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The role of issue linkage in managing the Mekong

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Abstract: The Mekong River is the major water source in Southeast Asia and shared by six countries. There is a rush to acquire sources of alternative energy and other benefits to meet the growing demand for water and energy, while China and Myanmar have refused to cooperate fully in the Mekong River Commission, leading to increase risks within the region. Development of the water resources of the Mekong River Basin is the subject of intense debate both within the Mekong region and internationally. This paper investigates the concept of issue linkage to resolve unidirectional externalities in the Mekong River. Using linked games, the paper shows that the downstream nations can consider the use of linkage as a form of side payment in achieving a basin-wide agreement. This analysis supports the integrated water resource management-based Basin Development Strategy adopted by the Mekong River Commission in April 2011 for managing the region's sustainability development.

Keywords: transboundary water resources, Mekong River Basin, externality games, issue linkage, cooperative solution

JEL classification: C71, C72, D62

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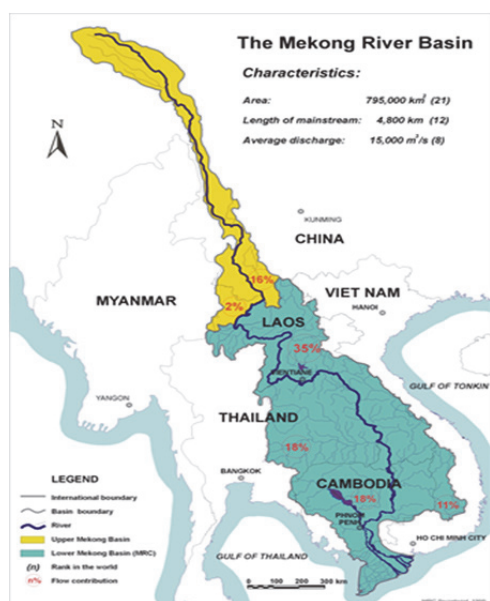
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1 Introduction

The Mekong River (MR) is the major water source in Southeast Asia, shared by six countries. Originating at over 4,500 meters elevation in the Tibet Qinghai plateau, the Mekong—the tenth longest river in the world—flows for over 4,800 kilometres through China, Myanmar, Laos, Thailand, Cambodia, and Vietnam (MRC 2005). Before entering the South China Sea, it drains over 795,000 square kilometres (ADB 2004; MRC 2005; Mehtonen et al. 2008). The Mekong River provides not only a source of energy through hydropower production but also many environmental, economic, and other benefits for the region, including fisheries, wetlands, ecosystem services’ valuation, transportation, trade, water supply, and tourism.

Like many transboundary river basins in the world, managing water resources has become the subject of increasing competition between many sectors in the Mekong River Basin (Figure 1) and is a source of tensions (Campbell 2009). The four downstream nations (Thailand, Laos, Cambodia, and Vietnam) signed the 1995 Mekong Agreement and formed the Mekong River Commission (MRC) to promote development and management of the river and its resources in a sustainable manner (MRC 2005). The MRC is considered the primary regional organization in the Mekong Basin and has the mandate to cooperate on development, including mainstream and tributary damming. To date, it is largely dependent on overseas donor funding (Suhardiman et al. 2012) and has only managed to involve its member states on apolitical issues (Matthews 2012). Currently the MRC has faced difficulties in sustaining the basin resources. About 21 per cent of the Mekong River Basin (MRB) area is eroding; only 31 per cent of its original forests are left intact and only 5 per cent are under protection (UNEP 2006). In addition, about 75 million people that depend upon its resources for food production (Osborne 2004; Cronin and Hamlin 2010) are likely to face some monumental challenges in the years to come. One of the most urgent developmental challenges is the management of water resources to meet growing demands for food production and energy. In developing the MRB—home to the world’s poorest and fastest growing populations—this challenge is exacerbated by rapid and often chaotic social and economic changes, environmental degradation, and limited understanding of the complex web of interactions between water-related uses in different sectors.

Figure 1: The Mekong River Basin



Source: World Bank (2006).

The MRB has attracted considerable international attention due to a long and somewhat successful history of institutionalized river basin cooperation (further details, see Jacobs 1995, 2002). On the other hand, it has also been experiencing recent challenges in terms of the potential alteration of complex ecological and social systems (Dore and Xiaogang 2004; Campbell 2009), especially given the very high economic growth rates in China and the political intransigence of the Government of Myanmar. Southeast Asia's need for energy is big and development is rapid. The rush to acquire sources of alternative energy and other benefits have led to the so-called 'water grabbing', where powerful states and private actors are able to mobilize power to control the benefits of hydropower, while livelihoods and ecosystems that depend on the water resources that hydropower disrupts are negatively impacted (Matthews 2012). Though the MRC appears to be caught between short-term economic-focused water resources management agendas of the Mekong states, there is a large disconnect between the MRC's programme objectives and those of regional governments (Suhardiman et al. 2012). China¹ is a host to the Mekong's origin and has played a leading part in the Upper MR. It is able to exert its power both in traditional terms (military and economic diplomatic actions), as well as more non-traditional ways (i.e. unidirectional upstream externalities).

Recent studies show the urgent need to support the MR countries in their responses to foresee impacts of climate change and adaptation in the MRB, including cooperation as expressed in the 1995 Agreement (Phillips et al. 2006; Fox and Sneddon 2007; Osborne 2010). The downstream co-riparians remain at risk under circumstances where China and Myanmar have refused to cooperate fully in the Mekong River Forum (Phillips et al. 2006; Osborne 2010). Without China's full participation in the MRC, the commission is 'vulnerable to biophysical and socio-economic stress as it cannot estimate the amount and quantity of water in the MR due to the development of Chinese hydroelectric and water infrastructure projects in Yunnan (Hensengeth 2009). As the Lower Mekong Basin (LMB) states have largely failed to bring China to the negotiating table and apparently lack the will to challenge China on its dam-building, China can expand its dam capacity without the need for cooperation with the LMB nations. The MRB's sustainable development provision remains largely ambiguous due to the lack of a legal framework and procedures for management (Browder 2000; Phillips et al. 2006; Bearden 2010; Osborne 2010). In addition, the partition of the water is just one issue to be taken into account, and it is insufficient on its own to establish a viable regime (sustainable development), which reflects all water-related management problems in the Mekong.²

The literature on transboundary river management shows that economic efficiency alone is not a sufficient condition for cooperation, especially when it is related to the transfer of a scarce resource, such as water, among hostile potential cooperators (Dinar and Wolf 1994). Therefore, when negotiations address an issue with strong asymmetry, grouping relevant issues with opposite asymmetry, interests can be advantageous because countries are more likely to exchange in-kind side payments than monetary side payments and facilitate credible threats against defections (Just and Netanyahu 2000). The Transboundary Freshwater Dispute Database also shows that 43 per cent of river treaties include linkages with non-water issues (cited by Biba 2012). In their works, Bennett et al. (1998), Kliot et al. (2001), and Kemfert (2004) suggest that the complexity of international negotiations can be better modelled by linking independent games. Linking can offer advantages for international cooperation in principle because full cooperation is often not feasible otherwise. Countries are more likely to (i) exchange in-kind side

¹ China was one of three countries voted against the adoption of the 1997 UN Convention on the Laws of the non-navigational uses of International Watercourses.

