

# **The 2013 DIAnet International School, its aims and principles against the background of the sustainability challenges of the Danube River Basin**

This overview is a slightly amended transcript of the presentation delivered at the opening of the DIAnet School<sup>1</sup>. It addresses sustainability challenges with particular reference to the Danube River Basin and links them to the school's aims and outcomes.

## **1. THE DIANET SCHOOL – AIMS, PROCESSES, OUTCOMES**

We have identified three aims for your work over the coming days. Before I go into details, let me briefly remark that the hours on the schedule are the minimum deemed necessary for completing the assignments; this is an advanced course, we count on your initiative, interest and active involvement. After completing your assignments, you should have gained basic knowledge of several methods useful for research on the Sustainable Development (SD) of

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<sup>1</sup> I would like to thank Diana Frausin for the meticulous work of transcribing the tape of my presentation.

the Danube River Basin (DRB); you should have gained insights into the work of an interdisciplinary (ID) group and learned to tackle the pitfalls of ID communication (there are quite a few such pitfalls); and your group should have co-developed and presented a paper on one particular challenge for the SD of the DRB, analysing its links to other such challenges. This paper should be conceived as part of a potential application to a granting agency. Working at these tasks, you will gain experience and skills useful and necessary in sustainability research.

You have already been assigned to a working group according to your area of disciplinary training. The groups were put together to ensure the utmost level of interdisciplinary. You will soon find out to which group you have been assigned and with your working group you will identify the subjects and appropriate methods that you as a group most want to pursue together. Next Monday you will present a 15-minute version of your paper. Your papers are, as I said, to be written as research proposals. If any one of them is really good there is no reason why you should not take it to one of the governments, funding agencies or other potential sources of funding after the school – you as a group will jointly hold the intellectual property right on your idea.

Now let me explain how you will work. Your working group will identify the themes you most want to work on together after this introduction. You will receive an outline for the paper to be produced. Each day, you will add information from excursions, lectures and discussions to the outline and do extra reading to fill it in. On Monday, April 22<sup>nd</sup>, you will present a 15 minute version of your paper (as a group).

Altogether, you will deliver a 5-10- page paper consisting of four parts:

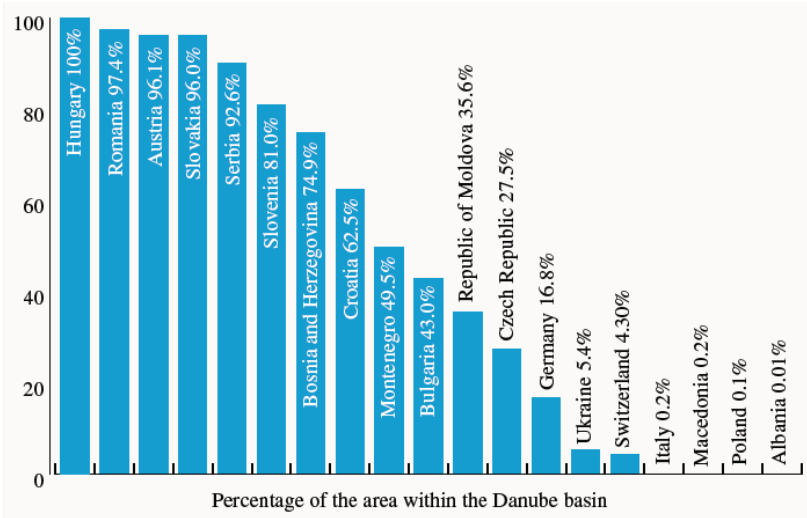
1. Present your theme (How and Why is your theme a sustainability challenge for the DRB?)
2. Which research/ which scholars are needed to tackle it and for what are they needed (data, processes, approaches...)?
3. Which methods do you envisage necessary for solving the problem and why?
4. Give a concrete example of how your theme connects to another sustainability issue of the DRB.

## 2. SUSTAINABLE DEVELOPMENT (SD) IN THE DANUBE RIVER BASIN (DRB)



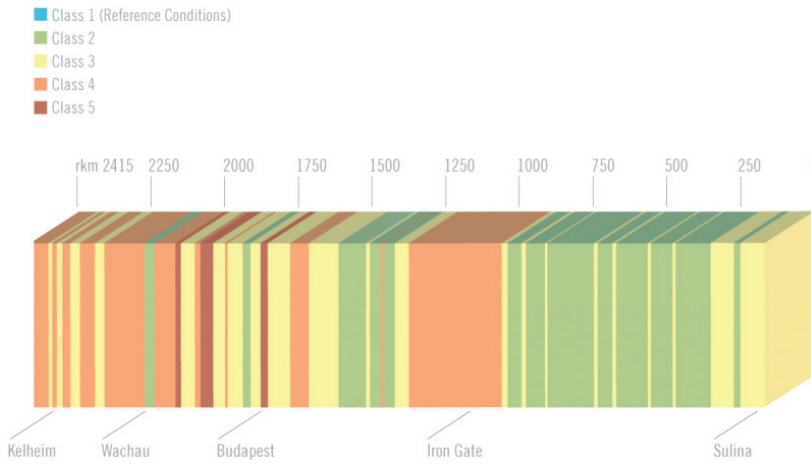
**Figure 1:**  
**Map of Danube Basin by ICPDR all maps © ICPDR, see <http://www.icpdr.org/main/Special> features of the Danube Region**

The Danube River Basin (DRB) is a very complex geographical area, shared by 19 countries and 81 million people, with an extension of ca. 800.000 km<sup>2</sup>. The length of the Danube River cannot be known with precision, it is about 2,780 km long, up to 1.5 km wide, and up to 8 meters deep (see Fig. 1). The countries that share the territory of the Danube River Basin can have a large portion of the DRB within their borders, or just a very small percentage. Hungary lies entirely inside the DRB, and countries such as Romania, Austria and Slovakia also lie largely, over 95% of their territory, inside the DRB. On the contrary, Poland and Albania have only 0.1% and 0.01% of their territory belonging to the DRB respectively. The graph of Figure 2 shows the different percentages for each country of the DRB.



