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Challenges to the integration of wetlands into IWRM: The case of the Inner Niger Delta (Mali) and the Lobau Floodplain (Austria)

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ABSTRACT

Wetlands are too often perceived as standalone elements and are poorly integrated into river basin management. The Ramsar Convention recognizes the critical linkage between wetlands, water and river basin management; the governments that are party to the Convention have committed to conserving their wetlands within a framework of Integrated Water Resources Management (IWRM). The ''Critical Path'' approach and related guidance have been adopted by Contracting Parties of the Ramsar Convention in order to effectively integrate wetland conservation and management into river basin management planning and decision-making. However, despite international acceptance of the approach, it is not widely implemented. This paper provides one of the first case study based assessments of the Critical Path approach. The analysis of two contrasting Ramsar sites is presented in order to better understand the barriers to implementation in different development contexts. These are the Lobau wetland in Austria, where management institutions and regulatory frameworks are highly developed; and the Inner Niger Delta in Mali, where the capacity to implement IWRM is less evolved. A planning approach is proposed which involves structured and transparent methods for assessing ecosystem services and institutional capacity, and is suitable as a tool for identifying, prioritizing and negotiating trade-offs in ecosystem services and improving livelihoods. Based on the analysis, two main barriers to implementation are identified; mismatch between local and national or basin level priorities, and a lack of recognition of the ecosystem services provided by wetlands.

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1. Introduction

Pressures on the World's freshwater resources are increasing rapidly due to rising populations and climate change, necessitating improved management of freshwater ecosystems if the many services they provide are to be sustained. The links between poverty and water access are clear, with considerable evidence demonstrating that providing the poor with access to even relatively small amounts of water for personal and productive uses can transform their lives (Merrey et al., 2005). The concept of Integrated Water Resources Management (IWRM) provides a framework which facilitates the protection and sustainable use of environmental resources while addressing poverty alleviation, and implementation of the concept is particularly crucial for water-stressed areas or areas of high demand. Although there is a general consensus regarding the concept and need for IWRM, in practice national responses in planning for IWRM and its local implementation within river basins have only developed over the last decade, and continue to evolve (Chéné, 2009).

While the effective implementation of IWRM is critical for the protection and wise use of rivers and other wetland ecosystems, wetlands are essential components of water resources infrastructure and their consideration as such can help support IWRM programs in particular in relation to water supply and development objectives (MacKay et al., 2009). Despite their importance, wetlands in many of the World's major river basins continue to be degraded and have been identified as one of the most threatened ecosystems globally (MEA, 2005). Although awareness of the need to integrate wetlands into river basin management[1] (RBM) and planning has been increasing and guidelines exist for the integration of wetlands into basin scale IWRM, wetlands are still frequently omitted from basin level decisions related to water allocation.

The WETwin project (enhancing the role of wetlands in Integrated Water Resources Management for twinned river basins in EU, Africa and South-America in support of EU Water Initiatives) has been carried out under the 7th EU Framework Programme, with the overall objective to enhance the role of wetlands in basin scale IWRM. The Ramsar ''Critical Path'' approach offers guidance to integrate wetlands into RBM, but few assessments of implementation success exist. This paper provides one of the first case study based assessments of the approach. The challenges and contrasts in the integration of wetlands into RBM as well as barriers to the implementation of the Critical Path approach are discussed, drawing on lessons learnt from two contrasting WETwin case studies selected for their different development contexts; the Inner Niger Delta in Mali, and the Lobau wetland in Austria.

2. Integrated Water Resources Management (IWRM)

The objective of this paper is not to debate the relevance or effectiveness of IWRM, but to accept the concept as a response to the heavily criticized top-down sectoral approach to water management (Pahl-Wostl, 2007) and to assess the integration of wetlands within IWRM. A brief history of the development of IWRM and its pros and cons is provided in Online Resource 1. At the Rio+20 conference held in 2012, it was reported that substantial progress has been made on the application of IWRM over the past two decades with 80% of countries embarking on reforms to improve the enabling environment for water resources management (UNEP, 2012). While the principles of IWRM have been widely accepted and it is supported by many as the best way to manage water resources, operationalizing and implementing successful IWRM poses enormous challenges, which are typically even greater in the developing world; at Rio+20, UNEP (2012) highlighted that only 50% of developing countries currently have IWRM plans at the national or federal level.

Although no alternative concept to IWRM has been widely accepted, in recent years there has been increasing emphasis on the need to integrate an ecosystem management approach into IWRM. Despite the challenges to implementation and the impediments of IWRM, it provides a useful context within which to implement the paradigm of ecosystem management, allowing society to harness the functioning of ecosystems and ensure their sustainable use (Jewitt, 2002). While the rationale for the synergistic use of IWRM and the ecosystem services paradigm is conceptually clear, the adoption of IWRM as a management framework before the development of ecosystem service methodologies resulted in a focus on physical volumes of water rather than the various values derived from water use (Roy et al., 2011). As a result, the management of water resources to meet human demands has often been achieved at the expense of freshwater biodiversity and the integrity of wetland ecosystems (Gilman et al., 2004).