² Linkage of political issues has also been common since the 1950s.

payments and (ii) sustain self-enforceable agreements that facilitate credible threats against defection. Regional economic development, which can involve treaty commitments to develop the basin through construction of infrastructure (such as land transport projects in the Greater Mekong Subregion, dams, barrages, or irrigation networks, or even linking trade agreements) is the most promising direction perceived by states to generate positive gains.

This paper analyses systematically various opportunities for the joint management of a wider MRB. We consider the interaction between upper and lower Mekong in a general form of externality games and view the negotiation of achieving a wider basin agreement as the outcome of the aggregated isolated linked games. The paper aims to address the following questions: (i) to which degree (condition) should different policy issues be linked in MRB agreements? (ii) Are existing MRB institutions limiting the ability of nations to enhance welfare because it does not link more policy issues in the same agreement? Using the notions of games with externalities and issue linkage, we show that the LMB riparian nations can consider the use of issue linkage as a powerful tool in negotiating with China. We also demonstrate that the LMB has potential opportunities to show that a basin-wide agreement might indeed contribute to the region's sustainable development. In the Section 2, we provide a background (conflict and cooperation) for the region and outline the possibilities of issue linkages. A generalized framework of linkage games for analysing the role of regional states' cooperation in managing the Mekong is presented in Section 3. Section 4 illuminates the role of issue linkage in managing the Mekong. Policy implications and concluding remarks follow in Section 5.

2 Conflict and cooperation challenges facing the Melong River Basin

The transboundary nature of the MR adds an extra dimension of complexity to the debate about equitable sharing of the river's resources. This section provides a brief review of the Mekong River Basin's situation, including conflicts and cooperation for sustainable development.

2.1 The Mekong River Basin

The MRB encompasses a vast range of geographic and climatic zones, and is divided into the Upper Mekong Basin (UMB) constituting China and Myanmar (24 per cent of the total drainage area) and Lower Mekong Basin (LMB) constituting Cambodia, Laos, Thailand, and Vietnam (76 per cent of the total drainage area). Table 1 presents a summary of the water and land resources of the MRB.

Although only 16 per cent of the total discharge originates from the upper MR, China is the important part of the basin. During the critical dry season, China discharge amounts to most of the mainstream of the MR in Laos and Thailand and contributes to almost 45 per cent of the average flow in Cambodia (Goh 2004). Moreover, about 35 per cent of the spring flow and over 55 per cent of the sediment flux originates from its upper territory (Kummu et al. 2008). The MRB is home to nearly 75 million people.³ It possesses the region's largest potential water resources and related resources that support on-going economic development and basin for community livelihoods.

³ This is one of the poorest regions in the world as a third of whom survive on a few dollars a day (ADB 2004; Mehtonen et al. 2008).

Table 1: The water resource profile of the MRB

	China	Myanmar	Laos	Thailand	Cambodia	Vietnam
Areas ($\times 10^3$ km ²)	165	24	202	184	155	65
Catchment area as % of MRB	21	3	25	23	20	8
Flows as % of MRB	16	2	35	18	8	11
Average flow (m ³ /sec)	2410	300	5270	2560	2860	1660

Source: MRC (2005).

Table 2 presents some selected aggregated indicators of the Mekong region. Populations range from 6.6 million people in Laos to over 90 million in the combined Yunnan/Guanxi region of China.⁴ As a whole, its average growth of real gross domestic product (GDP) has continuously increased in recent years (ADB 2012). Despite this, the proportion of the population living below the poverty line exceeds 30 per cent, including over 100 different ethnic groups, in parts of Laos, Cambodia, and Vietnam (UNEP 2008). Poverty is a critical issue across the basin, despite its significant economic growth.

Table 2: Selected aggregate indicators for MRB and China in the Great Mekong Subregion 2006

	Population (mil)	Population growth (%)	GDP (US\$bil)	GDP growth (%)	PPP (US\$)
Cambodia	14.95	1.68	12.86	6.1	2200
Laos	6.59	1.66	7.89	8.3	2700
Myanmar	54.58	1.07	51.93	5.5	1300
Thailand	67.09	0.54	345.60	0.1	9500
Vietnam	91.52	1.05	122.70	5.9	3400
China	1343.24	0.48	7298.0	9.2	8500

Source: CIA (2012).

The Mekong riparian nations have quite different long-term using patterns of the river. However, the river's waters are used mainly for hydropower and irrigation (MRC 2010). Table 3 presents the annual economic values of China and the LMB, based on the four main water-using sectors in 2010. The economic value of the LMB is calculated as the aggregate of the individual MRC members. Irrigation generates the highest aggregate-economic value for both China and the LMB, contributing 40 per cent and 62.5 per cent of each region's aggregate-economic value, respectively. The water use for irrigation is expected to increase in the LMB (FAO 2012). Water use for hydropower generation contributes the second highest economic value (32 per cent) for China, while fishery is the second highest (22 per cent) for the LMB.

Currently the LMB's actual hydropower generation takes place in the tributaries and produces only 2 per cent of the aggregate-economic value, reflecting the undeveloped hydropower potential in the LMB. The MRC has proposed many plans for developing this potential through dam projects; there are 11 mainstream dam proposals and 30 planned tributary dams to be developed between 2015-30 (Kubiszewski et al. 2012).

⁴ Yunnan's population is about 45 million.

