

Integration of Danube River Basin Information Resources

Multinational Water Related Information in World Wide Web

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Abstract

Der Schutz der Fließgewässer ist eine wesentliche Teilaufgabe im Umweltschutz. Informationssysteme unterstützen die Entscheidungsfindung für Gewässerschutz-Maßnahmen, die im gesellschaftlichen, ökonomischen und ökologischen Bereich zu treffen sind. Im Donauroum wird derzeit versucht, verfügbare Informationskomponenten in ein multinationales Donau-Informationssystem zu integrieren.

Die vorliegende Arbeit bietet eine Standortbestimmung, wie sie u.a. durch das Donau-Umweltprogramm, das Donauschutzübereinkommen und durch die Internationale Kommission zum Schutz der Donau geprägt ist. Vorgestellt wird ein Modell für einen systemorientierten Gewässerschutz. Mit diesem Modell können Beziehungen zwischen Umweltbelastungen und deren Wirkungen beschrieben und inhaltliche Schwerpunkte eines Informationssystems für den Donauroum identifiziert werden. Weiters sind in dieser Arbeit die Informationsquellen und Informationsflüsse zusammengestellt, wie sie in einem neu strukturierten, WWW-basierten Informationssystem zu berücksichtigen sein werden.

Mit Inkrafttreten des Donauschutzübereinkommens ist in den Donau-Anrainerstaaten eine verstärkte Vernetzung der Informationsquellen zu erwarten. Die bestehenden Informationssysteme sind geeignet, in ein umfassendes, umweltbezogenes Donau-Informationssystem integriert zu werden.

Initial Situation

The Danube River Basin covers 817.000 km² in 17 countries in the heart of Central Europe (Figure 1). The cumulative inflow of nutrients to the Danube River system is causing eutrophication problems in the River itself and pollution of its groundwater, as well as adding to the degradation of the unique Danube delta and the north-west shelf region of the Black Sea.

The cumulative inflow of nutrients to the Danube River system is causing

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eutrophication problems in the River itself and pollution of its groundwater, as well as adding to the degradation of the unique Danube delta and the north-west shelf region of the Black Sea.



Figure 1: The Danube River Basin (Source: City Council of Vienna, Departement 45- Water Management and GRUPPE WASSER, VIENNA)

To reduce the pollution load the international *Environmental Programme for Danube River Basin* was established. Within this programme, a *Danube River Information Network* (DBIN) for the management of water quality was initiated and a prototype *Danube Information System* (DANIS) was developed.

These and other environmental information and communication activities were influenced through the

- Environmental Programme for the Danube River Basin (PCU FOR EPDRB, 1997)
- DANUBE RIVER PROTECTION CONVENTION (1994).
- Environmental Action Program (DANUBE STRATEGIC ACTION PLAN 1995).

An early step in implementation of the EPDRB Programme was to co-ordinate and support monitoring, data collection, assessment, emergency response systems and preinvestment studies. For this purpose the Danube Task Force (Figure 2) set-up its Sub-Groups or expert groups (EG) for:

- Monitoring, Laboratory and Information Management (MLIM),

- Accident Emergency Warning System (AEWS) and
- Data Management (DM).

Further more, a transnational network of water quality monitoring stations (TNMN) was established and later on a Emission Working Group (WG) began start her activities. A special ad-hoc Working Group were formed to assist in transferring activities from Task Force and the Danube Programme Co-ordination Unit (PCU) to the International Commission for the Protection of the Danube River Basin (ICPDR) and its (interim) Secretariat.

