

Deliverable D6:

CABRI-Volga

Future Research Agenda



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TABLE OF CONTENTS

Executive Summary	3
1 Methodology	4
1.1 Scope.....	4
1.2 Sources for D6 Report and CABRI-Volga Research Findings	4
1.3 Thematic Areas.....	5
2 Research Agenda: from Current Findings to Future Challenges	6
2.1 Directions for Future Research	6
2.2 CABRI-Volga Research Findings.....	7
2.3 Gaps in Knowledge.....	8
3 Future Research Agenda and Action Plan.....	10
4 Rationale for Future Research	14
References	23

Executive Summary

The major goal of the CABRI-Volga “Future Research Agenda” Report (D6 Report) is to develop a research agenda and action plans for follow-up multidisciplinary research proposals based on major CABRI-Volga scientific findings. The red thread is how to effectively integrate research within broader European context, exchange knowledge from river basins across countries and expand cooperation of scientists.

The focus of D6 Report is on expand multidisciplinary research aimed at enhancing coordination and cooperation between stakeholders in environmental risk management in large river basins in Europe, with a particular emphasis on the Volga Basin. Future research agenda covers both, the domestic research in Russia, as well as the EU and Russia scientific cooperation and joint studies.

The D6 Report summarizes the major possible future research suggested by the CABRI-Volga experts according to seven major directions:

- New approaches to sustainable development and integrated water management in large river basins
- Multi-stakeholder partnerships in river basins – from exchange of info- and knowledge to coordination and joint actions
- Observation, monitoring and user-friendly data and knowledge sharing
- Drinking water quality – innovative technologies, governance and behavior
- Water-related risks and vulnerability assessments are coupled with scientific advise about a package of responses
- Mitigation and adaptation to environmental and human change within river basins (biodiversity, climate)
- International coordination and cooperation in science and technology

Each of the seven research directions is filled-in below with concrete suggestions for future research actions – both at the national and international levels. Major directions of future research and concrete future research actions within each of these directions form the CABRI-Volga Future Research Agenda.

1 Methodology

1.1 Scope

The major goal of the CABRI-Volga “Future Research Agenda” Report (D6 Report) is to develop a research agenda and action plans for follow-up multidisciplinary research proposals based on major CABRI-Volga scientific findings. The red thread is how to effectively integrate research within broader European context, exchange knowledge from river basins across countries and expand cooperation of scientists.

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1.2 Sources for D6 Report and CABRI-Volga Research Findings

The major sources of CABRI-Volga Future Research Agenda are the expert opinions, assessments and suggestions of about 70 invited project external experts from Russia and the EU and of partners of the project. Recommendations for future research are based on evaluation of major CABRI-Volga results, existing gaps and problems in multidisciplinary water related research and existing knowledge compiled during the lifetime¹ of the project by:

- Three CABRI-Volga Expert Groups Meetings held in N.Novgorod in 2005, in Kazan and Cherepovets in 2006 and their meeting reports;
- Three CABRI-Volga outreach scientific workshops held in 2007 in Astrakhan, Yaroslavl and Pushino²
- CABRI-Volga Mid-Term Validation Workshop in 2006 in Karlsruhe.

¹ From December 2005 to February 2007

² Environmental Risk Reduction in the Lower Volga. Astrakhan, 9 February 2007; Industrial and Sanitary Zones Management: Experiences and Current Problems. Yaroslavl, 16 February, 2007; New Challenges and Opportunities for Sustainable Development in the Oka Basin. Pushino 26 February 2007.

Deliverable D6
CABRI-Volga Future Research Agenda

1.3 Thematic Areas

The scope of recommendations for future research is rooted into the five major project areas that are thematically structured into the CABRI-Volga Expert Groups:

Expert Group 1: River & Environmental Rehabilitation

Expert Group 2: Human Security and Vulnerability

Expert Group 3: Natural Resources & Their Sustainable Use

Expert Group 4: Connecting Goods and People

Expert Group 5: Institutional Coordination & Cooperation

The five major themes covered by the CABRI-Volga Expert Groups have been viewed from an integrative perspective for the purposes of developing the research agenda.

This had been combined with suggestions and finding from the three regional outreach scientific workshops. Each of these workshops had been discussing the future research directions and future research actions suggested by CABRI-Volga experts. Also, they have been identifying a number of possible additional research proposals that can be carried out either by national or international research teams. These workshops suggested a number of possible future studies for the Volga Basin in general and its sub-basins, i.e. the Lower Volga and the Oka Basin.