**Figure 2:**  
**Percentage of territory within the DRB for all ICPDR member countries<sup>2</sup>**

**Overall total hydromorphological assessment in five classes as longitudinal colour-ribbon visualisation**



**Figure 3:**  
**The Joint Danube Survey 2 results of 2007/8: Nowhere does the Danube exhibit reference conditions<sup>3</sup>**

2 <http://www.icpdr.org/main/danube-basin/countries-danube-river-basin>  
 3 [http://www.icpdr.org/jds/final\\_results/hydromorphology](http://www.icpdr.org/jds/final_results/hydromorphology)

The legendary “Blue Danube” is anything but blue. As can be seen in the graph below (Fig. 3)<sup>4</sup>, which shows a colour-ribbon visualisation of the river from its source to the delta, the blue colour is missing. This is a clear sign of the unsustainable development which is characterising the DRB at the moment, and indicates that action towards sustainable development in the region is necessary and no longer deferrable.

The River is called differently by the people who live along its course. In Hungarian it is called Duna, in Romanian Dunăre, in German Donau, in Slovakian Dunajin, in Serbian Dunav (Дунав), and so forth. In the DRB, 81 million people communicate through 20 different languages, at least 17 of which are official national languages. Parts of these populations speak other languages of the Danube basin as their mother tongue. This is due to the eventful history of the Danube basin and is an important common feature of all countries of the Danube basin. It is important to realize that a communication challenge in the DRB exists, which needs to be met and overcome in order to allow shared decisions and policies which are essential if we really want the DRB to enjoy a sustainable development.

The European Community in 1994 came up with the idea of joint action and created the Danube River Protection Convention. The body entrusted with taking care of the execution of the Convention, ICPDR (International Commission for the Protection of the Danube River) was founded in 1998 with the following goals: safeguard the Danube’s Water resources for future generations; achieve naturally balanced waters free from excess nutrients; eliminate risk from toxic chemicals; enable healthy and sustainable river systems; and seek ways to make floods damage-free. The latter is very important because many people live in flood plains. For the DIAnet School we suggest your groups take up these goals as the core of your project works.

Figure 4 shows the area of the DRB with a dot for each river and habitat interruption by a dam, or any kind of construction in the river. Every red dot in this map is a construction that interrupts the natural flow of water and fish passage, every red dot signifies an obstacle to species movement. Many such obstacles are present in the upper basin. Let me mention e.g. two power plants which provide sustainable energy from hydropower but which also interrupt the natural flow of the river and the free movement of species. There are no easy solutions to these problems.

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4 [http://www.icpdr.org/jds/files/page/graph\\_p16\\_hymo\\_large.png](http://www.icpdr.org/jds/files/page/graph_p16_hymo_large.png)



**Figure 4:**  
**Obstacles in the Danube and its tributaries, depicted is the situation in 2009<sup>5</sup>**

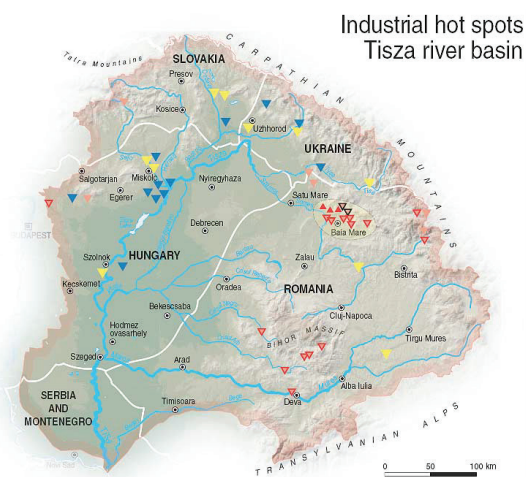


**Figure 5:**  
**Artificial water bodies (mainly canals) in the DRB as of 2009<sup>6</sup>**

5 [http://www.icpdr.org/main/sites/default/files/DRBMPmap05\\_ContInterr2009.pdf](http://www.icpdr.org/main/sites/default/files/DRBMPmap05_ContInterr2009.pdf)  
6 [http://www.icpdr.org/main/sites/default/files/DRBMPmap13\\_HMWB.pdf](http://www.icpdr.org/main/sites/default/files/DRBMPmap13_HMWB.pdf)

Figure 5 shows the presence of heavily modified and artificial water bodies in the Danube River. One of these is the Rhein-Main-Donau-Kanal which links two different river systems and consequently two ecological systems, a situation potentially creating havoc among species. Some of these modified or artificial river bodies have been modified in the distant past. Such artificial water bodies are not necessarily a problem, but we have to realise that if we want to work for the sustainable development of the DRB, we must take into account that the course of the Danube River has been heavily modified.

