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Opening the Gates of the Pak Mun Dam: Fish Migrations, Domestic Water Supply, Irrigation Projects and Politics

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ABSTRACT: The Pak Mun Dam on the Mun River in Ubon Ratchathani Province in northeastern Thailand has long been one of the most controversial hydropower projects in Southeast Asia. The environmental and social impacts associated with blocking important fish migrations between the mainstream Mekong River and the Mun River Basin are particularly well known. Fishers, non-governmental organisations and academics have advocated for opening the gates of the dam either year-round or at least for an extended period, and especially at the beginning of the rainy season when a large number of fish migrate upstream. Crucially, however, the dam's gates are not always opened at the beginning of the rainy season as required by previous agreements. Water management issues associated with opening the Pak Mun Dam have become increasingly complex and fraught because of additional challenges relating to the construction of new infrastructure such as irrigation dams on tributaries, and because of an increasing demand for piped domestic water to supply urban dwellers in Ubon Ratchathani City. In this paper, we adopt a political ecology approach to examine the present economic, ecological and political circumstances associated with the management of the Pak Mun Dam, including the trade-offs associated with different possible management decisions.

KEYWORDS: Hydropower dam, fish migration, infrastructure, fisheries, Pak Mun, Thailand

INTRODUCTION

The Pak Mun Dam is a large so-called 'run-of-the-river' hydropower project that blocks the Mun River in Ubon Ratchathani Province in northeastern Thailand, just 5.5 km from the Mun River's confluence with the Mekong River and about 80 km downstream from Ubon Ratchathani City (Figure 1). At 17 m high and 300 m wide, the dam includes eight gates that can be opened to release water. The Pak Mun Dam has an installed electricity generating capacity of 136 megawatts (MW), although the actual amount of energy produced during peak demand periods is much less than initially anticipated. From an energy generation perspective, one of the problems with the Pak Mun Dam is that when the Mekong River is high the Mun

River backs up; when the water level in the Mun River is high the capacity of the Pak Mun Dam to generate power is reduced (WCD, 2000). However, it is due to the dam's heavy social and environmental impacts that the Pak Mun Dam is among the most controversial and heavily criticised large hydropower projects ever built in the Mekong River Basin (PER, 1993; Wongpattana, 1996; Roberts, 1993, 2001; Foran and Manorom, 2009; WCD, 2000; Glassman, 2001; Ishida, 2002; Missingham, 2003).

Different fish species migrate up and down the Mekong River and its tributaries at various times of the year (Baird et al., 1999, 2001, 2003, 2004, 2011, 2018, 2019; Jutagate et al., 2001, 2003, 2005; Baird and Flaherty, 2004; Baran et al., 2005; Baird, 2006, 2011; Hogan et al., 2007). It is well established, however, that there are two main times for fish migrations; the first is the onset of the rainy season, which begins in early to mid-May (Roberts and Baird, 1995; Baird et al., 2004; Warren et al., 2005; Hogan et al., 2007); the second is during the dry season which is around the month of February, when large numbers of fish migrate upriver from Tonle Sap Lake in Cambodia to the Mun River (Roberts and Warren, 1994; Roberts and Baird, 1995; Baird et al., 2003; Baird and Flaherty, 2004; Warren et al., 1998).

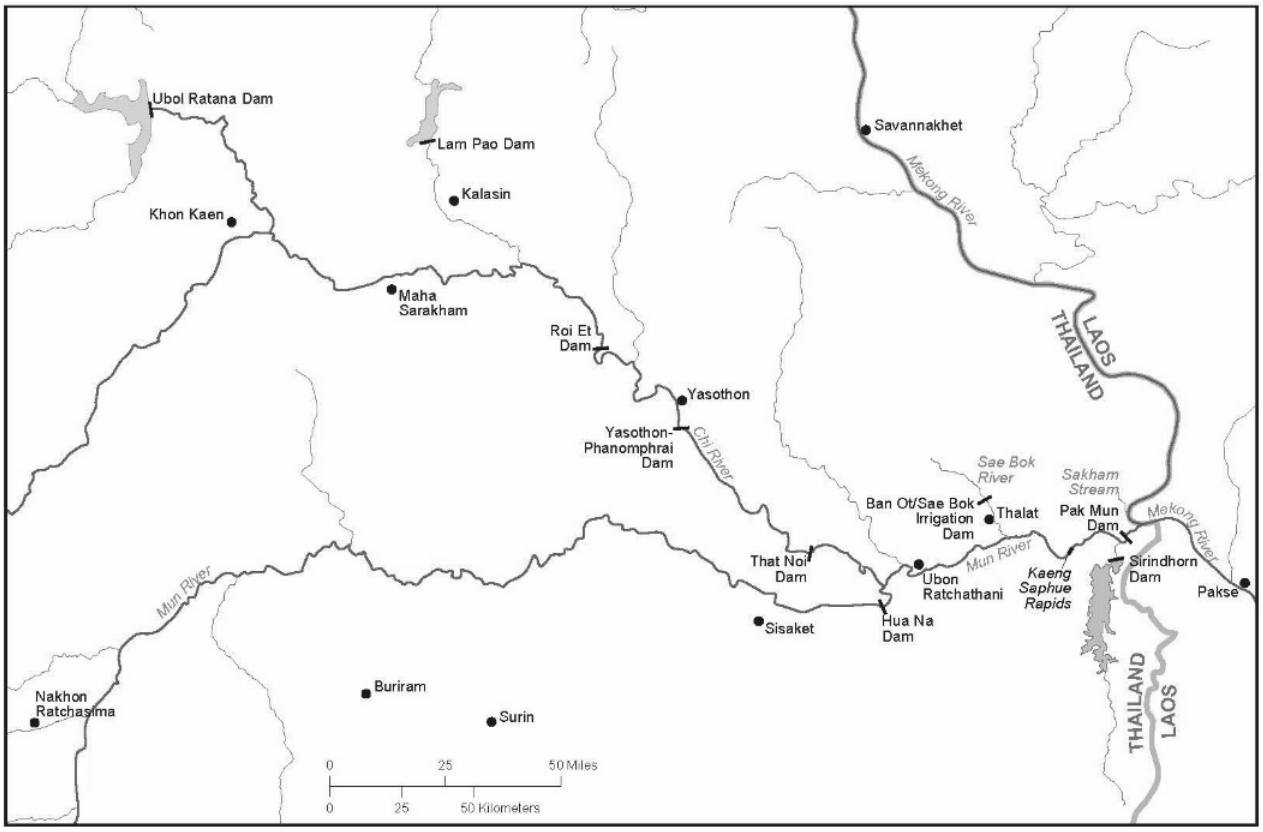
It is widely recognised that the Pak Mun Dam blocks the seasonal migrations of a wide range of fish species that move between the mainstream Mekong River and the Mun River Basin (Roberts, 1993, 2001; WCD, 2000; Schouten et al., 2000; Amornsakchai et al., 2000; Jutagate et al., 2001, 2003, 2005, 2007; Payooha et al., 2004; Foran and Manorom, 2009; Baird et al., 2019). This in turn has led to serious negative impacts on a large number of people living in the Chi-Mun River Basin. In an eleventh-hour attempt to mitigate the project's negative impacts on migratory fish – or at least to look like they were doing so – a poorly designed fish ladder was hastily added to the Pak Mun Dam; while fish do use it, it has generally not been successful in allowing large numbers of fish to migrate past the dam (Nicolson, 1995; WCD, 2000; Roberts, 2001; Sripatrprasite, 2005).

