European and Chinese Integrated River Basin Management: experiences and perspectives

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Abstract

This paper addresses Integrated River Basin Management as a solution to water stress through a comparative analysis of water management in Europe and China. It makes a preliminary assessment of the European experiences so far with the Water Framework Directive (WFD) – and the additional groundwater protection and flooding directives – on river basin management and investigates its potential value for other areas, focusing on China. Problems and possibilities of water policy transfer are investigated. The main questions to be discussed are whether the EU WFD could be made part of China’s water management regime and whether the experiences of the WFD could help China’s water managers and decision-makers to improve water management based on the principles of IRBM. We will deal with these and other questions, discussing the differences in water management and context between Europe and China.

Keywords: China, European Union, floods, Integrated River Basin Management, Water Framework Directive, policy transfer.

1 Introduction

Water stress, including water scarcity, large-scale flooding and high-level contamination of drinking water, is a serious problem in the world of today in which regions, countries and localities experience different problems – or mixtures of problems – in different levels of severity. Flooding, e.g., threatens delta areas, while drought threatens many inland areas. Global warming aggravates these problems, including the introduction of new types of problems.
like flood hazards to complete delta areas, which could entail not only direct human suffering but also lead to local and international conflicts about the availability, distribution and risks of scarce water resources.

It has long been accepted that a socio-technical systems approach is critical to address water management problems and to generate solutions [1–5]. Balancing the interests of different water using sectors and different actors, combining arrangements and decisions at different scales, and linking communities to their physical resource base are seen as prerequisites for sustainable development. All of these issues can only be addressed from a systems perspective, focusing on the interactions and relations between the various components, rather than treating them as isolated issues as well as considering the dynamics of the systems themselves. Integrated River Basin Management (IRBM) – like Integrated Water Resources Management (IWRM) – clearly builds on a systems approach to water resources management and, consequently, it is a promising tool for dealing with present-day water stress.

This paper addresses IRBM through a comparative analysis of water management in Europe and China. It focuses on the European version of IRBM: the Water Framework Directive (WFD) as well as its additional groundwater protection and flooding directives and it investigates its relevance for China. Questions dealt with are: Is the WFD appropriate and feasible in the Chinese context? What would be the implications of introducing the WFD for Chinese water management? What adaptations might be necessary? How would context and adaptations influence the potential benefits of the WFD? First, we will enter into the European WFD and its backgrounds and expansions. Consequently, we will describe and analyse the water problems and policies in China. Last but not least, we will discuss the possibilities and limitations of policy transfer from Europe to China.

2 European IRBM

Water resources management and development have a long history in Europe. Trans-boundary rivers like the Rivers Rhine (1,233 km long) and Danube (2,860 km long) required conflict management for a long time, while the post-war rapid economic growth affected river systems and called for intervention too. Water-related legislation has been developed since the 1970s with various aims, e.g. reducing emissions of certain substances from different sources and water quality objectives for drinking water and bathing. During the early 1990s, however, needs emerged to address water management challenges from a more integrated and holistic perspective. In December 2000, the Water Framework Directive (WFD) was issued after long time cross-national negotiation and implemented in all 25 EU member states.

The main objectives of the WFD are:
- Expanding the scope of water protection to all waters (inland surface waters, transitional water, coastal waters and groundwater) in a holistic way
- Achieving “good status” for all waters by the target date of 2015, satisfying human needs, ecosystem functions and biodiversity protection
- Water management within the hydrological/geographical boundaries of river basins via effective cooperation of all administrations and institutions involved
- Combined approach towards the control of both point and non-point pollutant sources with emission limit values and water quality standards
- Getting the right prices of water with the elements of cost recovery and cost-effectiveness provisions
- Getting citizens more closely involved in river basin management activities
- Streamlining legislation by repelling existing fragmented and burdensome regulatory systems [6].

The European WFD provides a common framework for water policy employing integrated approaches and innovative instruments to water management. It was developed as a response to the fragmented European environmental legislation. However, the international cooperation concerning the Rhine, starting in the nineteenth century, can be considered a pioneering effort.