3. Wetlands and IWRM

The value of wetlands for people arises from the interaction between human society and the ecological functions that wetlands perform, detailed reviews of which can be found in the Millennium Ecosystem Assessment (MEA, 2005). Although awareness of the need for integration of wetlands and their water requirements into water sector planning has been growing since the early 1990s, formal initiation of this integration has only begun occurring in most countries within the past 10–15 years as wetlands have traditionally fallen through the cracks of water policy and legislation due to their position as partly land and partly water based ecosystems (Ramsar, 2008). This has resulted in the widespread degradation and loss of wetlands. Studies have demonstrated that it is almost always more cost-effective to maintain natural wetlands than to drain or convert them to other, often marginal uses, and then to try to provide the same services through, for example, structural control measures (Dickens et al., 2003). It is therefore critical that wetlands are managed as essential components of water infrastructure preferably at the river basin scale.

[1] River basin management (RBM) uses the river basin as the geographical unit of study, and is a primary component of IWRM.

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3.1. *The Ramsar Convention and the Critical Path approach*

The Ramsar Convention was one of the first international treaties to have adopted the ecosystem approach, in particular recognizing the fundamental ecological functions of wetlands as regulators of water regimes (Pittock et al., 2006). The Convention recognizes the critical linkage between wetlands, water and RBM; the governments that are party to the Convention have committed to conserving their wetlands within a framework of IWRM. Guidance on the primary activities needed to achieve this is provided by the Convention. This sequencing, presented as a ''Critical Path'', is intended to provide a template for selection, recording, analysis and presentation of wetlands within the context of RBM. The Ramsar guidance identifies three key requirements for effective integration; (i) a supportive policy, legislative and institutional environment that promotes cooperation between sectors, (ii) Communication, Education, Participation and Awareness (CEPA) programs to support communication of needs and objectives across sectors, and (iii) sequencing and synchronization of planning and management activities across sectors.

The ''Critical Path'' approach (Fig. 1) is a cycle of ten steps arranged within several phases, providing a road map for the integration of wetlands into RBM, and is based on the observation that the sequence of the various activities can be as important as the activities themselves. While the process should ideally begin with Step 1 at the river basin level and move in sequence through the cycle, it is recognized that in many cases water and land management at the basin level may have been undertaken in parallel, or independently to, wetland management at the site level. The Ramsar guidance thus suggests identifying where each sector is in terms of its planning and management cycle, and beginning from this point with a process of gradual integration and synchronization (Ramsar Convention, 2008).

4. Implementing the Critical Path approach in WETwin

As IWRM and RBM are relatively new approaches based on experience rather than theoretical knowledge, case studies have been a popular vehicle to share experiences and explore potential solutions to common problems, with a large number available from different countries and river basins (MacKay et al., 2009). In contrast, very few examples exist documenting the integration of wetlands into RBM. Two Ramsar sites in different development contexts (the Inner Niger Delta in Mali