Because of the serious negative impact of the Pak Mun Dam on the movement of migratory fish from the Mekong River to the Mun River Basin (Roberts, 1993, 2001; WCD, 2000; Baird et al., 2019), fishers, NGOs and academics have been advocating for many years – in fact since the dam was first closed in 1994 – to open its gates year-round, or at least for an extended period, especially at the beginning of the rainy season, when the largest number of fish species migrate upriver (Foran and Manorom, 2009). As a result of pressure put on the Thai government by protesting fishers and their allies, in 2001-2002 the dam's gates were opened on a trial basis for one full year, a move that fishers and their NGO supporters celebrated as a restoration of ecological processes, fish migrations and related wild-capture fisheries (Villagers Affected by Pak Mun Dam, 2002; Sretthachau, 2002; SEARIN, 2002; Sretthachau and Deetes, 2004). Indeed, through this process villagers used their high levels of ecological knowledge about fish in the Mun River Basin to oppose the dam (Sretthachau, 2002; Mekong Watch, 2004; Sretthachau and Deetes, 2004). Since the trial year-round opening in 2001-2002, the gates of the dam have been opened for a few months a year; however, there has not been consistency from year to year as to months when the dam was open and there has not been enough effort to determine how water management could better accommodate fish migrations, wild-capture fisheries, and biodiversity generally. In other words, the rights of the river and of the aquatic animals that depend on it – a concept that has yet to be adopted by activists in the Mekong Region – have not received sufficient consideration, nor have the many rural people who depend on wild-capture fisheries for food and income.

The Pak Mun Dam is presently being opened at various times during the rainy season, between June and September; this is often long after most important fish migrations have ended. It is therefore particularly important that the gates be opened at the beginning of the rainy season, preferably in May (Baran et al., 2005; Baird et al., 2018, 2019). This coincides with what has been requested by the fishers who rely mainly on their detailed local ecological knowledge, which combines generations of accumulated knowledge with their deep personal and intimate experiences as fishers. New kinds of infrastructure, however, such as water pumps, pipes, irrigation systems and different kinds of dams, are making the management of water and fish populations much more complex and politically uneven; this increases the likelihood that migratory fish and the livelihoods of those who depend on them will be

sacrificed. In this paper, we consider these changes in the Chi-Mun River Basin, demonstrating the links between the Pak Mun Dam, upstream irrigation dams, and domestic water supply in Ubon Ratchathani City. In particular, we argue that changes in domestic water demand and an increase in the number of large and small irrigation dams in the Chi-Mun River Basin are resulting in a complexity and political unevenness in resolving questions about when and for how long the gates of the Pak Mun Dam should be open (and other related trade-offs). New measures to facilitate fish migrations are thus required. In this paper, we adopt a political ecology approach to frame these questions as it is useful when considering the complex interactions between political economy, society, power and ecology (Forsyth, 2003; Robbins, 2004), and thus is appropriate for framing the unevenness and complex trade-offs associated with the management of the Pak Mun Dam.

Figure 1. The lower Chi-Mun River Basin, including the Pak Mun Dam.



In the next section, we outline the methods used to conduct this research. We then provide a short history of the Pak Mun Dam, including important background information regarding the controversy around when and for how long the dam's gates should be open each year. We then consider some new challenges to opening the gates of the Pak Mun Dam, especially those related to domestic water supply and irrigation dams – challenges whose remedies require serious effort and coordination. Finally, we consider some of the complex and uneven trade-offs associated with the dam and provide some options for partially addressing the problems.

METHODS

This research was conducted as part of a three-year fisheries research project entitled *Fisheries Impacts of Hydropower Dams on Thailand Mekong Tributary Rivers*. This project investigated fisheries in two

major tributaries of the Mun River, the Sebok River and the Khayung Stream. Researchers from the University of Wisconsin-Madison and Ubon Ratchathani University collected continuous small-scale fishers' catch data between 2014 August and July 2016. With the help of Margaret A. Cargill Foundation funding, it also collected relevant policy data for a three-year period. In the course of this project, we demonstrated that wild-capture fisheries in parts of the Mun River Basin that were previously not considered to have been impacted by the Pak Mun Dam, have in fact been negatively impacted. We also learned that fishers living in the Mun River Basin upriver from the Pak Mun Dam continue to be concerned about when and for how long the Pak Mun Dam is opened each year. They believe that it is particularly important that the dam be opened at the beginning of the rainy season, when large quantities of many species of fish migrate from the Mekong River into the Mun River Basin (Baird et al., 2019). Our research findings were discussed at a final workshop organised in May 2017 in Ubon Ratchathani. The workshop brought villagers, local authorities, government officials and researchers together.

Both during and after the end of the project, we collected relevant data from various sources regarding the controversy surrounding the yearly opening of the gates of the Pak Mun Dam. This included gathering data produced by the Electricity Generating Authority of Thailand (EGAT) which is Thailand's main public energy utility, as well as from Ubon Ratchathani's domestic water supply office and the Department of Irrigation Region #7 office located in Ubon Ratchathani City. We interviewed the head of the Region #7 office in 2017; however, to ensure that the data collected were accurate, in 2019 we interviewed the official responsible for river water management at the Region #7 office, who confirmed much of what we heard in 2017. He also provided some additional information, since he is directly responsible for making water management decisions and is thus more familiar with the system than anyone else. Here we present some of the fish catch data collected over a two-year period at Thalat Village. Thalat is on the Sebok River, the closest community to the Pak Mun Dam where fisheries data were collected. Although Baird et al. (2019) published some of this data, time-specific information from the same data set are being published here for the first time.