Many things with a bearing on sustainable development have happened in the basin. Let me start with the more recent past, the year 2000. You might remember the cyanide spill in Baia Mare, and later in Baia Borsa, in January and March 2000. On the evening of January 30<sup>th</sup>, 2000, a tailings pond burst at a facility near the city of Baia Mare, Romania, which was reprocessing old mining tailings and re-depositing the waste sludge into a new tailings pond. This led to approximately 100,000 m<sup>3</sup> of waste water containing up to 120 tonnes of cyanide and heavy metals being released into the Lapus River, then travelling downstream into the Somes and Tisza rivers into Hungary before entering the Danube. On March 10<sup>th</sup>, 2000, another tailings dam burst in Baia Borsa in the same region close to the Ukrainian border. While some of this material was retained within the dam complex, 20,000 tonnes of sediments were released into the Novat River, a tributary of the Viseu and Tisza rivers.<sup>7</sup>



**Figure 6:**  
**Hotspots of industry in the River Basin of the Danube's largest tributary<sup>8</sup>**

7 <http://reliefweb.int/report/hungary/report-international-task-force-assessing-baia-mare-accident>  
8 <http://www.grida.no/publications/et/ep3/page/2589.aspx>

As Figure 6 shows, there are many industrial hot spots in the Tisza river basin. Baia Mare is a region of particularly intensive industrial development and this led to a lot of incidents. Scientists have therefore studied the environmental legacies in the area.

The graphs of Figure 7 come from such a publication. The upper series of maps shows the heavy metal concentrations in surface river water, the lower shows the same concentration in river sediment:

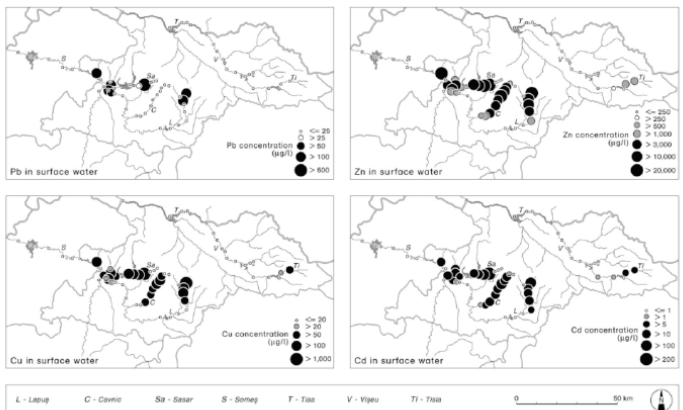


Fig. 2 Surface river water concentrations of Pb, Zn, Cu and Cd in Maramures County. Shaded proportional circles show where concentrations fall either below (white) or above (grey) EC target values, or where they exceed (black) EC imperative values for drinking water abstraction.

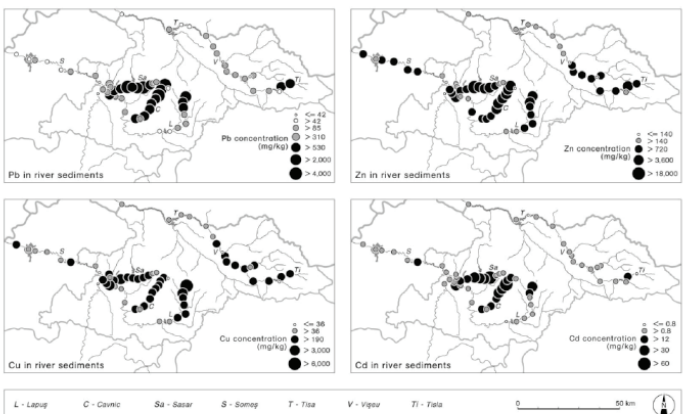


Fig. 4 River sediment concentrations of Pb, Zn, Cu and Cd in Maramures County. Shaded proportional circles show where concentrations fall either below (white) or above (grey) Dutch target values, or where they exceed (black) Dutch intervention values for soil remediation.

**Figure 7:**  
**Heavy metal pollution in river water and sediment in the Tisza basin (from Macklin et al, 2003)<sup>9</sup>**

9 Macklin MG, Brewer PA, Balteanu D, Coulthard TJ, Driga B, Howard AJ, Zaharia S. The long term fate and environmental significance of contaminant metals released by the January and March 2000 mining tailings dam failures in Maramures County, upper Tisa Basin, Romania. *Applied Geochemistry*, 2003, 18/2, 241-257.



The occurrence of pollutants in sediment is strange and unexpected; it means that the concentrations of heavy metals are long-standing. As dangerous as spills might be, the environmental problems of the area have not arisen in recent years. The authors sum up their findings: "Indeed, more widespread contamination is clearly arising from ongoing mining activity in the Cavnic, upper Lapus, Sasar and Tisla catchments. While not downplaying the short term ecological effects of the spills, they should be seen more as compounding much longer term problems associated with many decades of poorly regulated, and largely untreated, industrial, mining and urban discharges into local rivers." (p 256).

What can be learned from the Baia Mare spill and the astounding results of this study? Legacies of past practices determine the river development today. You have to think about such legacies when you talk about SD. The contamination is stuck in the sediment. If you move it, you release the pollutants into the environment. It is easy to stipulate that pollution should be stopped. But the victims should not be blamed as villains. People do not pollute for fun, they pollute because economic considerations make this a viable option. Sustainable development has to take this into consideration.

## CONFLICT AS A SUSTAINABILITY PROBLEM

Peace or war make a difference in terms of sustainable development. People in the Danube region fought for centuries and have left all kinds of legacies, but the sustainability problems created by the most recent conflicts are the most dangerous. The UNEP has a database for post-conflict environmental reports<sup>10</sup>. In the report on the Kosovo war, the infamous depleted uranium penetrators are depicted. The uranium is not used because it is radioactive, but because it is a heavy metal, and because it is so heavy, penetrates very well. But this issue, which received widespread media coverage is not the major problem of the legacy of the Kosovo war.

