely entering in it, but at the same time it does not disturb the organization or uniformity of the room (Kirovska, 1981). Such positioning of entrance also enables optimal use of space, which is of importance for the wine cellar space, because barrels and tubs are placed along the walls in order to provide a free central part for handling and work on wine processing.

Cutting the outer corners

Given that the streets in the Rajac complex are mostly very narrow, cutting the outer corners, where possible, has been considered while building the wine cellars, thus providing the enlargement for maneuvering during transportation of grapes.

With irregular bases of wine cellars, this principle was necessary to implement because of some backside corners, otherwise it would be difficult to maintain and use wine cellars. In cases when it was necessary to free a wider alleyway, the corners of wine cellars were cut to a greater extent, or an "entrance on the corner" was built.

Ornamentation

In addition to the basic function of doors to provide connection between two spaces, the doors in folk architecture have also served for identifying the room to which they have led. More representative doors have been more richly decorated, often with shallow carved surface decorations and geometric lines (Kirovska, 1981).

The examples of decorating the doors are also found in the Rajac wine cellars, where ornaments may be found on the entry doors leading to wine cellars, as well as on window openings, eaves, and corners of houses.

Besides having a role in decorating, the ornament symbols have also indicated the purpose of the space on the other side of the door.

At many places, anthropomorphic representations of abstract faces symbolizing the owner or some of his/her family members may be found above entrances to the wine cellars. Through portraits carved in stone, the owner or person to whom the wine cellar is dedicated is identified with his/her house. The ornaments in the form of geometricized bunch of grapes, as well as unusual symbols of Ionic volute and eye, may also be found.

Choice of materials and way of construction

If we look back into the architecture of the past, the buildings were mainly built out of stones (Martinković, 1985):

1. In the areas where stone was used as a basic building material, regardless of difficulties in extracting stone from excavation pits and its subsequent processing;

2. Whenever someone wanted to emphasize his/her own wealth, prestige and political power; and

3. When there were tendencies towards achieving the visual harmony between the building and its natural environment, etc.

Processed (roughly or finely chipped) or raw stone was used to build the Rajac wine cellars. Finely chipped freestone was used to build wine cellars belonging to affluent persons, as well as for strengthening the wall ends. The stone used to be transported from quarries on the hill across the wine cellars. The raw stone was used to build walls, foundations and staircases.

The stone ranged in several colors from natural stone color, natural white color, grey and golden-yellow or their gradation, just like in other examples of folk architecture in surroundings (Kirovska, 1981).

The walls were built out of more massive blocks on the corners of the houses in order to strengthen the wall-to-wall connection (stretcher & header type), while walls were filled with

broken stone. An average thickness of the wall was about 50cm, being sufficient enough to provide the necessary conditions for wine care.

At some places, the projected stones served to strengthen the wall - to - wall connection of neighboring wine cellars, at the same time providing cheaper construction.

This old customary rule was known throughout Croatian and Montenegrin coast as the "right to share a wall".

Windows and doors

Bridging the span by stone arcades, which has been for centuries passed on in form of architectural experience and tradition has been carried out in the form of profiled arch in the Rajac wine cellars with decorative geometrical, anthropomorphic and vegetable ornaments edging.

Most of authentic doors and window openings in the complex have stone arches, except for a smaller number of them with wooden lintels above doors and windows. Arches on doors and sometimes on windows are mainly profiled and the single-layer or double-layer ones (with the second profile being slightly recessed).

Fig. 6. Windows and doors

Over time, bricks have been used as a building material mainly for various repairs and renovations. However, although bricks have not been an original building material, at some places they have been well and harmoniously placed.

Window openings on wine cellars have mainly been equipped with board-and-batten wooden shutters (sometimes coated with sheet metal) or without any visual or thermal protection, except for iron grilles. Widows have mostly been north-oriented, thus protecting wine cellars from direct exposure to sunlight.

The original entry doors in wine cellars were made of wood. Later, they have been coated with sheet metal and for 10-15cm wider and higher than the largest wine vessels designed for cellars (ranging in size from~200 to 220 cm).

Roof structure and roofing

Most of the roofs are double pitched and four pitched roofs, although there are more complex forms of roofs at places with cut corners of wine cellars. Roof structure also contains rafters connected to wooden ceiling beams by wooden hangers.

Specific feature of roof structure are "double-layer" eaves with rafters supported by ceiling beams and thresholds often projected for about 120 cm and more. They served for driving in the carts, so the work could be easily carried out even during the rain.

Similar example of roof structure may often be found in the examples of ethno-architecture in the south of Serbia and in the Republic of Macedonia.

The roofs have mainly been covered with mission tiles, but they have recently being replaced with flat roof tiles. Precisely the roof represents the greatest problem in association with wine cellars in terms of necessary technological conditions, since the roofs cannot satisfy the modern technological conditions for wine care due to lack of adequate thermal protection and intensive overheating of space through the roof surface.

In the past, the roofs were covered with a layer of reed which was fastened to the lower part of the ceiling beam. Over time, the wine cellars have been poorly maintained due to which they are today in a poor state.

When walking through the complex, one can easily notice that there are no chimneys. Wine cellars have since ancient times been called "houses without fireplace".

Given that primarily they have not meant to be a place for stay, but a place for wine production and storage, chimneys are found only occasionally and mainly on one-storey houses with wine cellars.

This is precisely one of the essential differences between the complex of wine cellars and other settlements in the Republic of Serbia, since they have been large production complexes with visual and other characteristics of the settlement.

IMPLEMENTATION OF RULES OF CONSTRUCTION AND THE INFLUENCES OF MIGRANT WORKERS IN BUILDING THE WINE CELLARS

The majority of wine cellars, , was erected by borrowed workers – upon request (Žikić, Đorđević, 1999). Building the wine cellars was not a simple task at all, it required experienced craftsmen. We learnt from many sources (Pantelić, Maslovarić, Hasanbegović) that the original wine cellars were built by migrant workers coming from the Republic of Macedonia. After completion of the renovation of the first wine cellars, migrant workers explained their way of construction to some villagers. Some of them even settled and continued to live in Rajac.

What has not been sufficiently clarified, but may only be hinted, is to what extent the immigrant workers have influenced the way in which the wine cellars have been built, as well as whether the customary rules have been implemented in building the original wine cellars and, if so, to what extent?

Analyzing the spatial organization of the complex, it may be noticed at first sight that the structure of the complex probably emerged spontaneously, but that, nevertheless, there are certain regularities which may be explained as a result of social consensus.

In the period before the coming of the migrant worker, the old social norms that were passed on from generation to generation in form of customary rules had a dominant influence. Based on these rules, the first wine cellars were positioned on top of the hill, far from damaging smells and the village. Furthermore, awareness of being thrifty while building the wine cellars, is reflected in the fact that they built only on barren land less exposed to the sun, as well as in the need for wine cellars to be closer to vineyards, indicates the logics which is not used only in this region, but in other regions as well (Dubrovnik, Korčula, etc.).

In the period when the wine cellars needed to be renewed, the migrant workers brought other (Oriental, Byzantine) influences reflected in a specified way of building with stone and taking into account previously defined spatial organization of the settlement.

Therefore, these influences may be classified into two groups: the first group, comprising old customary rules of construction which implementation resulted in a specific organization of the settlement, and the second group, comprising the influences from "outside", which may be recognized in the way of construction of migrant workers.

Customary rules might have had an influence during the organization of the original settlement and positioning of wine cellars:

1. Land division - parceling, the use of barren land, wells, and organized payment of watchman's compensation;
2. Right to share a wall - right to free access to wine cellar;
3. Wine cellars in the vicinity - it has not been possible to go to vineyard, work in it and then return to the village in the same day;
4. Right to healthy environment - tendency to relocate dirty facilities far from the house (in the village), as well as to build wine cellars far from strong smells and dirt;
5. Arable land and development - tendency to save arable land by positioning and building the wine cellars on barren land;
6. Grouping the wine cellars - adapting to terrain topography and cost-effective construction;
7. Gathering place of the villagers - the need for a space at which festivities and rituals are to take place (at the tree - inscription).

Influences of Byzantine and partially Oriental architecture, interwoven in the architecture of the Rajac wine cellars thanks to migrant craftsmen, are the following:

1. Entrance on the corner - the use of poorly accessible place for entrance
2. Projecting the deep eaves - possibility to work even during the rain
3. Carved rafters - need for beautification, being distinct
4. Ornamentation - need for beautification and hint of activity carried out on the other side of the door or window
5. The right to share a wall - leaving projected stones as a possibility for neighboring wine cellars to be later connected.

It is difficult to find out what has had more influence on the final elevation of wine cellars, either migrant worker's way of construction or the need for obtaining adequate conditions for wine processing and wine care.