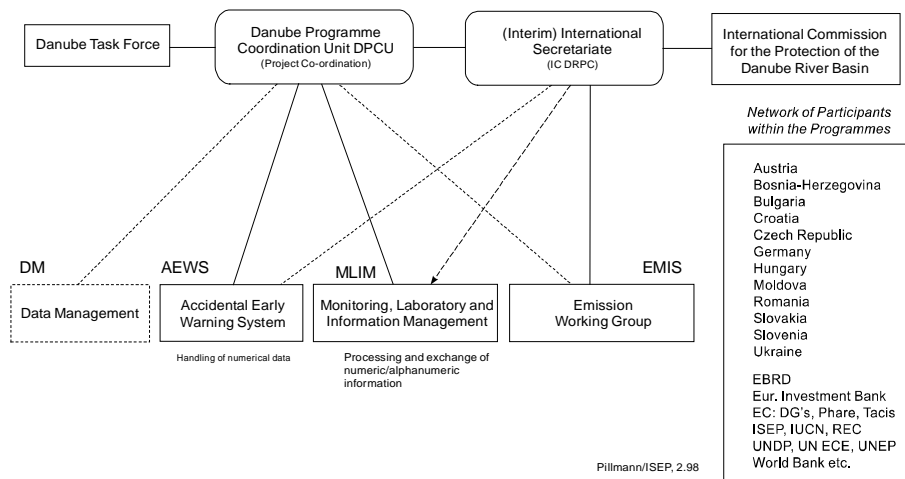


Figure 2: Organisation structure within the DRB Environmental Programme (1998)

In addition 13 Applied Research Programmes (ARP) have been initiated to provide reliable scientific information in order to help define future environmental policies. Later individual working groups with the assistance of international consortia established additional ARPs.

Involvement of non-governmental organisations was realised through the establishment of the Danube Forum and NGO Information Systems, as well as general public establishing ACTION FOR A BLUE DANUBE brochure (1995) and the DANUBE WATCH, a periodical published newsletter. Some further references to the EPDRB can be found in FLECKSEDER (1997), PROTECTING DANUBE RIVER BASIN RESOURCES (MURPHY ed., 1996), and in WINGÅRD (1997).

Principles of Danube River Basin Information System

During the Danube Applied Research Project Conference held in September 1997, the development of a *Basinwide Information Management Project* was proposed

(RUZIC, PECAR-ILIC 1997). Conclusions from discussions about the Information System needed are presented in Table 1.

<i>The users of information</i>	<i>Type of inform. needed</i>	<i>Sources of information</i>	<i>Information processing</i>	<i>Methods and techniques</i>
<ul style="list-style-type: none"> ○ Experts and scientists ○ Decision-makers and managers ○ Mass media and general public 	<ul style="list-style-type: none"> ○ Primary information, monitoring ○ Interpreted, summary information ○ Selected interpreted information 	<ul style="list-style-type: none"> ○ Scientific Studies, Applied Research Project ○ Monitoring TNMN, AEWS, EMIS ○ National statistics; other sources 	<ul style="list-style-type: none"> ○ Validation of primary information ○ Introduction of metadata ○ Quality Assurance; updating ○ Statistical treatment; abstracting ○ Modelling 	<ul style="list-style-type: none"> ○ Information updatability ○ Electronic multimedia ○ High level of integration new technologies ○ Statistical methods ○ Mathematical models, visualisation

Table 1: DANUBE Applied Research Project conference (Sinaia, Romania 1997)

To identify current and potential users of environmental information from Danube River Basin all kinds of interested persons, groups, organisation must be taken into account. In addition there is often a identity between information providers and users of Danube related information. Large number of users exists especially in countries where access to environmental information and public participation in environmental decision making is established. Therefore we can expect that the situation may be different in individual countries.

The access to information within an environmental information system should be as broad as possible taking into account eventual restrictions of information availability. There is a need of information on institutions and organisations, on experts, on publications and reports, about projects and programs and standards. Information about monitoring and applied research projects should include metadata such as programs and projects for which the data are generated, financial sponsors and environmental compartments about which the information is generated. In addition spatial references should be available if linking with a geographic information system (GIS) is possible.

Within the International Commission (IC), the following information of interest are defined on the basis of the Danube River Protection Convention (DRPC):

- Immission assessment (in-stream water quality, in charge MLIM-EG)

- Emission assessment (pollution loads discharged to the receiving waters, in charge EMIS-EG, connected with Action Program for the Reduction of Pollution loads)
- Accident and emergencies, the warning system (in charge AEWS-EG, connected with minimising of the risk involved by preventive and control measures)
- Water balance of the Danube River Basin
- Interaction between the waters (stretches of rivers, ponds and lakes)
- Risk caused by floods and ice hazards
- Sustainable use of waters (connected with construction and operation of hydraulic works, transfer of waters, erosion etc.)
- Results of research and development.