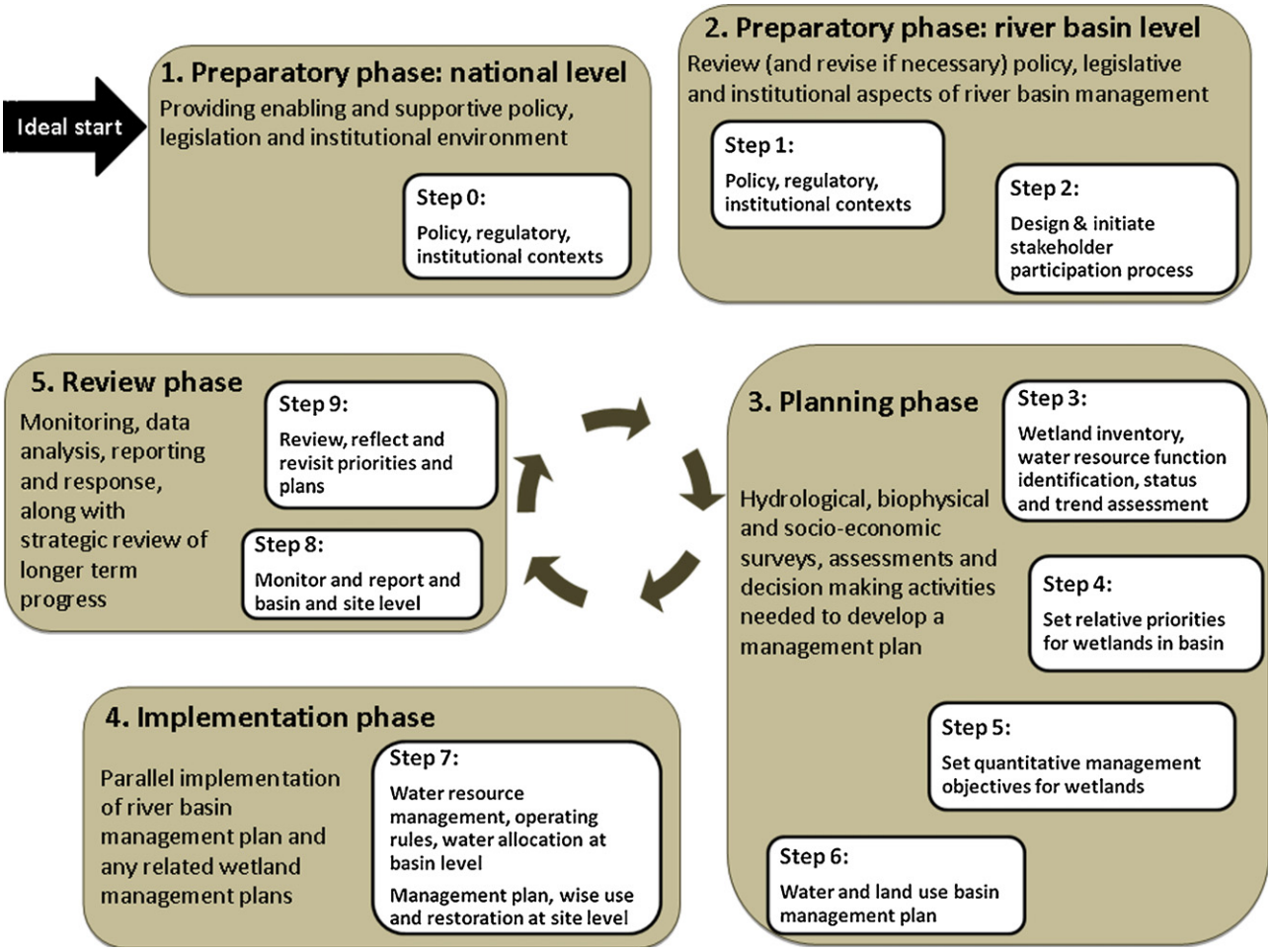

Fig. 1 – The "Critical Path" approach.
Source: Adapted from Ramsar Convention (2008).

and the Lobau wetland in Austria) were thus selected for a comparative case study under the WETwin project, which developed and tested methods to formulate and assess options for managing wetlands using an approach that nests within the Ramsar Critical Path. The WETwin methodology is described in detail in Johnston et al. (in this issue). The approach adopted in the component presented here followed Phases 1–3 of the Critical Path (Fig. 1) extending this framework to include an assessment of ecosystem services to inform the discussion of priorities for management with particular emphasis on developing methods suitable for data-poor contexts. The adaptive management ''loop'' was not closed in any of the case studies, since implementation of management plans was beyond the scope of the project.

For Phases 1 and 2, the institutional, policy and legal context within each country and river basin (Steps 0–1) was derived from the 'Water Governance Database' of the Twin2Go project, based on a questionnaire and associated scoring system (Knieper, 2011; Pahl-Wostl et al., 2012). Each case study was analyzed to identify relevant stakeholders, and a strategy for stakeholder engagement was formulated (Step 2). For Phase 3 (Steps 3–6), structured assessments and a participatory approach were used to combine best available information including quantitative modeling, qualitative ''expert opinion'' and local stakeholders' knowledge and values. For the Lobau, extensive eco-hydrological modeling was available to describe flow and sediment conditions under current and potential future management (Baart et al., 2010, 2012; Funk et al., 2012). For the IND, a hydrological model of the upper Niger catchment and a prediction tool for the flooding of the IND (OPIDIN) were developed (Zwarts, 2009; Liersch et al., in this issue). Frameworks developed in South Africa for assessing wetland ecosystem services and health (Kotze et al., 2008) were used to analyze potential changes in ecosystem services under different management regimes. Priorities for wetland management were discussed with stakeholders, and multi-criteria and trade-off analyses were used to assess the impact of management options on wetland system components and consequently to select the most appropriate management options. The impacts of external factors (such as climate change, population growth and upstream developments) were explored using scenario analysis to establish the vulnerability of the wetland systems, and to find management solutions that are robust under changing conditions (Liersch et al., in this issue).

5. The Inner Niger Delta and the Niger River Basin

The Niger River Basin is the largest in West Africa. It spreads over ten countries, has an area of 2.2 million km^2 and an estimated population of 150 million people. The IND (see Online Resource 2) is a large inland floodplain located in Mali between the Markala dam (near Ségou) and Tombouctou. An area of 41,195 km^2 of the wetland was designated as a Ramsar site (1ML001) in 2004 by Mali.

