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The Potential Benefits
of Transboundary Co-
operation in Georgia
and Azerbaijan: Kura River
Basin

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ENVIRONMENT DIRECTORATE

**THE POTENTIAL BENEFITS OF TRANSBOUNDARY CO-OPERATION IN GEORGIA AND
AZERBAIJAN: KURA RIVER BASIN - ENVIRONMENT WORKING PAPER No. 114**

By Pierre Strosser (1), Gloria De Paoli (1) and Tatiana Efimova (2)

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ABSTRACT

This study was one of the first attempts to evaluate and quantify the benefits of transboundary co-operation between Georgia and Azerbaijan. A specific framework for inventorying these benefits, taking into account all the different dimensions of transboundary water management, was built and applied to the major transboundary water bodies. Though a thorough assessment of the costs and benefits of transboundary co-operation in the two selected cases was not possible due to the lack of some quantitative and economic data, the assessment results highlighted the importance of promoting the integration of economic thinking in transboundary water management. The present and future prospects for transboundary co-operation on water management are still very positive: the two countries are working on a Transboundary Agreement, which will provide the necessary regulatory framework for co-operation and, most importantly, will set up a Joint Commission on Sustainable Use and Protection of the Kura River Basin. The outcomes of this study allowed for the identification of priorities for future work on transboundary co-operation between Georgia and Azerbaijan, and namely, support to developing guidelines on mechanisms to update databases, but also on new tools and systems.

Keywords: Transboundary water management, benefits of water co-operation, economic instruments, water policy, river basin.

JEL Classification: Q15, Q25, Q28, D78

RÉSUMÉ

Cette étude fait partie des premiers travaux menés pour évaluer et chiffrer les avantages d'une coopération transfrontalière entre la Géorgie et l'Azerbaïdjan. Afin de les répertorier en tenant compte des différentes dimensions de la gestion transfrontalière de l'eau, un cadre a été spécialement conçu à cet effet et appliqué aux principales entités hydrologiques. Malgré l'impossibilité, faute de données quantitatives et économiques suffisantes, de procéder à un examen approfondi des coûts et avantages d'une coopération transfrontalière dans les deux cas retenus, l'analyse a mis en évidence l'importance d'encourager l'intégration d'une réflexion économique dans la gestion transfrontalière de l'eau. Les perspectives actuelles et futures d'une coopération dans ce domaine restent très prometteuses. Les deux pays travaillent à un accord transfrontalier qui définira le cadre réglementaire indispensable à l'instauration d'une telle coopération et, surtout, qui portera création d'une commission conjointe sur l'utilisation durable et la protection du bassin versant de la Koura. L'étude a permis de définir les priorités des travaux à consacrer à la coopération transfrontalière entre la Géorgie et l'Azerbaïdjan et de faciliter l'élaboration de lignes directrices concernant les mécanismes d'actualisation des bases de données, ainsi que de nouveaux outils et systèmes.

Mots-clés : gestion transfrontalière de l'eau, avantages de la coopération dans le domaine de l'eau, instruments économiques, politique de l'eau, bassin versant.

Classification JEL: Q15, Q25, Q28, D78

FOREWORD

The objective of the paper is to provide further insight on the potential benefits of transboundary co-operation between Georgia and Azerbaijan in the Kura river basin. Economic analysis can help identify potential benefits of improved co-operation on water resources management, and allocate them fairly, to drive further improvement of the river management. The outcomes of this study allowed for the identification of priorities for future work on transboundary co-operation between Georgia and Azerbaijan. To implement a pilot study and draft the paper, the OECD commissioned two water experts, Pierre Strosser and Gloria de Paoli (all ACTeon, France). Tatiana Efimova at the OECD provided essential oversight and inputs into the paper. The authors would like to thank the OECD staff: Guillaume Gruère, Xavier Leflaive, Kumi Kitamori and Matthew Griffiths for helpful comments and Maria Dubois and Lupita Johanson for editorial support.

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EXECUTIVE SUMMARY

This study was one of the first attempts to evaluate and quantify the benefits of transboundary co-operation between Georgia and Azerbaijan.

A specific framework for inventorying these benefits, taking into account all the different dimensions of transboundary water management, was built and applied to the major transboundary water bodies.

As a second step, a methodology for assessing the net benefits of transboundary co-operation under different scenarios was developed, which included both the assessment of the gross benefits and costs of co-ordinated action. In order to conduct a detailed and quantitative study within the time and resource constraints, two case studies were selected, namely: (i) water quantity issues in lake Jandari; and (ii) flooding issues along the Kura river.

However, a thorough assessment of the costs and benefits of transboundary co-operation in the two case studies was not possible, due to a lack of basic, quantitative data on water use and of economic information and data.

In particular, in the case of water quantity issue in lake Jandari, very little data is currently available with respect to the expected benefits of transboundary co-operation, and thus only a limited part of these benefits could be assessed –namely, the benefits for water companies related to efficiency improvements. As a result, the costs of transboundary co-operation on water quantity issues seem to heavily outweigh benefits in most cases. However, even if calculations are incomplete, results clearly suggest that, in case of transboundary actions on water quantity issues, it can be significantly more cost-effective to concentrate efforts in the country (or area) with the lowest water efficiency levels, as the same abstraction reduction targets can be achieved at the least cost.

Serious issues with data availability were also experienced in the second case study on flooding issues along the Kura River. As information on existing and current measure for flood prevention and mitigation were lacking, the case study focused on the costs and benefits of setting up a joint early warning system –and, also in this case, cost and benefit information was scarce. As a result, only first estimates could be produced. Nevertheless, even taking into account the inadequacy of basic data supporting these estimates, there is a large disproportion between the costs and benefits of setting up a joint early warning system: the estimated benefits outweigh the expected investment costs by more than 15 times. This suggests that investing in a joint early-warning system could be a particularly recommendable choice for both countries.

Overall, difficulties in gathering good economic data to build the case studies, as well as discussions held during the meeting with national experts prior to the Regional Meeting, highlighted a need for stressing the importance and promoting the integration of economic thinking in transboundary water management –which is lacking at present. However, the scarcity of good economic information, as well as the resulting lack of economic thinking in water management in the two countries, has deeper roots: the main issue identified by the countries is in fact the lack of basic data on water uses and water uses inventories in the two countries.

The lack of economic thinking in water management can result in non-optimal water management choice, especially if we think of transboundary water management as a way of addressing economic and environmental objectives at the same time. Economics should inform the decision-making process from the very beginning, hand-in-hand with environmental data. This also implies that good

quality quantitative information on water use is required. To support future decision-making and institutional capacity building, this report includes a table detailing the main steps of the transboundary decision-making process; for each of these steps, the table provides examples of the required quantitative and/or economic information required.

In this perspective, whenever it is worth co-operating on transboundary water management issues, the collection of primary data is recommendable. This is of course an additional cost, but a cost that can be compensated by the benefits of an effective co-operation. In any case, it should be kept in mind that economic data and information must only support the decision-making process, and not substitute it.

Overall, the present and future prospects for transboundary co-operation on water management are very positive: the two countries are in fact working on a Transboundary Agreement, which will provide the necessary regulatory framework for co-operation and, most importantly, will set up a Joint Commission on Sustainable Use and Protection of the Kura River Basin. The Commission will co-ordinate transboundary efforts and activities, filling an institutional gap that is currently putting a brake on co-operation. Nevertheless, some challenges to transboundary co-operation still need to be addressed, such as for example the lack of qualified personnel within the responsible Ministries and Agencies.

The way forward

The outcomes of this study allowed for the identification of priorities for future work on transboundary co-operation between Georgia and Azerbaijan, and namely¹:

- Capacity building is a priority in Azerbaijan and Georgia. Other needs include guidelines on mechanisms to update data bases, but also on new tools and systems. However, the two countries have different needs for follow-up of the present study;
- The Bilateral Commission is an important step in co-operation among the two countries. Therefore, an international community needs to consider a possible support to ensure the financial sustainability of the Commission, as well as technical support to the two countries.

¹ Priorities established and agreed upon during the Regional Workshop held in Tbilisi, on 11 November 2014.

INTRODUCTION

The context

Azerbaijan and Georgia have shown commitment to implement the principles of the EU Water Framework Directive; they end to reform their water institutions and policies and to develop river basin management plans in relation to these principles. Improved water management is an essential contribution to adaptation to climate change, in two vulnerable countries. Azerbaijan and Georgia share some important water management issues in the Kura river basin, such as flood prevention and management, and pollution from untreated wastewater.

The accelerating economic development in the recent years puts an additional pressure on the environment. Improved water resources management in these Southern Caucasus countries can contribute to green growth and poverty alleviation. It can mitigate tensions on the transboundary river and contribute to peace in the region.

Preliminary work on related issues confirms that transboundary co-operation in the Kura basin remains problematic. There is a need to strengthen a shared knowledge base on the physical, social and economic features of co-operative river management, on experience with IWRM and, in particular, flood risk management. A bilateral agreement between Azerbaijan and Georgia on the Kura is supposed to improve co-operation considerably.

In the past, some regional projects have already tried to address the issues linked to transboundary water management in the Kura river basin, as for example:

- “Second assessment of transboundary rivers, lakes and groundwater” (UNECE – Convention on the Protection and Use of Transboundary Watercourses and International Lakes, 2001). The assessment covers all transboundary river basins in Europe and Central Asia, thus including the Kura river basin;
- “Reducing transboundary degradation in the Kura-Aras Basin” (UNDP-GEF);
- “Strengthening the economic and financial dimension of integrated water resources management in Azerbaijan, Georgia and Armenia – A case study on the Kura river basin” (OECD, 2012). This project built on the co-ordinated national assessments of the economic dimension of water management, and it was aimed at exploring opportunities for co-operation.

However, despite the numerous technical assistance interventions that have taken place in the region there is still strong demand for external support in assessing economic benefits of co-operative management in the basin. Economic analysis can help identify potential benefits of improved co-ordination/co-operation, and allocate them fairly, to drive further improvement of the river management.

This project

This project has been put in place to address this need by providing further insight on the potential benefits of transboundary co-operation between Georgia and Azerbaijan. The overall objective of project was to inventory the benefits of co-operative management of the Kura river (for Azerbaijan and Georgia) and to develop a method to assess the economic ones. It built on three main phases:

1. Inventory of the potential benefits of co-operative water management between the two countries;
2. Assessment of the economic benefits to be gained from co-operative action in water management between Azerbaijan and Georgia. Under this task, different *development paths* that combine consumptive and non-consumptive uses, to maximise the system value, were considered. At the same time, a share of benefits and costs for each riparian country will be assessed under alternative scenarios and options to share the costs and benefits of co-operation more equitably were explored; and
3. Suggestions on mechanisms to realise these benefits. This was one of the initial objectives of the study. However, the lack of data prevented a thorough assessment of benefits, so the identification of mechanisms to realise those benefits was deemed premature. Instead, key challenges and lessons learnt for policy making in the field of transboundary water management between the two countries, under an economic perspective, were drawn from the outcomes of the study. In addition, a section is dedicated on the current and future prospects for transboundary co-operation between the two countries –and it includes an overview of current and future institutional mechanisms for transboundary co-operation.