There has been an old story amongst the Rajac villagers that, during the period when grape Phylloxera plague spread in Europe, a group of French wine growers came to the village in search for the best place to protect their best grape sorts until the disappearance of grape Phylloxera plague. It is quite possible that they exchanged their experiences with the villagers, since the period when the first stone wine cellars were built coincides with the time when French oenologist came.

Probably that in the time of emergence of wine cellars, it was necessary to provide elementary conditions for wine making and care. In that period, the Rajac wine cellars were not much different from other wine cellars in their surrounding. When the need has arisen and their financial position has become better, the Rajac villagers erected wine cellars worthy of the value of their wine.

It is well-known that the Rajac villagers are extremely proud of the quality of their wines. They are also very proud of their neighbors from Rogljevo and Smedovac, so that it may be assumed that their immeasurable rivalry has emerged from building these exceptional wine cellars.

CONCLUSIVE CONSIDERATIONS ON THE IMPORTANCE OF WINE CELLARS AND APPICABILITY OF CUSTOMARY RULES TODAY

One of the reasons for actuality of these theme lies in the need to indicate the existence of customary rules in folk architecture also on the territory of the Republic of Serbia, their appropriateness and justifiability in the past, as well as to indicate the possibility for their implementation today in plan and technical documentation (Maksin-Mićić, 2005), but also in promoting and revitalizing cultural heritage (Đokić, Radivojević, Roter-Blagojević, 2008).

The Rajac wine cellars are a valuable indicator of regularity in organizing economic (wine) settlements in old times, that has been considered nonexistent in such form in the Republic of Serbia.

The closest examples of similar organization of wine and other settlements may be found in the Republic of Croatia (Korčula, Dubrovnik, Ilok, Grožnjan, Motovun) and the Republic of Montenegro (Budva, Kotor), where their existence and the use of customary rules in building the structures has been ascertained[3].

Customary rules are a specific example of folk methodology of organization and construction since they are based on the respect for life, space and good neighborly relationships.

They have existed for centuries in customary laws and have been orally passed on to new generations, to be, in a certain moment, integrated in written form into town statutes of economically developed towns[4].

Today, when we are witnesses of arrogant behavior, illegally built structures and even more bizarre architecture in the Republic of Serbia, it is necessary to point out the existence of rules which have been used in old time as oral rules for building the space. A feeling for the culture in building as perceived in old times has been lost. Today, the construction is more rapid, life is quicker and there is almost no respect for the spirit of the place, respect for heritage and proven cultural forms.

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[4] Statutes of Korčula of 1214, Dubrovnik of 1272 and Ilok of 1525 indicate the same or similar rules of construction: respect for old buildings, right to healthy environment, right to access, right to privacy, right to view, inviolability of parcel, gathering place of the collective, division of land against compensation, right to share a wall, right of passing, etc.

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IMPACTS OF TRADITIONAL ARCHITECTURE ON THE USE OF WOOD AS AN ELEMENT OF FACADE COVERING IN SERBIAN CONTEMPORARY ARCHITECTURE

Jelena Ivanović Šekularac[1], University of Belgrade, Faculty of Architecture, Belgrade, Serbia
Nenad Šekularac, University of Belgrade, Faculty of Architecture, Belgrade, Serbia

The world trend of re-use of wood and wood products as materials for construction and covering of architectural structures is present not only because of the need to meet the aesthetic, artistic and formal requirements or to seek inspiration in the return to the tradition and nature, but also because of its ecological, economic and energetic feasibility. Furthermore, the use of wood fits into contemporary trends of sustainable development and application of modern technical and technological solutions in the production of materials, in order to maintain a connection to nature, environment and tradition. In this study the author focuses on wood and wood products as an element of facade covering on buildings in our country, in order to extend knowledge about possibilities and limitations of their use and create a base for their greater and correct application. The subject of this research is to examine the application of wood and wood products as an element covering the exterior in combination with other materials applied in our traditional and contemporary homes with the emphasis on functional, representational art and the various possibilities of wood. In this study all the factors that affect the application of wood and wood products have been analyzed and the conclusions have been drawn about the manner of their implementation and the types of wood and wood products protection. The development of modern technological solutions in wood processing led to the production of composite materials based on wood that are highly resistant, stable and much longer lasting than wood. Those materials have maintained in an aesthetic sense all the characteristics of wood that make it unique and inimitable. This is why modern facade coating based on wood should be applied as a facade covering in the exterior of modern architectural buildings in Serbia, and the use wood reduced to a minimum.

Keywords: ***wood, wood-based products, composite materials, modern facade coatings, coating of architectural facilities in Serbia***

INTRODUCTION

Influences and interpretations of traditional architecture elements in the contemporary architectural works in Serbia can be grouped into several categories. What makes popular architecture rich and varied is the diversity of historical phenomena and forms transposable to contemporary architecture in more or less recognizable way.

Various possibilities of interpretation of the motives used in contemporary architecture are developing based on the experiences of traditional folk architecture. These impacts can be classified into two main categories:

- creative procedure,
- creative analytical procedure (Trifunović, 1969).

The creative influence of tradition on contemporary architectural work is reflected in the direct visual recognition of the creative approach, which can be characterized as: formalism, imitation, citation, stylization (Trifunović, 1969).

The analytical creative process relies on the subjective experience of the interpretation of tradition by accepting the past as the criterion. This procedure excludes the past as a cult that should be cherished, and the past experiences transformation in the modern architectural work. The methods applied in this procedure can be characterized as a partial influence of tradition and transposition (Figure 1). The transposition in architecture, in the most abstract form, becomes the best artistic result that takes the past as the criterion, shows a sense of belonging and attachment, as well as the ability to re-interpret the sensibility of the traditional local architecture in the form of modern sensibility found in the new architectural work (Marić, 2006).

Figure 1. An example of partial impact of the tradition and transposition to the modern architectural work, House Pejović, Povlen, architect Blagota Pešić, 2004. (27th Salon of Architecture, 2005)

[1] Bul. kralja Aleksandra 73/II, 11 000 Beograd, Serbia
jelenais@sezampro.rs

As a reflection of the formalism in architectural structures in Serbia today, we can see the simplicity of form - great hipped roofs with emphasized eaves and elements of the wooden structure and flat facades with wood elements as decoration. This type of approach to the finalization of some modern buildings is based on the assessment of qualities of traditional folk architecture and the formal application of these elements in new buildings without the prior analysis of the element itself or its characteristics. The examples of family houses built in the style of traditional architecture by applying the forms and proportions of old buildings, as well as traditional materials, have an impact on the creation of new environments associated with the tradition and the preservation of existing environmental units in which the spirit of tradition is intertwined with the modern spirit.

The connection to the traditional architecture is sometimes expressed by a quote in the architecture, by introducing only a detail or element which represents a connection with the architecture of the past. The introduction of a symbol represents a process that establishes the connection between the modern architecture and the traditional and regional architecture. The application of the symbols of folk architecture – porch, emphasized wooden roof structure, wooden shingle as a roof covering, post and petrail construction on the facade, or wood as a facade lining in the contemporary architectural structures – represents the partial impact of tradition on contemporary architecture (Marić, 2003).

By using stone, wood, brick and S-tile as roofing i.e. original materials typical for the architecture of Serbia as a region, it is possible to emulate a certain style simplifying the form and shape. All this is applied in order to obtain a new work of contemporary architecture in which the stylization procedure modified the old element, but it is consistent enough to be recognizable. There are examples of successful stylization in a large number of vacation homes and public buildings built as original work by excellent architects in Šumadija and the Morava River basin.

Figure 2. Vacation Home, Mountain Rajac, architect Božidar Petrović, 1979., (Petrović, 1997)

Porches, hipped roofs, deep eaves, wood as an element of the facade cladding, stone as an element of connection with the ground, are recognizable elements of structures built by emulating a certain style or architectural work, resulting from the designer's desire to preserve the original values of folk architecture (Figure 2).

APPLICATION OF WOOD AND WOOD PRODUCTS IN MODERN ARCHITECTURE IN SERBIA

There is a tendency towards affirmation and realization of the continuity of the national heritage in one part of Serbian contemporary architecture. This is reflected in the protection of architectural heritage, the study of folk architecture and the inclination to transfer the principles and spirit of traditional architecture into the contemporary architectural works. The application of wood in contemporary architecture, as the old - new material, brought about the elements of national creativity as an attempt to introduce a change which has the aesthetic, constructive and stimulating effect on the overall perception and understanding of architecture.

It is possible to achieve an original work of creation by building in the style of regionalism with the use of indigenous materials, building technology and traditional designing methods for a specific situation – on the spot.