5.1. *The impact of the river basin on the wetland*

The economy of Mali is highly dependent on the Niger River (which has very high seasonal and inter-annual variability in flow), and there is competition for access to resources especially in dry years. Confronted with severe droughts in the seventies and eighties and a fast growing population and increasing food insecurity, large irrigation schemes (the Office du Niger; ON) and dams for irrigation and hydropower (at Markala, Bamako and Selingué) have been constructed in the upper basin. As a result flood intensity and peak flows have been reduced, while low flows in the dry season have increased due to dam releases. Controversial developments include the Fomi dam in Guinea and the extension of the acreage of the irrigated land of the ON by 4–5 times to approximately 500,000 ha. Substantial reduction in flooded area of the IND from an average of 16,000 km^2 (1950–1970s) to 8500 km^2 in 2020 will result in decreases in fish production (18,000–11,000 tons), rice production (65–43 million tons) and the area of floating bourgou grass (860–180 km^2). In addition,

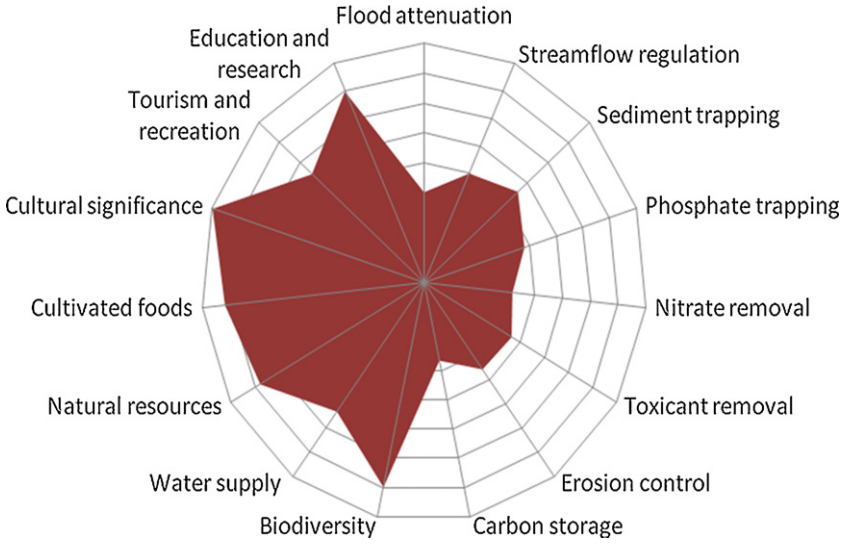

Fig. 2 – Ecosystem services in the Inner Niger Delta.

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under a worst case scenario (dry climate projections), climate change projections indicate a 17% reduction in peak discharges upstream of the IND and an additional 20% decrease of the Selingué and Fomi reservoir (Liersch et al., in this issue).

With an annual population growth between 0.7 and 2.75% demands in the IND are increasing. The shift from wild rice and semi-controlled rice to controlled irrigated rice is seen as the main adaptation option. Further priority options include fish farming and the restoration of bourgou, the main nursery for fish and the main source of fodder. However, taking into account the competition for land and water in the IND, the feasibility of these may be limited.

5.2. *The impact of the wetland on the river basin*

The results of the assessment of ecosystem services within the IND are presented in Fig. 2. These highlight the cultural importance of the wetland to the inhabitants, the livelihood dependence on the provisioning services provided by the wetland, and the importance of the wetland for biodiversity. The IND has various native habitats (flooded forests and bourgou pasture) and hosts several endemic species: 112 species of water birds, 134 species of fish, and mammals such as hippopotamus and manatee. In addition, the wetland is crucial for the livelihoods of 1.5 million people (herders, fishermen and crop farmers), many of whom are entirely dependent on the Delta's natural resources. Biological productivity (including food) in the IND is dependent on the intensity of the flooding, which is determined by the discharge of the Niger and its tributaries.

The population density of the IND (25 ppkm^2) is much higher than in its dry surroundings. Many people living in the Delta such as herders and fishermen move with the flood to make optimal use of the variation in productivity in different ecological zones. Herders migrate with their cattle (out of the Delta) while fishermen follow the shifting waterfront. The return of the cattle into the IND is an important cultural ceremony for which no substitutes exist outside of the Delta. As 80% of the goods and people are transported over water, the water level (and thus the flood intensity) in the IND is important for the length of boating period. Downstream of the IND, the Niger River passes through the Sahara desert and forms an essential supply of water for the population of Niger, one of the poorest countries in the world. For Niger, the IND serves as a natural water reservoir, releasing a stable flow downstream. However, this is dependent on the inflow into the Delta. The Niger Basin Authority has set a minimum inflow into the Delta of 50 m^3/s, but due to the high water abstractions upstream for irrigation this value is difficult to achieve (NBA, 2008).

5.3. *The institutional and legal context*

The results of the analysis for the Niger Basin are presented in Fig. 3. Mali has a strong legal framework for IWRM which follows hydrological principles and includes universal and non-discriminatory access to safe water, poverty eradication, and the protection of ecosystems including wetlands (Ostrovskaya et al., 2010). Although water is a priority in both national and local development plans, implementation is a challenge and coordination between levels could be improved. In terms of sectoral integration, established commissions with participation of different sector representatives exist at all levels of administration. At the Basin level, the Niger Basin Authority (NBA) is a formal transboundary authority. Founded in 1964 as the River Niger Commission, it is one of the oldest basin authorities in Africa. In 2003, the nine member states of the NBA, formulated a ''Shared Vision'' for the Niger Basin. This formed the basis for the Sustainable Development Action Plan (SDAP) for the basin, which is consistent with national and regional water resources management processes (NBA, 2008).