2 Research Agenda: from Current Findings to Future Challenges

2.1 Directions for Future Research

The D6 Report summarizes the major possible future research suggested by the CABRI-Volga experts according to seven major directions. They are considered by the experts as the most urgent for further amelioration of environmental situation and ecological risk reduction, for sustainable development of the river basins and for promoting good water governance.

The major directions of future research look as follows:

1. New approaches to sustainable development and integrated water management in large river basins
2. Multistakeholder partnerships in river basins – from exchange of info- and knowledge to coordination and joint actions
3. Observation, monitoring and user-friendly data and knowledge sharing
4. Drinking water quality – innovative technologies, governance and behavior
5. Water-related risks and vulnerability assessments are coupled with scientific advice about a package of responses
6. Mitigation and adaptation to environmental and human change within river basins (*biodiversity, climate*)
7. International coordination and cooperation in science and technology

Each of the seven research directions is filled-in below with concrete suggestions for future research actions – both at the national and international levels. The D6 Report briefly overviews the rationale governing the experts' research proposals which is summarized in Section 5 of the report.

Major directions of future research and concrete future research actions suggested by the experts form the CABRI-Volga Future Research Agenda. Besides, the future agenda takes into account the major CABRI-Volga scientific findings and existing gaps in knowledge identified in a course of expert discussions.

**Deliverable D6
CABRI-Volga Future Research Agenda**

The CABRI-Volga Future Research Agenda is that it aims at multidisciplinary approach, at building closer links between natural and social sciences and between their research communities. Today, the development of tighter linkages between science and practice is of the utmost importance. The major CABRI-Volga approach is that today the *social responsibility of science* is growing and its role in interaction – both top-down and bottom-up, with all stakeholders in the river basins is growing. The questions of *How to better incorporate the scientific knowledge and results into policy* and *How to develop a regular dialogue with different actor groups in river basins* is in the core of the future research activities.

Social responsibility of science:

Types of interface

- * Science - practice interface
- * Dialogue between science and decision-making
- * Partnerships between science and stakeholders
- * Science-education-public awareness interface
- * Social – natural sciences dialogue
- * Multidisciplinary research

2.2 CABRI-Volga Research Findings

The Future Research Agenda presented in the D6 Report is based on the major research findings of the CABRI-Volga project. They are summarized below:

- New approaches in water governance presuppose integration of sustainable development principles into integrated water resource management in large river basins
- Coordination and stakeholder partnerships is among important tools in integrated water management in large river basins
- Multidisciplinary research and dialogue between science and multiple stakeholders ensures sustainable management of water resources in river basins
- Specifics in basin water management in different countries, success, or failures in implementation of particular water policy options is defined to a high extent by existing domestic socio-economic and political contexts
- Combining scientific, technical, social, economic, institutional and financing solutions is crucial for dealing with one of the priority problems at the environmental agenda of the Volga Basin, i.e. the need for drinking water quality amelioration

Deliverable D6
CABRI-Volga Future Research Agenda

- CABRI-Volga research favors a proactive approach to water-related disaster risk reduction including the combination of mitigation, prevention, emergency and rehabilitation responses which need to be coordinated among different stakeholders in a river basin
- The conservation of natural river ecosystems and biodiversity conservation is to be taken into account in future sustainable water use options within a river basin
- These days communication of water-related information and knowledge to the local public and to decision-makers in a user-friendly manner is becoming a 'must' in integrated water management in the Volga, and, here, the role of scientific community (natural and social sciences) is significant.
- There is a growing understanding among scientists that bottom-up approach in science-civil society dialogue is needed: engaging the opinion of end-users of knowledge and data at initial stages of monitoring and scientific programmes contributes to better understanding and response to water-related risks
- 'Packaging and transfer' of knowledge and practices in water management across river basins in various countries without prior adaptation to national cultural, social, economic, political specifics and natural conditions might be misleading
- The scientific cooperation between the EU and Russia in water related research in natural and social sciences is gaining momentum; promotion of the twinning initiatives and development of science and technology partnerships between the stakeholders in the Volga and the EU river basins is a crucial part of the common research agenda