Table 3: Annual economic value (in billion US\$) from different types of water uses in 2010

	China	The LMB	The entire MRB
Households and industrial	0.408 (17)	1.956 (14)	2.364 (15)
Hydropower mainstream	0.758 (32)	0	0.758 (5)
Hydropower tributaries	0	0.206 (2)	0.206 (1)
Irrigation	0.961 (41)	8.619 (62)	9.580 (59)
Fisheries	0.237 (10)	3.000 (22)	3.237 (20)
Total	2.364 (100)	13.781 (100)	16.145 (100)

Note: In parentheses are rounded percentages of the types of water-use values.

Source: Author's construction based on Houba et al. (2013).

2.2 Overview of development and cooperation

China considers the upper Mekong primarily as a source of hydropower and as a trade route. Laos also considers the Mekong primarily as a source of hydropower. More than 90 per cent of electricity in Laos is produced from hydroelectric plants (Campbell 2009). Thailand considers the Mekong as a water resource for irrigation. The main value of the Mekong for Cambodia is for fishery production, while Vietnam relies on the water to support the Mekong Delta's agricultural production. There are clear potential conflicts between these demands, which will require trade-offs among water-using sectors. A number of agreements exist between the Mekong riparian nations, though the different agendas and frameworks reflect the different political and economic interests of the riparian states.

Over the years, the six riparian states of the Mekong have grouped into different water institutions and programmes for managing the Mekong. An increasing number of river-based cooperation institutions have emerged in mainland Southeast Asia since 1991. Among these are the Mekong River Commission (MRC), the Greater Mekong Subregion (GMS), and the Mekong Basin Development (MBD) in the overarching framework of the Association of Southeast Asian Nations (ASEAN). As the MRC is troubled by the diversity of expectations among the member countries, the last mentioned institution has played an important role in economic development of the Mekong region and has attracted international attention (details, e.g., see Weatherbee 1997; Hensengeth 2009). In this paper we also pay attention on these institutions for analysing the opportunities of issue linkage in arranging a basin-wide agreement.

The MRC is among the first international joint-river commissions to have been established. The current MRC was formed by the Agreement on Cooperation for Sustainable Development of the MRB (the Mekong Agreement) that was signed by the four lower Mekong nations in 1995, after three years of negotiation, with support from the United Nations Development Programme (UNDP). Having the longest history of cooperation in the Mekong region, the MRC is involved in water resource management. It also supports a joint basin-wide planning process, the so-called the Basin Development Plan, using the principles of integrated water resources management (IWRM). As a successor to the moribund Mekong Committee, which had been created in 1957, the MRC is also involved in fisheries management, promotion of safe navigation, irrigated agriculture, watershed management, environment monitoring, flood management, and exploring hydropower options. Though it has the support of various international organizations, the MRC has failed to attract China and Myanmar as members.

The GMS comprises Cambodia, Laos, Myanmar, Vietnam, and two regions of China (the Yunnan province and the Guangxi Zhuang Autonomous Region). With assistance from the

Asian Development Bank (ADB), the six MRB countries/regions launched the GMS Economic Cooperation Programme in 1992 to promote integrative economic links among riparian nations. Unlike the MRC, the GMS has the advantage of having all six riparians as its members. This allows it to proceed with the implementation of large-scale water infrastructures (such as building commercial relations in terms of cross-border trade and transportation, energy development, investment, and water resource usage). This was also brought about by the peaceful resolution of conflict in Indochina in the early 1990s, the integration of Cambodia, Lao PDR, Myanmar, and Vietnam into ASEAN, the gradual opening of Yunnan province and China itself to its southern neighbours and coupled with financial support (most notably from the ADB). GMS has become a key area for growth and development in mainland Southeast Asia over the past decade.

Established in 1967, ASEAN is made up of Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. ASEAN had set up an ASEAN Mekong Basin Development Cooperation (AMBDC) institution in June 1996 comprising all member states of ASEAN and China. Moreover, in January 2007, ten countries of ASEAN agreed to implement the ASEAN Economic Community (AEC) by 2015. This would permit free movement of goods, services, foreign direct investment (FDI), skilled labour, and free flows of capital (Petri et al. 2012). All states of the Mekong region are committed to developing market economies, although with varying degrees of structural adjustment. ASEAN's Mekong concept document emphasizes the complementarity of existing development programmes linking them to the ADB-GMS and the UNDP-MRC (Weatherbee 1997). Since all Mekong countries have experienced rapid economic growth in the past few decades, the growing demand for electricity and the abundant hydroelectricity potential make hydropower development in the Mekong region inevitable.

Recent hydropower project developments in the MRB are largely unbridled because of the lack of legal hurdles and international coordination on such projects (Phillips et al. 2006; Bearden 2010; Osborne 2010). The MRC's mission is to promote and coordinate sustainable management and development of water and related resources for the countries' mutual benefit and people's well-being by implementing strategic programmes and activities, as well as providing scientific information and policy advice (MRC 2005). The absence of China, however, is one of the MRC's main weaknesses. Governments in the LMB face critical decisions about the future of the mainstream MR.

2.3 Impacts of hydropower projects on the Mekong River Basin

With economic growth, electricity demand in the Mekong region has grown rapidly, at annual rates ranging from 4.9 per cent to 20.9 per cent since 2000 (ECA 2010). In particular, China's economy has been doubling since its reform period began in 1978, leading to surging energy demand. The fast export-led growth in Thailand, Laos, Cambodia, and Vietnam has also increased demand for electricity in the middle and lower Mekong region. China has more than doubled its consumption between 1997-2007, while its hydroelectricity production presently provides roughly 6 per cent of the country's total electricity (Gleick 2009). China's energy demand has been an important driving force for the development of hydropower projects along the MR.

Table 4 presents the electricity consumption forecast for 2020 and the expected annual growth rates in the period 1993-2020. Currently there are about 80 dams in various stages of planning and construction in the Mekong mainstream and its tributaries (Li 2012). Most of the recent interest in developing hydropower on the mainstream focused on locations in Laos, the Laos-Thai border, and the Cambodia reaches of the Mekong mainstream. The MRB consumption forecasts suggest that there will be a need for increased capital investment from US\$5 billion in

2004 to US\$14 billion in 2020 (Yu 2003). Hydropower projects in the Mekong region have generally been profitable for both host governments and private-sector sponsors.