The outcomes of this study built on several activities, which saw the involvement of national experts, policy makers and other relevant stakeholders, and namely:

- Literature review and desk research;
- Data collection at the national level, carried out by national experts;
- Discussions with national experts, national policy makers in the field of water management and other relevant stakeholders, in the context of two Regional Workshops held in 2014: (i) Baku, 24th January; and (ii) Tbilisi, 11th November;
- An internal meeting with national experts, held in Tbilisi on 10th November.

This final report gathers together the results of the three phases of the study, including:

- The analytical framework developed for the benefit inventory. The outcomes of the inventory of the potential benefits of transboundary co-operation, conducted for the six main transboundary water bodies shared by the two countries;
- The methodology used to build co-operation scenarios and assess the benefits of transboundary co-operation in the two case studies. The results of the benefit assessment in the two case studies;
- Lessons learnt and key policy challenges in the field of transboundary water management, from an economic perspective.

BUILDING AN ANALYTICAL FRAMEWORK FOR BENEFIT INVENTORY

Existing analytical frameworks

In recent years, the assessment and valuation of the benefits of water policy implementation has increasingly relied on the Ecosystem Goods and Services (EGS) framework². This framework is particularly suitable for assessing the consequences of policy decision, as it allows for linking pressures/impacts, policy actions, improvement of water status and corresponding benefits, as illustrated in Figure 1.

Figure 1. Linking policy actions, ecosystem good and services and corresponding benefits

(adapted from Keeler et al., 2012)

To understand this relationship, the first step is to agree on a clear definition of ecosystem goods and services or, in other words, to choose a suitable classification framework among the existing ones. The framework proposed here is the TEEB classification (TEEB, 2010)³, which is seen as being more efficient when it comes to articulating the ecologic and economic aspects of the analysis for valuation purposes. This framework, which groups EGS in four categories, is summarised in the Table 1.

Table 1. TEEB Classification of ecosystem goods and services

EGS Type	Ecosystem Goods and Services
Provisioning services	Food (e.g. fish, game, fruit)
	Water (e.g. for drinking, irrigation, cooling)
	Raw materials (e.g. fibers, timber, fuel wood, fodder, fertilizer)
	Genetic resources (e.g. for crop improvement and medicinal purposes)
	Medicinal resources (e.g. biochemical products, models and test-organisms)
Regulating services	Ornamental resources (e.g. artisan work, decorative plants, pet animals, fashion)
	Air quality regulation (e.g. capturing dust, chemicals, etc.)
	Climate regulation (incl. C-sequestration, influence of vegetation on rainfall, etc.)
	Moderation of extreme events (e.g. storm protection and flood prevention)
	Regulation of water flows (e.g. natural drainage, irrigation and drought prevention)
	Waste treatment (especially water purification)
	Erosion prevention
	Maintenance of soil fertility
Habitat services	Pollination
	Biological control (e.g. seed dispersal, pest and disease control)
Cultural and amenity services	Maintenance of life cycles of migratory species (incl. nursery service)
	Maintenance of genetic diversity (especially in gene pool protection)
	Aesthetic information
	Opportunities for recreation and tourism
	Inspiration for culture, art and design
	Spiritual experience
	Information for cognitive development

² At the EU level, for example, research and policy debates are currently focusing on the application of the EGS framework to environmental and water policy. On-going efforts include, for example: (i) the quantification and mapping of EGS in Europe (MAES project, carried out by the JRC); (ii) the role of the EGS framework in WFD economics (a study for the European Commission carried out by COWI, ARUP and DHI)

³ The Economics of Ecosystems and Biodiversity: www.teebweb.org/. Other existing EGS classifications include, for example, the Millennium Ecosystem Assessment framework: www.unep.org/maweb/en/index.aspx.

In this framework, the complete range of services (and resulting benefits) that humans derive from ecosystems is made clearly explicit and is described in a very comprehensive manner; in other words, it provides a complete inventory of these services. This also ensures that the same service is not assessed twice. In addition, habitat services –related to biodiversity- are made explicit in this framework: although their value might be very difficult to assess, the simple inclusion of such services recognises the importance of biodiversity for humans.

At the same time, as the focus is on services enjoyed by humans, it does not always make a direct link between water management actions and resulting benefits. In some cases, this link is quite straightforward: the provision of regulating services such as, for example, regulation of water flows, is clearly enhanced by hydromorphological measures. In contrast, the provision of services such as water supply can be enhanced by either water-quality related measures (e.g. treatment plants) or water-quality related measures (e.g. water demand management policies) (Pascual et al., 2010).

In addition, this framework might not be fully effective in assessing the benefits of transboundary water management. In the case of international shared water, in fact, the focus is on “benefit sharing” among countries, deriving from mutually beneficial co-operative action. In fact, countries will rationally engage in transboundary co-operation only if they can obtain benefits which they could not obtain in the case of no co-operation. This means that co-operative action will yield specific benefits which could not be obtained otherwise (UNECE Working Group, 2013). In addition, benefits from transboundary co-operation are not only related to improved ecological status, but also to political factors. Identifying and assessing these benefits will thus require an ad-hoc framework, able to capture the specific benefits of co-operation.

A commonly used framework, developed by Sadoff and Grey (2002), identified four types of benefits of transboundary water management, described in Table 2.

Table 2. Classification of transboundary benefits of co-ordinated water management

Benefit Type	The Challenge	The Opportunities
Type 1: increasing benefits to the river	Degraded water quality, watersheds, wetlands and biodiversity	Improved water quality, river flow characteristics, soil conservation, biodiversity and overall sustainability
Type 2: increasing benefits from the river	Increasing demand for water, suboptimal water resource management and development	Improved water resource management for hydropower and agricultural production, flood drought management, navigation, environmental conservation, water quality and recreation
Type 3: reduced costs because of the river	Tense regional relations and political economy impact	Policy shift to co-operation and development away from dispute/conflict, improved food and energy security, reduced risk or dispute/conflict and reduced military expenditure
Type 4: increasing benefits beyond the river	Regional fragmentation	Integration of regional infrastructure, markets and trade

To the authors’ view, however, the benefits deriving from improved ecological water status are not properly defined, and some overlaps exist among Type 1 and Type 2. For example, benefits from improved water quality are not further specified. Improved water quality can be in fact considered an impact of water management actions, but it is not a benefit in itself: better water quality provides a range of benefits including safer drinking water, safer swimming water, better opportunities for recreation and so on. In addition, water quality is mentioned in both benefit Type 1 and 2, so when it comes to actual benefit assessment it is difficult to understand which benefits belong to one type or the other, and this can result in double counting issues.

Another major issue with this framework is that different water policy actions such as, for example, hydromorphological measures, can generate benefits belonging to both Type 1 and 2. Type 2, in particular, mixes benefits linked to improved water quantity management, benefits generated by hydromorphological measures, benefits generated by water quality-related measures, as well as benefits generally linked to recreation.

Therefore, the application of this framework to practical assessment exercise might present significant challenges.

The available assessment frameworks present strong advantages but may limit their application to the practical assessment of transboundary assessment. Therefore, for the purposes of this project the OECD developed a revised framework which aims at maximising the advantages of both frameworks at the same time.

Table 3. Proposed framework for benefit inventory

Typologies of benefits	EGS Type	EGS	Associated benefits	Specification (if needed)	Relevance in a transboundary context
Type 1 : Benefits related to water quantity More specifically, this typology concerns the direct benefits related to a more efficient and equitable water resource allocation, and it refers to demand management strategies aimed at addressing water scarcity issues. However, this category is not limited to the direct economic benefits enjoyed by water user groups, but it also includes the benefits of ensuring minimum ecological flows	Provisioning services	Water supply	Increased (or more stable) agricultural production → Increased (or more stable) income from agricultural activities		Shared surface and ground water bodies
			More secure drinking water supply		
			Increased (or more stable) industrial production		
			Increased (or more stable) capacity of hydropower generation		
	Habitat services	Maintenance of biodiversity	Improved ecosystem functioning and integrity	Minimum ecological flows	
Type 2: Benefits from improved water quality This category includes all use values (direct benefits) related to improved water quality, as well as the benefits for the ecosystems.	Provisioning services	Water supply	Reduced health risks Reduced treatment costs	Clean drinking water: reduced nitrates (and other mineral pollutants)	Shared surface and ground water bodies
				Safe drinking water: reduced Toxins, bacteria and other contaminants	Shared surface and ground water bodies
		Food supply	Regeneration and increase of fish and shellfish stocks		Shared surface water bodies
			Safe food available for consumption	Toxins, bacteria or other contaminants	
	Habitat services	Maintenance of biodiversity	Regeneration of existing species and re-installation of previously disappeared species	Improved water quality	Shared surface water bodies
	Cultural and amenity services	Opportunities for recreation and tourism	Safe contact waters: Improved swimming conditions	Nitrates and Phosphorous - Toxins, bacteria and other contaminants	Shared surface water bodies
			Surface water recreation	All recreational uses	
Type 3: Benefits derived from the good functioning of watersheds and	Regulating services	Moderation of extreme	Reduced damages to national economies and human lives due	Flood prevention	Shared surface water bodies, in all cases where land-use in the upstream

aquatic ecosystems This typology includes the indirect use values of well-functioning watersheds and aquatic ecosystems. Such values are attached to an improved delivery of regulating services.		events	to flooding and mudflows		country (e.g. deforestation) affects land use in the downstream country
		Regulation of water flows	Reduced damage to harvest and livestock	Prevention of water scarcity and drought events	Shared surface and ground water bodies, in all cases where land-use in the upstream country (e.g. deforestation, interventions affecting infiltration capacity) affects land use in the downstream country
		Water purification	Naturally cleaner water → Reduced treatment costs		Shared surface water bodies (in presence of wetlands)
		Erosion prevention	Reduced banks erosion Reduced treatment costs	Sedimentation	Shared surface water bodies, in all cases where land-use in the upstream country (e.g. deforestation) affects land use in the downstream country
	Habitat services	Maintenance of biodiversity	Better development of species Better resilience in case of extreme climate events	Re-connection of species' habitats	Transboundary efforts for restoring river continuity from the source to the mouth
			Increased breeding capacity of migratory fish	Possibility for migratory fish to reach their nesting ground	
Type 4: Benefits from improved regional security and integration Secondary benefits: avoided costs of conflicts; improved trade relationships and regional integration	Not applicable				These benefits are delivered by every co-operation initiative, even at a very early stage (e.g. joint monitoring)
Type 5: Water management-related benefits Reduced aggregated water management costs deriving from transboundary, more cost-effective options for improving ecological water status. Transboundary water management -> improved ecological status -> reduced management costs for the administration	Not applicable				These expected benefits, be it in terms of reduced water management costs or enhanced ecological status, are delivered by substantial, integrated co-operative water management. They are likely to be realized in the medium and long run.

FROM THEORY TO PRACTICE: POTENTIAL BENEFITS OF CO-OPERATIVE WATER MANAGEMENT IN GEORGIA AND AZERBAIJAN

Transboundary water management issues in Georgia and Azerbaijan

The Kura river basin as a whole, presented in Figure 2, is shared by Georgia, Azerbaijan, Armenia, the Islamic Republic of Iran and Turkey.