The tendency to preserve the regional characteristics of architecture is an important, almost strategically important element of national expression from the viewpoint of the correct and rational use of land, preservation of the identity and particularity, the formation of high-quality environment in the natural or already built scenery, energy saving and conservation of natural resources and improvement of life conditions (Krunić et al, 2009).

In Europe as well as in the world, in addition to the general aspiration to reach universal integration and globalization, the sphere of arts, including architecture, witnesses the regional cultural trends that are being developed as a reaction to general tendencies. Considering the fact that the global trends in architecture are: diversity, variety, particularity and the pursuit of individual, in response to these aspirations in architecture in our country there is interest in regionalism and the inspiration is sought in the folk architecture (Figure 1 and Figure 2).

In many countries of the world in rural areas and areas outside urban centers, the stylization as a creative process of emulating the certain style and the simplification of certain elements or partial abstraction with more or less resemblance to the original style or work, maintains a constant connection to the traditions and folk architecture.

Our architectural tradition represents a great potential and can be an eternal inspiration for modern architects to find ways of building and designing homes that would be more compatible with the region. This statement can be adopted as one of the possible approaches and we could give it a real significance in the creation of modern architectural works. What is important and good in the world practice should be applied to the extent allowed by climate, functional, morphological and economic conditions in Serbia. We should build in a modern, but different way and successfully follow what is good in our traditional architecture. In our country, there are few modern buildings inspired by traditional architecture. We should not mindlessly copy the architectural tradition with no connection to contemporary trends in architecture. Our architectural tradition, whenever possible, should serve as inspiration to develop modern construction methods and design houses that would best fit in this area. The solution to many problems currently present in the Serbian architecture lies in undertaking efforts to educate the future generations of designers and builders and in taking a more inspiring, creative and modern approach to the implementation of traditional architecture elements in a new and modern way and their successful combination with modern materials.

Today, when an architect designs a building that needs to fit into the environment and conform to the principles of ecological construction, natural materials and appropriate protection measures must be used at every stage of construction and operation of the facility: the appropriate use of material depending on its functions, the protection of materials, maintenance and removal of failed parts.

Possibilities and limitations of wood application in our modern architecture

The possibilities and limitations of application of wood in our architectural practice are as follows:

- Architectural solution, type of assembly and the position within the architectural assembly condition whether and how the wood will be applied in one facility.
- In comparison to other materials (stone, brick, concrete, metal, glass), wood has a much shorter durability, which limits its application.
- Our climate conditions – cold and long winters, with precipitations and strong wind,

hot summers, with large oscillations of temperature, high humidity and exposure of the materials to solar radiation – have an unfavorable impact on wood and therefore require constant maintenance and occasional replacement of wood as a coating. Wood is the material of limited capacities in terms of durability and in order to extend its life and keep the original appearance one must apply special care, and also consider the application of modern products of wood industry, which in terms of durability and sustainability of the original look have better properties than wood.

- Construction in wood is wrongly associated with the accessory facilities or social housing, which is a big misconception about wood rooted in the understanding of people of this region. The reason for this prejudice is the several-decades-long practice to build accessory and temporary facilities solely of wood.
- A house of wood must be made in continuity, for wood as a material does not permit the construction in phases, and that requires considerable financial resources. On the other hand, what characterizes the construction in our country is precisely construction in phases, which often lasts for years due to lack of funds. Certain number of our individual family houses never get their final appearance, i.e. facade, because the owner of the facility is incapable to finalize it. In case of building wooden houses, the construction in phases is not possible because the house has to be completed entirely, including the final layer, i.e. a facade has to be complete, and this is the reason why a small number of houses has wood as the final layer.
- Lightness of wood as a material allows the self-construction.
- Wooden construction with its lightness contributes to the economy, especially for facilities that are built in inaccessible places. In case of construction of a wooden facility on an inaccessible site the costs are 40% lower than the cost of construction with concrete structure (Gauzin–Müller, 2004).
- The limitations of the use of wood in this country are also conditioned by the economic factors, since the necessity of ongoing maintenance and possible replacement of dilapidated elements of wooden panels with the help of skilled labor requires financial resources.
- The use of pre-dried timber and prefabricated elements greatly reduces the setup phase of construction and construction costs.
- The installation of wooden construction does not require large machinery, so the noise during the installation is significantly reduced.
- The facility built of wood fits well in the natural environment and achieves the unity between the building and nature.
- Contemporary architectural works built in the urban environment should also contain transposed elements inspired by traditional town home, but presented in a new and contemporary way, using modern materials and wood-based materials.

Based on the above, we can conclude that wood can be applied only in certain parts of the architectural object, with the application of appropriate protection measures and their implementation on an entire facility. The advantage of wood as a material is in its lightness and the possibility to construct without the use of complex machinery. In modern construction, wood industry products have a great advantage over wood since their exceptional features can compensate for all the weaknesses of wood as a building material.

Application of softwood in contemporary architecture in Serbia

Conifers are softwood and they are used as the building material for the inner and outer lining.

With soft wood the work is easy; it is found in large quantities and is suitable for use in a variety of activities. The types of soft wood that can be used as a facade cladding are: juniper, larch (yew), pine.

Raw, unprotected wood may eventually become grey under the influence of outside air. However, too much humidity and other unsuitable conditions may make it suitable for the development of tree fungi or ugly stains. If soft wood is not impregnated with protective means on time, its external surface remains unprotected and allows the natural tarnishing of wood to remain visible and in most cases ruptures and cracks appear on the outer surface.

Subsequent decay protection of already built-in wood is recommended as a kind of complete protection. The method of application of surface protective means differs from opaque coatings, which hide the color and the structure of wood, to transparent coating materials that allow the wood structure to remain clear and visible, and, depending on the pigments that are added, may or may not dye the wood.

Softwood in the form of veneer, wood wool, sawdust, splinters and fibers, with the addition of glue or other binders is usually used to obtain new composite products. Composite materials with plastic are also produced from softwood, as well as laminated constructions and wooden roof structures.

Application of hardwood in contemporary architecture in Serbia

Deciduous trees represent hardwood whose largest number of species (oak, hornbeam, etc.) is more lasting than coniferous, softwood.

Raw hardwood has a more universal application than raw softwood. The structure and color of hardwood, visible on the surface, are aesthetically more valuable than the structures and colors of softwood. Therefore hardwood is more often used in visible places, interiors and for furniture covering.

Hardwood and softwood are both widely used in construction: for making windows, door frames, and for different ways of facade cladding with boards, with and without flaps (in touch). This coating may be placed in different ways, depending on the desired effect, as follows: horizontally, vertically or diagonally.

Less resistant timber may be pre-protected by impregnation or may be protected by coating, which contains the paint for wood and thus protects it from tarnishing. These coatings can be opaque and completely cover the colour and structure of the wood; or transparent and leave the color and structure visible. Depending on the added pigments, they dye the wood to a greater or lesser degree.

Hardwood, due to its sometimes extraordinary visual characteristics, is most often used to obtain the products in which the veneers of selected hardwood have a major role.

It is important to emphasize that the application of a certain type of wood depends on its value. Wood with extraordinary aesthetic properties, such as walnut or mahogany, is primarily used for coating the interiors and furniture making because of very high prices. For luxurious works in the interior, the stairs and coating, high-quality types of wood are used: oak, ash, maple, elm and decorative exotic wood as monolithic wood or as laminated wood panels.

Use of products of thermo-wood in modern architecture in Serbia

Thermally treated wood products (thermo-wood) are used for exterior cladding. In Serbia, ash and hornbeam are exposed to the procedure of thermal treatment.

The term thermo-wood refers to wood that is thermally treated at temperatures ranging from 160 to 260° C. The exposure of wood to high temperatures is carried out for several reasons. During the thermal treatment the most important thing is to achieve increased dimensional stability and resistance which

significantly increases the durability of the wood. Under the influence of high temperature warping, swelling and pulling in of the wood reduces by 50%, which allows the use of thermally treated wood in conditions of high humidity and direct exposure to atmospherilia, which is typical for our climate areas. Thermally treated wood has a lower moisture equilibrium and therefore it is extremely resistant to the attack of rot fungi. Under the influence of temperature the thermal insulating properties improve, but it is necessary to point out that the hardness of certain types of wood may be reduced by this process.

Depending on the temperature level to which the timber was exposed during this process, its color changes and can vary from light beige to dark brown. Treated in this way, domestic species of wood are similar in color to tropical species. In addition to all the reasons above, the thermal treatment of wood is of particular importance for our country, rich in wood species whose quality is improved by thermal treatment.

Thermally treated wood is a completely ecological product which does not contain substances that may be harmful to the environment. The use of this new technology enabled the use of thermally treated wood not only for the interiors but also for external use, as facade cladding. Thermo-wood is used for the outer coating of porch floors, yards and pool decks (http://www.sagadrvo.rs/).