Table 4: Electricity demand for 2020 and annual growth rates in 1993-2020

Forecast for 2020	Low	Base	High
Demand (GWh)	415,242	597,298	830,799
<i>Average annual growth (%)</i>			
Cambodia	6.4	8.0	9.2
Laos	5.9	7.3	9.3
Myanmar	3.8	6.6	6.9
Thailand	6.4	7.6	9.0
Vietnam	6.7	8.0	8.7
Yunnan (China)	4.7	6.6	8.1
<i>Regional average</i>	6.2	7.6	8.7

Source: Author's construction based on Yu (2003).

According to Li (2012), the total monetary value of benefits from hydropower operations in the next 20 years in the region is estimated to be US\$15-20 billion. However, dam-building may have both positive and negative impacts that should also be taken into account. As a transboundary river, the hydropower resources of the Mekong are limited because too many dams may lead to the tragedy of the common. That is, multiple parties acting independently in non-cooperative behaviour will ultimately deplete a shared limited resource. Studies have already shown that upstream dams can lower water levels' downstream. Lowering the water levels and flow, upstream dams will also lower downstream hydropower potential and its expected economic return (Ziv et al. 2012; Kubiszewski et al. 2012; Biba 2012).

Although dams can help with flood control in the wet season and an increased water supply for irrigation and navigation during the dry season for downstream riparian states, the potential negative consequences for the LMB are multi-faceted and likely to materialize in ecological, economic, and negative political outcomes (Biba 2012). Planned dams will block critical fish migration routes between the river's downstream floodplains and upstream tributaries. For example, the Chinese upstream main Mekong dams' environmental impacts have received much attention. The report of the United Nations Environmental Programme - Asian Institute of Technology from 2009 suggests that the Chinese dams may pose considerable threats to the MRB, while Chinese scholars suggest otherwise (Li 2012). Recent studies on the impacts of dam constructions on the Mekong suggest that dams have a significant negative impact on fisheries, in some cases driving them to collapse (Pukinskis and Geheb 2012; Ziv et al. 2012). Ziv et al. (2012) find that the completion of 78 dams on tributaries would have catastrophic impacts on fish productivity and biodiversity. Moreover, the value of lost capture fisheries, future aquaculture production in the LBM, and the values of lost ecosystem services is estimated to be in the range of US\$33 billion to US\$274 billion (Kubiszewski et al. 2012). Therefore the transboundary nature of the MR adds an extra dimension of complexity to the debate about equitable sharing of the river's resources.

2.4 Challenges

The rich human and natural resources, as well as the current peaceful political situation of the Mekong region, have attracted many foreign investments and made it one of the world's fastest growing regions (UNEP 2008). In this section we report some opportunities and challenges of the MRB. As trade is an important issue driving economic growth and infrastructure is a necessity condition for trade, infrastructure development has a key role in economic development in various sub-programmes in both the MRC and GMS programmes. Our

attention is put on the water management and trade issues in the context of the MRC and the GMS programmes.

The MRC's scope of work has expanded from its original tasks during the Mekong Committee period (of primarily water resources related development) to include environmental, capacity building, and socio-economic considerations in its various programmes. Table 5 provides power trade and energy resources in the Mekong region in 2010. China, Myanmar, and Laos are three exporting countries.

China and Laos have the most mainstream hydropower potential, and are positioned to reap most of the benefits from damming the river. The heavy socio-economic costs will be disproportionately borne by downstream countries, especially Cambodia, Vietnam, and riverine parts of Thailand (Cronin 2012). For example, the MRC's Basin Development Plan estimates a cumulative net economic benefit of US\$33.4 billion over 20 years and total economic benefits for 11 proposed dams ranged from a small positive sum (US\$6.6 million) to a larger negative sum (US\$274.4 billion). Though the LMB countries overall seemed having positive total benefits, under the Basic Development Plan's assumption, only Laos has a net benefit whereas the impacts for the three other members of the MRC ranged from negative US\$50 billion to negative US\$128.9 billion (Cronin 2012; Kubiszewski et al. 2012).

Table 5: GMS power trade and net import in 2010 (GWh)

Country	Import	Export	Total	Net	Energy resources (2009)
China	1720	5659	7379	-3939	104370
Myanmar		1720	1720	-1720	39669
Laos	1265	6944	8209	-5679	17979
Thailand	6938	1427	8365	5511	4566
Cambodia	1546		1546	1546	9703
Vietnam	5599	1318	6917	4281	35103

Source: ADB (2012).

Water use in the Mekong region can be categorized as consumptive or non-consumptive. Consumptive use commonly refers to water that is unavailable for reuse in the basin from which it was extracted due to evaporation, incorporation into plant biomass, transfer to another basin, seepage to saline sink, or contamination. Non-consumptive use refers to water that is available for reuse within the basin from which it was extracted, such as return flows. Total water use is now understood to be a poor indicator of the value or productivity of water, and a poor indicator of true efficiency (Gleick et al. 2011). According to Gleick et al. (2011), the soft path for water recognizes that the real purpose of water use is not evaluated or measured in terms of total water volumes or new water produced, but by measures of the goods and services provided by that water use. Hence, society's goal should improve social and individual well-being per unit of water used (Wolf and Gleick 2002). In this regard, one can think of linking water and non-water issues in managing a water resource. As trade is an important issue driving economic growth, and infrastructure is necessary for trade, infrastructure development has a key role in economic development in the MRB.

The GMS countries have grown rapidly since 1992. Openness, as measured by the ratio of the sum of exports and imports of goods and services to GDP, increased in all the GMS countries except Myanmar during the last two decades (Srivastava and Kumar 2012). While there are some variations across the GMS, overall it remains a relatively poor region (Stone and Strutt 2010). Srivastava and Kumar (2012) find that in the five lower Mekong countries (GMS5), the growth of trade has been rapid even without China. Table 6 shows the Intra-GMS exports. In terms of

intra-regional trade dependence and the degree to which China plays a role in that dependence, China has grown faster than the overall GMS5.

Table 6: Intra-GMS exports

Export from/to (US\$mil)	Cambodia	Laos	Myanmar	Thailand	Vietnam	China
Cambodia		0.57	0.36	49.78	43.86	55.38
Laos	0.31		0.02	101.24	0.38	16.26
Myanmar	0.24	0.01		1089.4	0.44	206.04
Thailand	555.8	454.2	613.4		1978.0	12786.0
Vietnam	51.1	0.2	0.3	451.7		2516.1
China	624.3	86.1	969.8	7148.2	4863.4	

Source: Adjusted from Stone and Strutt (2010).