5.4. *Lessons learnt from the Inner Niger Delta*

In both the Niger basin and the IND an institutional tradition of integrated basin and wetland management has existed for decades, and provides the enabling environment for the ''wise use'' of wetlands. The legal framework exists, and stakeholder

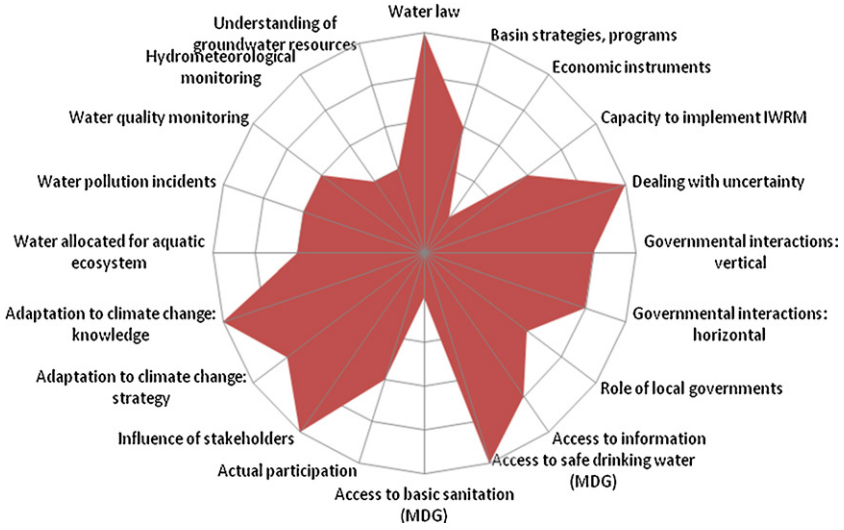

Fig. 3 – Institutional context for IWRM in the Niger Basin. Source: Knieper (2011).

involvement through steering committees is accepted practice for projects in the area. Management plans have been developed at the basin, wetland, and municipal scales centered on the ecosystem services provided by the wetland. At the local level, traditional and modern laws co-exist, although not in complete harmony. Local traditional chiefs still tend to solve conflicts prior to the official municipal authorities. Following implementation of the decentralization policy, the local governments gained responsibilities in the domains of water, education and health, bringing the policy priorities closer to the reality of local communities. Although the local authority is consulted by higher-level authorities regarding matters that might affect them, their advice is not necessarily taken into consideration. Local stakeholders and municipalities can therefore rarely influence national or basin level policy.

The main bottleneck however is the implementation, operation and maintenance of investments. Firstly, this is due to a lack of funds for water governance in general, exacerbated by the uneven distribution of finances between the national and local scale (relative to their mandate and responsibilities). The budget of local authorities at best suffices for their own subsistence. Investments are done fully or partly (a maximum of 10% co-financing) by international donors. Secondly, the lack of continuity and gaps in funding, organizational (operations, coordination) and technical capacity (maintenance) results in lower reliability of local management. As a response to this challenge, management planning for the whole IND was launched in 2009 by a multi-sectoral government platform. The plan was released in mid-2011 (PPD-DIN, 2011) and provides an overarching policy for 43 municipalities, including the IND as a major sub-catchment. Modeled scenarios illustrating potential impacts of upstream development were included in the plan to make data on expected impacts more transparent and available for local managers. Although the impacts of upstream activities on the wetland are described, they are considered to be beyond the mandate and scope of the wetland management plan. The ON (under the auspices of the Prime Minister) has its own management plan and rarely considers impacts on the IND.

Implementation of the management plan is currently the major challenge, and requires effective coordination and the identification of who will be responsible for implementation. Equally important is the need to strengthen the technical, human and financial capacity of the municipalities. Local stakeholders still have limited awareness regarding the importance of the IND, the vulnerability to upstream impacts, and their roles and responsibilities in management.

6. The Lobau wetland and the Danube River Basin

The Danube River Basin (DRB), the second largest river basin in Europe covers 801,463 km^2 and 19 countries. It is characterized by large regional differences in climate, landscape, socio-economic development, and wastewater treatment standards. The Austrian part of the basin covers an area of 80,600 km^2; the Lobau is an urban wetland 22 km^2 in size located within the city of Vienna in the Upper Danube (see Online Resource 5). Part of the Trilateral ''Floodplains of the Morava-Dyje-Danube Confluence'' transboundary Ramsar site, an area of 9.15 km^2 of the Lobau was designated as a Ramsar site (3AT003) by Austria in 1982, 53.8 km^2 by the Slovak Republic in 1993, and 115.25 km^2 by the Czech Republic in 1993.

6.1. *The impact of the river basin on the wetland*

Management and regulation of floods in the DRB has severely affected the state of the Lobau wetland. Hydrological and morphological alterations in the 19th century, including works to protect Vienna from floods, resulted in the loss of aquatic habitats, reduction of the total wetland area, and a decrease of the retention volume. During the channelization of the Danube between 1830 and 1880, the floodplain was disconnected from the main channel by the construction of a flood protection dam. Lateral embankments along the main river channel severely altered the geomorphic and hydrologic dynamics and impeded the natural sequence of erosion and sedimentation (Hohensinner et al., 2008). During recent decades vertical erosion in the main river bed along with on-going aggradation in the floodplain have further separated the wetland both hydrologically and ecologically from the river (Reckendorfer et al., 2006).