2.3 Gaps in Knowledge

The Future Research Agenda takes into account the existing gaps in scientific knowledge about environmental risk management in large river basins with a particular focus on the Volga. Its list does not pretend to be comprehensive and to incorporate all existing loopholes in scientific knowledge, but reflects the results of expert discussions during the project expert meetings. Future research both in natural and social sciences intends to fill-in some of these gaps. The existing shortages in knowledge as identified by the CABRI-Volga experts are listed below:

- inadequate R&D in processing and supply of drinking water of good quality are coupled with shortages in scientific advice about good water governance in the Volga Basin
- poor multidisciplinary assessment of risks of water-related disasters (floods, droughts)

Deliverable D6
CABRI-Volga Future Research Agenda

- loopholes in assessment of hydro-technical facilities/dams and associated risks to human and ecological security
- loopholes in knowledge about best possible solutions to coordinate and package the structural and non-structural responses to water-related disasters
- gaps in scientific knowledge about how to factor ecosystems, biodiversity conservation and provision of eco-services into the future models of the basin development
- uncertainties and inadequate scientific knowledge about global climate change impacts on the Volga Basin and possible human adaptation and mitigation responses
- deficiencies in scientific knowledge about a choice of institutional innovations to coordinate stakeholder actions in river basins
- loopholes in knowledge about possible package of options in water consumers behavior and economic incentives for sustainable water use and protection
- poor regular communication and user-friendly dissemination of water-related scientific knowledge and reliable observations data to decision-makers and the public is insufficient
- gaps in public awareness in the Volga relating to water quality, hazard risks and water management problems is partly attributed to poor communication of scientists and data-managers to the stakeholders
- innovations in water monitoring methods is essential, including the application of modern hydrological measurement devices and methods of water quality analysis, long-distance and automotive water monitoring
- poor scientific advise about best possible options for institutionalizing the system of the river basin councils in the Volga

3 Future Research Agenda and Action Plan

The Future Research Agenda incorporates seven major directions of research and concrete initiatives for future Action Plan within each research direction introduced by the CABRI-Volga experts. They are presented below:

1. New approaches to sustainable development and integrated water management in large river basins

- Assess of the Volga Basin sustainable development options under economic growth based on enhancing the innovations potential, the quality of life and effective water use/conservation
- Inventory and comparative research in the EU and Russia on best practices in sustainable water management in river basins including environmental amelioration goals, social and economic priorities
- Implement of a pilot RF-EU demonstration project in the Volga Sub-Basin to test new mechanisms of integrated water management in a river basin: Astrakhan Delta and Oka comparative case-studies
- Overview and assess the innovative sustainable finance mechanisms/tools for water basin management and options for their application in the Volga regions
- Economic and technical feasibility study and development of an integrative transport strategy for the Volga Basin till 2020
- Social research in urbanized industrial areas in the Volga aimed at identifying instruments and tools for coordination between poverty reduction and ecological/health amelioration
- Further R&D on industrial sanitary zones development in Yaroslavl and dissemination of scientific results, information and 'good practices' to other urbanized areas in the Volga Basin

2. Multi-stakeholder partnerships in river basins – from exchange of info- and knowledge to coordination and joint actions

- Develop new approaches, inventory and analysis of knowledge and good practices in stakeholder partnerships and multidisciplinary coordination for sustainable water management in river basins worldwide
- Study of river basin organizations (national and international) in Europe and other regions in sustainable water management and enhancing public participation in decision-making

**Deliverable D6
CABRI-Volga Future Research Agenda**

- Research on industrial zones management and riverside rehabilitation through joint efforts of municipalities, business and local public
- Develop models and schemes for coordination and interface between regional government agencies and non-state actors towards better water management in the Volga urbanized areas
- Design and test possible mechanisms and tools for building water partnerships between government, business and civil society in the Oka Basin
- Research on participatory approaches and methods to involving all stakeholders, including the public in natural disaster risk reduction and preparedness
- Pilot study on coordination of water allocation/use across sectors in the Oka Basin during high- and low-water seasons

3. Observation, monitoring and user-friendly data and knowledge sharing

- Develop the river basin monitoring and research programmes and networks for increasing effectiveness of river basin management
- Establish the programme for enhancing monitoring systems for the Oka basin based on automative hydrological data sets, on bio-indicators and bio-monitoring and on long-distance observations
- Develop and implement the programmes for children education and participation in ecological monitoring in the Oka; dissemination of its lessons and results to other Volga sub-basins
- Study and inventory of traditional water-related knowledge and practices in the locales of the Volga and combine them with innovative approaches
- Develop and apply modern methods for hydrological, hydro-geological, hydro-physical and hydro-chemical monitoring of water resources in the Volga Basin