On 1 January 2010, the China-ASEAN Free Trade Agreement (CAFTA) came into force. This established the third-largest free trade area (FTA) in the world, just behind the European Union (EU) and the North American Free Trade Area (NAFTA). However, China is now facing a great challenge in getting the agreement formally implemented because the trade structure between China and ASEAN countries (AFTA) is competitive rather than complementary (Wang 2011).

Various studies (for example, Barrett 1994; Dinar et al. 2013; and references therein) show that allocation procedures and mechanisms are more problematic in transboundary water resources. The two main characteristics of the problem are: countries' welfare is interdependent, through water quantity/quality externalities; and all solutions to the allocation problem must be consistent with the principle of national sovereignty—that is, a country's compliance with the agreement must be strictly voluntary and self-enforcing. A feature peculiar only to international river is the unidirectionality of river flow, which makes the allocation process even more difficult. Within this context, static games may generate outcomes in which the dominant strategy for the upstream country is not to cooperate, whereas the downstream country's dominant strategy is to cooperate. The resulting equilibrium is not efficient. To achieve an efficient outcome, side payments have been suggested (Porter 1988; Barrett 1994) as means to internalize the externality by the upstream country. With all that background it is obvious that an evaluation of a possible issue linkage would necessitate the use of a normative model. In the next section we present a model of issue linkage as a form of side payment.

3 A model framework

To address the peculiar situation in the Mekong, a model is developed with focus on the MRB structure. However, the features of the model allow easy adaptation of the model to structure and to number of riparian states in any other river basin. In the following we introduce the notions of issue linkage and linked games that will be used for analysing the potential and possibility of joint management in the Mekong.

We consider negotiating between upstream and downstream for achieving a basin-wide (i.e. China and four downstream countries) agreement as a two-stage game. In the first stage, countries (China and LMB)⁵ can play non-cooperative over independent policy

⁵ Myanmar is excluded both due to its political separation policy and thus, lack of data, and its minute contribution of water to the Mekong runoff.

issues⁶ (strategies) such as energy (hydropower generation), trading, and the ecosystem (fishery and agricultural productions) to determine (evaluate) their policy (variables). Then final outcomes as the results of linked issues are taken in the second stage for negotiating countries. The features of the model allow easy adaptation of the model to the structure and number of riparian states in any other river basin.

We view the MRB as a trans-boundary water resource, shared by two players (regions): China (upstream) and the LMB (downstream). Currently, the cooperation between these regions is lacking. As the LMB does not talk in one voice, the MRC has weak policy instruments and seems politically biased in favour of hydropower generation (Grumbine et al. 2012). Hence, on the water issue, the LMB riparian nations seem to face two strategies (regimes): weak (i.e. the four countries act individually) or strong governance (four countries can act collectively, i.e. MRC), whereas China has two strategies, to either cooperate or not with the LMB on water uses. On the trade issue, each player also has two strategies as is described below.

In January 2007, the ten Southeast Asian countries agreed to implement the ASEAN Economic Community (AEC) by 2015, committing to provide a comprehensive framework for economic integration (Petri et al. 2012). Based on the progress in the implementation of the blueprints for building the ASEAN community by 2015, there is an enhanced role for the ASEAN in dealing with regional and global challenges. As the four LMB nations are members of ASEAN, the LMB has advances on trading issue (such as introducing the elements of the AEC, as well as the AFTA and new international agreements with external partners) for negotiating with China.

Let $N = \{1, 2, \dots, n\}$ be a set of policy issues. Assuming that the two players, $J = U, L$ (i.e. upstream and downstream), make simultaneously a policy choice or action $a_J = (a_{J_1}, \dots, a_{J_n}) \in A_J$. An action (policy) profile $a = (a_U, a_D) \in A = A_U \times A_L$ specifies for each player (region) a policy choice with respect to each of $i \in N$. For example, we may think of dam construction plan, trading and energy plan, ecosystem protection, environmental policy, and so on. Furthermore, for each issue $i \in N$, each player J has a measurable payoff function w_{Ji}^a on action profile a with the players' objective function beings linearly separable in the policy issues, i.e. $w_J = \sum_{i=1}^n w_{Ji}^a$.

Since a basin-wide agreement can be achieved only if all players agree (i.e. cooperation and forming a grand coalition), we consider the (static) simplest games with two strategies: agree (cooperate) or defect and focus on bilateral (i.e. two regions) rather than multilateral games. In other words, to achieve an agreement through linked issues, each player has two possible actions: either takes C (or c) for cooperating (i.e. $a_{Jc} = \arg \max_{a_{Ji}} (w_{Ui}(a) + w_{Li}(a))$) or D for defection (selfish policy action $a_{Jd} = \arg \max_{a_{Ji}} w_{Ji}^a \neq a_{Jc}$). The corresponding stage game with strategy space $a_J = A_{J_1} \times A_{J_2} \dots \times A_{J_n} = \{c, d\}^n$ is denoted by Γ .

Let $\Gamma_i(a)$ be the 2-person (externality) game with respect to issue i .

⁶ We assume for simplicity that the LMB states act in one voice. While this is a simplifying assumption given the present on-going disagreements between the LMB states, we still believe that they have a common threat and interest in the conflict with China. In future work we will also add another stage to the game, where equilibrium is reached in the internal LMB. We address the ability of the LMB states to speak in one voice on Mekong water issues via the MRC ability to demonstrate weak or strong governance.

Definition: The policy issues i and k are called substitutes for player J , if $(w_{Ji}^a - w_{Ji}^{cc}) + (w_{Jk}^a - w_{Jk}^{cc}) < 0$, and complements if $(w_{Ji}^a - w_{Ji}^{cc}) + (w_{Jk}^a - w_{Jk}^{cc}) > 0$ for any action plan $a \neq (c,c)$.

One can easily see that if two issues are substitutes, a cooperative outcome would be a better choice for both players (i.e. a wider-basin agreement can be achieved) as the final outcome of cooperation generates a higher outcome. Therefore, if two issues (or more) are substitutes, linkage can maintain the positive allocation effects or increase the amount of available enforcement power, i.e. support cooperation. However, if two issues are complements, the surplus opportunistic potential of one policy could outweigh the surplus enforcement power of the other policy, making defection a dominant strategy in both regimes (policy issues), turning linkage into a destructive policy (destroy cooperation).