The WFD offers a policy frame for protecting and improving the quality of water resources, though it also involves flood and groundwater quality control (for which follow-up directives were issued; see below). It provides for cooperation at the level of river basins. A precise planning procedure for river basin management is part of it (fig. 1).

![Diagram of River basin management planning process](image1)

**Figure 1:** River basin management planning process [7].

The main point is towards water resources management at river basin level in districts. These River Basin Districts (RBD’s) are largely based on surface water catchments, together with the boundaries of associated groundwater and coastal water bodies. In April 2009, the conference of “Active involvement in River
Basin Management – Plunge into the debate!” in Brussels has supported the preparation of river basin plans [8].

The WFD got a supplement in 2006 with the Directive on the protection of groundwater against pollution and deterioration [9]. In 2007, another step was taken in realizing IRBM in Europe when the European Parliament adopted the Floods Directive [10]. This requires European countries to make flood risk assessments, focused on impacts on human health and life, the environment, cultural heritage and economic activity and to do so before 2012. These assessments will be used to produce flood hazard and risk maps (planned to be ready by December 2013), on the basis of which flood risk management plans will be drawn up (to be ready by December 2015). The latter plans will be developed together with all relevant stakeholders and should provide policy makers and developers with a base for measures that are both technically appropriate and socially acceptable.

The (expanded) WFD is the European edition of IRBM, stimulated and being conditioned by the post-war European unification process, in which public control measures follow on the establishment of a free market. The concept of IRBM comprises multi-purpose water projects, basin wide programs and comprehensive regional development. It has been created in the United States of America in the first half of the twentieth century on the basis of engineering and management experiences from all continents [4]. In fact, IRBM being a management tool strongly reflects the doctrines of planning, which originated from the Second Industrial Revolution taking place in Germany and the USA. Planning procedures were part of Roosevelt’s New Deal politics (e.g. the Tennessee Valley Authority), but became a dominant policy instrument first in the Soviet Union. After the Second World War, planning as part of management became widely adopted. Similarly, IRBM has been broadly accepted as a framework for water policy, in which water developers often combine modern concepts with endogenous water traditions. The European WFD is a case in point.

The EU WFD and its supplements, tailored to the specifics of the European countries, reflect many but not all the elements of IRBM. Experiences thus far are positive. Though it is causing tensions here and there in view of national water traditions [11], in general, the WFD seems to work quite well; the goal at least – in 2015 all waters in a “good condition” – is still within reach. However, recent assessments point out that at least 40% of the European water bodies are “at risk” not meeting the goal [12]. Nevertheless, the WFD has been hailed as a front-runner on integrated water management in the world owing to the introduction of a number of generally agreed principles and concepts into a binding regulatory instrument [13].

Consequently, the WFD and European IRBM in general have become a source of inspiration for water management reforms elsewhere, most notably in China. The Chinese water authorities have shown interests in adopting the WFD to fight the river pollution problems and manage flood risks that they are experiencing, e.g. in the cases of the Yellow River and the Yangtze River.
3 Chinese water management

Since the 1980s, China has experienced different kinds of water stress, especially floods, droughts, water pollution and the degradation of terrestrial and aquatic ecosystems, mainly due to the economy-orientated development mode, the huge population growth and the accompanying altered land use. Historically, China has been frequently hit by major floods and it has suffered from flooding disasters as well as droughts. In recent decades, China has put much effort on flood control, but the current challenges are still gigantic. During the period 2001-2005, the average area of land affected by floods was 12.8 million ha, with 1,510 people dead and a direct economic loss of 100.6 billion Chinese Yuan [14].

River pollution becomes more and more serious. The annual quantity of wastewater discharged increased from 58.4 billion m$^3$ in 1997 to 75.8 billion m$^3$ in 2008, of which around two-thirds was industrial wastewater and one-third domestic sewage [15]. Diffuse emissions from agricultural activities contribute to excessive loads of nutrients in rivers and lakes. In 2008, 20.6% of all 150,000 km monitored river sections had a water quality below Grade V (essentially useless), and 18.2% was Grade IV–V (appropriate only for agriculture and industrial use) [15].