A SHORT HISTORY OF THE PAK MUN DAM

The National Energy Office of Thailand first envisioned the Pak Mun Dam in 1967; later, the project was transferred to EGAT, which decided to push the project forward in 1982 by commissioning an initial project impact assessment. The assessment showed that if the water level was kept at 113 metres above sea level (masl), approximately 4000 households would have to be relocated from the dam's reservoir area. The dam was thus redesigned and relocated in order to reduce the number of displaced households, which was then expected to be 248. The Thai government cabinet approved the project in 1990 and a budget of ฿(baht)3.88 billion (US$155.2 million) was allocated for constructing the dam, which was completed in 1994. The final cost, however, ended up being ฿6.507 billion (US$260 million) due to modifications (WCD, 2000). The project was largely financed from within Thailand, but the World Bank provided a loan for about 10% of the project cost (Foran and Manorom, 2009).

After the Pak Mun Dam was commissioned in 1994, fishers living near the dam engaged in extended protests because of concerns regarding the dam's impacts on wild-capture fisheries, and especially on fish migrations from the Mekong River to the Mun River Basin. In 1995, EGAT and the Department of Fisheries (DoF) finally agreed to cooperate with local fishers and compensate them for fish declines caused by the dam. They also tried to mitigate dam impacts by stocking the Mun River with high-value aquatic animals, including giant freshwater prawns (*Macobrachium rosenbergi*) and commonly caught carp species such as *Puntius gonionotus, Hemibagrus spilopterus* and various other species. There were 6,900,000 fish released into the Mun River between 1995 and 1997. The total cost of stocking was covered by EGAT and initially ranged from ฿798,000 to ฿1,106,000 (US$25,000 to US$35,000) per year. The DoF's estimate for the total annual revenue from fishing due to these releases was believed to be overly optimistic and inflated (WCD, 2000).

At the same time, between 1995 and 2000 EGAT provided one-time payments to 6176 villagers who claimed to have lost fisheries income due to the Pak Mun Dam. Between 1995 and 2002, EGAT also compensated affected people for their property and livelihood losses (Table 1). New houses and farm plots were provided to villagers, along with improved roads, new schools and occupational training. The Assembly of the Poor (AoP) movement, which works on behalf of affected villages, also specifically claimed that compensation should be provided for the loss of fishing income during the four years of dam construction (Foran and Manorom, 2009; Amornsakchai et al., 2000; Sretthachau, 2002; Ishida, 2002; Jutagate et al., 2001; SEARIN and AoP, 2002; Ubon Ratchathani University, 2002. EGAT eventually agreed to provide ฿489,540,000 (US$15 million) worth of previously unplanned compensation, as seen in Table 1.

Table 1. Compensation provided to villagers who claimed fishery income losses due to the Pak Mun Dam.

Date of approval	Number of households	Amount (Thai baht)
19 June 1995	571	51,390,000
16 November 1995	2361	212,490,000
1 April 1996	247	22,230,000
26 September 1997	695	62,550,000
27 April 1998	92	8,280,000
25 January 2002	2210	132,600,000
Total	6176	489,540,000

Source: EGAT (2002).

The one-time payments for fisheries losses were not, however, enough to compensate for permanent fish losses; some villagers, therefore, have demanded that EGAT provide more compensation for permanent loss of fishing income (WCD, 2000; Ubon Ratchathani University, 2002; Foran and Manorom, 2009). Although fishing has generally declined, our research indicates that wild-capture fisheries for some species are still significant (Baird et al., 2018, 2019) despite narratives promoted by dam developers and government officials who assume that fisheries are bound to decline even without dams (Friend et al., 2009). In any case, the compensation issue remains unresolved up till now.

Beginning in 2002-2003, a special arrangement was made: at the request of the Tourism Authority of Thailand, it was agreed to open the gates of the Pak Mun Dam for ten days during the Songkran Buddhist New Year season so that the Kaeng Saphue rapids, which are on the Mun River about 29 km upstream from the dam, would be exposed for holidaying during this season; this practice continues till the present. Management decisions associated with this agreement are worth considering. Kaeng Saphue acts as a natural dam at 106.25 masl, translating into 106.5 masl at Ubon Ratchathani City, which is the river's minimum water level for accommodating domestic water pumping; the bottom of the Mun River at Ubon is 103 masl. Understanding this arrangement is important, as when the gates of the Pak Mun Dam are opened to allow Kaeng Saphue to emerge from under the dam's reservoir, dams upriver release water downstream to keep water levels at Ubon high enough to accommodate water pumping (Chaiphakdi, 2017; Pandam, 2019). During this ten-day period, about 10,000,000 m^3 of water is released; most of it comes from the Lam Pao Dam reservoir in Kalasin Province. Before the water flows from the Chi River to the Mun River, coordination is needed so that it is allowed to pass the Roi Et Dam, the Yasothon-Phanomphrai Dam, and finally the That Noi Dam in Ubon Ratchathani Province before the Chi River flows into the Mun River. Usually, 700,000 m^3 is released per day over the ten days, with another 3,000,000 m^3 kept in reserve. In some years, the Hua Na Dam, also in Ubon Ratchathani Province, releases 1,000,000 to 2,000,000 m^3 of water – but only when it is urgent – as it is the closest project to Ubon Ratchathani

City. At other times in the dry season, the That Noi Dam releases a minimum of 100,000 m^3/day in order to ensure that water flowing downstream is good quality. There are no requests for water releases from Ubol Ratana Dam, which is further up the Chi River Basin in Khon Kaen Province, as it take longer for this water to reach the Mun River and it often does not arrive as expected. Lower down in the Mun River Basin, the Sirindhorn Dam in Ubon Ratchathani Province is also sometimes asked to release water into the Lam Dom Noi River. This water then flows into the Mun River and, combined with water releases from the Lam Pao Dam, helps keep water levels at Ubon Ratchathani City high enough to pump water (Pandam, 2019)(see Figure 1).