APPLICATION OF WOOD AND WOOD PRODUCTS AS FACADE COVERINGS IN CONTEMPORARY ARCHITECTURE IN SERBIA

In contemporary Serbian architecture wood is hardly used as the material for the outer coating. There are only few examples of architectural structures in which this type of coating is present. Mountain winter tourist centers: Kopaonik and Zlatibor, where wood is present as facade cladding, are exceptions.

Figure 3. Wood in combination with a full wall carcass as a facade cladding and roofing, Grand Hotel, Kopaonik (http:// www.kopaonik.net/main.php?case=smestaj&leng=ser

The stone and wood combination is present in the mountain facilities. The walls of the ground floor are covered with stone, while the facade walls on the floors and big roof inclined planes are covered by wooden lining (Figure 4). Deep eaves lined with wood are the architectural features of buildings in these mountains. Wood applied for the facade and roof covering of buildings represents the organic approach to architecture in Serbia (Figure 5). Covering of roofs, eaves and small roof windows with wood is present at all facilities within the hotel and apartment ski resort of Kopaonik. In Belgrade, there are few examples of setting wood as facade panels. Wood as a facade cladding is exposed to all the negative external influences in our weather conditions which cause its natural aging. These examples of setting the natural wood as a facade covering represent the organic principle in architecture.

Figure 4. The combination of stone and wood as a facade cladding, "Paraglajder" Apartments, Kopaonik (http://www.kopaonik.net/main.php?case=smestaj&leng=ser)

Figure 5. Wood applied as a wall, facade and roof covering; organic approach to architecture, Mountain House "Rtanj", architect M. Đorđević, Kopaonik, (http://www.rtanj.com/ wp-content/uploads/2008/10/image025.jpg)

Following modern international architectural influences, with an aspiration for ecological design and application of modern materials, as well as fitting into the modern trends of sustainable development and connection with nature and tradition, leads to the application of modern technical and technological solutions in the design and implementation of individual architectural solutions.

The application of wood as a facade covering in the architecture of Serbia, if we exclude the mountainous area, is very rare. The reason for this lies in the features of our climate and the deterioration of the wooden panels under the influence of atmospherilia and solar radiation. Examples of setting timber on the facades are few due to need for permanent protection.

On one of the buildings which is an example of Belgrade modern architecture featuring elements of moderna, there is one part of the facade where natural wood is applied as a final facade cladding. The combination of wood with a painted wall surfaces, as well as other parts of the facade coated with composite materials, is a unique architectural work.

Figure 6. The facade is created as the combination of wood, composite materials and painted wall surfaces. Multi-family residential building "Condominium 41-7", Velisava Vulovića Street, Dedinje, Belgrade, architect Mustafa Musić, 2008., The appearance of the building (http://www.enterijermagazin.com/index.php/mustafa)

It is possible to combine wood as an element of facade covering with other materials, brick for example (Figure 7), but also with a simple flat painted wall planes. The example of such a building, of simple lines is given in Figure 8.

Figure 7. The combination of wood and brick as a facade lining, Milovana Marinkovića Street, Voždovac, detail of the building – the tower covered with wood (Ivanović-Šekularac, 2010)

Figure 8. Wooden facade lining in combination with white wall surfaces and details of metal, Residential building in Dedinje, Belgrade, architects Adam D. Miljković, J. Mitrović , 2004. The appearance of the building (Ivanović-Šekularac, 2010

The examples of completed architectural buildings in Belgrade, with natural wood as an element of facade covering, speak of the possibilities of applying natural wood in order to fullfil the artistic and aesthetic requirements in the materialization of contemporary architectural buildings.

Modern technological solutions provide the possibility to set thermally-treated wood in the places where the wooden cladding is exposed to environmental influences, which greatly improves the characteristics of wood panels and extends their lifetime. Of course, the original appearance of wood changes gradually. However, such thermal treatment delays the aging of wood and thus its physical deterioration. In that way, by using this kind of products, we can keep all the aesthetic features of natural wood that make it unique and unrepeatable. This modern solution affects the aesthetic experience of the architectural object.

The tendency to coat with small elements of natural wood influenced the application of modern coating – a substitute, as the final facade lining (Figure 9). These composite materials can be smaller in size – as elements of sawn timber or they can be bigger – in the form of boards (Figure 10).

Figure 9. Wood as an element of the facade cladding in combination with a facade of artificial stone, Residential building, Kumanovska Street, Belgrade, 2000. Branislav Mitrović, The appearance of the building (Ivanović-Šekularac, 2010)

Figure 10. The combination of composite materials and painted wall surfaces on the facade, Residential building in Gospodara Vučića Street , Street appearance of the building (Ivanović-Šekularac, 2010)

Facade coating with composite materials in the form of boards is represented in the observed objects. What is noticeable is that different types of composite coating appear in our market (Prodema, Parklex, Tespa, Fundermax).

There are high-quality composites applied in facade cladding with a front of natural veneer, or with a layer of real wood and the appropriate protection. These products have excellent aesthetic properties and uniqueness of real wood.

Figure 11. Composite material as a facade cladding in combination with glass and metal on the facade, Building in Jagićeva Street, Belgrade, Street appearance of the building (Ivanović-Šekularac, 2010)

These examples of completed architectural buildings in Belgrade speak of diversity in terms of aesthetic features, as well as the quality of applied composite facade products.

Figure 12. Composite material as a wooden facade cladding in combination with painted facade walls, Apartment building, Velisava Vulovića Street, Dedinje, Belgrade, 2008. The appearance of the building (Ivanović-Šekularac, 2010)

Figure 13. Composite material as a facade cladding, House on two corners, Mihajla Avramovića Street, Dedinje, Belgrade, architects Maša Bratuša and Lav Bratuša, 2006. The street appearance of the building (Ivanović-Šekularac, 2010)

Figure 14. The combination of composite materials as a facade cladding and a large glass surface, Building in Dušana Bogdanovića Street, Belgrade, MetricCo-architectural team, Street appearance of the building (Ivanović-Šekularac, 2010)

In the reconstruction of facilities composite material may be used as a new facade cladding.

Figure 15. An example of reconstruction of the facade by placing the composite material as facade cladding, Building in Aleksandra Stambolijskog Street, Belgrade, Street appearance of the building (Ivanović-Šekularac, 2010)

CONCLUSION

Natural wood as a facade cladding in Serbia is not often used. The reasons for such a rare application of natural wood are unfavorable weather conditions, high humidity, large temperature fluctuations and extremely hot summers and cold snowy winters. In addition, it is important to add the effect of solar radiation that adversely affects the outer coverings of natural wood. Therefore their permanent maintenance is necessary, which requires additional financial resources. By using products based on wood and composite materials it is to a certain degree possible to replace natural wood and eliminate the negative impact of weather conditions and effects of humidity and solar radiation. The modern way of coating with composite materials found its modest application in the modern architectural buildings in Serbia.

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FOREIGN DIRECT INVESTMENT IMPACT ON ENVIRONMENT IN SERBIA IN THE PERIOD 2000–2008

Sanja Simeunčević[1], University of Belgrade, Faculty of Architecture, Belgrade, Serbia

Foreign direct investment (FDI) is currently the largest source of capital reaching developing countries and a stimulant to economic growth. Although FDI benefits the economy of the "host" country, its impact on the environment can vary from pure exploitation of slack environmental regulations and the creation of "pollution havens", environmental political "chilling" effect, to the transfer of new clean technologies and the formation of "pollution haloes".

This paper focuses on FDI environmental impact in Serbia, in the period from the opening of the borders to foreign capital in 2000 until 2008, when the FDI in Serbia drastically decreased. The FDI growth of 65 times in the period of five years emphasizes the relevance of this analysis, if sustainable development is to be achieved. This paper envisages FDI impact and visible actual tendencies on Serbian environment, and defines to which of the theoretical concepts it could be arranged. The paper explores whether FDI influence in Serbia resulted in a dominant transfer of pollution intensive industries or a transfer of environmentally friendly technology and know-how, in reducing or improving environmental regulations in Serbia.

Key words: ***foreign direct investment, environment, sustainable development, developing countries, Serbia***

INTRODUCTION

The change of economic and political systems in the world caused by globalization, the setting up of a global market and intensified capital transit over national borders helped foreign direct investment (FDI) to become a capital resource indispensible for national economic growth. FDI inflow is intensive in both developed and developing countries. Global FDI flow rose five times in the period of 15 years. FDI is particularly important for developing countries. Since overseas development assistance has been reduced drastically over the last two decades, the only way for developing countries to get the funds needed for economic stimulation is through FDI. Competition for FDI is strong, and both developing and developed countries are striving to create more alluring conditions. FDI stimulates a country's economic development and GDP growth through direct and indirect benefits. However, in the context of sustainable development, economy cannot be observed separately from ecology and equity, responsible use of resources and environmental protection.