As ''Corridor VII'' of the European Union, the Danube is an important transport route. Since the opening of the Rhine–Main–Danube Canal, the river connects the Black Sea with Western Europe and with the Port of Rotterdam, and a minimum water depth and width for ship passage in the main river channel is required. This affects the restoration and reconnection of wetlands like the Lobau, as it restricts management options. In order to avoid possible conflicts with ecological issues, a ''Joint Statement on Guiding Principles on the Development of Inland Navigation and Environment'' in the DRB has been concluded by the International Commission for the Protection of the Danube River (ICPDR) and the Danube Navigation Commission (ICPDR, 2009). The wetlands are also sensitive to invasive species introduced by navigation and the direct connection with other river basins (e.g. the Rhine).

6.2. *The impact of the wetland on the river basin*

The results of the ecosystem services assessment are presented in Fig. 4. The Lobau wetland has very high biodiversity values, with more than 6000 plant and animal species (many endangered) including the recently reintroduced European beaver (Alluvial Zone NP Authority, 2004). Riverine wetlands in the DRB, including the Lobau, form an important migration route for a range of species. Due to its high biodiversity, the Lobau was designated as a UNESCO MAB Reserve in 1977, has been an integral part of the ''Alluvial Zone National Park'' since 1996, and was designated a Natura2000 site by the EU. The Lobau also plays a strategic role as a wilderness area for recreation in an urban context, with more than 600,000 visitors using the infrastructure of the floodplain for recreational and educational purposes every year.

The Lobau plays a central role in the regional water balance downstream of Vienna, retaining floodwaters and recharging groundwater. The current retention volume during extreme

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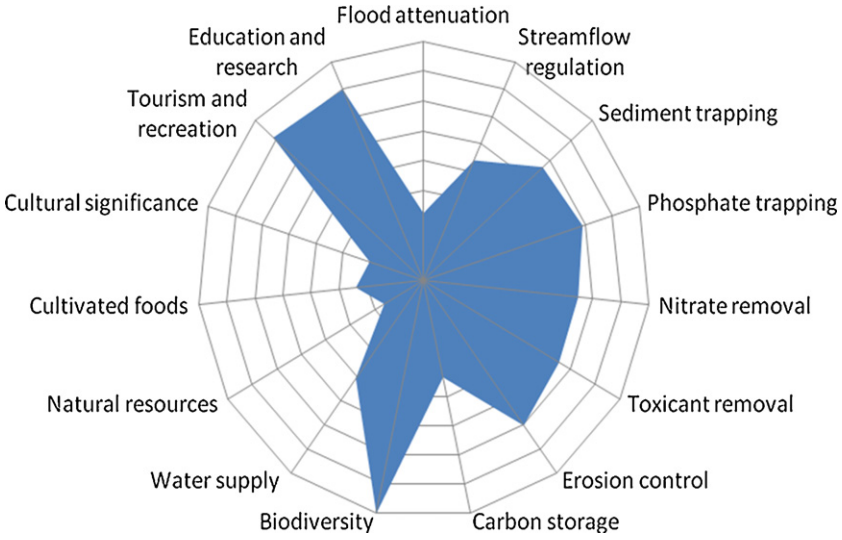

Fig. 4 – Ecosystem services in the Lobau.

flooding is approximately 45 million m^3. Due to its proximity to Vienna the Lobau has traditionally been of key significance for any flood protection scheme for Vienna and Lower Austria, and serves as an important drinking water reservoir for the city. During times of drought or supply maintenance activities, the floodplain provides sufficient drinking water for approximately 25% of Vienna's inhabitants.

6.3. *Institutional and legal context*

The results of the institutional analysis and context for IWRM in the DRB in Austria are summarized in Fig. 5. These highlight the strength of the legal and institutional context for the basin, with major gaps identified as technical information and the assessment of ecosystem services.

The Danube River Protection Convention (DRPC, 1998) forms the overall legal instrument for cooperation and transboundary water management in the basin. Its main objective is the sustainable and equitable use of surface and groundwater and the conservation and restoration of ecosystems. All Danube countries with territories of more than 2000 km^2 in the basin are Contracting Parties to the DRPC; the European Community is also a Contracting Party. The Parties cooperate on fundamental water management issues and take all appropriate legal, administrative and technical measures to maintain and improve the quality of the river and its environment. The ICPDR is the framework for the implementation of the DRPC and the development of a single, basin-wide coordinated DRB Management Plan (2009). A further legal framework for management at the basin scale is the EU Water Framework Directive (WFD, 2000). This provides a legal and internationally binding framework for the restoration, conservation, and protection of aquatic environments and adjacent wetlands, and all EU Member States are obliged to