Figure 2. Kura river basin: transboundary surface waters.

(Source: UNECE, 2011)

At the regional level, water availability is quite variable: whereas the mountainous areas of Armenia and Georgia enjoy abundant resources, Azerbaijan is often faced with water scarcity. The agricultural sector is the largest water user in the area. The main water management issues in the basin can be summarised as follows (UNECE, 2011):

- In recent years, a marked increase in agricultural production and irrigation has led to overdraft of groundwater resources. This, combined with inefficient drainage systems, has in many cases resulted in soil salinisation;

- Diffuse pollution (pesticides, nitrogen and phosphorous) from agriculture, viniculture and animal husbandry is a significant pressure;
- The discharge of poorly treated or untreated wastewater causes organic and bacteriological pollution, and it is a widespread problem;
- Solid waste management, including both official and illegal landfills, are exerting pressures on water quality;
- Water pollution from the industrial sector;
- The hydropower sector is constantly growing in the region (e.g. in Georgia), raising concerns about changes in the natural river flows and other negative impacts on the river dynamics, morphology and the transport of sediments;
- Natural disasters (e.g. landslides, mudflows) are also a common problem in some areas of the Caucasus;
- Climate change is predicted to have a significant impact on the river basin, especially in terms of water scarcity.

Scaling down the focus to Georgia and Azerbaijan, a comprehensive overview of transboundary water management issues can be obtained by looking in detail at the major transboundary water bodies. For each main shared water body, the fiches below provide a synthetic description as well as indications of main transboundary pressures and related water management issues as reported by UNECE, 2011.

Table 4. Kura River

Description	
Kura river is the main water body in the Caucasus region. It originates in Turkey; it flows across a significant part of Georgia and cross the border with Azerbaijan in South-Eastern part of the country.	
Main water uses	
Georgia: the river is a source of drinking water, but it is not used for irrigation. Azerbaijan: the Kura River is the source of drinking water for almost 80% of the population of Azerbaijan, as well as source of irrigation. Close to the border to Georgia, the Kura river flows into the large Mingachevir reservoir (70 km long and 18 km wide). Water from the reservoir is used for drinking water supply, irrigation and fishing. The largest hydroelectric power station of Azerbaijan is located on the reservoir.	
Main pressures	Main impacts and water management issues
Georgia Pressures on water quality: municipal wastewater discharges, pollution from controlled and uncontrolled dumpsites, industrial wastewater discharges (fertilizers industry and metallurgy in Rustavi city), discharges from mining sites copper and gold mining site in Madneuli polluting Mashavera river), some pollution from agriculture. Hydromorphological pressures: Logging has reduced forested areas, and deforestation and overgrazing makes areas vulnerable to erosion, resulting in reduced stability of the ground. Due to high rates of soil erosion sedimentation and turbidity of the river is also high.	Azerbaijan Water pollution: according to Azerbaijan, the ecological and chemical status of the river is not satisfactory. The MoE of Georgia, however, considers the Kura river to be moderately polluted. However, a main issue for assessing transboundary pollution is the lack of reliable information on the Kura water quality. Erosion upstream can cause sedimentation problems in the Mingachevir reservoir. The existence and magnitude of flooding issues should be investigated.

Table 5. Iori/ Gabirri River

Description	
Iori (called Gabirri in Azerbaijan) is 320-km long river originating in Georgia in the Greater Caucasian Range at 2,600 m. The upper part of the river sub-basin is mountainous and the lower part is lowland steppe (Kakheti Kartlino plateau). Major part of the river is located in Georgia. It crosses the border with Azerbaijan in the South-Easter part of the country and flows into the Mingechavir reservoir.	
Main water uses	
Georgia: Iori/Gabirri river and reservoirs (Sioni, Tbilisi and Dalimta reservoirs) built on it are used for irrigation (water from the river supplies about 94,000 ha of irrigated agriculture), hydropower generation and drinking water supply. Azerbaijan: the Iori/Gabirri is used for irrigated agriculture (about 1,522 ha). Water from the reservoir is used for drinking water supply, irrigation and fishing. The largest hydroelectric power station of Azerbaijan is located on the reservoir.	
Main pressures	Main impacts and water management issues
Georgia Pressures on water quantity: the withdrawal of surface water is a pressure factor. Withdrawal from agriculture, in particular, has the most widespread and severe influence. Pressures on water quality: diffuse pollution from agriculture and municipal wastewater, uncontrolled waste dumps on the river banks are the main anthropogenic pollution sources. In the Georgian part, wastewater treatment facilities in municipalities are not operational, and in rural settlements there is no wastewater collection system.	Azerbaijan Impacts on water flows at the border and into the Mingachevir reservoir should be better investigated, as no specific information was reported. Azerbaijan reported that there was little human impact on the river. The Ministry of Environment of Azerbaijan evaluated the ecological and chemical status of rivers as moderately polluted.

Table 6. Alazani/ Ganyh River

Description	
The Alazani river is 391-km long river with its source in the Greater Caucasus Mountain Range (elevation 2,600–2,800 m a.s.l.). The river flows for a substantial part of its length along the Georgia-Azerbaijan border, and discharges into the Mingachevir Reservoir in Azerbaijan. In the basins of left bank tributaries of the Alazani/Ganyh, the baseflow component to the river flow (from groundwater) is estimated to be 40–50%, which raises some concern about worsening conditions for generating baseflow. On the other hand spring flooding, as well as flooding in the summer, can also result in significant increases in water levels, especially in the lower reaches of the river.	
Main water uses	
Georgia: the river is used for irrigation. More than 60,000 ha is irrigated from the Upper and Lower Alazani irrigation systems. Azerbaijan: the river is used for irrigation. Water from the reservoir is used for drinking water supply, irrigation and fishing. The largest hydroelectric power station of Azerbaijan is located on the reservoir.	
Main pressures	Main impacts and water management issues
Georgia and Azerbaijan Pressures on water quantity: Both countries abstract water from the river for irrigation. In Georgia, irrigation infrastructure involves a high share of open unlined channels, so water efficiency is low. No information was reported on water efficiency in Azerbaijan. Georgia Pressures on water quality: Municipal wastewaters are among the main anthropogenic pollution sources in Georgia. Diffuse pollution from agriculture, viticulture and animal husbandry is also widespread.	Georgia and Azerbaijan The overall efficiency of water allocation among the two countries needs to be assessed. Water abstraction is likely to have an impact on ecological flows, which needs to be assessed. Azerbaijan Transboundary pollution from municipal wastewater (e.g. BOD, COD, nitrogen, phosphorus) and pollution from agriculture (e.g., nitrogen, phosphorus, pesticides) was reported. The river's ecological and chemical status is assessed as "moderately polluted."
Georgia and Azerbaijan Hydromorphological pressures: Flood-plain forests are still cultivated to some extent. Erosion of river banks is assessed by Georgia as severe, but local. The extent of erosion in Azerbaijan is unknown, and it should be better investigated.	Georgia and Azerbaijan The extent of flooding issues on both sides of the river needs to be investigated. Azerbaijan Possible sedimentation issues in the Mingachevir reservoir, which needs to be investigated.

Table 7. Ktsia-Khrami river

Description	
<p>The 201-km long Ktsia-Khrami River has its source in a spring on the southern slope of the Trialeti range at the height of 2,422 m, and discharges into the Kura. The Debed/Debeda is its major transboundary tributary.</p> <p>As its-sub-basin as a pronounced mountainous character, spring floods are significant. The rest of the year, the water level is mostly low, with occasional summer-autumn high waters.</p>	
Main water uses	
<p>Georgia: The total withdrawal in the Georgian part of the Ktsia-Khrami Basin is $853 \times 10^6 \text{ m}^3/\text{year}$, with 94% for energy, 3% for domestic purposes, 2% for industry, and 1% for agriculture.</p> <p>Azerbaijan: information not available. Water uses should then be better investigated.</p> <p>Joint monitoring was carried out by Armenia, Georgia and Azerbaijan in the years 2009-2010⁴.</p>	
Main pressures	Main impacts and water management issues
<p>Georgia</p> <p>Water quantity pressures: water is abstracted from the river for several uses. However, initiatives for increasing efficiency were put in place: (i) drip irrigation in agriculture); and (ii) water conservation measures plan developed by the JSC Madneuli mining company.</p> <p>Water quality pressures: pollution from illegal waste dumps, copper-mining industry (acid mine drainage, leaching of metals from waste rock dumps), municipal wastewaters (treatment plants in a number of cities are not operational, and in rural areas there is no sewage collection)</p>	<p>Azerbaijan</p> <p>Impacts on water flows and the efficiency of transboundary water allocation is unknown, and needs to be assessed.</p> <p>According to Georgia, in the period 2007-2009 only the concentration of ammonium ions in the Ktsia-Khrami exceeded the upper thresholds. However, more data would be needed to assess the extent of the impact of transboundary pollution.</p>

Table 8. Lake Jandari

Description	
<p>Lake Jandari (surface area 12.5 km²), which, through construction of the Gardaban Canal, was turned into a reservoir, is shared by Georgia and Azerbaijan. The volume of water is $51.15 \times 10^6 \text{ m}^3$, with a maximum depth of 7.2 m and average depth of 4.8 m. Water comes mainly through the Gardaban Canal (maximum capacity 15 m³/s) from the Kura River, and another canal starting from the Tbilisi (Samgori) water reservoir. 68 km² (67%) of the Lake Jandari basin is located in Georgia and 34 km² (33%) in Azerbaijan. The lake is quite rich in fish (carp and catfish).</p> <p>According to the agreement concluded in 1993⁵ Georgia and Azerbaijan, $70 \times 10^6 \text{ m}^3$ of water is delivered annually to Jandari water reservoir from Georgia. This includes $50 \times 10^6 \text{ m}^3$ for irrigation of 8,500 ha of land of the Akstaphi region of Azerbaijan, and $20 \times 10^6 \text{ m}^3$ for maintaining the ecological balance of the water reservoirs. According to the agreement concluded in 1997⁶, the two countries will consolidate their efforts and take all appropriate measures to ensure that the Kura River and Lake Jandari waters are used with the aim of ecologically sound and rational water management, conservation of water resources, and environmental protection.</p>	
Main water uses	
<p>Georgia: irrigation and commercial fisheries</p> <p>Azerbaijan: irrigation</p>	
Main pressures	Main impacts and water management issues
<p>Georgia and Azerbaijan</p> <p>Pressures on water quantity: increasing water abstraction for irrigation purposes</p>	<p>Georgia and Azerbaijan</p> <p>The water level has been decreasing in recent years. The impact on ecosystem needs to be further investigated.</p>
<p>Georgia</p> <p>Pressures on water quality: there are no direct wastewater or industrial discharges into the Lake. However, wastes from industry, residential areas and agriculture pollute water coming into the reservoir from the Kura River.</p>	<p>Azerbaijan</p> <p>The Lake does not have a good ecological or chemical status.</p>

⁴In the context of the EU Project: "Transboundary River Management Phase II for the Kura River Basin — Armenia, Georgia, Azerbaijan",

⁵ Agreement between the State Committee of Irrigation and Water Economy of the Azerbaijan Republic and the Department of Management of Melioration Systems of Georgia,