At the same time, the competition for water among agriculture, industry and municipalities is becoming more and more intense as a result of rapid urbanization, industrialization and sustained population growth. The total quantity of water used in 2008 was 591 billion m$^3$, of which 12.3% was for domestic water use, 23.7% for industry, 62% for agriculture and only 2% for the environment [15]. Moreover, various trans-jurisdictional conflicts are emerging, e.g. on water rights and pollutants discharge.

3.1 Laws


China’s water resources have been managed by means of administrative boundaries for decades. This pattern of administrative water management was legally strengthened by the first Water Law adopted in 1988, which emphasised that “the State shall exercise a system of unified administration on water resources in association with administration at various levels and by various departments” (Art. 9). It marks China’s water management shift from “administrative management” to “water governance by law”. However, several major rivers run through many administrative regions in China. The Yangtze
River (6,300 km long), for example, flows through 11 provinces including autonomous regions. Similarly, the Yellow River (5,465 km in length) runs through nine provinces and autonomous regions.

The River Basin Commissions (RBCs) actually started to develop since the 1930s; their main functions were water quantity management – e.g. aiming at flood prevention and keeping rivers running – and water and soil conservation. Consequently, there have been various upstream-downstream conflicts about water allocation, water pollution and river development, which the first Water Law (1988) failed to deal with.

Since the promulgation of the amended Water Law in 2002, China’s water management has started to move towards a new system using both administrative and hydrological boundaries. This is emphasised in several ways, such as “The State shall adopt a ‘combined division responsibility’ system of river basin management in conjunction with jurisdictional management” (Art. 12) and “the plan for a region within a river basin shall be subordinated to the comprehensive river basin plan” (Art. 15).

The amended Water Law also indicated that “The River Basin Commissions shall perform the duties of water resources management and supervision, which are specified by laws and administrative regulations, and granted by water administrative departments under the State Council; The administrative water management departments above the county level shall be responsible for the unified water resources management and supervisions in their regions” (Art. 12). Moreover, it emphasised that “Water conflicts among administrative regions in river basins shall first be negotiated; if it fails, the case shall be sent to a higher level of government for judgment” (Art. 56).

3.2 Institutional structure

China has a long history of river basin development and management in various forms, including the establishment of seven river basin commissions (RBCs) since the 1930s and consequent attempts to develop river basin plans. RBCs primarily focused on traditional hydropower and flood control projects. Until now, they hardly apply the principles of Integrated River Basin Management, while their institutional capacity for water conflict resolution among different administrative regions is weak. Water quantity management is emphasized, rather than water quality management. Furthermore, there are many unclarities in the division of water resources management between the administrative agencies and the RBCs. In practice, this may slow down action in emergency situations, such as large-scale water pollution and flood events in river basins, when fast and effective responses are required.

China has a highly top-down water administrative structure, involving a variety of water-related organisations. At the national level, there are a couple of departments administering water resources affiliated to the State Council, e.g. the Ministry of Water Resources (MWR), the Ministry of Environmental Protection (MEP) and the State Flood Control and Drought Relief Headquarters (SFDH). In this context, water institutional arrangements are often criticised for being inefficient, sectoral and incapable [16, 17].
An example of the current fragmented water management system is the separate water quantity and water quality management framework (fig. 2). At the river basin level, the MWR is mainly responsible for water quantity management in water systems, while the MEP is mainly responsible for pollutant discharges from land to water. The Water Protection Bureau of the RBCs, assisting in water quality management, is led by the MEP as well as the MWR. Consequently, it is very hard to coordinate water quantity and quality management in river basins. Actually, the core of the present river basin management is to control floods and to coordinate water allocation in view of different demands. In order to improve the practices of IRBM in China, it is very important to first clarify the various responsibilities of water institutions at all levels and then develop effective coordination mechanisms suitable for China’s national conditions.