4. Drinking water quality – innovative technologies, governance and behavior

- Research and inventory of innovative approaches and good practices worldwide (science and technology, economic, institutional) for effective management of drinking water in the Volga
- Assess and develop innovative approaches to reforms in water services sector
- Assess possible economic instruments and innovative public behavior practices in the households towards sustainable use of water

**Deliverable D6
CABRI-Volga Future Research Agenda**

- Design the R&D programmes for better water treatment technologies and water distribution networks coverage in the Volga regions and expert advise for rehabilitation and renovation of public water treatment facilities and networks
- Participate in development of water quality monitoring networks, including regular public reporting in a clear and user-friendly manner on drinking water quality and possible health risks
- Study the preservation and/or restoration of ecosystems which can serve as a natural water purification systems (methodology development-monitoring-impact assessment)

5. Water-related vulnerability assessments are coupled with scientific advise about a package of responses

- Assess the water-related multi-hazard risk/vulnerabilities, including social, economic and ecological analysis at the local level
- Assess and produce the scientific advise on a possible package of mitigation and adaptation responses to water related natural disasters in the Volga which is based on combination of structural and non-structural measures within each stage of disaster risk reduction (i.e. mitigation, preparedness, emergency response and rehabilitation)
- Inventory and comparative analysis of knowledge and best practices in river basins across Europe in water related disaster risk reduction (flood and droughts)
- Comparative analysis and evaluation of existing international and national methodologies for integrated assessment of hydro facilities and their adaptation to the specific needs of the Volga Basin
- Assess the hydrological regimes, water quality indicators, ecological parameters, social and economic impacts of artificial reservoirs and the Volga cascade
- Assess risks associated with hydro-technical facilities and related local ecological and socio-economic impacts in the Oka Basin

6. Mitigation and adaptation to environmental and human change within river basins (*climate, biodiversity*)

- Research on variations of the Volga Basin hydrological regime under the climate change, assessment of socio-economic effects and possible adaptation and mitigation strategies
- Develop the mid- and long-term forecasts for water management in the Volga-Caspian basin under the climate change

Deliverable D6
CABRI-Volga Future Research Agenda

- Develop a decision-support system based on GIS for the river basin integrated water management in Oka under high- and low-water annual regimes
- Enhance the system of forecasts for hydrological regimes and water use under the economic growth; develop the environmental indicators for assessment of possible limits of human pressures
- Impact assessment of natural resources development in the Volga-Caspian on biodiversity and on the state of the basin ecosystems; develop the set of integral indicators characterizing the state of natural ecosystems
- Develop the scientific advice for sustainable use of water resources and ecosystems in the Lower Volga and elaboration of 'ecological services' approaches

7. International coordination and cooperation in science and technology

- Joint research on application and adaptation of IWM approaches within various river basins
- Develop the scientific basis for the EU-Russia rivers twinning initiatives
- Disseminate and test the EU-RF Volga-Rhine Project results and findings (multidimensional water quality and water quantity studies) in the Oka sub-basin
- Joint EU-Russia research on application of bio-monitoring methods in large river basins
- Cooperate in monitoring, data compilation and processing for effective management of large river basins and regular exchange of data
- Design the 'tool kit' for raising the public awareness regarding water-related risks and support for public action and participation in decision-making
- Cross-national comparative analysis on knowledge and practices in good water governance in large river basins worldwide

4 Rationale for Future Research

New approaches to sustainable development and integrated water management in large river basins

During the last decade there have been considerable developments in notions and perceptions about integrated water management (IWM) in river basins. IWM is a conceptual approach to water problems studies, planning and practice in water use and water protection. Today there is a variety of approaches on the issue. Typically, they stress three main interrelated components: 1) combination of economic, social and environmental concerns in water use and water protection taking into account natural characteristics of an entire river basin, 2) cross-sectoral water management, and 3) institutions in the basin at various levels.

Sustainable development principles, and particularly sustainable management of water resources in a river basin – with a close intertwine between economic, social and environmental components- are becoming to play a growing role in IWM concept. Moreover, sustainable water management is increasingly linked to social aspects of the problem, and particularly to enhancing of the life quality (including poverty reduction) of population within a river basin. In the context of the recent high annual economic growth rates in Russia, scientific advice is urgently needed about how to decouple rapid economic development and water protection and conservation in the Volga.