⁶ Agreement on Collaboration in Environmental Protection between the Governments of Georgia and Azerbaijan

Table 9. Alazani-Agrichay aquifer

Description	
<p>Alazani-Agrichay aquifer is a transboundary aquifer shared by Azerbaijan and Georgia. This is the largest groundwater aquifer in Southern Caucasus. It is situated in the east of Georgia and north-east of Azerbaijan. In the north the aquifer touches south-east foothills of Greater Caucasus, on the south – Neogene foothills. The aquifer begins in the territory of Georgia, with the emersion from Greater Caucasus mountains along Alazani river and as a narrow band of 12-15 km wide stretches forth to 270 km up to Ismaili region of Azerbaijan. About 70 km of the aquifer length falls on Georgia, 200 km – on Azerbaijan (Figure 4).</p> <p>In geological terms, Alazan-Agrichay aquifer consists of merged alluvial cones of rivers flowing from the mountainous zone of Greater Caucasus. This is mostly river fed aquifer and linked with unique ecosystems such as floodplain forests of Alazani river and protected areas in Lagodekhi, Vashlovani (Georgia), Zagatala, Illisu (Azerbaijan).</p> <p>In the Georgian part, the aquifer discharge is more than 26m³/s, in Azeri part it is more than 70 m³/s. According to several research reports Azerbaijan groundwater resources exceed 105 m³/s. The region has great opportunities to provide a wide range of customers with drinking water-supply both within own and contiguous territory.</p>	
Main water uses	
<p>Alazani-Agrichay aquifer is of critical importance for communities, economies and groundwater-dependent ecosystems in the sub-basin. Natural springs, that are widespread here and are fed by groundwater, have a social and cultural significance as well. Having the importance for socio-economic development of Azerbaijan and Georgia, the both nations have plans to further exploit ground water of the shared aquifer.</p> <p>Current uses of groundwater of the transboundary aquifer and plans for future development are largely unco-ordinated between Azerbaijan and Georgia, both at national and local levels. There is not enough reliable information on the quantity and quality of groundwater, neither there is a proper monitoring network and information exchange system in place, and the use of groundwater is largely unregulated.</p> <p>Georgia: water is extensively abstracted for water supply, irrigation and industry.</p> <p>Azerbaijan: water is also extensively abstracted for water supply, irrigation and industry. As of 1990-es in the Azerbaijan part of Alazani-Agrichay valley abstraction of groundwater was about 260 mln m³/year; 230 mln m³/year were used for technical needs and irrigation and only 30 mln m³/year – for household and drinking and sanitation needs. The Oguz-Gebala-Baku water pipeline, with a capacity of 5m³/s, was constructed in 2000-ies to convey drinking water from this aquifer in Sheki-Zakatal Plain to Baku.</p>	
Main pressures	Main impacts and water management issues
<p>Georgia and Azerbaijan</p> <p>Pressures on water quantity: groundwater abstraction is already sustained (and probably unsustainable), and it is expected to increase in the coming years. In addition, water abstraction is not co-ordinated between the two countries.</p> <p>Pressures on water quality: (i) pollution from agricultural and industrial activities; (ii) the majority of settlements (especially in Azerbaijan) do not have sewerage, and sanitary sewage is discharged into the sewer, rivers, and then migrates to collecting layers. Where the aeration zone is thin, favorable conditions are being created for groundwater pollution. And such zones occupy significant areas of the concerned territory, mainly in the low streams.</p>	<p>Georgia and Azerbaijan</p> <p>Unsustainable and unco-ordinated use could lead to reduction of groundwater quantity</p> <p>Competing demands and uses of groundwater may lead to social and political tensions.</p> <p>Pressures on water quality are imposing high risk to human health and social well-being in the basin. In Georgia, bacteriological pollution levels of all samples taken exceeded national drinking water standards (tested in 2001). In Azerbaijan part of the basin regional groundwater pollution has not been recorded yet. Water taken from aquifers usually are fed to supply network without treatment. Chlorine is used for disinfection in larger towns only. Elsewhere the supplied water is not disinfected, resulting in potentially significant risk for public health.</p>

Source: Information source for this subchapter is a pilot project proposal Cooperation Development for Sustainable Management of Alazani-Agrichay Transboundary Aquifer prepared in 2006-2007 under the UNDP-GEF PDF B phase project Transboundary Degradation of the Kura-Aras River Basin, and it was taken from the Georgia National report drafted for the OECD project on the economic and financial dimension of integrated water management in the Kura river basin (2012).

Inventory of potential benefits of co-operative management in transboundary water bodies

The assessment of main pressures and water management issues occurring to the main transboundary water bodies allow for the identification of the main potential benefits which could be delivered by a co-ordinated approach to water management. Such benefits also depend on the specific water uses occurring in each water body –for example, benefits related to increased and safer fish stocks

were only retained in those water bodies used for fishing. The proposed framework, in fact, is very comprehensive, and not all the benefits listed there are likely to be obtained in all shared water bodies.

This is true, in particular, for benefit Types 1, 2 and 3, as these benefits are heavily dependent on ecosystems process and, as a consequences, on the current pressures posed on water bodies. Benefits Types 4 and 5, in contrast, can be obtained in every case of transboundary co-operation; in some cases (e.g., Alazani-Agrichay aquifer), however, this benefits might be even more significant, as competing uses of water resources were reported to pose a risk of social and political tensions.

In addition, when it comes to actual assessment of such benefits, it can be more effective to focus only on the main (more substantial) benefits which can be generated by specific co-operation initiatives. The fiches below illustrate, for each transboundary water bodies, the most relevant potential benefits which could be generated by a transboundary approach to water resource management. These fiches are aimed at serving as a basis for the benefit assessment which will be carried out in the second phase of this project.

Table 10. Benefits for Kura River

Main pressures	Typologies of benefits	Associated benefits
Pressures on water quality →	Type 2: Benefits from improved water quality	Reduced health risks
		Reduced treatment costs
		Regeneration and increase of fish and shellfish stocks
		Safe food available for consumption
		Regeneration of existing species and re-installation of previously disappeared species
		Safe contact waters: Improved swimming conditions
		Surface water recreation
Hydromorphological pressures →	Type 3: Benefits derived from the good functioning of watersheds and aquatic ecosystems	Reduced damages to national economies and human lives due to flooding
		Reduced damage to harvest and livestock
		Reduced banks erosion
		Reduced treatment costs (for sedimentation)
n.a.	Type 4: Benefits from improved regional security and integration	To be assessed case by case
n.a.	Type 5: Water management-related benefits	To be assessed case by case

Table 11. Benefits for Iori/Gabirri River

Main pressures	Typologies of benefits	Associated benefits
Pressures on water quantity →	Type 1 : Benefits related to water quantity ⁷	Increased (or more stable) agricultural production → Increased (or more stable) income from agricultural activities
		More secure drinking water supply
		Increased (or more stable) industrial production
		Improved ecosystem functioning and integrity

⁷ Due to the size of the Mingachevir reservoir, flow variability from the river is not expected to have a significant impact on hydropower production.

Pressures on water quality ➔	Type 2: Benefits from improved water quality	Reduced health risks Reduced treatment costs
		Regeneration and increase of fish and shellfish stocks
		Safe food available for consumption
		Regeneration of existing species and re-installation of previously disappeared species
		Safe contact waters: Improved swimming conditions
		Surface water recreation
n.a.	Type 4: Benefits from improved regional security and integration	To be assessed case by case
n.a.	Type 5: Water management-related benefits	To be assessed case by case

Table 12. Benefits for Alazani/ Ganyh River

Main pressures	Typologies of benefits	Associated benefits
Pressures on water quantity ➔	Type 1 : Benefits related to water quantity ⁸	Increased (or more stable) agricultural production → Increased (or more stable) income from agricultural activities
		More secure drinking water supply
		Increased (or more stable) industrial production
		Improved ecosystem functioning and integrity
Pressures on water quality ➔	Type 2: Benefits from improved water quality	Reduced health risks Reduced treatment costs
		Regeneration and increase of fish and shellfish stocks
		Safe food available for consumption
		Regeneration of existing species and re-installation of previously disappeared species
		Safe contact waters: Improved swimming conditions
		Surface water recreation
Hydromorphological pressures ➔	Type 3: Benefits derived from the good functioning of watersheds and aquatic ecosystems	Reduced damages to national economies and human lives due to flooding and mudflows
		Reduced damage to harvest and livestock
		Reduced banks erosion
		Reduced treatment costs (sedimentation)
n.a.	Type 4: Benefits from improved regional security and integration	To be assessed case by case
n.a.	Type 5: Water management-related benefits	To be assessed case by case

⁸ Due to the size of the Mingachevir reservoir, flow variability from the river is not expected to have a significant impact on hydropower production.

Table 13. Benefits for Ktsia-Khrami River

Main pressures	Typologies of benefits	Associated benefits
Pressures on water quantity ➡	Type 1 : Benefits related to water quantity	Increased (or more stable) agricultural production → Increased (or more stable) income from agricultural activities More secure drinking water supply Increased (or more stable) industrial production Increased (or more stable) capacity of hydropower generation Improved ecosystem functioning and integrity
Pressures on water quality ➡	Type 2: Benefits from improved water quality	Reduced health risks Reduced treatment costs Regeneration and increase of fish and shellfish stocks Safe food available for consumption Regeneration of existing species and re-installation of previously disappeared species Safe contact waters: Improved swimming conditions Surface water recreation
n.a.	Type 4: Benefits from improved regional security and integration	To be assessed case by case
n.a.	Type 5: Water management-related benefits	To be assessed case by case

Table 14. Benefits for Lake Jandari

Main pressures	Typologies of benefits	Associated benefits
Pressures on water quantity ➡	Type 1 : Benefits related to water quantity	Increased (or more stable) agricultural production → Increased (or more stable) income from agricultural activities Increased (or more stable) industrial production Improved ecosystem functioning and integrity
Pressures on water quality ➡	Type 2: Benefits from improved water quality	Regeneration and increase of fish and shellfish stocks Safe food available for consumption Regeneration of existing species and re-installation of previously disappeared species Safe contact waters: Improved swimming conditions Surface water recreation
n.a.	Type 4: Benefits from improved regional security and integration	To be assessed case by case
n.a.	Type 5: Water management-related benefits	To be assessed case by case

Table 15. Benefits for Alazani-Agrichay Aquifer

Main pressures	Typologies of benefits	Associated benefits
Pressures on water quantity ➔	Type 1 : Benefits related to water quantity	Increased (or more stable) agricultural production → Increased (or more stable) income from agricultural activities More secure drinking water supply Increased (or more stable) industrial production
Pressures on water quality ➔	Type 2: Benefits from improved water quality	Reduced health risks Reduced treatment costs
n.a.	Type 4: Benefits from improved regional security and integration	To be assessed case by case
n.a.	Type 5: Water management-related benefits	To be assessed case by case

Selection of the case studies for the benefit assessment

The selection of the two case studies was based on **two criteria**: the **level of priority** for the two countries and the **availability of information**. The two case studies were selected together with national experts, national policy makers in the field of water management and other relevant stakeholders during the Regional Workshop in Baku and further consultations. The final selection includes:

- **flooding issues on the Kura river**: despite the existence of other water management issues in the Kura river, this case study will only focus on the co-operative management of flooding issues, for two reasons: (i) due to the time constraints of this study, it would not be possible to tackle all issues of a large water body such as the Kura; and (ii) addressing flooding issues in this river is a first-level priority for Azerbaijan;
- **Lake Jandari**: this lake, shared by both countries, was deemed as an interesting case study. The limited size of the water body makes this water body a very good case study. A preliminary screening of the case study highlighted that co-operative management on water quality issues might not have been so relevant for this water body, so the assessment focused on water quantity issues.