In general the following sources of information could be identified: minutes of coordinating bodies and expert groups (for example MLIM, AEWS, DANIS, EMIS, ARPs, Integrated environment Study, SAP, Strategic Implementation Plan - SIP, Environment Action Plans - EAP), international institutions (UNEP/GEMS, UNEP/GRID, WMO, UNESCO), national reports and studies (such as questionnaires, National Reviews, NSAPs, NSIPs and NEAPs) and national statistics, scientific papers, workshop and conference reports, pre-investment and pre-feasibility studies and other information sources, especially those generated by NGOs and public media.

The use of information depends strongly on responsibility of the user. In reality there may be significant differences in situation for individual countries. In some cases serious problems may appear because of inefficient collaboration between different sectors of the government. Sometimes, national focal points, country programme co-ordinators (CPCs) or national delegation does not get enough support from the government in their activities.

Priorities in Information Integration

After organisation of the GEF/UNDP Implementation Inception Workshop (Krems, Austria 1997), a framework for the development of an Danube Information Network is initiated within the Global Environment Facility GEF-Project implementation activities. The main goal of this initiative is to contribute to the establishment of such a *Danube Information Network*. On the basis of this workshop a special study of information needs and suggestions for integration of reliable data in a Danube river basin information system was prepared (PILLMANN/RUZIC 1998). The results of this study were used during the GEF/UNDP Danube River Basin Information Systems Workshop (Baden, Austria 1998), where the use and the interdependencies between the information components were discussed. Furthermore communication on

environmental aspects and reinforcement of public awareness building were recognised as very important issues. An agreement about priorities in the development of the DRB Information system has been reached (FRAMEWORK FOR THE DEVELOPMENT OF AN INFORMATION NETWORK, 1998). Some of the proposals for such priorities are:

- Identifying internal, external and general components of the information system (see example of the European Information and Observation Network (EIONET) organised by the European Environmental Agency).
- Establishing efficient communication between International Commission, MLIM (Information Management WG - IMWG), AEWS and EMIS expert groups and Danube Water Quality Management Program (DWQM) concerning the development of an IS (establishment of a working group) to avoid overlap and promote co-operation.

„The 'INTRANET' of the ICPDR's information system has not only to serve the Secretariat in its link with the Delegations, but also all other Expert Bodies supporting the ICPDR. At the level of the Expert Groups, MLIM, AEWS and EMIS are the 1st ones where work can start“. (FLECKSEDER in: FRAMEWORK FOR THE DEVELOPMENT OF AN INFORMATION NETWORK 1998).

- Improvement of the textual IS and establishment of its efficient management (DANIS and/or other existing information system should be improved)
- Establishment of dynamic WWW theme pages with downloadable information about the DRB including maps of different scales and selected technical information, including elements of interactive communication with users
- Establishment of training missions/courses for national information managers where and when needed
- Establishment of efficient communication with European Environmental Agency (EEA) and Black Sea Information System (the access to EIONET should be negotiated for chairmen of working groups)
- Participation at conferences like Ecoinforma, Computer Application for Environmental Protection etc. should be planned in order to ensure the access to information about the latest development in information and communication technology
- Preparation of the concept for the access to the results of projects (e.g. ARPs)
- Testing of ISDN infrastructure for the improvement of electronic communication between CPCs, national data managers and PCU-PHARE/GEF offices.

Evaluation of Existing Information Systems

One of the major achievements of the Baden Workshop was the evaluation of existing and initiated Information systems. The workshop participants gave their

assessment on strengths, weaknesses, cost of implementation and maintenance. The existing systems are:

- DANIS (<http://www.ceit.sk/wwwisis/danis.htm>) – a textual information system, established within the Environmental Programme for the Danube River Basin.
- DBIN – a collaborative project to develop a prototype information network for the Danube River Basin ([www.syslab.ceu.hu/...](http://www.syslab.ceu.hu/) (not public accessible). This project is based on INFODANUBE – the first prototype of environmental information system, produced within the Regional Environmental Center (REC Budapest, now Szentendre, Hungary).
- GRID Hungary – the regional GRID center for CEE countries; an example of a national water quality information system (<http://www.gridbp.meh.hu>).
- AUSTRIAN Water Quality Information System – a system on the Web of the Federal Ministry of Agriculture and Forestry and the Federal Environmental Agency; an example of a complete national water quality information system (http://www.ubavie.gv.at/info/wasser/Was_home.htm).
- CROATIAN Water Quality information system – a new information system with TNMN-DRB detailed data from Croatia (RUZIC, HAK, PECAR-ILIC 1997; <http://faust.irb.hr/~pecar/danube/danube.htm>). At present Croatia is acting as a central point for integrating and maintaining basin wide TNMN data for water quality (at present not available to the general public).
- CEDAR – The Central European Data Request Facility with environmentally, relevant information (<http://www.cedar.univie.ac.at>).

