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MRC Council Study
Cumulative impact assessment of water resource development scenarios

Cumulative Impact Assessment Key Findings Report

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Executive summary

Introduction

Cumulative assessments provide a big picture understanding and become meaningful where disciplinary assessment indicators lead to conflicting recommendations. In these situations, some disciplines highlight development gains while others report losses, which triggers policy makers and planners to request a synthesising view. The Council Study included hydraulic and hydrological, ecological, socio-economic and macro-economic assessments, which are accompanied by a set of sector-focused assessments. Each disciplinary and thematic assessment comes with its own set of indicators and some of these assessment indicators suggest that the development investments considered in 2020 and 2040 development plans are likely to lead to positive outcomes while other indicators highlight negative consequences. This cumulative assessment (CIA) aims to provide an additional integrating layer. It explicitly does not aim to replace the results provided by the other assessment reports. Many of the provided assessment reports include indicators that are critical to decision making. These should be considered side-by-side with the cumulative assessment indicators provided in this report.

This cumulative impact assessment combines ***three main concepts***. First, it applies a ***resilience and vulnerability*** perspective to derive the *combined effect* of positive and negative implications identified by the disciplinary and thematic reports. The resilience analysis combines core factors (e.g. food and income security) with both mitigating and amplifying dynamics from the natural, social, and macro-economic environments. Second, a ***sustainability*** index was developed for the CIA based on the sustainable development goals. This implies testing indicators from the UN level in the Mekong context. This index combines the social, environmental and economic dimension of the MRC Indicator Framework. The founding principles for the MRC's water diplomacy emphasise sustainability as one of the two core values for lower Mekong basin development. Therefore, it seems paramount to synthesise all assessment results through a sustainability lens. The third assessment perspective implemented by CIA was focused on sectoral and transboundary ***trade-offs***, which the *Cooperation Dimension* in the *MRC indicator Framework*. This perspective addresses the MRC's second founding principle, the goal of *balanced development*, in the case of the CIA, balanced across sectors and countries.

The Council Study involved a prolonged design phase, which defined a set of four main development scenarios. The main scenarios define a combination of investments in multiple sectors, in particular in hydropower, agriculture and irrigation, flood protection, and navigation. Thus, assessments of these main scenarios highlight the *combined effect* of the proposed development plans. The first main scenario (M1) assumes the prevalence of the development situation of 2007. The second main scenario (M2) assumes investments as planned for 2020 and the third main scenario (M3) combines investment projects that are considered in plans for 2040. A fourth main scenario (M3CC) includes projected climate change applied to the 2040 development scenario.

The combined assessment of large investment bundles as defined by the main scenarios provides a variant of cumulative assessment, that although revealing synergetic effects, limits the attribution of impacts to sector-specific investments. In order to reveal sector specific impacts a set of sub-scenarios were introduced that assume the potential development situation of 2040 with climate change but

remove one-by-one sector-specific investments. For instance sub-scenario H1a removes hydropower investment while all other sector developments remain as planned for 2040 (M3CC). Sub-scenario H1b removes only mainstream dams and realises all tributary dams. Sub-scenario A1 removes all land use change and agricultural expansion, sub-scenario Irr1 removes all irrigation projects, and F1 removes all flood protection projects. The sequential removal of sector investments from the 2040 development plan enabled a more precise quantification of sector-specific impacts. Additional sub-scenarios make other variations, which is explained further below. Two sub-scenarios acknowledge the high uncertainty of climate change projections and assume alternative climate change paths.

Vulnerability and resilience related impacts

The main scenario results suggest a deterioration of resilience in several zones of the lower Mekong basin, particularly in Lao PDR and Cambodia as food security declines and income security does not improve proportionately. This would disadvantage poor population segments without subsistence production, in particular the urban poor and landless people. Amelioration would require a range of investments to reduce undesirable social developments and promote distributional fairness. These household level changes in food and income security are likely to be amplified by deteriorating ecosystems and sub-optimal macro-economic processes. If climate change turns out to be drier than currently assumed, vulnerability is likely to increase substantially for the 2040 development plan.