CONTROVERSY ASSOCIATED WITH THE OPENING OF THE PAK MUN DAM

After the Pak Mun Dam's gates were opened for a year, between 2001 and 2002, there were essentially three options proposed: 1) open the gates of the dam year-round, 2) open the gates of the dam part of the year, and 3) do not open the gates of the dam at all (Foran and Manorom, 2009).

On 1 October 2002, a cabinet resolution was issued stating that the Pak Mun Dam's gates should be opened for four months each year, from 1 June to 30 September; however, the AoP, on behalf of villagers opposed to the dam, asked that it be opened earlier, in May, which fits with what villages we work with have advocated (Baird et al., 2018, 2019). This request was agreed upon on 8 June 2004 (Foran and Manorom, 2009: 72), and was implemented for two years until a military coup ended the Thaksin Shinawatra government in 2006. Between 2007 and 2014, the dam's gates were opened inconsistently (Table 2), with openings appearing to often be dependent on political trade-offs, especially those related to flooding and drought. Many NGO workers and villagers also believe that EGAT has variously influenced the gate opening process in order to keep the dam operating as much as possible; indeed, EGAT has conceded that if the Pak Mun Dam was to be decommissioned, it would set a precedent for people in other parts of the country to similarly call for the decommissioning of other destructive dams.

It has been difficult for EGAT to justify the Pak Mun Dam in relation to energy production, especially since it cannot produce energy in the wet season when Mekong River water levels are high (WCD, 2000). It produces an average of 280 GWh of electricity a year (EGAT, n.d.), which is in line with what was expected (WCD, 2000). The Pak Mun Dam, however, was built primarily to provide energy during four-hour peak power periods, and in this regard it has failed to even get close to meeting expectations during the dry season; as a result its financial viability has been serious questioned (ibid). Because of this, EGAT has tried to repurpose the dam so that it can be justified in other ways; for example, it has provided funding for some villagers to raise fish in cages in the reservoir area. Not all of those who do cage culture on the Mun River have received support from EGAT, and various cage culture projects have been unsuccessful. According to Department of Fisheries Statistics, however, in 2017, 375,600 kg of fish were cultured in cages on the Mun, with a gross value of about US$740,000.[1] This is another way that fish have become actors in Pak Mun Dam politics. It is in line with the way in which Ashley Carse (2012) theorises 'nature as infrastructure', the enrolment of landscapes and nature in support of infrastructure through providing ecosystem services using the example of the conservation of forests in upper watersheds to ensure that the Panama Canal can operate. EGAT has also repurposed the dam to support up to 4000 hectares (ha) of electricity pump irrigation near the reservoir; to do this it has increased the number of pump stations from 30 in 2002 to 60 in 2019. EGAT also supports other economic activities, partially in order to develop a constituency of people who do not want water levels to go down due to aquaculture or because they benefit from pump irrigation or other projects supported by EGAT. Furthermore, EGAT has worked to get some of the villagers who support them onto the provincial committee that determines when the gates of the dam should be opened (Foran and Manorom, 2009). EGAT has an interest in

[1] Source: 2019 published fisheries data, and a personal communication (20 January 2020) with a Department of Fisheries official in Ubon Ratchathani Province.

keeping the dam operational and thereby not losing face after its long period of struggle against activists and villagers opposed to the project. All these things have affected decisions associated with the management of the Pak Mun Dam.

Nature is also playing a role in other ways. In 2014, for example, the dam's gates were opened for only two and a half months due to drought, and it was very difficult for the AoP to negotiate with the military government, as the 2014 drought was the most severe in decades (Chandran, 2015). Then, in 2019, the worst drought in a decade was used to justify the plan of the Office of National Water Resources to speed up the development of water resources infrastructure (Bangkok Post, 2019). Thus, we can see how weather patterns have also become intertwined with politics. Similarly, in 2019, Ubon Ratchathani experienced the heaviest flooding in 50 year, which allowed AoP to claim that keeping the gates of the Pak Mun Dam open would reduce the risk of flooding in Ubon Ratchathani City (Prachathai, 2019).

In 2014, the military government dissolved the Multi Stake Committee that was previously charged with determining when the gates of the Pak Mun Dam should be opened and closed (Multi Stake Committee, 2008). Then, in 2015, the military appointed the National Pak Mun Dam Resolution Committee to replace it; this committee consisted of academics, NGOs, civil society members, EGAT and dam-affected villagers. It set up new criteria for the period of the dam gates opening and closing; that is, it was agreed that the gates of the dam would be opened if the discharge level of water reached 500 m^3 per second at M7 Station which is located at the Democratic Bridge in Ubon Ratchathani City, or if the water level at the Sakham Stream measuring station, at the confluence of the stream and the Mekong River, was above 95 masl (Figure 1). The gates of the dam would be closed when the water level at the M7 Station dropped to 107 masl, or if the level of water discharge in the river declined to 100 m^3 per second (Prachathai, 2018).

The committee agreed that the above-mentioned criteria would be applied in 2016; they ordered the provincial subcommittee on the management of the Pak Mun Dam to follow the 2015 criteria. In 2016, however, the provincial subcommittee decided to follow the criteria for only the opening the gates of the dam, and not for their closing. The subcommittee proposed to EGAT to shut the gates of the dam when the water level at Ubon Ratchathani City dropped to 111.40 masl and the discharge was 1975 m^3/sec, which is much higher than the national committee's reference point for closing the dam's gates, which was agreed upon in 2015 (500 m^3/sec). EGAT followed the advice of the subcommittee by closing the dam's gates accordingly.[2]

Consequently, seven academic members of the national committee resigned on 17 November 2016, even though they were only appointed on 29 July 2015 (Prachathai, 2016; Lamdee, 2016). They claimed that the government and EGAT were not complying with the agreed-upon 2015 criteria on the Pak Mun Dam's management but were instead allowing the provincial subcommittee to overrule the national committee. In fact, in keeping with the specifications for managing the dam, the water level in the Mun River was still high enough to supply water to other users, but if the dam's gates were closed earlier than planned fishers would suffer from a reduced catch.[3]

Between 28 June and 13 July 2018, water levels were at 97.51 masl, 2.51 m above the point when the dam should have been opened; without providing a reason, however, the governor of Ubon Ratchathani Province chose not to open the dam according to the rules, which upset fishers who demanded that the dam's gates be opened (Prachathai, 2018). This further illustrates the considerable politics associated with decisions regarding the opening and closing of the Pak Mun Dam.