There is a whole variety of national information centres within different Danube countries. Water quality and water quantity data in different countries are under the responsibility of different authorities. In general individual countries develop their own information system. Some countries have difficulties in transferring their national data to the international and harmonised systems. Several national regional and interregional organisations are also involved in development of environmental information systems. Some of them are included in other river basin transnational networks (like Rhine, Elbe and Odra).

Additional projects are proposed within the Danubian region, e.g.

- ARGE Donauländer proposed a Water Management Information System
- DAKOWAMIS – a study which will prepare water management information system for the Danube countries with particular emphasis on GIS and
- ADONIS – a Geo-information system for waterways administrative authorities (initially in Germany, Austria and Slovakia).

Information System Model

Every information system should be developed on the basis of a conceptual model. Then the conceptual model should be mapped into the logical structure and, finally, the relational physical representation could be designed depending on available information and communication infrastructure. Like other environmental information systems a comprehensive information system for Danube River Basin is complex because there are to include e.g. physical, administrative and legal relevant data, data about the programme management, project organisation, and results of research programmes and dissemination of information to interested parties.

In order to define a general structure for the comprehensive information system for the Environmental Programme of the Danube River Basin, as well as for every other international river basin a multidimensional diagram has been developed (from Ruzic and Pecar-Ilic. A short description can also be found in RUZIC/ PILLMANN (1998).

A Danube River Basin Information System (DRB-IS) should serve the International Commission for the Protection of the Danube River (ICPDR) as a tool to improve water Quality, reduce risks and build a basis for the tasks within the DANUBE RIVER PROTECTION CONVENTION (SOFIA 1994). At the same time the IS should meet the needs of scientists, person from enterprises, industry, the administration and the public as well.

For this purpose, available and new established components of the DRB-IS should include water related data and information from

- Water Quality monitoring stations
- Waster water disposal
- Waste water treatment plants
- Prevention of water pollution
Sanitation of surface and groundwater; Soil remediation etc.
- Hydrology, geology and land use
- Water Supply
- Flood protection
- Irrigation and drainage
- Nature conservation: wetlands
- Hydropower plants
- Water Management regulations
- Remote Sensing measurements etc.

Further more links to information of stimulating processes for environmental stress e.g. industrial production, agriculture, tourism etc. should be incorporated in the system.

To select, initiate and evaluate measures for pollution reduction, the analysis of causes of pollution and effects are necessary. Similar to the pressure - state - response approach, in Fig. 3 the graphical representation of a *System for Water Pollution Prevention and Control* is depicted in form of a cascade control system with input/output process elements.

Point and area emission sources as from urban areas, industrial plants, tourism centres and the agriculture but also natural sources can be seen as origin of pollution. Water pollutants itself are measured in measurement networks, which delivers samples of water quality data. Over the information feedback, a water quality control can be established, including legal measures, information of the public and influencing political processes. For emission reduction purposes, instruments like environmental impact assessment and participation of the public can be used within the planning phase of e.g. industrial plants and residential building to reduce environmental burden. In all cases, information resources are of vital importance for an efficient pollution prevention.