This paper concentrates on FDI impact on the environment. Since FDI is mobile, which means it can easily change location and choose another country for capital, its impact on the host country's environment can be intense. The climate of preferable conditions for FDI can sometimes include attractive environmental protection regulations. The matter of attractive environmental offer can vary from strict to loose regulations. On the other hand, the fear of losing FDI can restrain countries from tightening their environmental protection laws. As a result of FDI preferences and national strategies for development, FDI impact on the host country's environment can extend from the transfer of high pollution industries and the creation of centers of intensive environmental degradation, through a downscaling of the legislative framework on environmental protection, to positive changes through a transfer of modern eco-friendly technologies, knowledge and awareness of environmental protection relevance. Developing countries are most vulnerable to negative impact of FDI, because their level of sustainable development and environmental protection is below that of developed countries. Since Serbia belongs to the former group of countries, this research concentrates on FDI impact on the environment in Serbia.

The amount of FDI inflow in Serbia increased from 64 million dollars in 2000 to 4,200 million dollars in 2004 (SIEPA, 2008). The intensive growth of FDI inflow poses a question of its impact on the environment in Serbia. This research examines the FDI impact on the environment in the period from 2000 to 2008, since this was a period of intensive FDI inflow and 2008 was also the year when a global economic crisis started, changing economic conditions. By performing a multilayered research based on the available data, this research is attempting to reveal the impact FDI used to have on the environment in Serbia within the examined period, namely to determine whether the environment was degraded or improved. It offers an answer to the question of which theoretical concepts the FDI impact on the environment in Serbia belongs to, and what can be expected in the near future if this trend continues.

FDI INFLOW VOLUME AND RELEVANCE FOR DEVELOPING COUNTRIES` ECONOMIC GROWTH

Over a long period of time, poor and low income countries depended on Overseas Development Assistance (ODA) if they wanted their economy and growth to be stimulated. However, since 1990 total ODA has dropped

[1] Bulevar kralja Aleksandra 73/II, 11 000 Beograd, Serbia
simsanja@gmail.com

by more than a half. Greater relevance is transferred to alternative sources of capital to finance national development (ECOSOC, 2000) and FDI became the largest source of foreign capital that reached developing countries.

Foreign direct investment is defined as the investment of capital in a company, located in another country, through which the majority ownership, management and control is acquired, by purchasing existing companies, through mergers, fusion or acquisition of financial assets or by means of manufacture, or by establishing or building new companies (greenfield investment) (Zeković and Savić, 2004, p. 22). FDI is described as companies based in one country (the "home country") which own 10% or more of the stocks of the company located in a foreign country (the "host country") - this amount of stocks is generally enough to enable the home country company to exert significant control over the host country company.

From 1970 to 1990, average annual global FDI inflows amounted to 58 billion dollars, or less than 0.5% of global GDP. In 2000, global FDI inflows reached a total of 1.5 trillion or 4% of global GDP. In 2007 global FDI inflow reached the record of 1700 billion dollars (Economy Watch, 2008). As a result of the global economic crisis, FDI inflows recorded a decline in 2008, which continued into 2009. Although most of the FDI inflows refer to transactions between developed countries (around 88%), the upwards trend of FDI inflows towards developing countries is apparent (Global Insight, 2007). Brazil, Russia, India and China have been predominant recipients of FDI in developing countries over the last decades. They moved from recipients to the sources of FDI, showing their intensive development (UNCTAD, 2004). FDI has special significance for developing countries, since it is observed as a solution for the development of the economy.

FDI can have direct and indirect positive effects on the host country. Direct effects refer to the inflow of new financial resources, capital and production diversification by introducing new companies (OECD, 1998). Positive indirect effects on economic growth are more important: increase of income, local employment, foreign exchange and access to foreign markets, and improvements in income distribution; production capacity: transfer of technology and management practice, stimulation of local suppliers and subcontractors, stimulation of domestic investment, increase in the productivity of domestic companies, integration in global markets, cost reduction through competition and increase in innovation (WWF, 2003). Inflow of new capital raises a country's GDP through growth of budget income, tax income, productivity and new market expansion (Borensztein et al., 1998). FDI can play the main role in the stimulation of economic growth, although its benefits are sometimes overestimated by government policy.

Regardless of the benefit of economic growth stimulation, FDI provides risk to the home country. Negative sides of FDI may be determined as follows: hostile takeovers and extinction of companies in order to gain a monopoly, increase of wages spillover in domestic companies which cannot be supported by productivity growth, increase in unemployment through downsizing in privatized companies and environmental pollution. FDI can correlate with decrease in national economic growth (Moran, 2005). The entry of stronger production systems changes domestic market and pushes out domestic companies with its lower prices. Up to 30% of domestic companies have reported the loss of domestic market after FDI inflow (Lin and Saggi, 2005).

Without adequate local regulations, there is a wide range of possible "direct damages" which can be inflicted by multinational companies. This paper will concentrate on environmental risks, pollution and degradation as a result of FDI inflow in host developing country in the case study of Serbia.

FDI inflow in Serbia

Countries in the Balkan region, including Serbia, have seen fundamental changes under the influence of various interacting agents of economic integration and transition (Petrakos and Totev, 2000). Serbia has been transiting from a planned economy towards a market one. During the 1990s, Serbia underwent a difficult economic and political period. Like other countries in the Balkans, Serbia went through a period of transitional recession, which overlapped with wars and international sanctions. In 2000, the level of GDP was 40% of its value from the 1990s economy (Hadžić and Zeković, 2005). The political changes in the early 21st century opened Serbia to accelerated economic transformation by returning the country into the international community, particularly international financial institutions. Serbia set off on a path of intensive transition towards a market economy. Since it did not have enough capital to go through privatization, it turned its strategy towards FDI as the main source of live capital.

In the year of 2000, with the amount of 64 million dollars, FDI was barely present in Serbia. The very next year the shift to a new economic system was more evident and FDI stood at 165 million dollars. Serbia adopted a new Law on Foreign Investment[2] in 2002, which made FDI easier and stimulated its inflow. In the following years, the rise of FDI was constant and on an upwards scale, rising from 475 million dollars in 2002, through 1,360 million dollars in 2003, 965 million dollars in 2004 to 1,515 million dollars in 2005. In 2006 Serbia attracted a record amount of FDI, up to 4,264 million dollars, proving its attractiveness as an investment target. Unfortunately, FDI inflow plummeted in 2007 and was only 2,295 million dollars (SIEPA, 2008). A similar trend was also evident as well in 2008, with 2,255 million dollars. The year of 2009 brought a further decrease caused by the global economic crisis (SIEPA, 2010).

Economic stabilization and the country's growth are evident. GDP growth in 2007 was 7.2% (SIEPA 2008). Inflows of FDI in Serbia behave similarly as in other countries in transition and development: through privatization of socially-owned enterprises, investment in the food industry and the electronic, telecommunication and financial sectors (Filipović et al., 2006, p. 228–232).

This strategy did not take into account a broader view of economic development and it did not consider sustainable development. The possible impact of intensive FDI inflow in Serbia on environmental degradation and pollution was not analyzed and precaution regulations were not proposed (Hadžić and Zeković, 2005).

CONCEPTS OF POSSIBLE FDI ENVIRONMENTAL IMPACT IN DEVELOPING COUNTRIES

Intensification of global competitiveness for FDI raises concerns that heterogeneity of environmental standards will give advantage to countries with less demanding regulations, and industries which create pollution will be relocated there. This may result in a global pollution increase. Developing and low income countries are most sensitive to these threats, because they do not have as strict laws and high monitoring capabilities as developed countries. FDI impact on the environment can vary from irreparable damages to improvement of environmental quality. These influences could be classified into four theoretical

[2] Zakon o stranim ulaganjima, Službeni list SRJ br. 3/2002.

concepts: "pollution haven", "race to the bottom", "regulatory chill" and "pollution haloes".

Concept of „pollution haven"

The concept of a "pollution haven" implies global competitive forces which exert influence on foreign investors to locate their industrial complexes in countries with low environmental standards, where operational costs, in the light of environmental regulations, are lower (Gray, 2002, p. 307). As a result, countries may resort to trimming down their environment regulations and monitoring in order to remain competitive (Mabey and McNally, 1998, p. 3). Relocation of polluting industries to poor and developing countries leads to the creation of pollution havens and excessive environmental degradation.

Several research case studies conducted in developing countries support this hypothesis, but empirical evidence of consistency is lacking. The hypothesis is more sector-oriented towards industries that have high costs of environmental preservation and a small possibility of technological alterations, for which environmental regulations are the most important factor when choosing new locations (Gray, 2002, p. 307).