The provincial subcommittee is comprised mainly of villagers, together with a few academics and others; crucially, however, EGAT is supporting some villagers on the subcommittee through the financing of development initiatives, which has resulted in disagreements between the AoP and villagers who

[2] http://voicelabour.org

[3] http://voicelabour.org

support EGAT. The subcommittee claimed that the Pak Mun Dam's gates needed to be closed earlier because of drought (Table 2 below details the Pak Mun Dam gates' openings and closings since 2002). According to the Irrigation Department in Ubon Ratchathani, the official top priority is supposed to be drinking water, the second is management for environmental benefits, and the third is supporting agriculture and industry (Pandam, 2019); in reality, however, demand for agricultural water appears to

Table 2. Schedule of opening and closing of the Pak Mun Dam's sluice gates (2002-2019).

Year	Date of opening	Date of closing	Number of months and days	Remarks
2002	Opening of the dam's gates all year around (Foran and Manorom, 2009)			Ubon Ratchathani University to study impacts of opening of the dam's gates
2003	June	September	4 months*	Four-month seasonal opening policy implemented
2004	June	September	4 months*	
2005	May	August	4 months*	
2006	May	August	4 months*	
2007	12 August	5 December	3 months and 23 days	
2008	9 June	1 November	4 months and 22 days	Late closing due to heavy flooding
2009	15 June	26 October	4 months and 11 days	
2010	22 August	29 December	4 months and 8 days	Late opening due to long drought
2011	26 June	29 November	5 months and 3 days	Late closing due to heavy flooding
2012	15 July	22 October	3 months and 7 days	Early closing due to drought
2013	12 August	25 November	3 months and 13 days	Based on the cabinet resolution, 28 May 2013 (military government)
2014	28 July	13 October	2 months and 15 days	Late opening due to late and erratic rainfall, and early closing due to drought
2015	16 August	20 November	3 months and 4 days	Based on the Pak Mun Dam's national board
2016	13 July	29 October	3 months and 15 days	Based on the recommendation of the steering committee of the Pak Mun Dam management
2017	7 June	19 November	5 months 12 days	Based on the Pak Mun Dam's national board, long period of flooding
2018	21 July	13 October	2 months and 23 days	Based on a meeting led by the Ubon Ratchathani governor
2019	2 September	8 October	1 month and 5 days	Based on the meeting at Ubon Ratchathani City hall led by the Ubon Ratchathani governor[4]

Sources: EGAT, 2017; AoP, 2018; Khao Sot 2017; Manager Online, 2018; Prachathai, 2019.

[4] The biggest year of flooding in Ubon Ratchathani in 50 years occurred in 2019 (Prachathai, 2019).

be more of a political priority than ensuring that there is enough water to facilitate fish migrations past the Pak Mun Dam. The priorities of powerful government agencies such as the Irrigation Department, EGAT and the domestic water supply office in Ubon Ratchathani City seem to take precedence over the priorities of fishers, who have not received strong government support. Even the Fisheries Department seems to be more focused on promoting aquaculture and ensuring that villagers follow the Fisheries Law than on assisting villagers in lobbying other government agencies to take fish migrations more seriously. This may be partially because of the Fisheries Department's orientation towards aquaculture and also due to it having relatively less power than other government institutions such as the Irrigation Department or EGAT.

Fish migrate unevenly according to season and various researchers have confirmed that a crucial season of the year for fish migrations begins in May and continues into June. Baird et al. (2004), for example, studied migrations of Pangasiidae fish (*Pangasius, conchophilus, Pangasius hypophthalmus*, and *Pangasius larnaudei*) up the Mekong River just below the Khone Falls in southern Laos, and found that although peak catches varied from year to year depending on hydrological conditions, migrations peaked between mid-May and mid-June (see also Baran et al., 2005).

Fish catch data from Thalat Village, on the lower Sebok River about 10 km from its confluence with the Mun River, indicates that May and June are key months for fish migrations and for fishing. In 2015, for example, the months of May, June and July – the beginning of the rainy season – were the most important fishing months for villagers since that is the time of year when fish typically migrate upstream. According to the five fishers who collected data for us in Thalat Village, 138.51 kg were caught in May, 193.54 kg were caught in June, and 159.95 kg were caught in July. Notably, in August catches dropped to just 107.41 kg, presumably because the main migration season was over. Catches increased to 161.03 kg in September and 126.98 kg in October (the latter part of the rainy season), as fish were captured as they migrated downstream out of tributaries of the Sebok River. The point is that opening the gates from July to September – as was the case in 2007, 2010, 2012, 2013, 2014, 2015, 2016, 2018 and 2019 – is too late for fish migrations. Catches in Thalat Village would have certainly been better if the Pak Mun Dam had not been opened quite late, on 28 July in 2014, and on 16 August in 2015 (Table 2).

Only a few kilograms of Pangasiidae catfish were caught at Thalat Village during the two years that data were collected there, although fishers told us that they had caught more in previous years, probably during years when the Pak Mun Dam was opened earlier in the season. (Indeed, as shown in Table 2, the two years of reduced catch corresponded to the two years that the gates were opened late. Moreover, the few Pangasiidae catfish recorded in catches were mainly caught in August and September, after the dam's gates had been opened.)

Another catfish, *Hemibagrus spilopterus*, also normally has high catches in May and June (Baran et al., 2005), but in Thalat the highest catches were in August, possibly because before then some fish were being blocked from migrating upstream due to the Pak Mun Dam. Presumably much more would have been caught if the dam had been opened earlier in the rainy season, and even more would be caught if the Pak Mun Dam was decommissioned and removed.

Some fish species that particularly tend to migrate upstream at the beginning of the rainy season are different species of *Mystus*, with catches in May, June and July being the highest, and *Barbodes altus*, with its highest catches being in May. In addition, data from Thalat Village indicates that some species, such as *Osteochilus* spp. ; *Ompok bimaculatus, Gymnostoma* spp. ; *Labiobarbus leptocheilus, Hampala* spp. ; *Pristolepis fasciata, Thynnichthy tynnoides*, and *Oxyeleotris marmorata* are most abundant in June catches. Another important species, *Puntoplites falcifer*, is caught in larger quantities in May and then, after a dip, again from July to September; this probably indicates its movement in and out of tributary streams during the height of upstream migrations at the beginning of the rainy season, and then downstream migrations at the end of the rainy season.