The legacies of the recent war in the Balkans are varied. A bombed oil storage facility in Bor, a destroyed oil tank at Novi Sad point to the pollution legacies of the war, one of the sustainability challenges that we face is to overcome the legacy of war. This is a task for the humanities, a task for the social sciences, it cannot be solved by natural sciences. As long as nations fight

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10 The UNEP report on the Kosovo war (UNEP/UNCHS. The Kosovo Conflict Consequences for the Environment & Human Settlements, 1999.) can be found at: <http://postconflict.unep.ch/publications.php?prog=kosovo>.

against each other, sustainable development will be compromised. Each war creates new legacies not just of pollutants and destruction, but also of conflict and trauma which have to be overcome.

But back to the pollution issues. Pančevo has become famous for 250 tonnes of liquid ammonia spilled into the Danube during the war. UNEP reports about this incident: "As a preventive measure, about 250 tonnes of liquid ammonia were released into the open canal from the fertiliser plant by site managers fearful that a direct air strike on stored ammonia could kill large numbers of people. This release was probably responsible for fish kills reported in the Danube, up to 30 km downstream. Fertiliser production prior to the air strikes had been accelerated in order to minimise the quantity of ammonia in storage." So, site managers had done every possible thing to keep the damage small – but had to decide between risk for people or damage to the environment. In the water of the Danube, due to the Balkan war, a lot of extra pollution was found, again in the wording of the report: "Serious leakages of 1,2-dichloroethane (EDC) and mercury; burning of vinyl chloride monomer (VCM) to form dioxins; burning of 80,000 tonnes of oil & oil products releasing sulphur dioxide and other noxious gases; high concentrations of EDC found in water of canal running into the Danube; high concentrations of mercury and petroleum products in the canal sediments." Even more important are the social insights that UNEP formulates in conclusion. "Social, economic and administrative disruption are likely to cause an increase of pressure on natural resources, both within and outside protected areas (e.g. increased use of wood for cooking and heating, due to loss of electricity supplies). Tourism, and the income it generates will also be reduced, though, it should be recalled that development of skiing infrastructure in Kopaonik had been reported as a conservation problem. Experience from reconstruction activities in other Balkan countries shows that future reconstruction in Yugoslavia will place heavy demands on raw materials (e.g. gravel, rock, wood products, water). The Federal authorities responsible for telecommunications facilities within protected areas formerly paid rent to the protected area concerned (though reportedly not for facilities located in Montenegro). The future of these financial contributions is unclear." (UNEP Kosovo Final report, p 68)

I would in conclusion quote one sentence from the UN report which points to the political ramifications of the Kosovo [and any other] war: "**An unhealthy and dangerously polluted environment does not provide a sound basis for the well-being of human populations or for business and trade.** However, the implementation of the recommendations will not only depend on the availability of funds; political concerns related to the international embargo of Serbia will also have to be taken into account." (UNEP, 1999: 72)

War and the havoc it wreaks are not a pleasant subject to talk about, but there is an important point to learn: if you don't confront the past, it will haunt you. But, on the other hand, if you confront the past, it turns into a unique learning opportunity. With this knowledge, we can try to prevent wars and their environmental legacies from happening again.

The larger point that I am making here is that democracy itself needs sustainable development. But we can also turn this sentence around: sustainable development needs democracy. In an ecologically degraded world, long-term economic development is impossible and social unrest will increase.

The politicians and administrators of Europe – in reaction to future challenges, but also in reaction to the legacies of war, have developed the frameworks within which the further, sustainable development of the Union is to be fostered. In the following passage, we will quickly review the most important ones.

## THE EU STRATEGY FOR THE DANUBE REGION

One of the reasons why the European Union designed the Danube Strategy might have been that the Danube River Basin history poses a very unique challenge of the Danube River Basin, a history of turbulence, violence and nationalism. This is very much in line with Horizon 2020, the new framework program for research and innovation, because its aim is to build a better society.

The Horizon 2020 website starts with the following text:

### **Tackling Societal Challenges**

Horizon 2020 reflects the policy priorities of the Europe 2020 strategy and addresses major concerns shared by citizens in Europe and elsewhere. A challenge-based approach will bring together resources and knowledge across different fields, technologies and disciplines, including social sciences and the humanities. This will cover activities from research to market with a new focus on innovation-related activities, such as piloting, demonstration, test-beds, and support for public procurement and market uptake. It will include establishing links with the activities of the European Innovation Partnerships (EIP).<sup>11</sup>

Horizon 2020 is operationalizing this aim by focussing on several challenges, these challenges are:

- Health, demographic change and wellbeing;
- Food security, sustainable agriculture, marine and maritime research, and the bio-economy;
- Secure, clean and efficient energy;
- Smart, green and integrated transport;
- Inclusive, innovative and secure societies;
- Climate action, resource efficiency and raw materials.

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11 Horizon 2020: [http://ec.europa.eu/research/horizon2020/index\\_en.cfm?pg=better-society](http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=better-society) (last accessed on 24/10/2013); EUROPE 2020: [http://ec.europa.eu/europe2020/index\\_en.htm](http://ec.europa.eu/europe2020/index_en.htm).