"Race to the bottom" concept

"Pollution haven" is in correlation with a "race to the bottom" concept. Host countries may attempt to exempt or loosen their environmental regulations to become more competitive for FDI inflow. This phenomenon can be based on the actual differences in environmental standards, without further direct actions on behalf of host countries. Studies of national regulation support the "race to the bottom" concept, indicating that countries may have benefits from eased regulations. For example, even developed countries, such as Canada and Germany, have streamlined environmental laws or relaxed enforcement in order to maintain competitiveness and keep investments from going offshore.

On the other hand, empirical evidence tends to refute the "race to the bottom" concept. It is unlikely that the state will change laws on purpose, against national interest. Moreover, most multinational companies apply equal standards on all operations, regardless of the host country, and sometimes these standards can be stricter from national environmental laws. Evidence that a government is modifying environmental laws in order to attract FDI is not obtainable, especially because negotiations with possible investors are not transparent (Gray, 2002).

"Regulatory chill" concept

The most obvious effect of the global competition for FDI is the chilling effect of regulations and its enforcement. "Competition and the fear of losing potential investors may keep regulations 'chilled', not allowing them to reach their socially optimized level (Mabey and McNally, 1998, p. 39)." This concept affects both developing and developed countries. For example, the attempt to implement tax on carbon dioxide failed, because the USA and Australia were concerned that it would deflect investment to other countries.

"The concept of 'regulatory chill' can be best described in the following manner: countries refrain from enacting stricter environmental standards because they are afraid of losing a competitive edge against other countries in obtaining FDI" (Gray, 2002, p. 310). The "chilling" attitude of the government has a particularly negative effect on developing countries, which have little or no environmental laws. Although this is the most probable scenario of a government policy, doing this in order to stay competitive while vying for FDI is the hardest to prove.

Hypothesis of "pollution haloes"

Many people fear that high environmental standards will deter FDI, but on the contrary, they can even be preferred by investors (WWF, 2003, p. 10). The costs of environmental preservation are a single segment of a wide range of factors, such as infrastructure, wages, worker productivity, political risks, market growth, that influence a relocation decision. Costs of adhering to environmental regulations are approximately 2–3% of total production costs for most companies (OECD, 1998). This is sector sensitive and in several branches, such as the petrol industry, energy, heavy metals industry, processing of non-metals and others, these costs are much higher and can influence the decision on location.

On the other hand, multinational companies are merely looking for consistency in environmental standards and their implementation. Low environmental standards usually suggest that there could be sudden alterations in legislation, sometimes after the investment has already been placed. According to the "pollution haloes" concept, foreign companies, which are the subject of tighter regulations in the home country, use cleaner technologies and more efficient management and transfer their knowledge to the host country (Gray, 2002).

The observed FDI impact on the environment does not have one determined trend: FDI can improve, degrade or have no influence on the environment of the host country. Other factors – government regulations, economic growth, sectors which are the subject of FDI, are the main variables that determine how the effect on the host country's environment will vary.

FDI IMPACT ON THE ENVIRONMENT IN SERBIA

Serbia has attracted a significant amount of FDI inflow in the previous decade. The question is how FDI actually influenced the environment in Serbia, whether Serbia turned into a "pollution haven", or it perhaps resulted in law modifications, or moved towards the hypothesis of "pollution haloes". With the actual political strategy based on FDI as the stimulant of economic growth, it is important to establish what aspect of environmental impact can be anticipated in the future according to existing indicators.

Research methodology

Analysis of potential impacts of FDI on the environment in Serbia cannot be based on direct input because of resource constraints, poor history of systematic data collection and an inadequate monitoring system, just as in other developing countries (Bhattacharya, 2002, p. 18). Research of the potential FDI impact on the environment in Serbia was carried out through available indirect data.

Evaluation of FDI impact is multi-layered and based on three different analyses, so that the results of the research would be as relevant as possible, with the available data. In the first analysis, the interdependence between GDP and environmental pollution was examined by the application of Environmental Kuznets Curve (EKC) in the case of Serbia. In the second part, the structure of FDI inflow along with production sectors was examined and it was determined whether they belong to a high pollution industry. In the third step, a comparative analysis of permissible limit values of pollutants in Serbia and in the EU was carried out. The tendency of law modification was part of the research, along with a comparison of laws. The results of the three analyses were compared and a final conclusion was drawn.

Analysis of interdependence between economic growth and environmental pollution in Serbia

FDI in Serbia has the role of the main financial resources inflow, with the aim of boosting economic development. In 2004, the amount of FDI stock as a percentage of GDP was 17% (UNCTAD, 2005, p. 64). FDI stock as percentage of GDP was in constant increase. In 2005 it reached 20.7%, in 2007 it was 33.1% and in 2008 it stood at 39.5 % of GDP (UNCTAD, 2006 and 2010). It is about one third above the world average. When FDI inflow as a percentage of the gross fixed capital formation (GFCF) is considered, FDI impact on Serbia's economic growth becomes more apparent. FDI inflow as a percentage of the GFCF was double the world average. It is evident that economic development, largely influenced by FDI, will have an important influence on the environment in Serbia. To that effect, it is important to understand the interdependence between economic development and the quality of the environment in Serbia, for which Environmental Kuznets Curve is going to be used (Grossman and Krueger, 1991).

EKC hypothesizes an inverse U-shaped relationship between a country's GDP and its pollution level. According to EKC, increased income is associated with an increase in pollution, through intensified industrialization, production and energy consumption, until a certain level of GDP is achieved, when the process becomes reversible. With an enhanced economy, countries reach the position in which they have enough resources for investment in environmental improvement. EKC "turning point" for the majority of countries was between 4,000 and 5,000 dollars of GDP per capita in 1985 (Grossman and Krueger, 1995), or between 6,200 and 8,000 dollars in 2001. However, EKC is country-specific.

EKC for Serbia was evaluated for the purpose of this research by using some indicators of environment quality – SO_2, NO_2 and smoke in the period between 2000 and 2008 in Serbia.

The EKC for Serbia shows that, with the FDI inflow from 2000 environmental pollution also intensified. The pollution was not severe, but Serbia passed the critical point of 1,600 GDP per capita when the level of pollution is the highest (Panayotou, 1995). According to the calculated EKC, the tGDP will result in an improvement of environmental quality, is between 5,000 and 6,000 dollars. In 2007 GDP in Serbia reached 5,600 dollars per capita, and it can be said that it was on the top of the reverse-U-shape curve. This suggests that with the further growth of GDP in Serbia, improvements in environmental quality and a decrease in pollution can be expected. However, the EKC does not give the whole picture. It shows the potential, but the usage of economical potential depends on national strategies, politics and regulations. Improvement of environmental quality can be achieved if Serbia effectively realizes a sustainable development strategy and implements the Kyoto Protocol[4], which means stricter enforcement of laws for integral control of pollution and regulations on the emission of pollutants.

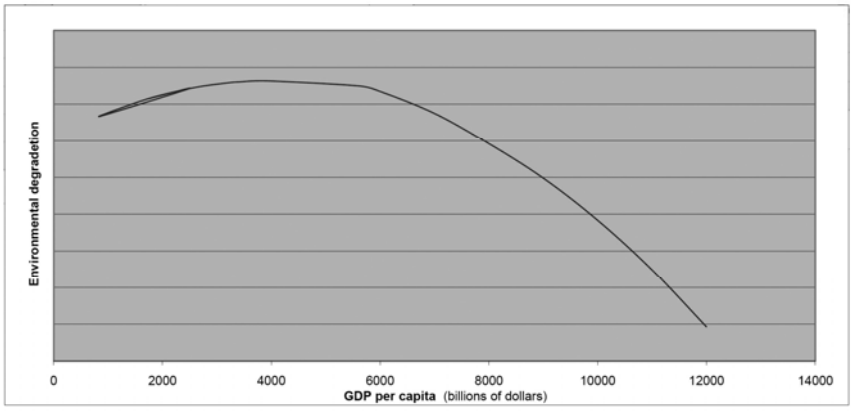

Figure 1. EKC for air pollution indicators for Serbia[3]

EKC for air quality indicators does not give a full overview, therefore the result needs to be taken with reservations. Grossman and Kruger (1995) determined the turning point of 7,500 dollars for water pollution, so it can be expected that water pollution in Serbia will still be on the rise. If the turning points of 16,300–16,600 dollars for CO, and 37,000–57,000 dollars for CO_2 (Cole et al., 1997) are taken into account, it is evident that the overall improvement of environmental quality in Serbia requires much more time and a higher level of the economic growth.

Besides income, there are also other factors that influence the quality of the environment. Studies have shown that political freedom, democracy, density and structure of industry are of equal or even greater importance than income for determining environmental quality (WWF, 2003). GDP can create favourable conditions, but actual environmental improvement depends on effective public participation and strong civil society which can exert pressure on the government demanding higher environmental quality and sustainable planning if it is to become a reality (Perović, 2008). Environmental improvement depends on government development strategies and their implementation.