![Diagram](image.png)

**Figure 2:** Separate water quality and quantity management in China.

### 3.3 IRBM

Though the concepts of sustainable development are gradually becoming prominent in China, water management policies and practices towards IRBM (and IWRM in general) remain out-of-date and fragmented. The awareness grows, however, that comprehensive water resources development and management at river basin level is crucial to improving the current water situation and to ensuring the long-term availability of water resources as a base of social welfare [18].

Problems to overcome include weak water governance, low level of public participation, inefficient implementation of laws and regulations and overlapping legal and institutional functions. IRBM-based water reforms are necessary, and should include strengthening and improving the legal position of RBCs, water demand management, flood risk management, pollution control and prevention, balanced hydro-ecological system protection and economic development, coordination with regard to laws, regulations and institutions as well as
appropriate planning and decision-making procedures. International experiences, e.g. with the EU WFD, could help China in this regard.

4 Discussion

IRBM has attracted attention from both developed and developing countries in addressing present-day water stress. Valuable lessons can be learned from experiences elsewhere, for example in Europe. However, policy transfer is far from easy. Hooper [19, 20] argues that south-south exchange of experiences is more likely to promote effective IRBM implementation than north-south dialogue, partly because of divergent basin realities. Attempts to use the Murray-Darling model in Vietnam and China have encountered serious problems [21]. These cases show that river basin management strategies must be adapted to local situations and that institutional water reforms in developing countries cannot result from duplicating management in developed countries. Does this also hold for implementing European IRBM in China? Could the EU WFD be adopted in China, having the same beneficial effects as in Europe?

China is facing major challenges in managing its scarce water resources to sustain economic growth and it makes tremendous attempts to fight water stress with elements from foreign water approaches, including IWRM methods. Some researches and activities have been carried out in order to find and assess learning possibilities, involving e.g. water management in Austria [22], the EU and USA [23] as well as the International Yellow and Yangtze River Forum. The WFD inspired the EU-China River Basin Management Programme (2007-2012, focussed on the Yellow River and Yangtze River basins [24]).

In order to answer the above questions, there are some facets to take into consideration, including differences and similarities between China and Europe and the water situation in both regions [25]. Table 1 gives an overview of differences in water management in the EU and China, reflecting differences as to the specific water stress situation, both physically and perceived, development status, policy priorities as well as the broader socio-economic, political-economic and socio-cultural context and historical backgrounds.

The differences in the present-day water regimes as well as in the social, economic, political and cultural context between the EU and China seem to preclude the complete importation of the WFD. Three points deserve attention.

1. A striking difference is the political structure as well as political tendencies, which determine developments and possibilities in the water domain. Presently in China, central guidance in water management to address the varied and complex water problems is getting more and more difficult, which implies the necessity of exploring combined central and decentral strategies to be explored. The European case offers an interesting example in this respect, though the other way around: Europe is moving toward increased central guidance in a basically decentralized (nationally organized) social system, whereas China tries to adopt decentral elements in its water management approaches in order to solve complex water administrative problems. China and Europe are
representing two archetypal organizational models for implementing IRBM, i.e. the authority model and the coordination and negotiation model. Interestingly, however, a tendency to convergence can be noted, though great differences still remain.

2. It makes sense to manage rivers in regard to hydrological boundaries. Consequently, river basin administrations are considered to be of essential importance in both China and Europe. The problem, however, is how to distribute power between China’s administrative water management agencies and RBCs. China definitely needs rivers to be fully managed and developed in terms of complete basins as Europe presently strives after, but the question remains how to adapt the EU’s river basin management framework to China’s specific socio-ecological context.

3. The involvement of local stakeholders in basin-level planning and actions was right from the start a main point in Europe, logically related to the political organization of decision-making and policy implementation in Europe. The April 2009 Active involvement in River Basin Management conference in Brussels exemplifies this. It brought decision-makers and stakeholders from all across Europe together in view of the formulation and publication of river basin plans before 2010 [7]. How to realize such in present-day China? In general, China’s progress in realizing IRBM depends on the public awareness of environmental problems in relation to economic growth and the development of a civil society.