Horizon 2020, it can be inferred, is about sustainable development of the EU without using the word. But what about the regional aspect of this development? In 2009 the European Council formally asked the European Commission to prepare a EU Strategy for the Danube Region. Commissioner Danuta Hübner on the open day in October 2008 made the importance of this macro-regional strategy abundantly clear: "The importance of the Danube Basin for the EU cannot be underestimated. Our policies and the investments we are making in the Basin through the EU's cohesion policy in particular have an impact on the livelihoods of 20 million citizens. The Danube needs a specific strategy comparable to the strategy we are developing for the Baltic Sea Region. A one-size-fits all approach doesn't work in an EU of 27 Member States and 271 regions. We need a targeted policy for the Danube that meets its ecological, transport and socio-economic needs<sup>12</sup>,"The Danube Strategy 2010 was developed in the months following this proclamation.

## EUSDR – DANUBE STRATEGY 2010

"The EU Strategy for the Danube Region (EUSDR) is a macro-regional strategy adopted by the European Commission in December 2010 and endorsed by the European Council in 2011. The Strategy was jointly developed by the Commission, together with the Danube Region countries and stakeholders, in order to address common challenges together. So it is based on a bottom-up approach, not a top-down approach. The Strategy seeks to create synergies and coordination between existing policies and initiatives taking place across the Danube Region. The Danube Region Strategy will serve the goal of increasing prosperity, security and peace for the peoples living there, especially through enhancing cross-border, trans-regional and trans-national cooperation and coordination" (Danube Strategy, 2010). The Strategy is about people, and this is why you are here. It is also about the future; the future is for you and the future is also your responsibility. The DIAnet School invites you to take the Danube Strategy seriously: think and work in cross-border, in trans-regional and in trans-national cooperation and coordination. Therefore the groups that have been put together are not just as interdisciplinary as possible but also as international as possible.

How is the Danube Strategy designed? Like other macro-regional strategies, EUSDR is not about new money or new institutions, the aim is to create synergies by fostering co-operation, bundled into certain priority areas. The

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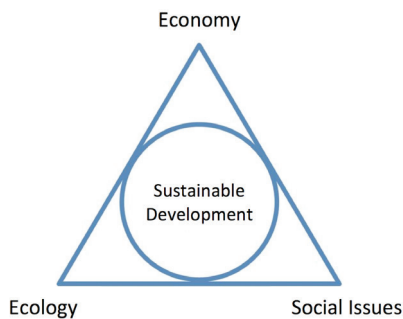
12 [http://europa.eu/rapid/press-release\\_IP-08-1461\\_en.htm](http://europa.eu/rapid/press-release_IP-08-1461_en.htm)

strategy consists of 4 pillars divided into 11 priority areas. The 4 pillars are depicted in Figure 8: connecting the region, protecting the environment, building prosperity and strengthening the region.

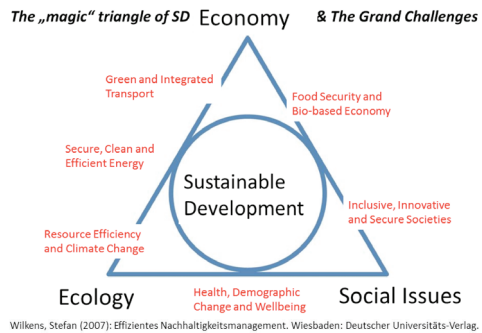


**Figure 8:**  
**The organization of the Danube Strategy (<http://files.groupspaces.com/EUStrategyfortheDanubeRegion/files/163255/Presentation+EUSTR.ppsx>)**

Let us now explicitly pursue the connections between sustainable development, the Horizon 2020 goals and the Danube Strategy. Figure 9 depicts the magic triangle as it is known in the sustainability literature, Figure 10 maps the Horizon 2020 challenges onto it, and Figure 11 depicts the EUSDR Pillars in connection with the triangle, while Figure 12 links the Horizon 2020 challenges directly to the Danube Basin.

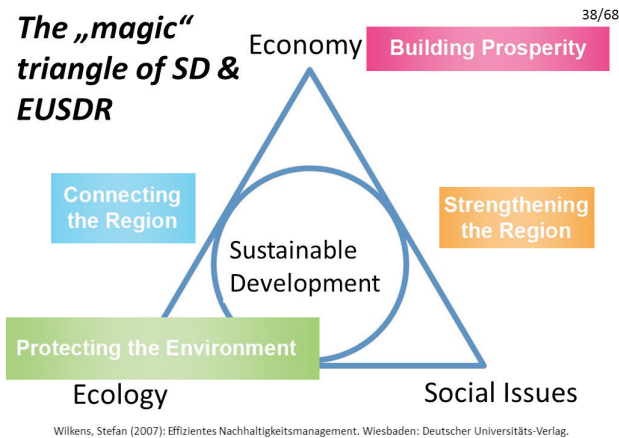


**Figure 9:**  
**“The magic triangle” of sustainability [publishes in numerous publications, e.g. Wilkens, 2007]<sup>13</sup>**



**Figure 10:**  
**Horizon 2020 and the magic triangle of sustainable development (Source: V.Winiwarter, 2013)**

13 Wilkens S. Effizientes Nachhaltigkeitsmanagement, 2007. Wiesbaden: Deutscher Universitäts-Verlag.



**Figure 11:**  
**EUSDR’s pillars and the sustainability triangle (Source: V.Winiwarter, 2013)**

The mapping exercise should not be seen as a mere intellectual play. It is important to identify where funding opportunities for research can be generated, but above all it is important to link one’s own interests with those of a wider public as represented by the EU politicians.

The Horizon 2020 challenges can be further mapped onto the challenges identified by ICPDR for the Danube River Basin. These are:

- Safeguarding the Danube’s Water resources for future generation
- Naturally balanced waters free from excess nutrients, which means agricultural reform
- No more risk from toxic chemicals, which means industrial reform and sustainability in the industrial sector
- Healthy and sustainable river systems, which means nature conservation
- Damage-free floods, which I don’t think is a goal that can be achieved, but we can do a lot of things to protect ourselves against floods. One of the things is to let the river move in a retention space large enough to absorb a flood. But this means not to build near the river – contrary to what currently happens.