BUILDING SCENARIOS AND ASSESSING BENEFITS FOR THE MAJOR TRANSBOUNDARY WATER BODIES: PROPOSED METHODOLOGY

The overall framework

Transboundary water management issues between two countries can be solved through different levels of co-operation, involving different level of efforts for each of the two countries. The possible levels of co-operation can be translated in co-operation scenarios, as illustrated in Figure 3.

Figure 3. Country co-operation scenarios

How to build co-operation scenarios? An example

How can the scheme above support the development of co-operation scenarios between the two countries? As an example, let us imagine a simple case: an aquifer shared by two countries. Both countries withdraw water for agricultural and domestic uses. Both countries, however, abstract larger volumes than what would be sustainable (i.e. abstracted volumes are higher than the natural aquifer recharge on both sides), and the water table is progressively lowering, as shown in Table 16.

Table 16. Water abstraction balance

	Country 1	Country 2	Total
Abstraction	200	200	400
Groundwater recharge	150	150	300
Overall balance	-50	-50	-100

The general scenarios presented in the scheme above can be applied to this specific case, as illustrated in the following table. In this case, two sub-scenarios can be imagined under scenario 4 (co-ordinated action): co-ordinated action can imply either a higher effort by the first country or by the second one, and it will be important to explore the costs of both options.

Scenario		Country 1	Country 2
S ₁		Reduces abstraction by 100	No action
S ₂		No action	Reduces abstraction by 100
S ₃		Reduces abstraction by 50	Reduces abstraction by 50
S ₄	a	Reduces abstraction by 75	Reduces abstraction by 25
	b	Reduces abstraction by 25	Reduces abstraction by 75

Both S₃ and S₄ imply some reduction of abstracted volumes by both countries. The difference is that, in S₃, each country reduces abstraction on the basis of the national imbalance⁹, whereas in S₄ abstraction is reduced in a co-ordinated way by the two countries, i.e. taking into account the overall imbalance occurring to the groundwater body. Although apparently similar, these two options might perform very differently in terms of cost-effectiveness. This consideration supports the discussion about how to assess the different benefits obtained by the three scenarios.

The net benefits of the different co-operation scenarios

The analysis of costs and benefits obtained through the different scenarios allow for the identification of the most cost-effective scenario (Figure 4).

Figure 4. Net benefits of the different co-operation scenarios

$$\text{Net benefits (B}_1, \text{B}_2, \text{B}_3, \text{B}_4) = \text{Gross benefits} - \text{Costs of action}$$

The potential gross benefits of transboundary co-operation in the major shared water bodies were described and inventoried in the first phase of this project.

The cost components of transboundary water management are equally important: in fact, it might be less costly to reduce abstraction by 25 and 75 in country 1 and 2 respectively, than to reduce abstraction by 50 in each country, whereas benefits might be similar in the two cases (total abstraction is always reduced by 100). This is due to the different cost components to be taken into consideration, which include:

- The costs of measures: the direct (technical) costs of implementing the measure as well as the administrative costs. Let us suppose that four types of measures must be implemented to effectively reduce abstraction (M₁, M₂, M₃ and M₄). Depending on the level of co-operation, the four measures might be implemented in only one country at once, in both countries at the same time (all measures in both countries) or in a co-ordinated way between country 1 and 2, as shown in the table below.

Scenario		Country 1	Country 2
S ₁		M ₁ +M ₂ +M ₃ +M ₄	No action
S ₂		No action	M ₁ +M ₂ +M ₃ +M ₄
S ₃		M ₁ +M ₂ +M ₃ +M ₄	M ₁ +M ₂ +M ₃ +M ₄
S ₄	a	M ₂ +M ₃ +M ₄	M ₁
	b	M ₁	M ₂ +M ₃ +M ₄

⁹ In S₃ action is considered “unco-ordinated” because the two countries act together, but without co-ordinating the extent of the intervention –in this example, the countries just reduce abstraction by 50% each, regardless of efficient water allocation, share of costs etc. A co-ordinated action would take into account these variables before setting the reduction target by each country.

- This is, of course, an over simplification (e.g. measures might be implemented to different extents in the four scenarios), but it gives the idea of how the different actions needed under the envisaged scenarios, and thus the different associated costs.
- Indirect costs: the impact on water-use sectors (loss of revenues). Different scenarios are likely to entail different impacts on water use sectors; such differences are directly linked to the productivity of water in the different activities and to the value of water for different uses. For the sake of the example, let us suppose that country 1 uses its water for high-value crops, adopting very efficient irrigation techniques; in contrast, in country 2 water is used for low-value crop, using highly inefficient irrigation techniques. An abstraction reduction of 50 in both countries would have a much higher economic impact on agriculture in country 1 than in country 2. Similar, it would not be rational to reduce abstraction by 75 in country 1 and by 25 in country 2. In contrast, if abstraction is reduced by 25 in country 1 and by 75 in country 2 (e.g. by introducing more efficient irrigation techniques) the overall loss of revenues in the two countries (i.e. the indirect costs of the measures) would be lower.

As the net benefits of each scenario are given by total benefits minus total costs, the least costly scenario is likely yields higher final benefits.

JANDARI LAKE

Water quantity issues: an overview

The Jandari lake can represent a very good case of transboundary co-operation:

- Competitive water use in the two countries
- Concerns about decreasing lake levels
- Overall efficiency of water allocation needs to be investigated

However, decreasing lake levels must be investigated.

Figure 5. The main transboundary water quantity issues

Before showing how the case study was developed, it must be highlighted that available data proved to be scarce and often insufficient, and assumptions had to be made at several stages. In fact, discussions and consultations with national experts and representatives of public administrations of both countries highlighted a lack of basic data on water use, including for example reliable data on total water abstraction and by main user groups, water use per type of crop and so on. It follows that also economic data related to water use are often scarce and insufficient to produce reliable and complete cost and benefit estimates.

On a more general level, a lack of economic thinking in water management was reported by national stakeholders: to address this issue, a specific chapter of this report is dedicated to illustrate how economic data and thinking can strengthen transboundary water management, and how such economic dimension can be developed in national and transboundary water policies.

Building scenarios

To build realistic scenarios, an overall realistic abstraction reduction target must be identified, as well as national reduction target.

Note: in Georgia, water is not abstracted from the lake itself, but from the Gardabani channel –the only relevant tributary of Jandari lake¹⁰.

Table 17. Water abstraction by countries

	Georgia	Azerbaijan
Total water abstraction - m ³ /year	69.7 mln m ³	
Total water abstraction for irrigation - m ³ /year	41 mln m ³	50 mln m ³
Total water abstraction for industrial use - m ³ /year	5 mln m ³	
Total water losses in the network - m ³ /year	23.7 mln m ³	
Total inflow from Gardabani channel - m ³ /year	57.3 mln m ³	
Total inflow for maintaining ecological balance - m ³ /year	20 mln m ³	
Total inflow for providing irrigation water to Azerbaijan - m ³ /year	37.3 mln m ³	
Total irrigated area (from Gardabani channel in GE and Lake Jandari in AZ) - hectares	25 500	8 500
Average water use per hectare – m ³ /ha	2 537	5 882
Maximum and minimum lake levels	Different data provided by the two countries – Need to further investigate	
Average lake level and seasonal distribution (to compare to optimal level)	Different data provided by the two countries – Need to further investigate	

In order to identify realistic and appropriate abstraction reduction targets, more accurate information would be needed. All results presented in the following paragraphs are, in fact, depending on strong assumptions made where data were not available, and thus have to be taken with caution.

¹⁰ According to national experts, inflow from other tributaries (small rivers) is almost negligible.

The first steps towards a reduction of the total water abstraction by the two countries are the followings:

- Reduce current water losses from the network (rehabilitation);
- Upgrade irrigation techniques to improve irrigation efficiency.

Thus, reducing abstraction in both countries does not necessarily imply a reduction of current irrigated areas, as increasing the overall efficiency of the system might be sufficient. For the purpose of this study, therefore, only the costs of rehabilitation and upgrade of the system will be taken into account.

Nevertheless, some co-operation scenarios can already be developed –although these might be intended as illustrative scenarios, due to the weakness of some data.

First of all, it is necessary to establish an overall abstraction reduction target, to be achieved by combined action by the two countries. This can be calculated by looking at current inflow into the lake from Gardabani channel (not including the share required for maintaining the ecological balance) and at the current water abstraction by Azerbaijan, as shown in the Table 18.

Table 18. Water imbalance (inflow and outflow) of Jandari Lake

Georgia		Azerbaijan		Overall	
Total inflow	57.3				
-					
Volume for ecological balance	20				
=					
Volume for irrigation in AZ	37.3	-	Total abstraction 50	=	Overall imbalance -12.7

Therefore, the combined actions of the two countries must lead to an overall abstraction reduction of 12.7 mln m³ per year. The different scenarios of co-operation involve different levels of effort by the two countries, and namely:

- Scenario 1: Georgia does all the effort;
- Scenario 2: Azerbaijan does all the effort;
- Scenario 3: both countries reduce abstraction by the same amount (i.e. each country reduces abstraction by 50% of the overall abstraction reduction target);
- Scenario 4: both Georgia and Azerbaijan contribute to the overall abstraction reduction target, based on the current share of abstraction from both the Gardabani channel and the lake. In this case, the respective abstraction shares in the two countries are very close (Georgia abstracts 58% of the total, Azerbaijan 42%), so the abstraction reduction targets are very similar.

Scenario 4, however, is not based on the most efficient allocation of water resources. At present, water consumption per hectare is 2537 m³ in Georgia and 5882 in Azerbaijan. Supposing that an efficient allocation would correspond to similar water consumption levels per hectare in the two countries, Azerbaijan should do all the effort: if Azerbaijan alone decreases its water use per hectare, this would still

correspond to a water consumption level of 3212 m³ per hectare. Therefore, in this case Scenario 2 is the one scenario that gets closer to an efficient allocation of water resources between the two countries. Scenario 4 has been developed anyway as a “middle” option, implying the same level of effort for each country.

Scenario	Georgia	Azerbaijan
S ₁	Water abstraction from Gardabani channel is reduced by 12.7 mln m ³	No action
S ₂	No action	Water abstraction from the lake is reduced by 12.7 mln m ³
S ₃	Water abstraction from Gardabani channel is reduced by 6.35 mln m ³	Water abstraction from the lake is reduced by 6.35 mln m ³
S ₄	Water abstraction from Gardabani channel is reduced by 7.4 mln m ³	Water abstraction from the lake is reduced by 5.3 mln m ³

As water abstraction for industrial uses is very low in Georgia, and not reported in Azerbaijan, it is assumed that water abstraction reduction will be at the expenses of the agricultural sector.