Table 1: Comparison of contemporary water management between Europe and China.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>EU (WFD)</th>
<th>China</th>
</tr>
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<tbody>
<tr>
<td>Objectives</td>
<td>Good status of all waters (including surface and groundwater)</td>
<td>Water conservation and pollution prevention (mainly surface water)</td>
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<tr>
<td>Scope of planning</td>
<td>River basin planning, update river basin plan every six years</td>
<td>Combination of river basin planning and regional administrative planning</td>
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<tr>
<td>Pollutants management</td>
<td>Combined approach towards control of both point and non-point source pollutants</td>
<td>Focus on the control of point source pollutants; no effective measures for non-point source pollutants</td>
</tr>
<tr>
<td>Decision making</td>
<td>Top-down and bottom-up, centralized and decentralized management</td>
<td>Top-down, centralized management with strong and varied hierarchy</td>
</tr>
<tr>
<td>Role of RBCs</td>
<td>Responsible for all water-related issues at river basin level</td>
<td>Mainly responsible for water quantity management, e.g. flood control and water allocation</td>
</tr>
<tr>
<td>Water allocation and water rights</td>
<td>Controls on water abstraction and groundwater recharge; member states’ own policies specify water rights</td>
<td>Rational allocation to alleviate the upstream-downstream conflicts; ambiguous water rights at regional and local levels</td>
</tr>
<tr>
<td>Water pricing</td>
<td>Full cost recovery and cost-effective provisions to be taken into account</td>
<td>Preliminary research on water price, its components, and measurement</td>
</tr>
<tr>
<td>Public participation</td>
<td>Getting citizens more closely involved in river basin management activities from early stages</td>
<td>Insufficient stakeholder participation in water planning and management as well as flood control</td>
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</table>
China’s legislation on IRBM does not provide clear guidance on how to achieve it. European policies can be used as an example. Theoretically, the European approach is helpful for China, especially with regard to alleviating river pollution and ecological degradation. However, the contextual differences on hydrology, water stress, legal and institutional structure and the like clearly indicate that WFD cannot be applied directly to China.

5 Conclusion

The experiences with the EU WFD and European IRBM in general are far-reaching and relevant beyond the scope of Europe. It changes the widely held view that water resources primarily serve economic development. Furthermore, it puts forward a series of management facets, e.g. clear and effective water legislation, public participation, water management on hydrological boundaries and cost recovery, which offer potential lessons for the development of integrated river management elsewhere. Consequently, the WFD – as an example of IRBM – has attracted foreign attention, most notably from the Chinese water authorities.

Controlling rivers has been the main priority in China’s traditional “hydraulic society”, especially involving dam construction and long distance water diversion. Although water management strategies have shifted from “water engineering” to an approach of managing and developing “water resources” in the 1990s, more adaptive strategies towards IWRM and IRBM in China are necessary for fighting the massive river pollution, the frequent seasonal floods and other water problems at the scale of a river basin.

However, there are large differences in the scope and scale of water management as well as in the geo-morphological, social, economic and cultural context between Europe and China, which seem to preclude the complete importation or ‘transplantation’ of the WFD and its supplementary directives. Furthermore, European IRBM is very complex and requires a lot of (inter)national cooperation. The implication for China is that pure legislative and institutional reforms do not suffice. The water management agencies should get full opportunity to supervise integrated water resources planning and management, enforce water laws effectively and promote public participation at all different levels.

Nevertheless, the experiences with the WFD and European IRBM in general can be valuable for river basin management in China. Given all the water management aspects it introduced and systemized, the WFD could serve as a reference case. It could facilitate the development of more effective river basin management systems in China in the long term, supporting the country’s rapid processes of social and economic change and transformation, while taking into account the particularities of individual river basins.
References