Various approaches to IWM and sustainable water management in large river basins had been highlighted during the project meetings by the CABRI-Volga experts from the EU and Russia. There is a unanimous expert opinion that both concepts are quite comprehensive and difficult, they are at initial stages of elaboration when efforts are taken worldwide to shift from ambitious declarations to profound everyday analysis, and a lot of research is needed to advance their further development and practical applications in policy-making within river basins.

Furthermore, it is becoming common in the EU countries and Russia that good water governance is based upon *river basin* management approaches. These approaches and research results are started to be actively applied in practice. In the EU the Water Framework Directive prescribes the basin management approaches for all countries and stakeholder groups; in Russia the new RF Water Code introduces the basin management as a core approach in research and practice.

A number of interesting niches for future research in this direction had been identified. Within most of other expert future proposals this theme can be qualified as cross-cutting, and it is regarded among core scientific approaches of CABRI-Volga.

Multi-stakeholder partnerships in river basins – from exchange of info- and knowledge to coordination and joint actions

Coordination and multiple stakeholder partnerships approach is a powerful tool in good water governance in river basins and it is heavily rooted into IWM. It is a comparatively new concept and since recently a significant amount of research and action are underway to develop approaches for coordination, to identify effective measures and tools in the field and to apply them in policies. CABRI-Volga research in this area focuses on the problems of how to better (1) coordinate (vertically and horizontally) between various institutions in river basins and develop possible coordinated institutional frameworks at a basin level, 2) build partnerships between multiple stakeholders in large river basins.

CABRI-Volga studies indicates that among possible tools for the coordination of interests of multiple stakeholders and establishing a dialogue between them, the river basin authorities had gained an increased worldwide recognition. There is a variety of examples when coordination institutions promote shifts from conflicts to cooperation as it has been, for instance, in the Scheldt Estuary when the coordinating body managed to ensure at the beginning of the current decade a shift from a long-standing bilateral water-related conflict between Belgium and the Netherlands to cooperation and joint policy-making. However, still a lot of research questions remain unanswered. Thus, a profound inventory and assessment of good practices and lessons learned from various river basins in Europe is a part of the research agenda.

Further research on institutional coordination and stakeholders partnerships is of a high importance for the Volga Basin. Not much has been done so far by the social sciences in that respect. There are significant gaps in scientific knowledge on how to coordinate interests, build consensus, dialogue and joint actions of multiple stakeholders in the Volga – away from possible conflicts, and to involve them in decision-making on water protection and conservation within the entire basin. Especially important are scientific assessments on formation of river basin councils which is introduced by the new RF Water Code. Scientific advice is also needed on how the newly established basin councils promote the local public participation in a dialogue and decision-making which is still a weak segment in environmental institutional framework throughout the country. CABRI-Volga expert suggest that a variety of studies and exchange of knowledge accumulated within the different European river basins is important for the Volga.

Future scientific assessments and advice about possible pathways and methods to design interactions within the triangle 'government-business-public society' in water protection and conservation is needed by practice today. Equally important are concrete multidisciplinary

Deliverable D6
CABRI-Volga Future Research Agenda

studies in particular sectors and thematic areas on coordination of interests and joint actions by various stakeholder groups in sustainable water management.

Observation, monitoring and user-friendly data and knowledge sharing

Regular water resources monitoring, data compilation and its dissemination to end-users and society is essential for decision-making. Despite significant government and research efforts underway during many decades in the Volga Basin³ to develop a system of water resources data compilation and processing, today, significant problems exist in the field. These gaps are the part of the national crisis of the 1990s in water resources observations; while in the past hydrological monitoring in Russia was well organised and coordinated. CABRI-Volga experts note that primary data sets on water resources compiled as a result of basin-wide monitoring had declined significantly as a result of network deterioration: the number of surface water hydrochemical and hydrobiological water quality monitoring sites had been reduced, as well as the number of analytical testing laboratories⁴. Slow renovation of water measuring devices and techniques, and poor application of automatic and long-distance monitoring methods basin-wide are among serious loopholes in knowledge development. Gaps in information and data sets hinder information processing and its dissemination to decision-makers in the Volga and its tributaries.

The role of science in presenting the water-related information to its consumers in a user-friendly manner is enormous. Besides, particular emphasis is made by the experts on the need for participation of the scientific community in broad and regular dissemination of accurate water-related data to the public and locales in the Volga regions. Existing loopholes in public awareness in the Volga relating to water quality, hazard risks and a variety of water management problems are partly attributed to poor communication of scientists and data-managers to stakeholders and local public. These days communication of information and knowledge to the local public is becoming a 'must' in integrated water management.