If one cross-links the EU challenges to those of the Danube River Basin, the size of the challenge to move the Danube River Basin socio-ecological system towards a more sustainable future becomes immediately visible:

**Figure 12:**  
**The Horizon 2020 challenges (vertical) liked to the challenges identified for the Danube Basin by ICPDR**

Challenge/ICPDR priority	Long-Term Water Resource protection	Stopping eutrophication	Stopping toxic chemical releases	Healthy and sustainable River systems	Flood risk mitigation
Green and Integrated Transport	X			X	X
Secure, Clean and Efficient Energy				X	X
Food Security and Bio-based Economy	X	X	X	X	
Health, Demographic Change and Wellbeing		X	X		X
Inclusive, Innovative and Secure Societies	X	X	X	X	X
Resource Efficiency and Climate Change	X	X	X	X	X

### **3. LONG-TERM-SOCIO-ECOLOGICAL-APPROACHES TO SUSTAINABLE DEVELOPMENT**

While sustainability studies offer a wide range of approaches, I would like to particularly emphasize the importance of long-term socio-ecological approaches to sustainable development. Why do I suggest this? Because we are dealing with an integrating approach to the management of a river basin, and what has been called “Integrated River Basin Management” at the moment does not work very well. IRBM has been defined as a process „which promotes the coordinated development and management of water, land and

related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems”<sup>14</sup> But there is a gap between theory and practice. Authors such as Varis, Ramahan and Stucki bemoan the hiatus between international recommendations and reality in large international river basins, and are concerned about the evolution of the quality of recommendations, which does not seem substantial<sup>15</sup>. McDonnell concludes that new approaches are needed which take on board important research findings emanating from fields such as social theory and geographical information science (GIS science). This is encouraging news for those who believe in the study of coupled socio-natural systems, but a historical perspective does not rank high on the agenda of the author. For McDonnell, historical data are solely used to characterize the baseline conditions of the area<sup>16</sup>. Braga mentions the historical context in which the planning process is situated, but does not go into any historical depth in describing the antecedents influencing the planning process<sup>17</sup>. Varis et al. give a very brief sketch of climate history in their case study on the Senegal River Basin, but, more interestingly, they hold that “River basins are the cradles of mankind, and each basin has its own age-old and recent history. The former is a mix of cultural, ethnic, political and other factors and the latter includes institutional arrangements and governance characteristics, locally, nationally and internationally. They all influence the implementation of IWRM [Integrated Water Resource Management, V.W.]”<sup>18</sup>.

This situation can be improved if long-term socio-ecological research (LT-SER) is used. My argument is also that you need to study the historical legacies because they influence the current situation. But what are and to what benefit does one undertake “Long-Term Socio-Ecological Studies”?<sup>19</sup> The authors of a conceptual paper concluded that sustainability-oriented long-term

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14 Braga BPF, Lotufo JG. Integrated River Basin Plan in Practice: The São Francisco River Basin. *International Journal of Water Resources Development*, 2008, 24(1), 37-60. Here 37.

15 Varis O, Rahaman MM, Stucki V. The Rocky Road from Integrated Plans to Implementation: Lessons Learned from the Mekong and Senegal River Basins. *International Journal of Water Resources Development*, 2008, 24(1), 103-121.

16 McDonnell RA. Challenges for Integrated Water Resources Management: How Do We Provide the Knowledge to Support Truly Integrated Thinking?. *International Journal of Water Resources Development*, 2008, 24(1), 131-143.

17 Braga & Lotufo, 2008:40.

18 Varis et al, 2008: 117.

19 Haberl H, Winiwarter V, Andersson K, Ayres RU, Boone C, Castillo A, Cunfer G, Fischer-Kowalski M, Freudenburg WR, Furman E, Kaufmann R, Krausmann F, Langthaler E, Lotze-Campen H, Mirtl M, Redman CL, Reenberg A, Wardell A, Warr B, Zechmeister H. From LTER to LTSE: conceptualizing the socioeconomic dimension of long-term socioecological research. *Ecology and Society*, 2006, 11(2), 13. [online] URL: <http://www.ecologyandsociety.org/vol11/iss2/art13/>.



research made it necessary to link biophysical processes to governance and communication and to consider patterns and processes across several spatial and temporal scales. The authors were aware of the “difficulties of combining data from in-situ measurements with statistical data, cadastral surveys, and soft knowledge from the humanities”. This group, like McDonnell, stresses the importance of including pre-fossil fuel system baseline data but they also discuss a methodical challenge they perceived as the „often delicate balance between monitoring and predictive or explanatory modeling.” As an interdisciplinary group, they found it „challenging to organize a continuous process of cross-fertilization between rich descriptive and causal-analytic local case studies and theory/modeling-oriented generalizations.” Their conceptual framework comprises research into socio-ecological metabolism, studies of land use and landscapes, governance and decision making, as well as studies of communication and knowledge in a transdisciplinary framework. Ideally, all these themes would be studied in an integrated fashion. Haberl et al make clear that “the ecological and social legacies of institutional and jurisprudential models introduced in the past” have to be studied, because „the current situation is dependent on our material and immaterial inheritance”.

If one searches the internet for ‘toxic legacies’, signs warning trespassers to stay out of a polluted area or water can be found in large numbers.<sup>20</sup> Legacies abound and influence the choices we have, so it is necessary to know them before developing ideas for the future of an area. And I suggest that you look at two things: at the system of the river and at the “human factor” in it and understand them as an intertwined whole. This whole is called a “socio-natural site”.