The following model, based on Pham Do et al. (2012), explores the idea of using linkage as a mechanism for facilitating broader cooperation. The intuition behind this idea is that linking two (or more) policies (regimes) could allow countries to use surplus enforcement power that may be available in one policy domain to discipline cooperation in other domains. For example, for policy profile $a = (a_U, a_D)$ and two issues i and k (such as water and trading issues), the two-person games $\Gamma_i(a)$ and $\Gamma_k(a)$ are described as follows.

	Lower		Lower
	$\Gamma_i(a)$	C	D
Upper	C	$(w_{Ui}^{cc}, w_{Li}^{cc})$	$(w_{Ui}^{cd}, w_{Li}^{cd})$
	D	$(w_{Ui}^{dc}, w_{Li}^{dc})$	$(w_{Ui}^{dd}, w_{Li}^{dd})$
		Upper	
		$\Gamma_k(a)$	C
		C	$(w_{Uk}^{cc}, w_{Lk}^{cc})$
		D	$(w_{Uk}^{cd}, w_{Lk}^{cd})$
			$(w_{Uk}^{dc}, w_{Lk}^{dc})$
			$(w_{Uk}^{dd}, w_{Lk}^{dd})$

For any two independent games, we construct a two-linked game in which the values are determined as the sum of two values in the two games. Hence, in a linked game, the player J 's payoff is $w_J = w_{Ji}^a + w_{Jk}^a$. The objective of each player is to maximize its final outcome w_J ($= \max_a \{w_{Ji}^a + w_{Jk}^a\}$).

3.1 Water issue game $\Gamma_i(a)$

In many transboundary water problems around the world, 'free-riding' behaviours of parties have led to a 'tragedy of the commons' outcome despite the existence of cooperative optimal solution. The essence of this problem can be presented as a prisoner dilemma (PD) with a payoff structure⁷ given by

$$w_{Ji}^{dc} > w_{Ji}^{cc} > w_{Ji}^{dd} > w_{Ji}^{cd}, \text{ for all } J \text{ and} \quad (1)$$

$$w_{Ui}^{cc} + w_{Li}^{cc} > w_{Ui}^a + w_{Li}^a, \text{ for all } a \neq (C, C) \quad (2)$$

⁷ As each player has the only two strategies, we can use similar notations. That is the first upper letter indicates the player's choice, given the other's strategy. For example, if $J=U$ then condition (3.1) can be written as $w_{Ui}^{dc} > w_{Ui}^{cc} > w_{Ui}^{dd} > w_{Ui}^{cd}$ where the first upper letter is player U's strategy.

Equations (1) and (2) imply that this foregoing (water) game $\Gamma_i(a)$ has a unique solution (Nash equilibrium) in which cooperation cannot be achieved, though both countries could receive higher payoffs if they could agree to cooperate.⁸

In the water game $\Gamma_i(a)$, the dominant strategy is either not to share water (player U) or not to pay for the water (player L), because either sharing or making side payment always costs it some welfare reduction.⁹

Let $G_{Ji} = w_{Ji}^{dc} - w_{Ji}^{cc}$ denote the gain from defecting (or free riding) of player J and $L_{Ji} = w_{Ji}^{cc} - w_{Ji}^{dd}$ be the loss from foregoing the future gains from cooperation for issue i . A grim-trigger strategy supports a cooperation solution in the water game $\Gamma_i(a)$ if the following conditions hold.

$$0 \leq w_{Ji}^{dc} - w_{Ji}^{cc} = G_{Ji} < L_{Ji} = w_{Ji}^{cc} - w_{Ji}^{dd} \text{ for all } J \quad (3)$$

We therefore can consider G_{Ji} and L_{Ji} as cost and benefit for evaluating cooperation: a larger benefit a larger potential cooperation can be achieved.

3.2 Trade issue game $\Gamma_k(a)$

The standard trade theory uses a cooperative trading game with the assumption

$$w_{Jk}^{cc} > w_{Jk}^{dc} > w_{Jk}^{dd} > w_{Jk}^{cd}, \text{ for all } J, \quad (4)$$

which is one dominant strategy to restrict trade barriers.¹⁰

For the trading game (second issue) $\Gamma_k(a)$, Equation (4) implies $w_{Jk}^{cc} - w_{Jk}^{dd} > w_{Jk}^{cc} - w_{Jk}^{dc} > 0$ for all player J and $w_{Uk}^{cc} + w_{Lk}^{cc} > w_{Uk}^a + w_{Lk}^a$, for all $a \neq (C, C)$. Because of Equation 3 and 4, it holds that

$$w_{Ui}^{cc} + w_{Uk}^{cc} + w_{Lk}^{cc} + w_{Li}^{cc} > w_{Ui}^a + w_{Uk}^a + w_{Lk}^a + w_{Li}^a \quad (5)$$

or

$$w_{Ui}^{cc} + w_{Uk}^{cc} + w_{Lk}^{cc} + w_{Li}^{cc} = \max_a \{w_{Ui}^a + w_{Uk}^a + w_{Lk}^a + w_{Li}^a\}.$$

We now turn from principal possibilities to actual proceedings to see whether players would have been able to make use of any of the transformation strategies delineated.

For each player, the total defecting and cooperating on i and k issues are $w_{Ji}^{dc} - w_{Ji}^{cc} + w_{Jk}^{dc} - w_{Jk}^{cc}$ and $w_{Ji}^{cc} - w_{Ji}^{dd} + w_{Jk}^{cc} - w_{Jk}^{dd}$. One can easily see (based on the definition provided earlier) that if

⁸ For example the Nash equilibrium $(w_{Ui}^{dd}, w_{Di}^{dd})$ is not a socially optimal outcome because $w_{Ui}^{cc} + w_{Li}^{cc} = \max_a \{w_{Ui}^a + w_{Li}^a\}$.

⁹ It is evident that China's GDP of roughly US\$8 trillion in 2008 was almost eight times the combined GDP of all four countries of LMB. Hence, LMB has not been able to financially compensate China to halt further dam-building (Biba 2012).

¹⁰ It implies that there is no need for negotiations that nations should liberalize unilaterally (Krugman 1997).

$w_{ji}^{dc} - w_{ji}^{cc} < w_{jk}^{cc} - w_{jk}^{dc}$, then issues i and k are substitutes. Hence, the (larger) gains from the second issue can be used for compensating (negotiating) the free rider in the first issue. The following proposition therefore is obtained.