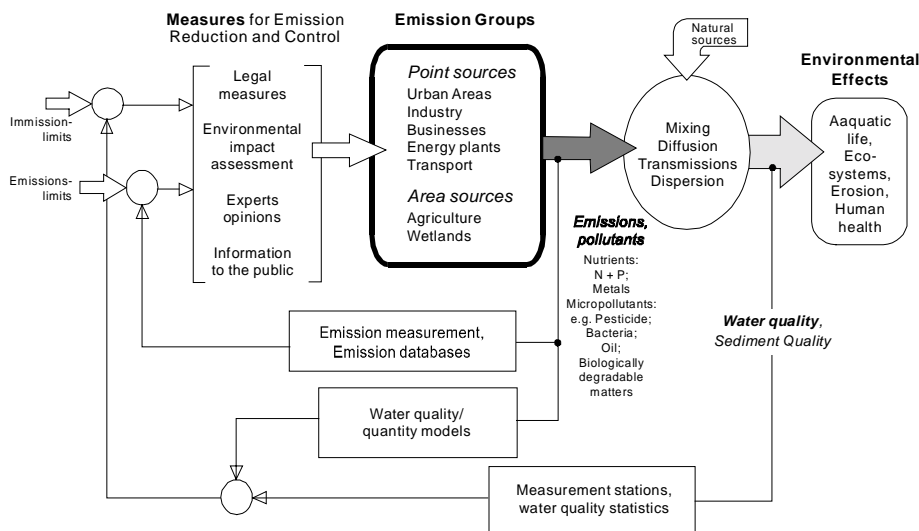


Figure 3: System for Water Pollution Prevention and Control

Information Sources and Information Flow

The collection of data- and information sources is a primary task during the development of a information system for the Danube River Basin. Further steps are the pre-processing of information, selecting tools for storing and retrieving data - also for geographical information - for telecooperation and to open access to the information system for experts, scientists, administrators and the public. Fig. 4 illustrates the information flow between information sources and potential users of the system.

To facilitate the access to environmental information, metainformation system are in use, which holds information about information sources. An examples is the *Umweltdatenkatalog*, a German/Austrian co-operation project, where a special database system was developed, meeting user needs to store, update and exchange metainformation (ZIRM/PILLMANN 1996).

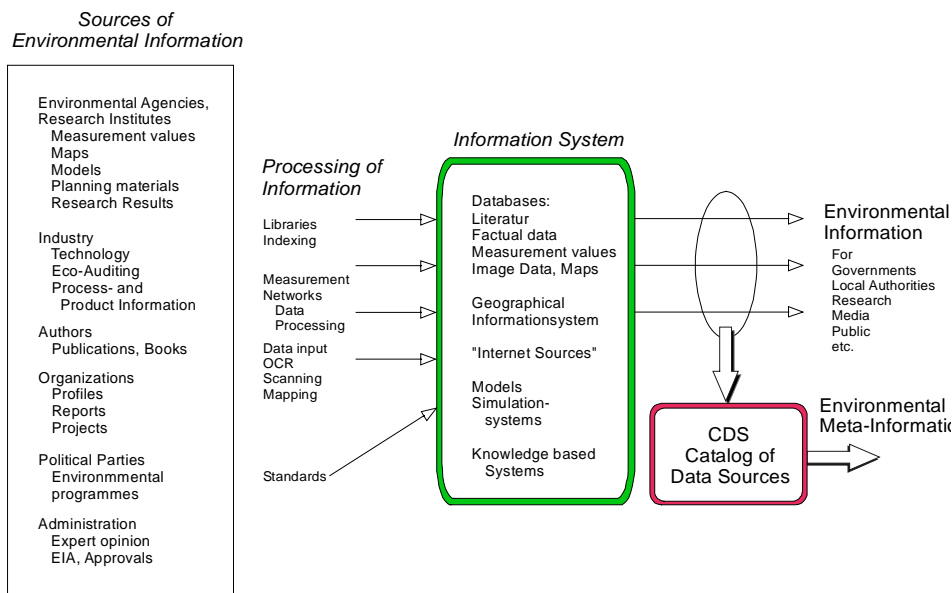


Figure 4: Generalised Data flow in a Environmental Information System

As a consequence of the various international co-operation activities, the European Environment Agency (EEA) foster the development of an European Catalogue of Data Sources (CDS). The CDS was established in order to provide a locator system on environmental information in Europe. The European Topic Centre ETC/CDS was installed, with the leading organisation in Lower Saxony (LESSING/SCHÜTZ 1994,

JENSEN 1998). A tool, created within the ETC/CDS consortium is GEMET, the General European Multilingual Environmental Thesaurus. The CDS is available in a Windows version and since May 1997, WebCDS has been made available to the public under http://www.mu.niedersachsen.de/cds/start_info.html (JENSEN 1998, KRAMER/NIKOLAI et al. 1996). To foster international co-operation, the use of the CDS in the Danube Region was recommended in the GEF/UNDP study FRAMEWORK FOR THE DEVELOPMENT OF AN INFORMATION NETWORK FOR THE INTERNATIONAL COMMISSION FOR THE PROTECTION OF THE RIVER DANUBE (1998).