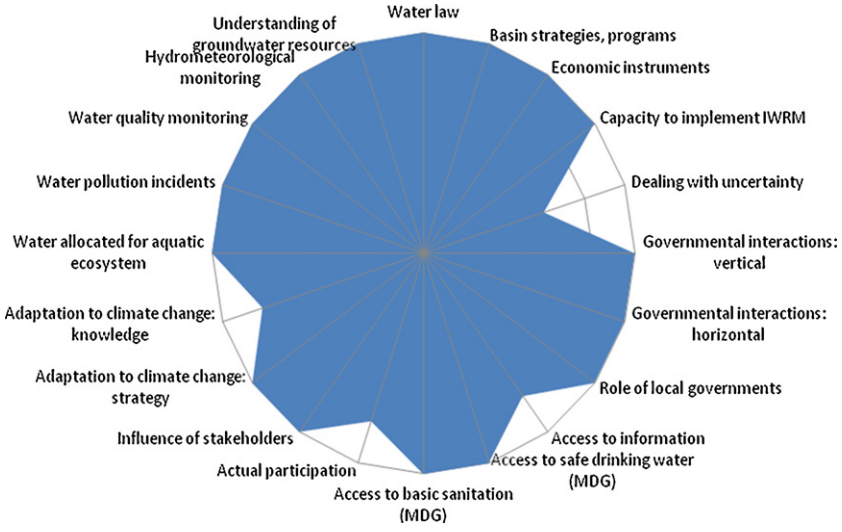

Fig. 5 – Institutional context for IWRM in the Danube Basin, Austria.
Source: Knieper (2011).

fulfill this directive. The non-EU-countries in the DRB have committed themselves to implement the WFD in their countries; Austria has accepted the WFD and has integrated it into its water policy and legislation (Water Act, 1959).

6.4. *Lessons learnt from the Lobau wetland*

In Europe riverine wetlands are currently seen as having strategic importance in reducing flood risk, resulting in the opportunity to integrate conservation and biodiversity management. The general policy defined in the DRBMP promotes restoration (not only conservation) of protected areas in line with other issues such as improved flood protection. However, in the case of the Lobau, the multiple uses of the wetland that have been established over the last 100 years or more (including secondary habitat development for rare species, water supply and recreational uses) may be in conflict with moves toward ecological restoration which aim for pre-regulation conditions. The current form of the wetland (as floodplain pools) provides a different set of ecosystem services than its ''natural'' form as a dynamic floodplain. In consequence ecosystem services such as water storage during high flow are of lower importance, while recreational uses have increased in importance. Current uses and values thus need to be considered in future management schemes to identify mutual solutions and develop adequate management plans (Sanon et al., 2012).

In the past, restoration and management of the Lobau has focused primarily on water management including changes in flow patterns, connection to the river, and water quality. As restoration efforts have progressed, however, it is apparent that sediment transport and its impacts on wetland geomorphology also need to be considered. Upstream water resources developments have reduced bedload and woody debris transport as well as geomorphic dynamics in the wetland, resulting in limited potential to generate pioneer habitats. Changes in land use affect transportation of fine sediment and associated nutrients. In addition, the changes in upstream impoundments and river regulation affect discharge, altering the magnitude, timing and duration of floods. These factors need to be considered in any restoration scheme, as the changed hydro-morphology at the basin scale will affect the responses of the wetland to restoration measures.

An important future step in management is the integration of ecosystem services, and identification of potential trade-offs based on the regional importance of the wetland. The current planning of restoration measures also considers constraints at the basin scale relevant to the Lobau and local management activities. The aim of the restoration measures is to improve the ecological conditions and contribute to a more stable development of the Lobau as floodplain ecosystem, while considering the current uses and constraints at the catchment scale. The major obstacles to implementation over the past few years have been competing interests based on different rights and legal frameworks. The approach adopted by the WETwin project to assess the ecosystem services, analyze the trade-offs and incorporate this information into management planning has the potential to find mutually beneficial management solutions, rather than those based on legal frameworks alone.

7. Discussion

The physical size, ecosystem services, and governance context for the Lobau wetland and the IND are vastly different, but the underlying management question – how to synchronize the management of the wetland and the river basin – is the same. While both support high levels of biodiversity, the importance of the Lobau is mainly in terms of regulating and supporting functions, tourism, recreation and education. In contrast the IND is critical to livelihoods due to the provisioning services it provides, and has a high cultural value to local populations. In both cases, legal and policy frameworks that underpin Phase 1 and 2 of the Critical Path exist nationally and for the transboundary river basins (through the ICPDR and NBA, respectively). The differences, however, are in the institutional capacity to support and implement management, particularly at local level.