Proposition: For any externality game, if two policy issues are substitutes, then linking issues always facilitates policy cooperation in a linked game.

The above proposition implies that if players do not cooperate on one issue they relatively value cooperation on substitute issues. Thus the players' ability to maximize their social outcomes can be obtained if there is existence of substituted linkage issues in linked games. The next section will show how the results above may apply to the Mekong situation.

4 The role of issue linkage in managing the Mekong River Basin

In this section we construct an empirical linked MRB game based on the two games (water and trading) and then illuminate how issue linkage can be used as a form of side payment in managing the Mekong. Due to a lack of information from Myanmar, our analysis comprises only five Mekong riparian nations.

To construct a water game, we adopt the model introduced by Houba et al. (2013) where the LMB represented by MRC has two options facing in bargaining with China: strengthening or not strengthening its governance¹¹ and China's strategies are to join or not to join the MRC. We also adopt the simulations of Petri et al. (2012) in deriving a trading game. Currently, governments in the LMB face critical decisions that involve trade-offs between (i) the economic benefits from hydropower generation and (ii) potentially irreversible negative impacts on the ecosystems that provide livelihoods and food security to the rural people. As a means of analysing the potential of cooperation even though China has refused to be a member of the MRC, we assume that both the LMB and China (UMB) are faced with two strategies (i.e. cooperation and non-cooperation) in each game.¹²

4.1 The water issue game

In the physical hydrological basin model, with an unidirectional water flow from China to the LMB, introduced in Houba et al. (2013), the LMB has two options: either to strengthen its governance or remain a weak player, and China can decide to join or not join the MRC. Due to the current situation of the LMB states, 'weak' governance represents a structure in which the LMB states consider to maximize their own profits of water uses without taking into account the externalities they cause. Strong governance represents a structure where the LMB regional welfare will be optimized. In this model, the economic values of water uses are determined by aggregating four main activities in each region and each season: industry and households, hydropower generators, agricultural irrigators, and fishery. During the wet season China's water resources can be used for industrial and household activities, storage for use in the dry season, hydropower generation that is reusable further downstream, and simply passing through a dam. China's outflow in the wet season fosters local fish reproduction before it runs to the mainstream of the LMB downstream. During the dry season, water inflow plus the (fraction of)

¹¹ Note that we assume the LMB states can speak in one voice on Mekong water issues via the MRC ability to demonstrate weak or strong governance (see footnote 6).

¹² For simplicity, given the present situation of the four lower Mekong states, 'cooperation' means to achieve a basin-wide agreement in the LMB strong governance's scenario.

stored water can be used for similar purposes as in the wet season and outflow from the dams can also be used for irrigation. China's irrigation reduces the river flow to the LMB downstream.

For the tributaries of the LMB, water inflow can be used for the same economic activities as in China and the water flows are similar as well, except for a modification for dams of tributaries instead of mainstream dams. The water inflow for the mainstream of the LMB solely consists of the outflow received from China. Future mainstream dams will only be used for hydropower generation. In the wet season, the outflow from mainstream and tributary dams inundates wetlands and Tonle Sap fostering fish reproduction and flushes salinity in the estuary. Table 7 outlines the results for the existing dam capacity and future expansion under non-cooperation in 2030 (in km³) studied in Houba et al. (2013).

Table 7: Dam capacity under non-cooperation in 2030 (in km³)

	China	LMB		LMB	
	Mainstream	Weak governance		Strong governance	
		Tributaries	Mainstream	Tributaries	Mainstream
Existing	75.441	75.454	—	75.454	—
Expansion	111.841	75.750	302.615	105.802	160.387
Total	187.282	151.204	302.615	181.256	160.387

Source: Adjusted from Houba et al. (2013).

One can see that currently China and LMB have similar dam capacities 75.441 and 75.454 km³ respectively.

Table 8: Aggregated economic net values for two governance regimes in 2030 (in billion US\$)

	Strong governance		Weak governance	
	China	LMB	China	LMB
Cooperation	2.75	22.06	3.76	21.05
Non-cooperation	2.73	22.03	2.73	20.03

Source: Adjusted from Houba et al. (2013).

While China's dams are built in the mainstream, the LMB's dams are mainly built in tributaries. In future, China's capacity expands by 48.2 per cent, which is in line with actual construction going on. Under weak governance (i.e. the LMB nations act separately), 302,615 km³ (80.4 per cent) of this planned capacity is installed, which even exceeds dam capacity upstream. These results indicate that the stakes are high for damming the mainstream of the LMR. Also, Chinese construction and electricity companies, which are already active in the LMB, are eager to build and operate such dams. Together with the MRC's preferences for hydropower generation, this explains the persistence of plans for mainstream dams. This pattern will continue and is evident in the recent Xayaburi dam project in Laos. The annual economic net values in the year 2030 under cooperation and non-cooperation is given in Table 8. From Table 8, a water game is constructed as follows.

Table 9: The Mekong water game

		LMB	
		Strong governance	Weak governance
China	$\Gamma_1(a)$		
	Cooperation	(2.75,22.06)*	(3.76,21.05)
	Non-cooperation	(2.73,22.03)	(2.73,20.03)

Note: *=Nash equilibrium.

Source: Author's construction based on Petri et al. (2012).

In this water game, we can see that the total annual welfare gains are US\$2.05 billion for cooperation¹³ (3.76+21.05=24.81) if the LMB is in weak governance. In addition, almost all of the maximal joint welfare gains can be realized by strengthening the LMB's governance (regardless China's situations). From the perspective of China, the incentives are quite different because China can gain more when it cooperates while LMB is weak in governance. This could help to explain why China is interested in signing bilateral agreements rather than multilateral.

The literature on water, conflict, and cooperation in international river basins suggest that cooperative relationships in the Mekong Basin declined from 94 per cent in the period before 2000 to 73 per cent in the period 2000-08 (De Stefano et al. 2010). However, recently China has become more engaged in a wide-ranging economic cooperation with all Mekong countries within the ASEAN. For example, China is considering expanding the construction of land transport lines from Yunnan and Guangxi to Thailand via Laos; it is also considering transport directly to Vietnam to link its southwestern inland provinces to the sea (Biba 2012). When China opens door policy and especially after Yunnan has emerged as an international gateway to the dynamic economies of Southeast Asia in 1991, the annual rates of export (31 per cent) and import (35.3 per cent) growth of Yunnan province during 1993-97 rose above the Chinese average after 1992 (Poncet 2006). Trade between Yunnan and Myanmar, and Laos and Vietnam is significantly greater than trade between those countries and other Chinese provinces. However, the exports and imports to GDP ratio of Yunnan remain quite low and closed compared to the national average because this province is deeply landlocked (Poncet 2006). In regard to the framework of China and the Greater Mekong Subregion, we construct the following trading game for analysing the second issue linkage.