Socio-natural Sites consist of material arrangements, which are guided by cultural programs and, though material, are not “natural”. They are constantly re-constructed by means of practices, actions of humans, which require, though guided by ideas, practical, physical interaction with the material of the arrangements. Arrangements can only be kept in working condition if labour is applied. Socio-natural Sites result from PRACTICES. Their material precipitates are ARRANGEMENTS. Socio-natural sites are composites (nexuses) of arrangements and practices<sup>21</sup>.

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20 Look, e.g. at: <http://indiancountrytodaymedianetwork.com/2013/09/02/americas-chernobyl-results-uranium-mining-great-plains-151091> ; <http://plpnmweb.ucdavis.edu/nemaplex/images/Pollution%20warning.JPG> ; <http://poopy.org/water-pollution/polluted-beaches-california/>; [http://friendsofcortemaderacreek.org/new\\_site/creek-care-2/pollution-in-our-creeks/](http://friendsofcortemaderacreek.org/new_site/creek-care-2/pollution-in-our-creeks/).

21 Winiwarter V, Schmid M, Hohensinner S, Haidvogel G. The Environmental History of the Danube River Basin as an Issue of Long-Term Socio-ecological Research. In: Singh SJ, Haberl H, Chertow M, Mirtl M, Schmid M (Eds.), Long Term Socio-Ecological Research. Studies in

If we look at a river for the material side of the socio-natural site, typical arrangements on the river are fortified river banks, weirs, harbours, but also power plants in the river, bridges and bathing beaches. The realm of possible human practices is determined by those arrangements already there (socio-ecological inheritance). This inheritance has a bearing on the practices: if you already have a power plant there, it is impossible to build a bathing beach or a harbour at the same site.

If we look at the Danube watershed, we can look at changes in arrangements and at changes in practices and then we can study what the driving forces of change are, in particular, we can explore history-policy links. A well-known concept trying to link driving forces with the state of the environment is the DPSIR Framework: DPSIR is an acronym built from: Driver, Pressure, State, Impact and Response. The framework was first developed by OECD and has been adopted by EEA, the European Environmental Agency. It is an interesting sustainability question what the driving forces of change are, how they impact nature and what a societal response to this impact could be<sup>22</sup>.

But one should not equate chance with deliberate action. Socio-natural sites change all the time. Life is thermodynamically highly improbable. To continue living, living beings need exergy. Human beings create via their practices arrangements from the material world to harvest exergy. These arrangements deteriorate due to wear and tear. All arrangements are part of the evolutionary setting of humankind, either because of (evolving) humans taking part in them, or because of other living beings which evolve being part of them. The higher the extent of exergy which needs to be controlled in an arrangement, the more likely is its deterioration, and therefore, the more likely is the production of potentially harmful legacies and their long-lasting effects<sup>23</sup>.

When we conduct research in the Danube River Basin, we work in a world of hybrids. Older ARRANGEMENTS (such as rectification works) influence younger ones. This changes the realm of possible actions for humans. This means that older arrangements influence the practices of humans today. We call these influences **socio-ecological legacies**. It is particularly important to take note of the irreversibility of interventions.

We are doing research in a world of hybrids, not nature, not culture. Older arrangements influence younger ones, and this changes the realm of possible actions for humans. You cannot simply turn the power plant off after you have

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Society-Nature: Interactions Across Spatial and Temporal Scales (Series: Human-Environment Interactions, Vol. 2), Dordrecht (u.a.) 2013, 103-122.

22 [http://root-devel.ew.eea.europa.eu/ia2dec/knowledge\\_base/Frameworks/doc101182](http://root-devel.ew.eea.europa.eu/ia2dec/knowledge_base/Frameworks/doc101182) has a graphic representation and short explanation.

23 See Winiwarter et al, 2013 (see Footnote 20)

built it and pretend nothing has happened. There have been changes which cannot be undone.

How can this conceptual framework be translated into research questions? We can ask how certain practices via material arrangements shape fish population distributions, change sediment characteristics, influence access to clean water for rural communities, lead to social conflict between actors and create long-lasting legacies (e.g. power plants).

**Figure 13:**  
**Arrangements and their Legacies (© Winiwarter and Schmid, 2013)**

Characteristics	Arrangements with short-lived legacies	Arrangements with stable, long-lived legacies	Arrangements with transformative legacies
Type of Legacy	Benign	Problematic	Wicked
Longevity of Legacy	Short	Middle	Long (indefinitely)
Maintenance requirements	Low	Middle	High
Energy expenditure centred on	Production	Production and Maintenance	Maintenance
Exergy harvest density	Low	Middle	High
Transformative Potential (Impact on practices)	Local, Sectorial	Local, Regional, Sectorial (1 or several)	Societal, global

Arrangements can be sorted into categories according to the more or less dangerous legacies they create. My colleague Martin Schmid and I have developed the following tripartite scheme shown in Figure 13. We suggest that Legacies can be benign, problematic, and wicked. Wicked arrangements have a very long lasting legacy, basically indefinitely long. What does indefinitely long mean? The half-life of plutonium is 24,000 years. So, after 24,000 years there is still half of the plutonium there. Plutonium is a dangerous heavy metal, not just radioactive, but very poisonous. It therefore creates very wicked lega-

cies. The longer the legacy, the more wicked it potentially is. And the more energy society needs to invest not for building an arrangement, but for maintaining it and for dealing with its legacies, the more wicked it should be considered. More effort goes into coping with this legacy than into the original cause, because it is so long-lasting and so difficult to deal with. Viewed from such a perspective, we gain fresh insight into what sustainability is all about: sustainability, it can be postulated, is about avoiding to produce too many wicked legacies, because taking care of them all the time limits the options and choices you have to a very high degree, and if you have created too many, you have no freedom of action left. Figure 13 gives an overview of the types of legacies and their power to transform society. Wicked legacies, because they bind society to deal with them over very long periods, transform society. A society having created an atomic legacy has to protect it from proliferating, and one can clearly see how this transforms society, e.g. when looking at the international politics towards Iran or Pakistan.