In the IND, although the enabling environment exists, implementation continues to be a problem. This is partly due to a lack of financial resources to implement management, but is also explained by the lack of clear links between the different levels of government. While decentralization policies have, in theory, devolved responsibility to local authorities, in practice this is only the case for local issues. It is thus difficult for institutions at the local level to influence national policies. This is not only the case for the water sector, and is exacerbated by the fact that local stakeholders perceive river basin issues as beyond their capacity and/or control. This situation is typical of many developing countries, and constitutes a major impediment to wetland management. In contrast, for the Lobau national and regional policies and laws are administered by strong local, regional and national authorities with both the mandate and resources to implement management. Regional (EU) agreements are important drivers of local policy, and strong legal and regulatory links between levels of government means policies are implemented. However, there is a mismatch between policy objectives at regional and national or local levels. At the regional level there is a strong focus on the restoration of ecosystems to natural conditions, but at the local level current uses have resulted in the demand for a different set of ecosystem services than that provided by the ''natural'' system, and thus, a different type of wetland ecosystem. It is debated whether the goal should be restoration to pre-regulation conditions, or a water enhancement scheme based on a negotiated set of ecosystem services and consequently a different wetland type determined by the priorities of local stakeholders. There is clearly a mismatch between local and national or regional priorities and policies at both sites. The WETwin project addressed this issue by establishing a dialog between the different levels of governance, and by clear delineation of the issues, drivers and priorities of different stakeholders as a first step in the process of identifying management options.

Processes for stakeholder participation (Step 2 of the Critical Path) exist in both wetlands. In the Lobau, this is achieved through a network of advocacy groups, local associations and partly through NGOs. The involved stakeholders have a clear focus on local ecosystem services and their uses. The local public is not involved in the process, but

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informed at regular information events. In the IND, stakeholder participation is well developed and has substantial influence at the local scale, partly as a consequence of the many initiatives and NGOs in the area funded by international donors for whom stakeholder involvement is a high priority. The IND stakeholders are typically aware of the potential impacts of catchment development on the wetland, but view these as beyond their control. In order to defend the stakes of the IND at the national scale better, a multi-stakeholder platform has been established as part of the new IND management plan.

For both the Lobau and the IND, extensive programs have been undertaken to provide the hydrological, biophysical and socio-economic information needed for management (Step 3 of the Critical Path). The dynamics of the wetland and linkages with the basin are reasonably well understood, but there is an obvious difference in both spatial scale and scientific detail. In the IND, the potential impacts of changes in flows to the wetland are understood only in general terms and are thus only considered in management planning in terms of gross changes in land and water use and allocation. In the Lobau, the system is sufficiently well studied and concerns now relate to technical details of the impacts of relatively subtle changes in management. In both cases the impacts of the river basin on the wetland are more recognized than are the values provided by the wetland at the basin level. This highlights the need for comprehensive assessments of the ecosystem services provided by the wetland, as well as improved negotiation and discussion tools to explain values and needs and identify potential trade-offs.

In terms of the remaining steps of the third phase of the Critical Path, management plans exist for each of the two wetlands but in both cases these need to be better integrated into basin management plans. For the IND, even though water for the wetland still receives a lower priority than the water requirements for upstream irrigation and hydropower, the management plan does include an impact assessment of planned upstream land and water development. It also includes a list of priorities for the wetland, quantitative targets (e.g. minimum acceptable flooded area, fish and rice production, and required acreage for irrigation in the IND) and actions to adapt to the upstream pressures. Yet, the effectiveness, feasibility and sustainability of the actions and targets have not yet been assessed. For the Lobau, the relative priority of the wetland has been recognized through both local and national plans. Quantitative management targets for wetlands and rivers have been established through the WFD and detailed management plans have been developed for both the basin (through ICDPR) and the wetland (under local national park authorities). Plans to restore the wetland are being evaluated, moving beyond the hydrology and taking into account the geomorphological, biological and socio-economic components of the system and their future development (Sanon et al., 2012).

Based on the case studies it is clear that the Ramsar Critical Path approach is useful for the integration of wetlands into RBM. However, it is not straightforward to apply and requires more elaborate guidance on how to implement the first three phases, especially with regard to (i) negotiation of joint priorities and the translation into concrete management options and objectives, (ii) rapid assessment to identify the most important issues and values in both the river basin and the wetland, and (iii) how to address the robustness of management options in basins which are rapidly changing. The latter is of particular importance for wetlands in developing countries where changes are occurring rapidly.

8. Conclusions

The need for integrated management of wetlands and river basins is accepted internationally and frameworks for achieving this have been proposed through IWRM and Ramsar guidelines, but documented examples remain scarce. One of the first case study assessments of the implementation of the Critical Path approach has been presented, contrasting two examples from different biophysical, institutional and development contexts.

In an institutional sense, the Lobau functions as a textbook case for embedding wetland management into RBM. Policies defined at basin scale are implemented effectively through a network of agencies with strong governance and accountability at all levels. However, the local uses and users of the wetland have changed over time, and the implications for management of this evolution is not necessarily well understood or accounted for in basin scale planning. In contrast, the IND encapsulates many of the issues inherent in linking wetland management and IWRM in the context of developing nations. These include weak linkages between local and national governance structures, ignorance or disregard at the national level of the local importance of wetlands to livelihoods, and lack of resources and capacity to implement management programs at local levels. In both cases, two main barriers to implementation have been identified; mismatch between local and national or basin level priorities, and lack of recognition of the ecosystem services provided by wetlands to the river basin. The recognition of water as an economic good is an important part of the IWRM discourse, and this places further emphasis on the need to understand the economic values of wetland ecosystem services, in order to ensure that these are incorporated into decision making and management responses at all levels.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.envsci.2012.11.002.

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