Analysis of pollution intensive industrial sectors' presence in dominant FDI in Serbia

Since economic development is not the only element which determines FDI environmental impact, as there are also technological characteristics of production that must be taken into account, there is a need to examine the character of companies and industries which arrived in Serbia as FDI from 2000 to 2008. The research enquired into the scope of the largest FDI in Serbia belonging to high pollution industry sectors – the so called "dirty" industries.

There are two ways for determining high pollution industrial sectors. A conventional approach identifies those industries which have incurred high levels of abatement pollution expenditure in total expenses as "dirty" (Low and Yeats, 1992). By this criterion, five sectors emerge as leading "dirty industries": iron and steel, non-ferrous metals, industrial chemicals, pulp and paper and non-metallic mineral products. The other, more direct approach, considers the emission intensity per unit of output (Mani and Wheeler, 1999). This research will use the ranking of high pollution industries proposed by Mani and Wheeler.

To determine which scope of FDI in Serbia belongs to high-pollution industries, the 40

[3] The EKC for pollution indicators for Serbia was calculated for the purpose of this paper on the bases of the data obtained from the Statistical Office of the Republic of Serbia and the Serbian Environmental Protection Agency

[4] Orientation to sustainable development of Serbia is declared by the adoption of the National Strategy of Sustainable Development of the Republic of Serbia (Nacionalna strategija održivog razvoja Republike Srbije. Službeni glasnik RS, br. 101–07), by its implementation in the Law on Planning and Construction (Zakon o planiranju i izgradnji, Službeni glasnik RS, br. 47–03) and the Strategy of Spatial Development of the Republic of Serbia 2009–2013–2020. Serbia ratified the Kyoto Protocol in 1997, and the Law on the ratification of the Kyoto Protocol was adopted in 2007 (Zakon o potvrđivanju Kjoto protokola uz okvirnu konvenciju ujedinjenih nacija o promeni klime, Službeni glasnik RS, br. 88–07), by which act Serbia joined the ranks of 191 countries.

largest FDI in Serbia (according to the data of the Serbian Investment and Export Promotion Agency, 2008) were analyzed.

FDI inflow in Serbia in the observed period was primarily directed towards the tertiary sector, namely into banking, real-estate and market. "The processing sector attracts a smaller amount of FDI, while the greater part is directed towards the banking sector, commercial activities, trade, insurance, hotel industry, logistics and storage, business services etc" (Zeković, 2009, p. 27). Foreign direct investment in the tertiary sector makes 58% of all FDI. Primary investment in the tertiary sector is not unusual. The situation is similar in other countries. The opening of borders in 2000 and the transfer from an industrial to a post-industrial economy created new open positions for companies in the services sector (Petrakos and Totev, 2000). Privatization of banks that began in 2001 attracted a large amount of FDI. The potential for taking over this part of the market, together with establishing companies, attracted investment in commerce.

Since the tertiary sector does not have direct influence on environmental pollution, it is exempted from this research. If the largest FDI in the primary and secondary sectors in Serbia is classified by Mani and Wheeler's rank of "dirty industries", it can be noticed that investment in high-pollution industries is evident, but the amount of investment does not indicate the prevailing presence. In ten high-pollution intensive industries 17.3 % of FDI is invested, or, if the tertiary sector is exempted, 41.4 %. By examining "dirty" industries that have an impact on specific elements of the environment, it may be concluded that water in Serbia is under an extremely highest risk of pollution. In industries which Mani and Wheeler classified as high water pollutants, 70.8 % of FDI is invested in Serbia, the tertiary sector excluded.

All in all, FDI in Serbia does not show the tendencies of dominant investment in "dirty" industries and the creation of "pollution havens". The situation has been neither too positive, nor too negative. Significant portion of FDI in "dirty" industries belongs to Brownfield investments – privatization of state enterprises and acquisition, by which the overall level of pollution pressure on the environment in Serbia has not grown.

Analysis of law regulations on environmental protection in Serbia

One of the criteria that multinational companies consider when choosing host countries is legislation on environmental pollution and efficiency of its enforcement. As the pollution level of industrial production is higher, environmental regulations are more important for relocation decisions (Mabey and McNally, 1998). To understand fully if FDI inflow induced the transfer of old and polluting industries to Serbia, it is necessary to conduct a comparative study of Serbian and other countries' environment legislations. For this comparison, European Union legislation was chosen because the EU is the main source of FDI in Serbia, and as well the rival territory for attracting FDI. Permissible limit values of the commonest water and air pollutants that were in force between the year 2000 and 2008 were compared.

Serbian legislation allows for higher levels of pollutants in water and air, by up to 50%. However, these differences in tolerated parameters are not drastic, except for smoke and nitrogen dioxide. When it comes to certain limit values, Serbia has a stricter criterion than the EU. Major differences are evident in water pollutant regulations, as waterways are under the biggest threat of degradation.

Table 1. Ranking "dirty industries" according to Mani and Wheeler (Mani and Wheeler, 1999, p. 5)

Rank	Air pollution	Water pollution	Metals	Overall
1.	Iron and Steel	Iron and Steel	Non-Ferrous Metals	Iron and Steel
2.	Non-Ferrous Metals	Non-Ferrous Metals	Iron and Steel	Non-Ferrous Metals
3.	Non-Metallic Min. Prd.	Pulp and Paper	Industrial Chemicals	Industrial Chemicals
4.	Misc. Petroleum	Miscellaneous Manufacturing	Leather Products	Petroleum Refineries
5.	Pnlp and Paper	Industrial Chemicals	Potterv	Non-Metallic Min. Prd.
6.	Petroleum Refineries	Other Chemicals	Metal Products	Pulp and Paper
7.	Industrial Chemicals	Beverages	Rubber Products	Other Chemicals
8.	Other Chemicals	Food Products	Electrical Products	Rubber Products
9.	Wood Products	Rubber Products	Machinery	Leather Products
10.	Glass Products	Petroleum Refineries	Non-Metallic Min. Prd.	Metal Products

Table 2. Distribution of the largest FDI in Serbia in "dirty" industries ranked by Mani and Wheeler

Rank of„dirty industries" by Many and Wheeler		FDI in Serbia (SIEPA, 2008)		
Rank	Overall	Company	Investment (in billions of dollars)	Percentage (%)
1.	Iron and Steel	U.S. Steel-Sartid	250	6.2
2.	Non-Ferrous Metals			0
3.	Industrial Chemicals			0
4.	Petroleum Refineries	Biotech Energy Lukoil-Beopetrol	380 210	14.6
5.	Non-Metallic Min. Prd.	Holcim-Novi Popovac Lafarge	170 126	7.34
6.	Pulp and Paper	Ball Corporation	60	1.4
7.	Other Chemicals	Stada	475	11.8
8.	Rubber Products			0
9.	Leather Products			0
10.	Metal Products			0
Air Pollution				
9	Wood Products			0
10	Glass Products			0
Water pollution				
4	Miscellaneous Manufacturing			0
7	Beverages	Interbrew-Apatinska brewery Coca Cola Carlsberg	427 142 100	16.6
8	Food Products	Phihp Morns-DIN JTI Droga Kolinska Grand prom	611 100 100	20.1
Metals				
5	Pottery			
8	Electrical Products			
9	Machinery	Fiat CIMOS	700 100	19.8
	Outside the highest pollutants	Hellenic Petroleum Neochimiki-Petroleum Raf.	50 31	2

Table 3. Comparison of permissible limit values of the commonest air and water pollutants – Serbia to EU legislations[5]

Pollutant	Serbian to EU Permissible limit values comparison
S02	same
Smoke	higher
N02	higher
CO	lower
Lead	same
Trichloroethylene	higher
Carbon tetrachloride	higher
DDT	higher
Trichlorobenzenes	lower
Simazine	lower
Polyaromatic hydrocarbons	same
Pentachlorophenol	higher
Octylphenol	higher
Nonylphenol	lower
Nickel	lower
Naphthalene	lower
Lead	lower
Isoprene	lower
Hexachlorocyclohexane	higher
Hexachlorobutadiene	same
Hexachlorobenzene	higher
Fluoranthene	higher
Dichloroethane	higher

Although environmental laws in Serbia do not offer numerous opportunities for transferring pollution intensive industries, there is another problem that should also be considered. Serbia has 25 air quality control stations, six of which do not have the capacity to measure all pollutants in the air, and only 12 water quality control stations (Republic Hydrometeorological Service of Serbia, 2009). Such a small number of environmental quality control stations devalues the importance of legislation and gives opportunities for pollution intensification to remain undetected or not linked to the concrete source. This could be the element that attracts pollution intensive industries to Serbia.