There is a growing understanding among scientists that bottom-up approach is needed: involvement of end-users of data and local public at initial stages of water monitoring programmes development, as well as in their implementation, contributes to better understanding and response to water-related risks. The recent example of the research community in Pushino Scientific Center to enhance the local public participation, and

³ Water-related information is stored in the State Water Cadaster ("Surface waters", "Use of Water", "Underground Water Resources") and by the Russian Register of Hydrotechnical Facilities compiled by RosHydromet, RosVodResursu, RosNedra and respective monitoring and processing centers. Water statistics, manuals and electronic data sets are also compiled within different economic sectors.

⁴ Today, in Russia, the national water monitoring network incorporates 1815 water quality (hydro-chemical) observation sites, 198- hydro-biological monitoring sites and 104 analytical laboratories.

Deliverable D6
CABRI-Volga Future Research Agenda

especially of the children and youth in the programmes of biological monitoring in the Oka promotes the development of the regional civil society network for water monitoring and environmental education.

Thus, CABRI-Volga experts suggested a number of recommendations for future development of science and technologies for enhancing the water monitoring and regional data sharing networks in the Volga Basin. All of these proposals target the ultimate goal of establishing the system able to ensure both profound inventory on water resources and the operational dissemination of reliable and thorough water related information to the public and economic sectors in the Basin.

Drinking water quality – innovative technologies, governance and behavior

Water quality amelioration, and especially the quality of drinking water supplied to the households through distribution networks is among the core problems in the Volga Basin: none of its major cities is supplied with drinking water with its quality meeting the national or WHO standards. Currently, poor drinking water quality, including microbiological contamination and poor water distribution systems and their coverage of the Volga regions are among the most important on the agenda. The major reasons are shortages in technical facilities, inefficient purification and disinfection systems, poor state of water supply distribution networks, and ineffective system of water services in the communal sector. Combination within a package of technical, social, economic, institutional and financing solutions is crucial for solving this problem which is characteristic not only for the Volga, but for the other regions of Russia.

The role of science and the R&D community is really important. Scientists are to generate expert assessments and advice for strategic approaches to developments in this sector and to ensure professional support and transfer of knowledge and expertise for the governments, industry, water services providers and the public.

Recommendations of CABRI-Volga experts for future research actions rank from the need to provide advice about technologies and innovations, to inventory of good practices applied worldwide and to assessments on possible policy mechanisms and tools to be used within the reform in the water services sector in the Volga. This relates both to enhancing water quality supplied through the centralized water distribution systems, including renovation of

**Deliverable D6
CABRI-Volga Future Research Agenda**

pipes and other infrastructure to deliver safe drinking water, and to improvements in water quality in rural areas⁵.

New segment of future research activities focus on assessments of behavior in the local public and households: changes in existing wasteful consumption patterns and development of sustainable attitudes for water use is urgently needed. Scientific advice on possible economic incentives for consumers is also crucial. Today, the decision-makers still face the conflicting choices about possible policy options in this sector, including increase of water pricing, privatization of services, ensuring social equity and support for effective public preferences and water consumer behavior.

CABRI-Volga believes that scientific community should have a more active stance and be the real driver in developing the urgently needed practical actions. For example, among serious problems is the inadequacy of information communicated to the public about the state of drinking water supply and associated health risks. As we have witnessed during the First CABRI-Volga Expert Groups Meeting in Nizhny Novgorod in September 2005 the lack of adequate official regular information about the state of the drinking water supply – accident in the network had been the cause for the hepatitis epidemic - aggravated the local situation. This case shows that scientific community needed to play more active role and to have higher social responsibilities.

Many other examples in the Volga indicate that scientists are to play the leading role in improving data sharing with the public about the water quality and related risks for human health. The existing problems and lack of information can be solved by closer coordination and partnerships between scientists and government officials.

**Water-related vulnerability assessments are coupled with scientific advice
about a package of responses**

CABRI-Volga research favors proactive approach to water-related disaster risk reduction including a combination of mitigation, prevention, emergency and rehabilitation responses. A number of studies of project partners from Europe and Russia containing assessments of good practices and major problems during the recent flood events are based on this approach. Further discussion with the invited experts indicates that there is a need for future research and scientific assessments of possible package of mitigation and adaptation responses to water-related natural disasters (floods and droughts) in the Volga. Such integrated approach envisages a combination of structural and non-structural solutions.