The costs of transboundary co-operation on water quantity issues: first estimates

In the absence of some crucial data, this first estimate of the costs of co-operation is based on several assumptions:

- The only intervention considered here is the rehabilitation of the existing networks;
- Currently, water losses from the network in Georgia are estimated at 50% - it is assumed that it is the same in Azerbaijan, as data on this country are not available;
- It is assumed that the rehabilitation of the network will lead to 40% water savings –assuming network losses of 10% even after rehabilitation;
- No cost figures could be found on the unitary costs (costs/ha) of system rehabilitation in the Caucasus region. Unitary figures could be found in the Aquastat Database on investment costs in irrigation (FAO¹¹): the database provides unitary cost figures for several water rehabilitation project across different regions of the world (but not including the Caucasus region). The unitary cost figure used for this estimation (1680 USD/ha) is an average figure, considering both all rehabilitation projects in Asia and rehabilitation projects from the North Africa and Near East region (the closest region to the Caucasus area). It is assumed that the unitary cost figure is the same in Georgia and Azerbaijan.

Due to these assumptions, the total costs of the four scenarios must be taken as rough estimates of what could be the actual costs of reducing abstraction in Jandari lake; however, they can surely provide indications of the cost ranges of different levels of effort in the two countries. These cost estimates are illustrated in the Table 19 –all data are in USD.

¹¹ www.fao.org/nr/water/aquastat/investment/index.stm.

Scenario 1						
Abstraction reduction			Costs - Mil USD			
	GE	AZ		GE	AZ	Overall costs
Reduction target - Mln m ³	12,7	0	Rehabilitation	19,52		19,52
Current water use - Mln m ³	69,7	50				
Rehabilitation - area (ha)	11622					
Scenario 2						
Abstraction reduction			Costs - Mil USD			
	GE	AZ		GE	AZ	Overall costs
Reduction target - Mln m ³	0	12,7	Rehabilitation	0	9,07	9,07
Current water use - Mln m ³	69,7	50				
Rehabilitation - Area (ha)		5400				
Scenario 3						
Abstraction reduction			Costs - Mil USD			
	GE	AZ		GE	AZ	Overall costs
Reduction target - Mln m ³	6,35	6,35	Rehabilitation	9,76	4,54	14,30
Current water use - Mln m ³	69,7	50				
Rehabilitation - area (ha)	5810	2700				
Scenario 4						
Abstraction reduction			Costs - Mil USD			
	GE	AZ		GE	AZ	Overall costs
Reduction target - Mln m ³	7,4	5,3	Rehabilitation	11,38	3,79	15,17
Current water use - Mln m ³	69,7	50				
Rehabilitation - area (ha)	6775	2255				

Table 19. Total costs of the four scenarios

Scenario	Actions - Georgia	Actions - Azerbaijan	Total costs – Mln USD
S ₁	Rehabilitation – 11622 ha	No action	19.52
S ₂	No action	Rehabilitation – 5400 ha	9.07
S ₃	Rehabilitation – 5810 ha	Rehabilitation – 2700 ha	14.3
S ₄	Rehabilitation – 6775 ha	Rehabilitation – 2255 ha	15.17

Estimating the gross benefits of transboundary co-operation on water quantity issues

The expected gross benefits of transboundary management of water quantity issues are illustrated in the Table 20. The same table also illustrates the data required to assess these benefits.

Table 20. Expected gross benefits of transboundary management of water quantity issues

Expected potential benefits of transboundary water management		
Typologies of benefits	Associated benefits	Data requirements
Type 1 : Benefits related to water quantity	Increased (or more stable) agricultural production → Increased (or more stable) income from agricultural activities	Current water productivity per crop Current farm revenues Current input costs of water per crop
	Less water is abstracted from the Kura river; more stable level of lake Jandari → Improved ecosystem functioning and integrity	E-flows should be investigated

However, very little data are currently available with respect to the expected benefits of transboundary co-operation on water quantity issues in Lake Jandari. Therefore, only some benefits could be assessed –namely, the benefits for water companies related to efficiency improvements.

For this preliminary benefit assessment, the followings were considered:

- Currently, water consumption per hectare is estimated at 2384 m³/ha/year in Georgia and 5882 m³/ha/year in Azerbaijan. However, due to water losses in the network, estimated at 50%, farmers only get 1192 and 2941 m³/ha/year respectively. The proposed measures (rehabilitation of the network in both countries, and sprinkler irrigation in Azerbaijan in Scenario 2) will only have an impact on the water lost from the network, so that farmers will likely receive the same amount of water they are receiving now. It's worth mentioning that inefficient irrigation systems are known to contribute to recharge aquifers. In addition, current pricing systems do not provide an incentive for a more efficient water use. In Georgia, farmers are charged a flat rate (43 USD/ha/year), which is paid irrespectively of the amount of water used. In Azerbaijan, farmers are charged on consumption (0,017 USD/m³), but the charge is so low that it cannot really provide an incentive for a more efficient water use. In conclusion, farmers are not expected to be impacted by the proposed measures, as water use is not expected to change after their implementation;
- Network rehabilitation and sprinkler irrigation, improving the efficiency of the system, are thus likely to yield economic benefits for water supply companies, which are estimated in the tables below;
- The environmental benefits linked to improve ecosystem functioning and integrity could not be assessed at this stage, as available information on lake levels and impacts of increasing water abstraction are scarce and contradictory.

Economic benefits for water supply companies

At present, water companies are providing 2384 m³/ha/year in Georgia and 5882 m³/ha/year in Azerbaijan - farmers only get 1192 and 2941 m³/ha/year respectively. After the proposed measures, farmers will still receive similar amounts of water, paying the same amounts they are paying now. However, due to substantial efficiency gains, water companies will provide 40% less water (in the case of rehabilitation of the network) plus an additional 10% (in the case of sprinklers). This will result in reduced operation and maintenance (O&M) costs incurred by irrigation water companies (e.g. for pumping less water), whereas the revenues would remain unchanged. These avoided operation and maintenance costs would be a direct financial benefit for irrigation water companies.

The estimation of avoided costs is based on the following elements and assumptions:

- Rehabilitation cost of irrigation system were previously estimated at 1680 USD/ha or 0.66 USD/m³ for Georgia. According to an expert judgment, it can be assumed that at least 5% of this investment is needed every year for maintaining the system properly. Thus, resulting O&M costs are 0.035 USD/m³;
- The total avoided costs per year are intended here as the unitary cost multiplied by the amount of water saved in each country in the four scenarios;
- The costs of implementing the proposed measures have to be intended as investment costs, realised in year 0. In contrast, the yearly benefits (avoided costs for water companies) are expected to be realised each year after implementation of the proposed measures. For this reason, for the sake of illustration we considered the net present value of the total benefits realised over a period of 30 years, using a discount rate of 4%.

Figure 6. Total yearly avoided costs in the four scenarios

Scenario 1		
	GE	AZ
Total yearly saving - Mln m ³ /year	12,72	
Total yearly avoided costs - 1000 USD/year	444,5	
Total yearly avoided costs - 1000 USD/year	444,5	

Scenario 2		
	GE	AZ
Total yearly saving - Mln m ³ /year		12,72
Total yearly avoided costs - 1000 USD/year		444,5
Total yearly avoided costs - 1000 USD/year	444,5	

Scenario 3		
	GE	AZ
Total yearly saving - Mln m ³ /year	6,35	6,35
Total yearly avoided costs - 1000 USD/year	222,25	222,25
Total yearly avoided costs - 1000 USD/year	444,5	

Scenario 4		
	GE	AZ
Total yearly saving - Mln m ³ /year	7,4	5,3
Total yearly avoided costs - 1000 USD/year	259	185,5
Total yearly avoided costs - 1000 USD/year	444,5	

Looking at the results illustrated above, it can be noted that the cumulative yearly avoided costs (i.e. the sum of benefits realised in the two countries) are always the same in the four scenarios: this is due to the fact that the same unitary O&M cost was used in the calculation, as direct data from the two countries were not available. It might well be the case that actual unitary O&M costs are different in the two countries and, in this case, the cumulative yearly avoided cost figure would differ across the four scenarios. With available data, cumulative cost figures do not change in the four scenarios, but benefits are shared by the two countries to different extents in the four scenarios; the same can be told of the costs of the proposed measures previously estimated. Therefore, the share of costs and benefits among the two countries in the four scenarios becomes a crucial element when evaluating which scenario could be more desirable.

The same applies to the total benefit figures, referred to a 30-year period, which are summarised in Table 21.

Table 21. Total benefit figures

	GE	AZ	Total
Scenario 1: Total avoided costs - Mln USD	7.7	0	7.7
Scenario 2: Total avoided costs - Mln USD	0	7.7	7.7
Scenario 3: Total avoided costs - Mln USD	3.85	3.85	7.7
Scenario 4: Total avoided costs - Mln USD	4.5	3.2	7.7

Comparison of costs and benefits estimates, and considerations over these first results

The Table 22 summarises the costs and benefits (for each country and in total, in Million USD) calculated so far.

Table 22. Costs and benefits for each country and in total
(in Million USD)

		GE	AZ	Total
Scenario 1	Costs	19.55	0	19.52
	Benefits	7.7	0	7.7
Scenario 2	Costs	0	9.07	9.07
	Benefits	0	7.7	7.7
Scenario 3	Costs	9.76	4.54	14.3
	Benefits	3.85	3.85	7.7
Scenario 4	Costs	11.38	3.79	15.17
	Benefits	4.5	3.2	7.7

It is important to stress, once again, that the current results are based on inadequate data –when needed, strong assumptions had to be made. Therefore, these preliminary data have to be taken as first indications of the potential costs and benefits of transboundary co-operation. Based on current calculations, the costs of transboundary co-operation on water quantity issues (i.e. joint actions to increase the overall efficiency of water use in the lake Jandari basin) heavily outweigh benefits in most cases. However, the information currently available does not allow for a full assessment of all the potential benefits of transboundary co-operation –only a (small?) part of these benefits could be assessed.

Nevertheless, some considerations can already be made. As previously mentioned, efficiency levels in the two countries are highly unbalanced: in Georgia, water consumption per hectare is, on average, 2530 m³, whereas in Azerbaijan more than twice as much water is consumed per hectare -5880 m³ on average¹². Unsurprisingly, reaching the same abstraction reduction target is much more costly in Georgia than in Azerbaijan, as in Georgia network rehabilitation would concern a much larger area than in Azerbaijan. This is shown very clearly by Scenarios 1 and 2: in these two scenarios, one of the two countries reduces abstraction by 12.71 million m³, whereas the other one undertakes no action. In Georgia, reaching this abstraction target requires the rehabilitation of the irrigation network over an area of about 11 600 hectares, and this would cost about 19.5 million USD. In Azerbaijan, to reach the same abstraction target, rehabilitation should be undertaken over about 5 400 hectares, for a total cost of about 9 million USD. Thus, reaching the same abstraction target would cost, in Georgia, more than twice as much than in Azerbaijan.

¹² These estimates are based on the overall water abstraction for agriculture, thus including losses from the network.