Finally, in the past, Thalat Village fishers have caught *Pangasius krempfi*, which is a well-known highly migratory species found in the Mekong (Hogan et al., 2007; Baird et al., 2004); they did not, however, catch any during the two years of fish catch data collection, probably due to the Pak Mun Dam blocking their migration. There were other species absent from catch data that were likely blocked by the Pak Mun Dam, including *Belodontichthys dinema*, *Micronema* spp. and *Bagarius yarrelli*.

NEW OBSTACLES TO OPENING THE PAK MUN DAM

We need to (re)think the controversy regarding the opening of the gates of the Pak Mun Dam and advocate for understanding more about the complex nature of both fish migrations and water management in the Chi-Mun River Basin. In doing so, the dam either needs to be decommissioned as has been often proposed in the past (WCD, 2000), or, at the very least, there need to be ensured that the gates of the Pak Mun dam are opened earlier in the rainy season when the most important upstream fish migrations occur. As mentioned earlier, however, EGAT wants to produce as much electricity as possible during peak power periods in order to justify its existence (see above), since the main goal of the project was to contribute to peak power supply. On the other hand, while the AoP and supporting villagers have long lobbied to have the dam decommissioned, the movement has been somewhat weakened by divisions within the AoP and among villager supporters; EGAT has also used its financial resources to foster divisions. Thus, the politics associated with the dam's management is important. The idea of drought – whether real or simply suggested – has often been used to justify opening the Pak Mun Dam's gates late or closing them early, with fish and fishers apparently receiving de facto low priority. Drought has also justified considerable investment in dams and other infrastructure; illustrative of this, in 2013 the Department of Water Resources announced an ambitious new ฿3.8 billion (US$126 million) initiative to develop the Khong-Chi-Mun project; this involves 19 pilot projects in 13 provinces in northeastern Thailand, including water pipelines, the creation of new reservoirs and upgrading of older ones, and the dredging of rivers and canals. Pumping stations and an estimated 10,000 km of pipelines were to be installed in order to deliver water to farmland (Wipatayotin, 2013). In the last number of years, moreover, water development project storage capacity in northeastern Thailand has doubled (Office of Agriculture Economics, 2010, 2019), indicating the extent to which water management is changing in the basin.

Over the last number of decades there has been a huge increase in coverage and use of water from the Mun River to support Ubon Ratchathani City's domestic water supply. At least at present the pipes that are used for transferring pumped water from the Mun River can only function properly when a minimum water level in the river is achieved, and water quality is also a concern. EGAT is therefore now arguing that one of the main purposes of the Pak Mun Dam is to keep water levels at Ubon Ratchathani City high enough at the end of the dry season to allow for domestic water supply pumping; our research suggests that this is indeed the case. The demand for piped water in Ubon Ratchathani City is now approximately 45,000 m^3/day, rising to 68,000 m^3/day when Warin Chamrap District (on the other side of the Mun River) is included. In 2005, the total use was about 1,200,000 m^3/month, but demand increased to 1,700,000 m^3/month in 2017 (Chaiphakdi, 2017; Pandam, 2019). While Ubon Ratchathani City removes the most water for domestic water supply from the Chi-Mun River Basin, water is also extracted by various private actors and government agencies, adding still more complexity.

According to the head of domestic water supply for Ubon Ratchathani, water pumping for domestic water supply is presently occurring at five locations: Warin, Tha Wang Hin, Hin Lat, Kut Lat and Tha Kok Hae, with the water being filtered at each location. Apparently, it is not possible to drill deeper at Tha Wang Hin, but it may be possible to do so at the other locations. Pumping has increased dramatically over the last decades, as illustrated in Table 3. Essentially, over a 60-year period, the domestic water pumping capacity in Ubon Ratchathani has increased from 40 m^3/hour in 1958 to 5850 m^3/hour in 2018. It is unclear exactly how much of this water returns to the Mun River, and what its quality is when it

returns. This situation has implications for the management of the Mun River and the Pak Mun Dam, as will be explained below.

Table 3. Domestic water usage from the Mun River.

Year	Pumping station location along Mun River	Water pumping capacity (m^3/hour)
1958	Wat Supat	40
1965	Tha Wang Hin	80
1968	Tha Wang Hin	160
1970	Tha Wang Hin	160, 500
1993	Tha Wang Hin	1000
2006	Tha Wang Hin and Hin Lat	1000, 500
2015	Tha Wang Hin, Hin Lat and Warin	1000, 500 and 950
2018	Warin/Pho Mun, Tha Wang Hin, Hin Lat, Kut Lat, Tha Kok Hae	950, 1000, 500, 2000, 1400

Source: Chaiphakdi (2017).

Mun River water levels at Ubon Ratchathani City need to be above 106.7 masl, as measured at the Democratic Bridge, in order for water pumping to function properly. Although water can still be pumped at Tha Wang Hin at 106.5 masl, some oxygen mixes with the water when the level is that low, which is far from ideal. Apart from reducing the amount of water pumped, it is also feared that if water levels are lower, water pumping could lead to serious riverbed erosion problems (Chaiphakdi, 2017).

From examining data showing the actual water levels in the Mun River, it appears that levels would dip below the required levels for pumping if the Pak Mun Dam did not hold back water and raise water levels at Ubon Ratchathani City; this remains the situation unless some of the many hydropower and irrigation dams upriver were to release more water downstream (Chaiphakdi, 2017). Previously, some activists believed that this would not be the case, as there are many rapids between the city of Ubon and the Pak Mun Dam. More importantly, possibly, is the fact that many anti-dam activists do not trust EGAT, as past actions indicate that EGAT has long been looking for reasons to justify the existence of the Pak Mun Dam. However, we spoke with Chaiphakdi, the head of the domestic water supply office in Ubon Ratchathani City , without making an advance appointment and, when we asked questions, he transparently let us view the data on his computer. His frankness, and the fact that he did not have any advance notice to potentially alter data, strongly suggests that the data presented to us was accurate. Indeed, water is released downstream when the Pak Mun Dam is opened for ten days during the Thai Songkran holiday in April (as described above), in order to keep water levels near Ubon Ratchathani City high enough to allow for water pumping. This is not simply a technical issue, however, as will be elaborated on later. The Pak Mun Dam and Ubon Ratchathani City are in Irrigation Region #7, and when water is needed, they have to coordinate with Irrigation Region #6, which includes the upper Mun River and the Hua Na Dam in Sisaket Province; they also must coordinate with Irrigation Region #8 which includes the Chi River Basin (Chaiphakdi, 2017).