The combination of sub-scenarios indicates that adjusting investments in hydropower and agriculture is likely to provide substantial resilience improvements if compared with M3CC. The erosion of mainstream river banks is likely to introduce substantial costs due to hydropower development, further increasing vulnerabilities. Flood peaks are projected in increase. However, flood protection plans are likely to mitigate damages from most floods. Extreme events (1:100 year flood events) would remain and given the development gains and the increasing exposure of assets damages were predicted to be extensive.

Sustainability effects

The design and quantification of sustainability indices has remained a research challenge for more than three decades. The fact that sustainability integrates a wide range of metrics and perspectives means that most stakeholders are disappointed with the final product as highly critical dimensions are merged, crucial information is lost and the results are often rendered as meaningless. Therefore, it is paramount to consider the results of the CIA sustainability assessment *in addition* to the critical outcomes highlighted by the disciplinary and thematic assessments. The sustainability index is *not intended to replace* these highly critical issues.

Another important issue is that the design of this sustainability index, explained in detail in the main text, involved a participatory process with the member countries and is intended to operate in the future as a step towards implementing the UN Sustainable Development Goals (SDGs) in the lower Mekong basin. The selection of SDGs was largely constrained by the initial design of the Council Study. However, the combination of the first set of sub-indicators drawn from the socio-economic, the BioRA, and the macro-economic assessments shows that the main scenarios M2 (2020) and M3 (2040) are likely to result in sustainability losses. For most countries the main scenario M2 is likely to cause larger losses than M3. The 2040 development scenario M3 would result in declining sustainability (Vietnam:-

31%; Cambodia: -29%; Lao PDR: -27%; Thailand: -17%). Hydropower developments and operation cause most of this decline, followed by agricultural expansion.

The sub-scenario perspective reveals that selection of fewer, highly beneficial hydropower projects and adding effective mitigation measures could restore large parts of the sustainability losses and potentially lead to sustainability gains. The agricultural sub-scenarios emphasise that sustainability is not likely to be achieved by implementing extensive agricultural expansion plans as currently proposed.

Ideally, the sustainability index would be based on a larger number of indicators, which was not possible because of the implementation process of the council study. The most effective process would have defined the sustainability index upfront and then specified disciplinary assessment criteria. Therefore, the absolute values of the current sustainability index are secondary while the ordinal comparison between scenarios is more robust (and unlikely to change after adding more indicators).

Transboundary and sector trade-offs

The disciplinary assessment reports of this Council Study highlight a variety of policy-relevant transboundary impacts. These include:

- Substantial reduction of fish stocks due to hydropower dams, which involves
    - the elimination of white fish in large parts of the Mekong,
    - a surge of exotic and generalist fish species, and
    - an extensive deterioration of the overall ecosystem integrity;
- Substantial reductions of sediment, which is likely to cause extensive erosion in all zones in the lower Mekong basin, in particular the Mekong Delta;
- Considerable changes of hydrological flow;
- Food security reductions, increasing undernourishment in the poor population segments in multiple areas, which results from a combination of declining fish catch and increasing food prices;
- Substantial economic profit transfers due to foreign direct investment in hydropower projects.

This assessment highlights that the majority of transboundary impacts results from cross-sector trade-offs. Building on macro-economic, socio-economic and BioRA assessment results, the most critical cross-sector effects can be mapped into the transboundary context, involving the following:

- Hydropower would trigger the largest transboundary effects.
- Transboundary effects emerging from hydropower investments fall into three main categories
    - Positive transboundary effects from Lao PDR to Thailand and from Cambodia to Vietnam resulting from returns on investments in hydropower projects
    - Negative transboundary impacts due to fish losses (LMB-wide: $21.7 billion), which confronts Cambodia with the highest hydropower-fisheries trade-off (58% for M3CC)
    - Negative transboundary effects due to the erosion of river banks, which would require a combined investment of $6.8 billion

- Thailand shows substantial hydropower-fisheries trade-offs as most of its fisheries sector is likely to disappear under the 2040 development scenario.
- Cambodia would face substantial macro-economic trade-offs (between agriculture and other sectors) due to workforce requirements in agriculture for 2020 and 2040 scenarios.