In addition, higher costs in Georgia would not be compensated by proportionally higher benefits. In Scenarios 1 and 2, for example, costs are highly unbalanced, but benefits are the same in both scenarios. As another example, in Scenario 4 Georgia would bear costs for around 11.4 million USD, but would reap benefits for only 4.5 million USD –in other words, benefits would be equal to 40% of the total costs. In contrast, the costs of measures for Azerbaijan would amount to 3.8 million USD, against benefits for 3.2 million USD –so that the benefits would cover for 84% of the total costs.

In short, as a result of current efficiency levels, these preliminary results seem to suggest **that** actions undertaken by Azerbaijan are more cost-effective than shared actions, or than action undertaken by Georgia. If this is the case, co-operation among the two countries might rather happen on a financial level or, in other words, by joint investments by the two countries for implementing measures in Azerbaijan. Joint investments would be justified by the fact that reducing water abstraction, no matter by which of the two countries, would be clearly beneficial for both Georgia and Azerbaijan: for example, if less water is abstracted by Azerbaijan, less water should be abstracted by the Kura river and transported to the lake through the Gardabani canal, and this would yield environmental benefits for the Kura river in both countries.

However, it must be kept in mind that these are only preliminary considerations: the scarcity/lack of data on Jandari lake, in fact, prevented accurate estimates of costs and benefits and did not allow at all for the estimation of an important part of potential benefits of co-ordinated action. For these consideration to be proved and confirmed, primary data on both water use and related economic activities should be collected, and further investigation and calculations should be undertaken.

Box 1. Supporting water efficiency improvements with adequate pricing mechanisms

Although necessary, network rehabilitation is not the only measure to increase the efficiency of water use in the area: the effects on efficiency levels would be much higher if the measure was coupled with adequate pricing mechanisms.

As previously mentioned, current tariffs for irrigation water in both countries are not encouraging a rational water use in agriculture, as tariff levels are very low or –almost symbolic, in fact:

- In Georgia, in the Jandari area, farmers are charged a flat rate (43 USD/ha/year), independent from the actual amount of water used. Based on average water use per hectare, this flat rate corresponds to about 0.018 USD/m³;
- In Azerbaijan, a volumetric tariff of 0.017 USD/m³ is applied to irrigation water.

Tariff levels are not only inadequate to ensure an efficient water use in agriculture, but also to cover for the O&M costs of providing irrigation water. Based on an expert estimate, O&M costs are around 0.035 USD/m³, which is about twice the amount paid by farmers in both countries. Ensure charges for water supplied to agriculture at least reflect full supply costs (OECD (2010), *Sustainable management of water resources in agriculture*, OECD Studies on Water, OECD Publishing).

In addition, the proposed rehabilitation of the irrigation network would have no impact on water consumption at the farm level, as it would only reduce losses from the network, so that farmers would still receive the same amount of water they are receiving today. With higher water prices, farmers are expected to reduce water consumption at the farm level, and this would result in additional water savings (Molle and Berkoff, 2007).

However, during the project national experts and water administrations raised the issue of whether higher water tariffs that could also involve changing agricultural activities (crops etc.), so this aspect should be further and carefully investigated.

FLOODING ISSUES ALONG THE KURA RIVER

Scenarios for transboundary co-operation

In this case, the scenarios for transboundary co-operation need to be built in a slightly different way as compared to the general methodology illustrated in the previous section, to account for the specific features of flooding issues.

Figure 7. Flooding issues along the Kura river

NOTE: Flood events are primarily originated by seasonal precipitation peaks. Deforestation and hydromorphological alterations of the water body, however, play a crucial role in exacerbating the intensity and magnitude of floods and, as a consequence, floods impacts.

As national experts and officials from both countries pointed out –and agreed upon– the necessary priority for transboundary co-operation on flooding issues is the establishment of a joint early-warning system. According to the Azeri national expert, most (if not all) losses due to flood events could be avoided by co-ordinated dam management in case of heavy rains, provided of course that there is a high-quality forecast of water reserves upstream and, of course, a good early warning system. Therefore, only the costs and benefits of setting up a joint early-warning system will be investigated.

The gross benefits of transboundary flood management

The expected gross benefits of transboundary flood management are expressed in terms of avoided costs of flooding, as illustrated in Table 23. The same table also illustrates the data required to assess these benefits.

Table 23. Expected potential gross benefits of transboundary water management

Typologies of benefits	Associated benefits	Data requirements (both countries)
Benefits from improved flood management	Avoided costs of flooding	Record of past flooding events: Frequency Intensity Costs of past flood events, in terms of: Human lives Damages to the built environment (including infrastructures) Damages to the agricultural sector (to crops and related losses of agricultural impacts) Damages to the industrial sector Estimate of the costs which could be avoided through early warning

Georgia: flood hazard distribution and the costs of flooding events

Flood events are frequent in Georgia. In Georgia flood hazard is mainly medium, although some high hazard areas occur –for example, in upstream areas as well as related to concentrated human activities in rural districts, and the presence of widening floodplains within a (semi)mountainous environment. An analysis of floods and mudflows in Georgia was prepared by CENN/ITC (2012). Based on collected historical information, flood discharge analyses were completed for all hydrological stations in the country, and expected discharges for different return periods were calculated. Subsequent GIS modeling approaches were applied to complete a flood hazard assessment for water bodies, presented in map format. Results show that tributaries as well as the main Kura river are assessed as having a medium to high flood hazard¹³.

Figure 8. Flood Hazard distribution in Georgia.

Source: WHO-ROE, 2010.

¹³ As above

Along the Kura river, the areas with the highest flooding risk are located in the Tbilisi area and all along the river until the border.

The occurrence and costs of floods, as well as related human losses, in the period 1995-2013 are detailed in Table 24. Overall, in the reference period flood costs amount to 298 mln USD, and they account for about one third of the overall costs of all natural disasters (thus including drought, strong winds, avalanches and hail)¹⁴.

Table 24. Flood and flashflood damages in Georgia in the period 1995-2013

YEAR	Flood-Flashflood		
	Number of events	Loss	
		Million USD	Human Loss
1995	4	1,82	1
1996	11	16,25	1
1997	12	21,66	0
1998	2	1,14	1
1999	8	17,39	1
2000	2	1,14	0
2001	4	2,34	0
2002	16	44,86	0
2003	6	2,39	2
2004	10	11,69	1
2005	20	45,60	4
2006	8	8,55	1
2007	7	22,97	1
2008	16	21,66	3
2009	20	17,10	5
2010	18	11,80	3
2011	23	20,01	9
2012	15	18,24	5
2013	8	11,40	0
Total	210	298,00	38

Overall, according to another source, the annual risk of economic losses caused by hydro-meteorological disasters, mainly floods, reaches US\$ 4 bln (UNISDR, 2007)¹⁵.

As an additional piece of information, Table 25 illustrates the estimated damages of selected flood events in Armenia, Georgia and Azerbaijan.

¹⁴ Source : Mariam Makarova, Georgian national expert – Ministry of Environment and Natural Resource Protection of Georgia.

¹⁵ Information provided by Georgian national expert, drawn from different literature source – original references not available.

Table 25 Estimated costs of selected flood events in Armenia, Georgia and Azerbaijan

Country	Date	Affected № of people	Economic damage (x 1,000 US\$)
Georgia	12-Jun-2011	1,750	n/a
Azerbaijan	4-May-2010	70,000	n/a
Azerbaijan	21-Sep-2009	5,000	n/a
Georgia	15-Jul-2004	n/a	2,156
Armenia	5-Mar-2004	n/a	n/a
Azerbaijan	16-Apr-2003	31,500	55,000
Armenia	22-Jun-1997	n/a	8,000
Azerbaijan	5-Jun-1997	75,000	25,000
Georgia	1-Jan-1997	n/a	19,500
Georgia	26-Apr-1997	300	10,000
Azerbaijan	5-Oct-1995	6,000	4,000
Azerbaijan	21-Oct-1995	2,800	n/a
Georgia	1-Jul-1995	300	2,200
Azerbaijan	15-Jun-1995	1,650,000	5,500
Totals (approx.)		1,842,650	131,356

Source: EM-DAT (2012); period 1995 to 2011.

Number of flood events in Azerbaijan

The observed number of flood events in Azerbaijan is illustrated in Figure 9.

Figure 9. Observed number of flood events in Azerbaijan

Following the operation of Mingachevir Reservoir, flooding events were only observed in downstream Kura below the Aras River connection. The areas most exposed to flooding are the Neftchala Region, with a population of 80,000 people, and Salyany region, with a population of 122,000 people – here, floods occur more often and are more intense. No data are available on the costs of flooding.

The avoided costs of flooding following the implementation of a joint early-warning system

Available information is not sufficient to make a reliable calculation of the expected benefits of a joint early-warning system. In order to reach an indicative value, some heavy assumptions must be made, and in particular:

- Available data on the cost of losses due to flooding events in Georgia are referred to the whole country, whereas the focus here is on the Kura river only. Similarly, the (little) available data on Azerbaijan are referred to the country as a whole;
- Keeping the above in mind, it is still possible to get an indicative estimation of flood damages along the Kura river per year, by calculating the average cost per flood event and assuming that one events occur in a year, along the Kura river, in each country. Based on data from Georgia, the average cost of a flood event amounts to 1.42 Mln USD. Of course, these are heavy assumptions, so the estimation of the yearly costs of floods in each country must not be taken as a reliable estimate, but rather as an indication of the magnitude of possible costs of floods along the Kura river;
- It is assumed that these costs, calculated as illustrated above, could be avoided by setting-up a joint early-warning system, coupled with co-ordinated dam management. These **avoided costs** are therefore the benefits of co-ordinated action;
- It is assumed that these benefits are realised each year over a period of ten years –assuming that the system can be run for ten years without significant updates. Thus, the net present value of these benefits is calculated by using a discount rate of 4%.

Table 26. Total benefits (avoided costs of floods) over a period of 10 years.

Georgia – Benefits Mln USD	Azerbaijan – Benefits Mln USD	Total benefits – Mln USD
11,52	11,52	23.03

However, this rough estimation leads to an equal share of benefits in both countries, which is unlikely to be realistic. In addition, such an estimate does not allow for reflecting on possible cost-sharing options in the two countries.

The costs of transboundary flood management

The costs of a joint early-warning system

An early warning system was recently developed in the Rioni River Basin in Western Georgia, which is almost the same size as the Georgian part of the Kura River Basin.

The total costs of the system reached about 743 000 USD, including:

- 5 Meteorological Stations. Each station costed 37 800 USD: Total – 189 000 USD;
- 20 Meteorological posts, with unit price 18 900 USD: Total – 378 000 USD;
- 10 Hydrological posts, with unit price 15 100 USD: Total – 151 000 USD;

- IT equipment (server, hardware and software): 15 000 USD;
- International consultants: 10 000 USD.

As no information is available on the possible costs of setting up an early-warning system along the Kura river in the two countries, we use this cost figure as a proxy of the costs in each country. This is an inaccurate estimate, but this magnitude of costs seems reasonable.

The costs of co-ordinated dam management

Besides the costs of setting-up a joint early-warning system, the costs of co-ordinated dam management in cases of heavy rain should also be investigated. However, available data so far do not allow for estimating such costs, and further investigation on this matter is needed.