For sustainability studies, it is important to understand that transformations, both those occurring thermodynamically or by biological evolution and those we bring about, not stability, characterises the present situation. In such a situation no single discipline has the key to success. We have to work together.

#### **4. THE ROLE OF INTERDISCIPLINARY AND TRANSDISCIPLINARY METHODS FOR SUSTAINABILITY RESEARCH IN THE DRB**

We also have to bring actors from outside the academic system into our teams. We should never assume that as academics, we are by virtue smarter than the people out there. In fact, the “people out there”, actors in the life-world, know a lot of their problems, not a lot “more” than we do, but they know different aspects of the problem. Scholarly expertise is needed, but cannot substitute local knowledge. The basis of such interaction on the field of sustainability is an interdisciplinary approach as detailed in Figure 14.

Only against the backdrop of history can the present be understood and a sustainable future planned. It is important to value traditional ecological knowledge (TEK) and not dismiss it on the unfounded hypothesis that people in the past were dumb. One has to see that they were confronted with different rationales and different possibilities and hence, reacted differently. In the post-fossil world, many of their insights will gain new relevance as they were produced in the pre-fossil age.

**Figure 14:**  
**Scholarly knowledge needed for planning sustainable futures:**

- Reconstruction of the state of arrangements over time
- using natural science methods
- using the methods of the humanities
- extract status data from historical sources

AND

- reconstruct the practices of humans, their perceptions, value systems and decision making rationales at a given time and place

The notion of sustainable development itself has a history, which is closely intertwined with the new notion that people should not be researched upon, but with. In a report prepared for the first ever UN conference on the environment (5<sup>th</sup>-6<sup>th</sup> June 1972, Stockholm: United Nations Conference on the Human Environment), which stands at the beginning of the sustainability sciences, Barbara Ward and Rene Dubos described the rationale for giving a new role to lay people. "Since policies concerning the human environment require both social judgment and specialized scientific knowledge, perceptive and informed laymen can often contribute as much as technical experts to their formulation. In certain cases, indeed, laymen may be wiser judges than experts because their overall view of the complexity of human and environmental problems is not distorted by the parochialism which commonly results from technical specialization."<sup>24</sup> Ward, Dubos, 1972, xvii.

That is the rationale for working in a transdisciplinary way. Interdisciplinary work, which is about crossing the communicative boundaries between disciplines, is in many ways not only necessary when working on sustainability issues, but also a good preparation for the communicative challenges of transdisciplinary work. Working on a specific place and on a specific problem is not enough to secure integration of a team. It is very helpful to devise tools of integration consciously when setting up a project. Figure 15 shows the main requirements of integrative concepts.

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24 Ward B, Dubos R. Only one Earth: The Care and Maintenance of a Small Planet, 1972. An unofficial report commissioned by the Secretary-General of the United Nations Conference on the Human Environment, prepared with the assistance of a 152-member committee of corresponding consultants in 58 countries.

**Figure 15:**  
**Requirements for an integrative concept**

- The concept should ...
- ... be open for quantitative and qualitative information
- ... allow the representation of entities, ideas, and events, along with their properties and relations, according to a system of interdisciplinary categories
- ... be independent of scale, if you work on the micro- or on the macro-level
- ... NOT be based on key concept of ONE discipline, possibly a fair intellectual work, otherwise we end up fighting against each other
- ... have the ability to connect with stakeholders, a requirement of particular relevance and a big challenge

Integration of a project is one of the greatest challenges in interdisciplinary research. Partners need to agree on the desirable levels of integration, there is no premium on a maximum of integration. Each discipline has a wonderful reservoir of very important things to bring in and it is not the best way to try to become an 'interdiscipline'. It is necessary to work with defined (rather than assumed) connections, otherwise integration will remain loose. It is of great importance to devote attention to the interfaces, to the communication process and a good idea to have an experienced communicator in a project with the sole role to develop meeting designs and oversee the communication process. Integration cannot be achieved by technical tools, but it can be greatly aided this way. There are many tools for technical integration out there, One of them are GIS (Geographic Information Systems). They are of particular importance in sustainability research, because they allow to integrate a diversity of spatially explicit data into a common research framework. Some of the basic functions of a GIS are listed in Figure 16.

**Figure 16:**  
**Basic GIS functions**

- data acquisition and pre-processing
- data base management and retrieval
- spatial measurement and analysis
- graphic output and visualization

The last function is important for effective communication with stakeholders. A 250-page report with footnote 670 containing the most important result will not suffice. Spatially explicit data on maps are often a good way to reach people and GIS is very powerful to create such maps.

This presentation has hopefully given you an overview of the issues at hand and the challenges of interdisciplinary and transdisciplinary work needed to address them. Interdisciplinary co-operation cannot be learned from lectures or books, one has to experience it, but it can be prepared by anticipating the challenges, for which the material presented should be a basis.

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2013 DIAnet International School – Opening Ceremony

Prof. Verena Winiwarter  
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