As much as 30% of Serbian laws that should be harmonized with EU legislation refer to the field of environmental protection (Dulić, 2008). In the period from 2000 to 2008, Serbia passed only seven new environmental laws. Law synchronization with the EU, the modification and tightening of environmental protection regulations was quite slow-paced in the observed period. However, three of the adopted laws (Law on Strategic Environmental Impact Assessment – SEIA, Law on Environmental Impact Assessment – EIA, Law on Integrated Pollution Prevention and Control – IPPC[6]) were crucial for environmental protection, especially for the control of industrial pollution. This way a basis for further regulation improvements was constructed. Environment quality station network has not been expanded or improved yet. The real reasons of slow changes and synchronization are impossible to determine, whether it is the "chilling regulation" effect, the fear of losing competitiveness for attracting FDI or of losing the existing domestic industries which could not meet the new required criteria, or perhaps other politic consensuses.

REVIEWING THE COURSE OF FDI IMPACT ON THE SERBIAN ENVIRONMENT – TOWARDS THE CONCEPT OF "POLLUTION HAVEN" OR TOWARDS THE CONCEPT OF "POLLUTION HALOES"

During the intensive industrialization after the Second World War, the former Yugoslavia made great progress in economic transformation, which resulted in high pollution and hazardous effluents. During the 1990s specific political conditions induced industrial decline, but without a positive turn in the environmental situation. At the beginning of 2000 the quality of its environment was almost the same as before 1990 (Stojanović, 2001, p. 24). With the political turnover in 2000, Serbia entered the period of intensive economic transformation. As a low income country, it based its economic development on FDI. Because of specific conditions of international isolation and economic sanctions, FDI inflow started with a delay compared to other developing countries. Between 2000 and 2008 Serbia attracted 15.8 million dollars of FDI (SIEPA, 2010). The intensive FDI inflow might have had an impact on the environment. The question is, with which theoretical concepts of FDI impact on the environment – "pollution haven", "race to the bottom", "regulatory chill" or "pollution haloes" – can the case of Serbia be labelled.

A conclusion can be drawn from three different analyses that Serbia did not escape a negative FDI impact on environmental quality, but also a high degradation of the environment and pollution did not occur – it did not turn into a "pollution haven".

GDP in Serbia in 2000 was 800 dollars per capita. Low GDP indicates a high level of poverty, which poses the main threat to environmental pollution and degradation. In the period of seven years, GDP in Serbia was raised to 5,600 dollars per capita (Statistical Office of the Republic of Serbia, 2008). The quick hike in GDP had a positive effect by reducing the period of negative effects of poverty on the environment.

During the observed period, many multinational companies came to Serbia. "Dirty" industries (without the tertiary sector) make 41.4 % of FDI in Serbia (SIEPA, 2008). Openness to FDI and a low level of development bring along characteristics of other developing countries, such as intensive inflow of high-pollution industries. But the overall level of pollution in Serbia in the period of intensive FDI inflow did not increase significantly. Large scale of FDI, excluding the services sector, came through brownfield investment. Takeover of existing industrial complexes resulted in a change of the work system and technological innovation, without increasing the number of industrial complexes in Serbia and exerting a higher pressure on the environment (Mabey and McNally, 1998). Old, large state-owned companies in Serbia are mainly non-flexible systems with outdated technologies (Zeković, 2009, p. 30) and cause the majority of pollution incidents.

[5] According to the Directive of the European Parliament and the Council on environmental quality standards in the field of water policy, and amending Directives 2000/60/EC and 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe, Pravilnik o graničnim vrednostima, metodama merenja imisije, kriterijumima uspostavljanja mernih mesta i evidenciji podataka. *Službeni glasnik RS*, No.54/92 and 30/99, Pravilnik o opasnim materijama u vodama. *Službeni glasnik SRS*. No. 31/82 and 46/91.

[6] Zakon o strateškoj proceni uticaja na životnu sredinu. *Službeni glasnik* RS, br.135/04, Zakon o proceni uticaja na životnu sredinu. *Službeni glasnik RS*, br.135/04, Zakon o integrisanom sprečavanju i kontroli zagađenja, *Službeni glasnik RS, br.135/04.*

The loosening of regulations with the aim of becoming more competitive is not evident. On the other hand, the introduction of new laws, which create the base of integral pollution control of investment, shows a tendency towards tightening the legislation. But, legislative in force in period 2000–2008 which regulates permitted levels of pollutants in the air, water and soil was from the 1990s, and was not changed in the observed period. Serbia did not turn to the "race to the bottom" concept. The existing laws were enforced. Even the existing permissible limit volumes of pollutants did not differ drastically from the EU. It cannot be determined if there were deliberate attempts to avoid enforcement of laws in some cases.

An overall conclusion of this research implies that the FDI impact on the environment in Serbia is closest to the concept of "regulatory chill", or in other words, that in the researched period the government and the local community did not invest enough efforts in environmental quality improvement and tightening the legislation.

The confirmation of the "regulatory chill" concept in Serbia in the period between 2000 and 2008 is present. In the period of eight years, significant law changes in the environmental protection sector were not introduced. Only seven new laws were adopted, although the number of laws needed to be synchronized with the EU is much higher. These laws were adopted after 2004, when Serbia approached the GDP of 5,000 dollars per capita. Dasgupta et al. (1995) claims that there is a strong connection between GDP and legislation force. The example of Serbia confirms this. Introduction of the National Strategy of Sustainable Development in 2007 and SEIA, EIA and IPPC shows a tendency towards stepping up environmental protection. Although the new laws were introduced, the improvement of environmental pollution monitoring and new sets of environmental control stations, which had been announced, were never realized. Monitoring is as important as regulation, and "chilling" the government investment in it is the same as "regulatory chill".

Unfortunately, FDI inflow in Serbia did not bring along technology and know-how spillover. There is no evidence of "pollution haloes".

It is important to emphasize the fact that analyses in Serbia indicate that the biggest threat of pollution is aimed at water. The largest amount of FDI in Serbia is in high water pollutants, and the conflict with the EU legislation is most evident in the area of water pollution. Besides that, in Serbia, as in other developing countries, 90% of wastewater is discharged without previous processing (Mayor and Binde, 2001).

Conclusion

The conclusion of this research is that FDI impact on the environment in Serbia can be placed in the concept of "regulatory chill". FDI did not intensively degrade the environment in Serbia, but on the other hand, neither did it bring about its improvement through positive technology and knowledge spillovers. Serbia did not manage to escape the transfer of "dirty" industries, but this type of FDI was not dominant. Most notable is the slow environment regulation modification and imposing of stricter environmental protection measures, absence of political will and resources for more intensive environmental quality improvement and pollution control.

The research gives an optimistic prediction. With further economic growth, awareness of the importance of sustainable development and investment in environmental protection and improvement will also rise. Preparations for better regulation of pollution and environmental protection started during the observed period, but adjustments of new environmental laws and plans took place in 2009 and 2010. In 2009 Serbia adopted a set of so called "green laws", 16 new environmental protection laws[7], synchronized with the EU. Furthermore, a Strategy of Spatial Development of the Republic of Serbia was also adopted this year, envisaging sustainable development. In 2010 the Serbian government passed a new National Strategy for the Inclusion of Serbia into Clean Development Mechanisms under the Kyoto Protocol[8]. All of this shows positive tendencies in environmental protection and further tightening of pollution regulations and the prevention of "dirty" industry transfer through FDI.

What impact FDI will have on the environment depends primarily on Serbia. In order to take advantage of FDI for environmental quality improvement through a transfer of modern technologies and knowledge, which Serbia itself does not have the money for, it must create an attractive framework for more FDI, which must also be an ecologically preferable one. Environmental protection requires well-organized decision-making processes and integration of environmental aspects in policy and planning. The precondition is the creation of a transparent and efficient system – administrative, legal, political and financial, eliminating extensive and overlapping spheres of activity and competence (Njegovan, 2004, p. 88). Attention must be primarily paid to institutional capacity increase and government employees have to be responsible for monitoring and environmental protection education. Synchronization of laws with the EU has to be performed with greater speed. Laws should compel multinational companies that come to the country to put ecology before profit, with the help of citizens and non-government organizations. Only with environmental and resource protection is it possible to ensure adequate sustainable economic development. Serbia needs to compose a serious strategy of sustainable development, a strategy of how to use FDI positively for improving the quality of life, economy and the environment.

[7] See Official Gazette of the Republic of Serbia, No. 36–09 and No. 38–09.

[8] Nacionalne strategije za uključivanje Republike Srbije u Mehanizam čistog razvoja u okviru Kjoto protokola za sektore upravljanja otpadom, poljoprivrede i šumarstva, Službenom glasnik RS, br. 8-10.

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