This study highlights the relevance of the trade-off between hydropower and fisheries. This underpinning assessment includes the expansion of fisheries due to reservoirs but does not include expansion of aquaculture as a likely livelihood adaptation in response to increasing fish prices.

These transboundary effects can be corrected by benefit and cost sharing mechanisms. However, benefit sharing schemes involve complex socio-economic interactions (e.g. migration, price changes; see Section 3.4) experienced in many development situations after implementing incentive changes similar to benefit sharing. The reported effects highlight the need to employ more sophisticated analytical methods than used in this study.

Against the CIA backdrop, it is critical to emphasise that the results provided here should be considered cautiously and not interpreted as definitive single point predictions. The CIA is focused on the most critical trade-off between hydropower and fisheries and considers the aforementioned facets of the transboundary trade-off as a set of draft "in-principle" benefit sharing mechanisms. The mechanisms and instruments could be designed involving a levy on hydropower, which could be estimated at up to 18.9% on annual profits from mainstream hydropower and 8.6% for tributary hydropower. However, as explained in more detail in Section 3.4, the calculations require analysis of a variety of interaction dynamics; the development of sufficiently robust estimates will require application of appropriate socio-economic simulation models. Most importantly, benefit sharing would need to be implemented as a cross-sector compensation between hydropower and fisheries, independent form national boundaries, and not necessarily as compensation between countries.

A benefit sharing mechanism for hydropower related erosion could be implemented as cross-country instruments as river embankments protection are typically funded by governments as public investments. A levy of 1.20% on annual profits from mainstream dams and 1.12% for tributary dams would compensate effects. This excludes erosion caused by hydropower in the Lancang (effect: $1.98 billion annually). Combining erosion and fisheries-focused levies results in 9.76% on annual profits from tributary dams and 20.1% on annual profits from mainstream dams.

Key messages and policy implications

The Cumulative Impact Assessment integrated the results and insights from the other Council Study disciplinary and thematic assessments, but does not replace them. The integration echoes many issues raised by other assessments:

- Development plans include a few highly beneficial hydropower and agriculture projects.
- However, the combined development plans for 2020 and 2040 are likely to trigger a decline in resilience, vulnerability, and sustainability of communities in the lower Mekong basin.
- Poor households are likely to be most disadvantaged. The urban poor are likely to face considerable challenges as food prices are likely to increase.

- Overall sustainability effects of the development strategies as defined by the main scenarios would cause substantial sustainability losses, which could be avoided or even reversed by adjusting investment levels in hydropower and agriculture.
- Projected climate variation in several years of the 24 year projected time horizon, combined with the loss of fish-based protein, is likely to create conditions of acute levels of food insecurity in communities in Lao PDR and Cambodia.
- The emerging trade-offs between hydropower and fisheries are substantial and suggest a project-by-project assessment to identify the most harmful and the most beneficial projects.
- Transboundary effects would be significant, combining (a) positive effects for Thailand and Vietnam as return on investments from hydropower in Lao PDR and Cambodia, and (b) negative effects due to losses in fisheries and river sediments.
- Benefit sharing mechanisms would need to be designed considering important socio-economic interactions. A hydropower-fisheries focused levy would amount to 18.9% on annual profits from mainstream dams and 8.6% for tributary dams.
- Hydropower is predicted to cause erosion, requiring $6.8 billion for riverbank re-enforcements. A cost sharing levy amounts of 1.20% on mainstream annual dam profits and 1.12% for tributary dams.

An emerging recommendation is that the large bundles of investment projects considered in this study need to be assessed on a project-by-project basis to identify sustainable development pathways. Sub-scenarios suggest that hydropower and agriculture investments are likely to have the largest impacts and appear to combine both highly beneficial with highly unsustainable projects. A disaggregated assessment would require more robust assessment methods that adequately integrate socio-economic and bio-physical interactions.