Water levels in the Mun River are not going up as rapidly at the beginning of the rainy season as they used to, and while this trend has already existed for some time (Chaiphakdi, 2017), it is becoming more noticeable as new irrigation dams are built each year; modelling work by the Irrigation Department has also confirmed this to be the case (Pandam, 2019). Indeed, many irrigation dams were built in the Chi-Mun River Basin in previous decades, including as part of the 'Green Isan' programme, and later the

Khong-Chi-Mun initiative (Floch and Molle, 2009; Molle and Floch, 2008; Sneddon, 2003) which was initially approved by the cabinet of the Thai government in April 1989 (Sneddon, 2003: 2241).

Each irrigation region of the Royal Irrigation Department has its own construction companies that move from one irrigation project to another within their specified area of operation, regardless of whether the projects are justified. Essentially, new projects are required or these construction teams cannot operate; it is this that drives the development of new projects. In addition, new projects are important from a budgetary perspective, as the Irrigation Department cannot justify new budget allocations if it does not spend its allocation from the previous year. This all happens without much consideration of the basin-wide or cumulative impacts of so many projects. During our research, we noticed, for example, that one irrigation dam that was constructed in Sisaket Province was completed by one of the construction units under the Irrigation Department without there being any way to actually use the water in the reservoir; amazingly, the project did not include irrigation canals as they were considered to be the responsibility of the local government, which had no funds. In another case, we observed an irrigation dam whose water was not being used for irrigation, but which was blocking fish migrations; ironically, we were told that the only value of the dam was to collect water to provide a habitat for fish. This was a case where, following Carse's (2012) ideas about 'nature as infrastructure', fish have again been politically mobilised in support of dam building.

According to the head of domestic water supply in Ubon Ratchathani City, previously most of the water that entered the Mun River at the beginning of the rainy season rapidly flowed into the lower part of the basin, raising water levels relatively soon after the rains fell. This has not been the case for some time, however, as there are now many small and large irrigation dams in the Chi-Mun River Basin from which water is generally not released at the beginning of the rainy season; instead, water levels are allowed to rise somewhat before water is released, thus delaying increases in water level downstream, including at Ubon Ratchathani City. Along with concerns about domestic water supply, this is further contributing to the late opening up of the Pak Mun Dam (Chaiphakdi, 2017). Essentially, water levels need to rise enough so that when the Pak Mun Dam is opened, water levels do not drop so far as to jeopardise water pumping potential. Furthermore, the level of the Mun River also depends partially on water levels in the Mekong River and, due to dams upriver in China, these levels are also rising more slowly at the beginning of the rainy season than they used to.

This being the case, it needs to be recognised that irrigation development projects throughout the Chi-Mun River Basin are impacting the hydrology and environment of the Mun River, particularly in downstream areas, and that this in turn is affecting the timing of the opening of the Pak Mun Dam, and negatively impacting fish migrations up the Mun River. However, so far there has been insufficient scrutiny of the role of irrigation projects in altering hydrology in the Mun River and in other river basins in Thailand. This lack of critical inquiry is undoubtedly related to what David Blake (2019) considers to be Thailand's long obsession with developing irrigation projects, an ideology which he refers to as 'irrigationalism'. This state obsession is one of the reasons that some academics have been so critical of the construction of large numbers of irrigation projects in Thailand (Blake, 2015, 2019; Floch and Molle, 2009, 2013).

It appears that so far little attention has been put into designing water extraction systems at Ubon Ratchathani City so that they do not obstruct the opening of the Pak Mun Dam. One design option would be to reinstall the water supply pumps so that they can operate below 106.7 masl, since the bottom of the Mun River is located at 103 masl. Indeed, it seems that if a real effort was made and if there was serious political will, it would be possible to pump water from deeper in the river than is presently occurring; possibly, not much effort has been put into doing this because little pressure has been put on them to do so, as the AoP lacks awareness of its importance to the opening of the gates of the Pak Mun Dam. An integrated approach attentive to politics is needed, one that gives priority to the river and to fish migration (Foran et al., 2019), but so far it appears that not much has been done to address this problem. The links between water supply and the opening of the Pak Mun Dam gates need to be more

explicitly drawn by those who are able to influence decisions, so that efforts are made to find ways to allow fish to migrate upriver past the Pak Mun Dam. Humans have the ability to make major changes in how we use and allocate water; fish can also adapt somewhat to water level changes, but they cannot do so to the extent that humans can. This is one reason why it is crucial to prioritise solving the problems of fish migration.

There are new plans to expand the coverage of the domestic water supply in Ubon Ratchathani City and surrounding areas, but it appears that few people recognise that there is an important link between this policy objective and the objective of opening the Pak Mun Dam at the beginning of the rainy season. This is a link that needs to be emphasised more; otherwise, fish migrations are likely to be sacrificed to an even greater degree than they have so far been.

More effort needs also to be put into coming up with a plan that specifies when water should be released downstream from hydropower and irrigation dams located in the upper basin, so as to facilitate the opening of the gates of the Pak Mun Dam at the beginning of the rainy season. While there are coordinated efforts to facilitate the use of the Kaeng Saphue rapids during the April holiday season, the same efforts have so far not been directed at facilitating the opening of the dam's gates for fish migrations; this appears to be because wild-capture fisheries are not receiving nearly as much consideration by government agencies including even the Fisheries Department.

Although many villagers would like to see the Pak Mun Dam decommissioned and removed, if that is not possible other options for allowing more fish to pass the dam need to be seriously considered. One of the requirements for opening the gates is a water level of 95 masl in the Mekong River, and thus one of the obstacles to opening the gates early in the rainy season is its failure to reach that level by then. If the gates are opened before a level of 95 masl is reached, under present conditions most fish would not be able to pass the dam because the base of the dam stands at 95 masl, thus blocking the movement of migrating fish. This problem may become even worse in the future as dams in the upper Mekong River also release less water downstream at the beginning of the rainy season.