⁵ The major part of the urban areas have centralized communal water distribution systems based mainly on surface water sources; 62 percent of rural settlements do not have centralized water systems and the water supply is based on underground sources.

Deliverable D6
CABRI-Volga Future Research Agenda

Indeed, there is a growing understanding that structural measures alone are not able to eliminate, for example, the flood risks and coordination within a river basin with responses in construction sector, land-use planning, forestry, agriculture, environmental protection, etc. is essential for enhancing security of livelihoods against floods. Further inventory and comparative analysis of knowledge and best practices in river basins across Europe in water related disaster risk reduction are suggested by the CABRI-Volga experts as well.

CABRI-Volga experts indicate at poor multidisciplinary assessment of risks of water-related disasters in the Volga Basin. Development, testing and application of indicators that allow assessing the vulnerability and coping capacity of a society to floods is important for effective disaster risk reduction. Such indicators are useful to enhance “knowledge for action” and they are to be taken into account by decision-makers. Special emphasis is done on the rationale for development of vulnerability indicators reflecting the situation at the local and community-based levels: because they help to identify vulnerabilities and capacities of households and local communities to manage and overcome disasters, including floods. Experts also note that research on new behavioral stereotypes of the local public in the Volga Basin is important. Local public participation in flood risk reduction needs to be enhanced and it is to be regarded as a way of life and a crucial element in integrated flood risk reduction approach.

Currently, there are significant loopholes in knowledge and data relating to human and ecological security of existing system of hydro-technical facilities and the Volga cascade of reservoirs. There is a common expert opinion that thorough assessments are urgently needed, which can be part of international cooperation initiatives. CABRI-Volga experts recognize that the state of some facilities pose serious threats to safety of communities living in the Volga and its tributaries. The innovative solutions need to be found to ensure both the safety of population and integrated water management in the basin. There is also a need to further multidisciplinary evaluations of the social and economic impacts of the artificial reservoirs on the Volga.

Mitigation and adaptation to environmental and human change within river basins (*climate, biodiversity*)

Recent studies suggest that global climate change will have an impact on the regions of the Volga Basin, and its effect on all natural ecosystems and society will increase in the future. It will primarily affect water resources and dynamics of hydrological regimes in the basin, extreme events, irrigation, navigation, industries, and it will increase evaporation from the reservoirs and irrigated fields. However, there is a great deal of uncertainties, first, regarding

Deliverable D6
CABRI-Volga Future Research Agenda

its particular effects (and scales) on natural ecosystems⁶. Second, a lot of unanswered questions remain about its consequences for the human society, and particularly for the economy and human health. Scrupulous research and modeling is essential. Possible human responses in the Volga to global climate change – is an area which needs a particularly thorough studies which are to focus both on mitigation and adaptation options.

Today, special attention of scientists is paid to the ecological problems of the Lower Volga and problems of biodiversity conservation in this naturally unique area of the river basin. The Volga Delta is a natural purification filter where transit polluted waters from upstream are subjected to mechanical, physical, chemical and microbiological purification by its ecosystems. Further development and testing of methods for biodiversity conservation in the delta area is a challenging direction of research activities. Besides, the system of reliable ecological indicators reflecting the sensitivity of ecosystems for a variety of anthropogenic pressures needs to be developed. Special attention of the CABRI-Volga outreach scientific workshop in Astrakhan is paid to elaboration of ecological monitoring and impact assessment tools for the study of water bodies' internal processes and integrity of water ecosystems. Its participants underlined that in the future the priority of ecological problems in the Delta is to be increased due to a broad set of reasons, and particularly because environmental problem solving has a direct link to amelioration of the quality of life of the local population.

International coordination and cooperation in science and technology

Water related research by natural and social sciences is gaining momentum within the EU and Russia's scientific agenda. This sector presents large opportunities for joint research and cooperative projects.

In the EU, significant attention has been devoted to designing the scientific agenda and research action on water. Over the last decade, the EU has invested significant resources in international scientific cooperation to study the water resources sustainable management. During 1994-2005 about 67 research projects on water had been implemented worldwide in cooperation with other countries. During this period the EU INCO programme has spent over €50 million on water resources management and water services in general. The result has been in enhancing regional cooperation, joint development of concepts for sustainable water resources management, and societal and economic innovation. "Partner countries learn from

⁶ The volume of water resources is likely to increase: in many regions of the basin the runoff might increase by 15-20%; the river discharge increases during the low flow period. Global warming of two degrees Celsius might lead to increase in precipitation of 75-150 mm/year in the upper reaches and 200-250 mm/year in the lower reaches of the Volga.