In addition, the harmonisation of multicountry information sources is a technical, financial but also a social/diplomatic communicative task. Some analytical details of the cross-section between technical and political solutions, necessary to elaborate during the development of environmental information systems can be found e.g. in ROLF/HILTY (1995), PILLMANN (1995), MACK/PAGE (1996), MAYER-FÖLL-STROHM/SCHULTZE (1996), POMMERENCKE et al. (1997) and DENZER/GÜTTLER/HOUY (1998).

Information Dissemination

Dissemination of information is always subject to certain rules and restrictions. Therefore the information system should be designed as a system of layers of different level of confidentiality (internal, external and general components of information system). An example of such a development is the EIONET of the European Environmental Agency, where users are grouped in distinct layers with different rights for information access (SAAREMAA 1998).

Some of these aspects are defined by DRPC Convention and were clearly expressed by the International Commission and its Secretariat. A new approach was established in the *Convention on access to environmental information and public participation in environmental management* in June 1998 at the Ministerial Conference in Aarhus, Denmark.

Efficient communication in the multicountry projects

When the amount of information is relatively small a centralised system could be used with high demand on common updating services. Distributed systems cannot be avoided on a long run. For this purpose advanced software tools should be used which can integrate distributed relational databases and geographic information systems (GIS) in the member countries with an efficient access on WWW facilities. Other Information systems e.g. from Rhine, Elbe or the Wadden Sea (POMMERENCKE et al. 1997) can be used as good examples how widely distributed, heterogeneous data of different origin can be handled in the multilingual/multicultural environment.

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WWW-References

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Black Sea Environm. Information Network	www.bsein.mhi.iuf.net mirror: www.grid.unep.ch/bsein
Catalogue of Data Sources: WebCDS	www.mu.niedersachsen.de/cds/start_info.html
Central European Environment	
Data Request Facility - CEDAR	www.cedar.univie.ac.at
Danube Information System DANIS	www.ceit.sk/wwwisis/danis.htm
Danube Basin Information Network DBIN	www.syslab.ceu.hu/... (not public accessible)
Environmental Action Plan Task Force	http://www.oecd.org/env/eap
European Environment Agency EEA	www.eea.dk
Expert Network ENWAP	www.ceit.sk/wwwisis/enwap.htm
Environment Protection Agency Austria	www.ubavie.gv.at/info/wasser/was_home.htm
GRID Hungary	www.gridbp.meh.hu
Transnat. Monitoring Network TNMN-DRB	faust.irb.hr/~pecar/danube/danube.html
Umweltdatenkatalog UDK	udk.ubavie.gv.at

List of Abbreviations

AEWS	Accident Emergency Warning System
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ARP	Applied Research Program
BSEP	Black Sea Environmental Programme
CDS	Catalogue of Data Sources
CEDAR	Central European Environmental Request Facility
CPC	Country Programme Coordinator
DANIS	DANube Information System
DBIN	Danube Basin Information Network
DMSG	Data Management Sub Group
DRPC	Danube River Protection Convention
EAP	Environmental Action Plan
EEA	European Environment Agency
EIONET	European Environm. Information and Observation Network
EMIS	Emission Expert Group
ENMR	Environmental and Natural Resources Management
EPDRB	Environmental Programme for the Danube River Basin
ETC/CDS	European Topic Centre on Catalogue of Data Sources
GEF	Global Environment Facility
GEMET	General European Multilingual Environment Thesaurus
GRID	Global Resource Information Database (UNEP)
ICPDR	International Commission of the Convention for the Protection and Sustainable Use of the Danube River Basin
IS	Information System
MLIM	Monitoring, Laboratory and Inform. Managem. Sub-Group
NAP, NEAP	National Action Plan; National Environmental Action Plan
NGO	Non Governmental Organisation
PCU	(Danube) Programme Co-ordination Unit
SAP	Strategic Action Plan
SIP	Strategic Action Plan Implementation Programme
TNMN	Trans-national Monitoring Network
UNDP	United Nations Development Programme