CONCLUSION

We have demonstrated that water resource management in northeastern Thailand, and by extension in the Mekong River Basin, is becoming increasingly complicated and multifaceted, especially as new demands are being made for the same water that is depended on by fish migrating from the Mekong River up the Mun River. The Chi-Mun River Basin is being increasingly affected by infrastructure, and wild-capture fisheries are not being given sufficient political support. River hydrology is being affected like never before due to new irrigation and water pumping infrastructure that is being constructed without much consideration of the cumulative effects or the possible trade-offs. Our interest has particularly been on fish migrations and wild-capture fisheries and how to ensure that as many fish as possible migrate up the Mun River beyond the Pak Mun Dam. We have emphasised that it is no longer possible to deal with concerns about fish migrations without also engaging with the various forms of infrastructure in the basin (including hydropower and irrigation dams and domestic water supply pumping stations) and without taking into consideration the associated politics. There is a need to more carefully consider the trade-offs; crucially, the uneven power relations among the various actors also need to be carefully considered, something that we have begun to do here.

Sustainability assessments are one tool that involves strong citizen participation in the consideration of social, economic and ecological issues (Gibson, 2006). However, politics and uneven power relations are also particularly important; small-scale fishers and aquatic biodiversity are both losing out to the powerful government agencies that are linked to energy production, irrigation and urban domestic water supply. More attention needs particularly to be paid to the changes being caused by irrigation projects, small and large (see Molle and Floch, 2008; Molle et al., 2009; Blake, 2015, 2019) and also cumulatively (see Baird and Barney, 2017). These issues are becoming increasingly important in the Chi-Mun River

Basin of northeastern Thailand. It would probably be advantageous to fish migrations, wild-capture fisheries and environmental and biodiversity purposes if more coordination occurred between the relevant bodies, including the Irrigation Department, the Department of Fisheries, the Ministry of Natural Resources and Environment, EGAT and domestic water supply authorities. Improvements cannot be expected to occur easily, however, due largely to limitations associated with Thailand's bureaucracy and development politics, including the allocation of resources and power among government agencies. The positions taken by politicians and high-level government officials are key and are not simply based on technical factors; government agencies have agendas, which are important to understand. Indeed, domestic water supply and even tourism appear to have been given priority; upstream irrigation, while not officially a higher priority than wild fish, has become a de facto priority simply because its infrastructure is in place and it is thus hard to justify not using it. Something urgently needs to be done to remedy the situation but the prospects of this happening seem slim.

There does not appear to be much political will to seriously support the interests of migratory fish or the people who depend upon them. While fish ladders and fish passages of various types can help mitigate some of the impacts of dam development (Warren and Mattson, 2000; Nicolson, 1995), there are many cases of fish passage failure either due to poor design, poor management, or both (WCD, 2000). Indeed, nothing is typically more successful in facilitating upstream fish migrations than opening the gates of a run-of-the-river project such as the Pak Mun Dam, as run-of-the-river dams do frequently obstruct fish migrations when their gates are closed (Roberts, 1995). Opening the gates of the Pak Mun Dam needs therefore to be prioritised, with the goal of doing so at the beginning of the rainy season in May and June; however, some redesign of the Pak Mun Dam will be necessary. We have already proposed some options, but there are probably others. The point is that more efforts need to be made to address the problem, and this can only be done by understanding the politics involved, including the fact that EGAT wants to generate as much power as possible and is willing to use its resources to divide affected communities.

River system modelling could also help better understand how water is being allocated and how water allocation for particular uses is changing over time. However, while river system modelling is often presented as being a politically neutral technical exercise (Chirachawala et al., 2020), the reality is that certain assumptions are always associated with water allocation decisions, and these decisions are always political because of the ways that issues are prioritised (Lane, 2014). Moreover, the cumulative impacts of large numbers of village-based weirs, farm ponds, pumps, etc. are likely to be significant, but their impacts are very difficult to integrate into models. The small-scale fishers who are particularly concerned about ensuring that there is sufficient water for fish to migrate upstream also almost never have the chance to officially question or alter these assumptions; therefore, modelling without giving more power to fishers is unlikely to achieve an equitable result or environmental improvements. Integrated river basin management also has a great deal of potential, but it is often similarly fraught due to uneven power relations that disadvantage rural peasants (Foran et al., 2019; Pegram et al., 2013). Political ecology helps us interrogate this unevenness; more innovative ideas are needed to address the issues presented in this paper but the uneven power relations are the core obstacle.

One option would be to build a very short fish pass to allow fish to get up the dam even when the gates are opened below the 95 masl level in the Mekong; indeed, ideas for short fish ladders on smaller projects are becoming increasingly popular (Baumgartner et al., 2019). A villager with whom we work and who lives along the Sebok River, proposed that the 95 masl base of the dam on one of the eight gates be dismantled so that fish could get upstream when water levels are low. Another option, proposed by the four (of seven) members of the National Pak Mun Dam Resolution Committee who resigned in 2016, is to conduct a feasibility study about constructing a fish pass that would go around the dam and thus be more effective than the present fish ladder (Lamdee, 2016).

Another consideration worth mentioning is the possibility of tapping into the increasing global support for the 'rights of nature' or, in this case, the 'rights of the river' in development planning, as power relations also disadvantage nature; this is a direction which an increasing number of jurisdictions in

different parts of the world have been moving in the last few years. In March 2017, for example, the Ganges and Yamuna Rivers in northern India were recognised by the courts as living entities (Safi, 2017). This decision came just days after the New Zealand parliament passed legislation to designate the Whanganui River as a living entity (Al Jazeera, 2017; Safi, 2017). Tom Fawthrop, the Thailand-based journalist and environmental activist, in a recent article about the Mekong River Basin, called the above two decisions a "remarkable development in environmental law". He also wrote that "the Mekong desperately needs wise and inspired leadership to protect its biodiversity", and that "it seems the time has come for UN [United Nations] agencies to get involved in asserting the rights of the Mekong" (Fawthrop, 2017). One might ask, what about the rights of the Mun River? What about the rights of the migratory wild aquatic animals that rely on the river and the constraints being put on those rights by the closing of the gates of the Pak Mun Dam? While Thais have not yet proposed the particular consideration of the 'rights of the river (and its fish)', we believe that this possibility deserves more attention. There are not likely to be quick changes, but there needs to be a move toward thinking differently – less anthropocentrically – about rivers; the concept of the rights of the river is a move in the right direction.

While the Chi-Mun River Basin is experiencing serious changes, it is still possible to more highly prioritise the migration of fish up the Mekong River into the Chi-Mun River Basin. Above anything else, however, there needs to be the political will to address the difficult but important question of uneven power relations, first of all by recognising the critical degree to which they impede movement in positive directions. The term 'stakeholder' suggests an equivalence of stakes and power and that trade-offs are not affected by politics; the reality, however, is that the stakes are much higher for some while it is often others who have more power.

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