Deliverable D6
CABRI-Volga Future Research Agenda

European experiences while Europeans learn about and from challenges in other parts of the world” <Directing, 2006>.

The current reforms in the water sector in Russia and introduction of the new Water Code in 2007 established the new institutional context for water-related social and natural sciences development: their role in sustainable water resources management is gradually increasing. The new goals are set for the scientific community by the government, while expanding the water-related scientific research and development of international cooperation in the field is among the recent government approaches <On amelioration, 2006>.

CABRI-Volga recognizes the growing role of scientific cooperation between the Volga regions and multiple stakeholders there with their counterparts in Europe. Building the twinning partnerships in the river basins is of a special importance. Interesting experiences of cooperation had been accumulated between the EU and the Volga regions, including, for example, the Volga Vision and the Volga-Rhine project. The latter one contributed to problem-solving during the freshet floods in the Volga and its tributaries, to Volga hydraulic modeling, assessing bottom sediments <Meeting, 2006>.

According to CABRI-Volga expert assessments the future challenges in science and technology cooperation between the EU and Russia in water related risk reduction are enormous. A broad variety of coordinated research actions are suggested. They include research proposals from joint efforts in development and application of integrated river basin management principles to and designing multistakeholder partnerships in sustainable water management in large river basins, or testing possible designs within pilot projects in particular sub-basin. Assessment of vulnerabilities and impacts of changes in hydrological regimes and corresponding designs of risk adaptation options, as well as projects on monitoring and data exchange, or study of possible means for local public participatory action in water conservation and innovative behavioral stereotypes of stakeholders are among the items for the future research agenda. Many of the suggested proposals fit into the research within the EC 7th Framework Programme “Environment (including climate change)”.

Knowledge about good practices and tools for coordination between stakeholders in water management in large river basins in the EU and Russia can be exchanged and transferred across countries. However, national conditions, cultural, social, economic, political specifics are to be carefully taken into account. There is also an opinion of some CABRI-Volga experts that ‘packaging and transfer’ of knowledge and practices across river basins, or across borders might be misleading. Significant adaptation of knowledge and practices to specific situations is required to make the imported tools effective. In that respect, the alternative possible option might be learning from each other in creating capacities and building

Deliverable D6
CABRI-Volga Future Research Agenda

preconditions that promote equal access, effectiveness, transparency, openness in water protection and conservation within river basins.

Among a variety of possible avenues suggested by CABRI-Volga experts for scientific cooperation between the EU countries and Russia in sustainable development and water protection/conservation in large river basins are the following:

- Incorporation of water related environmental risk management and human security issues into the new Partnership Cooperation Agreement between the EU and Russia
- Promote the twinning initiatives and development of partnerships between the stakeholders of the Volga and the EU river basins
- Joint efforts in identifying means, forms and instruments for enhancing various forms of 'acting' partnerships along the river
- Cooperation in integrating the sustainable development concepts into IWM; joint research on broader application of IWM approaches
- Joint efforts in development of effective systems in water resources management in large river basins
- Exchange and application of best practices in sustainable development that combine both socio-economic interests and ecosystems conservation
- Design and support for the European investments resulting in water conservation/protection in the Volga Basin
- Exchange of knowledge and practices in natural resources (water) management, including exchange of specialists, managers, student; organization of joint seminars, lectures, etc.
- Organisation of monitoring and research for effective management of large river basins and regular exchange of data
- Design the 'tool kit' for raising the public awareness regarding environmental risks and support for public action and participation in decision-making
- Commercial cooperation facilitated by the establishment of a Volga investment forum; this would be a meeting place of international and local investors for the development of common targets, action plans and investment plans.
- Technical cooperation in the form of know-how transfer for infrastructure development in the Volga Basin; in this context, the creation of intermodal freight ports which is well-advance in the EU was mentioned.
- Widening geographical scope, networking activities and research initiated by CABRI-Volga to other large river basins (Mekong, Red, Nile, others) and to marine coastal and delta areas worldwide

**Deliverable D6
CABRI-Volga Future Research Agenda**

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