Comparison of costs and benefits estimates, and considerations over these first results

Although the estimates above are preliminary, and cost estimates are incomplete, it is possible to make some first consideration over the comparison of benefits and cost figures, presented in Table 27.

Table 27. Comparison of benefits and cost figures

	Georgia	Azerbaijan	Total
Costs – Mln USD	0.74	0.74	1.48
Benefits – Mln USD	11.52	11.52	23.03

The current results are based on inadequate data –when needed, strong assumptions had to be made. Furthermore, cost figures estimated so far do not include all cost elements. Therefore, these estimates have to be taken as preliminary indications of the potential costs and benefits of transboundary co-operation.

Even taking into account the inadequacy of basic data supporting these estimates, there is a large disproportion between the costs and benefits of setting up a joint early warning system: the estimated benefits outweigh the expected investment costs by more than 15 times. This suggests that investing in a joint early-warning system could be a very recommendable choice for both countries.

THE ROLE OF ECONOMIC THINKING IN TRANSBOUNDARY WATER MANAGEMENT: HOW CAN ECONOMIC INFORMATION SUPPORT THE DECISION-MAKING PROCESS?

What do the case studies tell us?

Difficulties in gathering good economic data to build the case studies, as well as discussions held during the meeting with national experts prior to the Regional Meeting, highlighted a need for stressing the importance and promoting the integration of economic thinking in transboundary water management – which is almost lacking at present. However, the scarcity of good economic information, as well as the resulting lack of economic thinking in water management in the two countries, has deeper roots: the main issue identified by participants is in fact the lack of basic data on water uses and water uses inventories in the two countries.

The challenges encountered while developing the lake Jandari case study are a good example of how the lack of economic information can hamper effective and efficient transboundary water management, and in particular:

- Discussions during the Regional Meeting in Tbilisi highlighted that, from an economic point of view, agricultural activities in the Jandari area might not have a strategic role in the overall economies of the two countries. Thus, investments in water management might not be justified by adequate economic returns so that, from a larger economic perspective, investing in that area might not be the most efficient choice;
- Lack of data on crops patterns and water productivity in the area does not allow for evaluating whether the proposed abstraction reduction target are realistic, feasible and, most importantly, whether the proposed allocation of water resources is the most efficient one;
- The lack of economic data on agricultural activities in the area, as well as their environmental impacts, does not allow satisfactory/useful benefit figures. In particular, it is not possible to judge whether the proposed target and measures actually able to maximise the benefits of transboundary co-operation, and it is not appropriate to jump into the estimation of benefit figures at the end of the process, once co-operation targets and measures have been established.

The lack of proper economic thinking in transboundary water management is reflected, for example, in the following issues:

- Inadequate water pricing levels for farmers, as it is the case for example in Azerbaijan, can be considered as actual subsidies, with distortionary effects not only on water uses, but probably also on production choices. Proper basic and economic information would allow for finding alternative ways to support farmers, without recurring to “masked” subsidies.
- The inadequacy of economic information on water management can also have consequences for negotiations over transboundary agreements. This is the case, for example, of the UNECE Water Convention, which Azerbaijan is part of. Georgia is hesitating to sign the Convention because of the fear of additional obligations and costs. A specific project estimated the costs of joining the Convention related to administration and governance, as well as the benefits of entering the Convention; however, the benefits figures were inadequate to convince policy makers to sign the Convention.

The role of economic thinking in the transboundary decision-making process

Overall, the challenges encountered for example in the Jandari lake case study suggest that economics should inform the decision-making process from the very beginning, hand-in-hand with environmental data. This also implies that good quality quantitative information on water use is required.

Economics should have a central role in transboundary water management, as it aims to achieve both environmental and economic objectives at the same time. By thriving to ensure a sustainable use of water resources, in fact, transboundary water management aims, on the one hand, at preserving and improving the environmental quality of water ecosystems and, on the other hand, it aims at boosting regional development –especially in those cases where economic activities depend on water resources (e.g. agriculture).

Table 28 shows the steps of the transboundary decision-making process –as it could be, for example, the implementation of an agreement on the management of a specific river basin or water body. As illustrated below, each step of the process requires quantitative or economic information and thinking, and some examples of the type of information needed are provided.

Table 28. Steps of the transboundary decision-making process

Steps	Key questions to be answered	Examples of quantitative/ economic information needed
Appraisal	Where is it worth co-operating?	Connection to the market: Existing infrastructures (e.g. roads) Existing trade flows Issues and opportunities Value of agricultural production: Crop patterns and water requirements Crop productivity Water productivity Annual GVA of production Share of total GDP or GDP produced by agriculture
	And on which water management issues?	Which conflicts over water use? Which environmental issues to be addressed?
Setting targets	Which targets for co-operation?	The type of economic information needed depends on the main environmental issue(s) at stake. For example, in the case of water quantity issues, the information needed includes: Current water uses Current water efficiency levels Inefficiencies of the system Seasonal or annual water imbalances Etc...
Defining co-operation	Which actions?	Current water efficiency levels How to address inefficiencies of the system described in the previous phase?
	What are the expected impacts?	Assessment of expected environmental, social and economic impacts
	What are the expected costs?	Costs of implementing the measures (financial costs) Costs of operating and maintaining the measures (financial costs) Administrative and transaction costs (financial costs) Economic costs, thus including social and environmental costs (deriving from negative impacts of the measures, if existing)
	What are the expected	Financial benefits (e.g. higher revenues, avoided costs)

	benefits?	Economic benefits, thus including social and environmental benefits (deriving from positive impacts of the measures)
Implementation	Which mechanisms can ensure effective implementation? Which accompanying measures?	Example: installation of meters – Economic information needed: Costs of installing meters Example: setting up of volumetric pricing system, with adequate price levels – Economic information needed: Costs of e.g. water provision, and how to cover these costs through pricing Farm revenues Current share of water expenditures over total revenues Expected share of water expenditures over total revenues after reform of the pricing system Etc.
	Which cost-sharing mechanisms?	Share of costs and benefits by each countries
Monitoring	What are the observed environmental impacts? What are the actual costs? What are the realised benefits?	The monitoring phase allows for collecting updated and reliable primary data on the implemented measures.

Conclusion

With respect to the use of economic information in the transboundary decision-making process, the key issue in Georgia and Azerbaijan is the lack of reliable economic data. At a more general level, water is not treated yet as an economic good. Whenever it is worth co-operating on transboundary water management issue, the collection of primary data is recommendable. This surely implies costs, which however could be accounted for as investment costs for an effective transboundary water management, on the same level of direct costs (for e.g. infrastructures). Furthermore, collecting good economic data and qualitative information is a cost that can be compensated by the benefits of an effective co-operation in the future.

In any case, it should be kept in mind that economic data and information must only support the decision-making process, and not substitute it. Qualitative economic information can also suit this task, if quantitative data are not available or too expensive to get.

At a higher level, inclusion of the economic thinking in the transboundary water management is constrained by the lack of an appropriate legal framework on regional use of water resources –a bilateral commission, for example, should be established by the two countries.

CURRENT AND FUTURE PROSPECTS FOR TRANSBOUNDARY CO-OPERATION ON WATER MANAGEMENT BETWEEN GEORGIA AND AZERBAIJAN

When discussing the potential benefits of the transboundary co-operation in water management between Georgia and Azerbaijan, as well as the challenges to be faced towards an effective co-operation, it is crucial to have a look at the current and future prospects for transboundary co-operation, from an institutional point of view. These prospects were also discussed during the Regional Meeting in Tbilisi, in the context of a roundtable discussion which involved key representatives of the two Governments.

So far, co-operation on water management has involved the key Ministries in the two countries (Ministry of Ecology in Azerbaijan and Ministry of Environment in Georgia), but also other ministries, such as, for example the Ministries of Agriculture, Energy and Infrastructure.

At present, this topic is especially interesting as the Governments of the two countries are currently developing an official Transboundary Agreement on “*Co-operation in the field of protection and sustainable use of the water resources in the Kura river basin*”¹⁶. The objectives of the Agreement are the followings (Article 1):

- “Sustainable water utilisation on the basis of continuous protection of the water resources;
- Substantial decrease of the level of water pollution in the Kura river basin;
- Prevention of degradation and restoration of the aquatic ecosystems as well as maintaining biodiversity in the basin; and
- Prevention and mitigation of the effects of floods, landslides and mudflow, droughts, siltation, and other harmful water conditions”.

The Agreement is thus aimed at setting up co-operative, integrated management of water resources on all relevant aspects and, in particular, identifies crucial areas of co-operation, which include among others:

- Development and implementation of joint basin management plans, projects and measures;
- Carrying out joint scientific research, formulating common guidelines, standards and norms, as well as the development of a joint information system;
- Exchange of hydrological, meteorological and environmental data and information;
- Joint monitoring and environmental assessment.

Transboundary water management activities carried out under the Agreement will be co-ordinated and implemented by the Joint Commission on Sustainable Use and Protection of the Kura River Basin. The Commission will be composed of representatives of competent ministries and agencies of the two countries, as well as representatives of local authorities and competent NGOs.

¹⁶ These paragraphs are based on the latest draft version of the Transboundary Agreement (February 2014), provided by Mariam Makarova, Head of the Water Resources Management Service at the Ministry of Environment and Natural Resource Protection of Georgia, who was involved in this project as national expert.

At present, the Agreement is still under development and discussion, and authorities from the two countries could not forecast when it will be officially signed and adopted. Its entry into force, however, will be a crucial step in the consolidation of transboundary co-operation among the two countries. In fact, even though co-operation has been going on for many years already, representatives of the relevant ministries from the two countries reported, among the major challenges of transboundary co-operation: (i) the lack of a clear regulatory framework; and (ii) the absence of a specific intergovernmental body in charge of coordinating transboundary co-operation. The Transboundary Agreement will thus overcome these challenges, and it is seen as necessary by both countries –and, in particular, the creation of the Joint Commission is seen as essential, as it will allow for easier and more effective discussions and decisions.

According to the government officials, signing the agreement and setting up the Joint Commission is the first priority to be pursued in the transboundary co-operation in the short- and medium-term.

In addition to the Transboundary Agreement, in 2014, the competent Ministries from the two countries signed a programme for integrated water resource management. The overall aim of the programme is the development of joint river basin management plans for transboundary catchment, so it is in line with the objectives of the Agreement. However, this is an ambitious goal, which can only be achieved in the medium/ long term: for this reason, the programme indicates short-, medium- and long-term objectives as well as activities to achieve them. The Programme, however, is not binding.

Therefore, large efforts are being made to strengthen and consolidate transboundary co-operation between Georgia and Azerbaijan. Nevertheless, some main challenges still remain in particular:

- Lack of qualified personnel: good experts were available in Soviet times, but now young, qualified and trained experts are not so willing to work in the public administration, because the private sector offers much higher salaries.
- There is no established protocol for information exchange between the two countries – information sharing is inadequate and/or insufficient. In any case, monitoring is still insufficient in both countries, and quantitative information is needed.
- The development of the energy and agricultural sectors could create conflicts among the two countries, and this should be handled with care.

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