Since trade is an important driver of economic growth, ten members of ASEAN agreed to implement the ASEAN Economic Community (AEC) by 2015 to commit to free movement of goods, services, foreign direct investment, and free flows of capital (ASEAN 2010). Then all ASEAN economies are open to trade and investment. Over the last two decades, the trade/GDP ratio is 131 per cent for the region as a whole and exceeds 400 per cent for Singapore (Petri et al. 2012). ASEAN markets are especially important for Laos and Vietnam. For the MRB, we construct a trading game based on the only results related to the four downstream Mekong states and China. Taking AEC as a benchmark, the strategies of LMB as members of ASEAN are retain barriers with non-ASEAN partner economies; or remove the barriers, i.e. open trading with more others partners of the world. The United Nations Commodity Trade Statistics Database (UN Comtrade) cited in Petri et al. (2012: 97) reports that the region's share pattern is essentially symmetric: the shares of ASEAN, the USA and the EU, China and Japan, and the rest of the world each account for about one-quarter of the overall ASEAN trade. We consider China as a partner of ASEAN but it can be involved with AEC under two options/conditions either increase bilateral free trade area with four LMB states (CAFTA) or enjoys bilateral free trade area with AEC (as of AFTA).

¹³The total welfare in non-cooperation is 2.73+20.03=22.76 while the LMB is in weak governance.

4.2 Trading issue game

We adopt the results from Table 6 in Petri et al. (2012) to address the welfare gains from regional cooperation and from external partnerships in deriving a following trading game. Note that the welfare gain of the LMB is defined as the gains from all four LMB nations in ASEAN plans.

One can see that the LMB has ‘opened’ trading as the dominant strategy, while China’s is CAFTA. In this game, the Nash equilibrium (CAFTA, Open) is not efficient as the total outcome is the less than (AFTA, Open). Now we can construct a linked game as the sum of two independent games.

Table 10: The Mekong trade game

		LMB	
		Open	Restrict
China	$\Gamma_2(a)$		
	CAFTA	(-7.8, 15.4)*	(0.4, 2.8)
	AFTA	(-12.2, 52.9)	(-4.6, 12.2)

Note: *=Nash equilibrium

Source: Author’s construction based on Petri et al. (2012).

4.3 Linked game

As cooperation is the dominant strategy in the water game above, while open is the dominant strategy in the trading game, we will take two outcomes of the water issue and two outcomes of the trading issue to construct a linked game below.¹⁴

Table 11: Linked game

$\Gamma_{12}(\cdot)$	Cooperation	Non-cooperation
Cooperation	(-5.05, 37.46)*	(-4.04, 36.45)
Non-cooperation	(-9.45, 74.96)	(-8.44, 73.95)

Note: *=Nash equilibrium

Source: Author’s construction.

where

$$\Gamma_{12}(c, c) = (-5.05, 37.46) = (2.75 - 7.8, 22.06 + 15.4)$$

$$\Gamma_{12}(c, d) = (-4.04, 36.45) = (3.76 - 7.8, 21.05 + 15.4)$$

$$\Gamma_{12}(d, c) = (-9.25, 74.96) = (2.75 - 12.0, 22.06 + 52.9)$$

$$\Gamma_{12}(d, d) = (-8.24, 73.95) = (3.76 - 12.0, 21.05 + 52.9)$$

¹⁴ As we aim to investigate whether or not China will consider joining the MRC in the context of ASEAN, we assume the LMB states act in one voice in the linked game.

The linked game indicates that the total social welfare will increase. As a result, with a higher outcome, the LMB can make a side payment to China. The lost and gain are similar for both China and the LMB in linked game. For example, for $\Gamma_{12}(d,c) = (-9.25, 74.96)^*$, the total payoff is 65.71 (74.96 - 9.25); for $\Gamma_{12}(d,d) = (-8.24, 73.95)$, the total outcome is 65.71. For the others, $\Gamma_{12}(c,c)$ leads to the outcome of 32.41 and $\Gamma_{12}(c,d)$ also leads to 32.41. Thus, linkage issue will give more opportunities in negotiating.

5 Policy implications and concluding remarks

The transboundary negative externality nature of the MR flows adds an extra dimension of complexity to the debate about equitable sharing of the Mekong River's resources. Therefore, the MRC will have to decide how to strike a balance between hydropower development and the preservation of conditions necessary for sustaining (fish and agricultural productions, etc.) ecosystems in the future. Using the notion of externality games, this paper demonstrates the advantages of issue linkage for the Mekong region in bringing together six countries in order to provide a common framework for coordination and management. The capacity of issue linkage, to facilitate cooperation by allowing countries to tie issues in which they have dissimilar interests, is explored. Our results show that the countries in the LMB can benefit most from issue linkages. This allows balancing the interests of all stakeholders in the MRC. Water is just one issue to be taken into account, and is insufficient on its own to establish a viable regime (sustainable development) which reflects all water-related problems in managing the Mekong. Hence, the solutions to these problems also lie with human beings and their institutions. Thus, one must put all in considering place fair, efficient, and sustainable systems of water governance.

There are several conditions under which mutually beneficial solutions may be reached. In the Mekong, our analysis shows that China does have strong incentives to negotiate joint management and to use the MRC to promote the interests of its international dam construction and electricity corporations. We have also shown that, with the international and regional support, the LMB countries have incentive to negotiate with China in the trading issue. Therefore, China should consider playing a more active role in the MRC, expanding its involvement to the GMS and AEC programmes. In addition, the approach that is taken to solve water problems/issues often depends on the perspective or paradigm that is adopted. Properly understood, water management is not management of the water resources alone but also managing people. The proposed approach of building upon the IWRM principles and incorporating these into the appropriate institutional setting at the proper time, based on issue linkages, could serve as a model for confidence-building, as well as conflict prevention and management of the Mekong issues.

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