

BRIEFING PAPER: Transboundary River Governance for Flood Management in Urban River Basins



This project is supported by the UK Natural Environment Research Council (Project Reference: NE/S003282/1), the Newton Fund, the UK Economic and Social Research Council, and the Ministry of Research, Technology & Higher Education of the Republic of Indonesia (RISTEK-BRIN)

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**BRIEFING PAPER:
TRANSBOUNDARY RIVER
GOVERNANCE FOR FLOOD
MANAGEMENT IN URBAN
RIVER BASINS**

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Project Partners

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- BMKG (Indonesian Agency for Meteorology, Climatology and Geophysics)
- BNPB (National Disaster Management Agency)
- Balitbang PU (Ministry of Public Works, Research and Development Center)
- BAPPENAS (National Planning and Development Agency, Directorate of Irrigation and Water Infrastructure)

At provincial level

- BBWS CC (Ciliwung and Cisadane River Watershed Authority)
- BPBD (Disaster Management Office of West Java Province)
- Dinas Tata Ruang dan Cipta Karya (Department of Building, Spatial Planning and Land Affairs, Jakarta Province)

Funding statement

This project is supported by the UK Natural Environment Research Council (Project Reference: NE/S003282/1), the Newton Fund, the UK Economic and Social Research Council, and The Ministry of Research, Technology & Higher Education of the Republic of Indonesia (Ristekdikti).

Suggested citation

University of Huddersfield, Institute of Technology Bandung, Swansea University and STMKG (2023) Briefing Paper: Transboundary River Governance for Flood Management in Urban River Basins. *A report of the project: Mitigating Hydrometeorological Hazard Impacts Through Improved Transboundary River Management in the Ciliwung River Basin.*

For more information about the project, please visit www.resilientciliwung.com

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Key messages

Effective governance systems are essential in flood prone transboundary river basins. This is necessitated by the need to address a broad number of flood drivers in an integrated manner, and to manage the river basin holistically as an interconnected system.

This briefing paper focuses on how transboundary rivers can be governed to tackle flood risk in urban areas. Its purpose is to set out the challenges faced in managing flooding in transboundary basins, and to make recommendations for how governance may be improved to support flood management.

Common governance challenges facing flood management in transboundary basins include:

- Sector-oriented legal frameworks with undefined linkages.
- A lack of horizontal coordination within the basin, leading to fragmented flood management approaches.
- A lack of vertical coordination between levels of governance, leading to inconsistent flood management plans.
- Coordination platforms that lack power and resources.
- Limited implementation, or ineffective design, of public participation initiatives.
- Changing political leadership and political will to act and coordinate on flood matters.
- Insufficient capacity (funding, staffing, technical) of local governments to implement flood management at the local level.
- Fragmented sectoral working.
- A lack of data sharing mechanisms across sectors and administrative borders, that negatively impacts on flood-related decision making and flood warning provision.
- Limited implementation of climate change adaptation plans.

General principles for river governance in flood-prone basins are proposed. They apply to both international and within-country basins within multi-level governance systems:

- Basin level management arrangements, with consideration for relevant non-basin-oriented sectors.
- River basin organisations with clear roles and power balance.
- Clarity on the roles and responsibilities of relevant actors.
- Complementary legal frameworks.
- Build the capacity of those responsible for implementation.
- Meaningful public participation opportunities.
- Monitoring and evaluation for compliance and data generation.
- Shared initiatives and coordination for flood early warning.
- Climate change adaptation as a transboundary issue.

The Ciliwung River Basin (CRB), Java, Indonesia, presents an example of a flood prone urban river basin, and is used throughout the brief to demonstrate the complexity of the flood drivers, the governance challenges at play, and basin-specific recommendations for improved transboundary governance.

1. Purpose of this brief

This briefing paper focuses on how transboundary rivers can be governed to tackle flood risk in urban areas. Its purpose is to set out the challenges faced in managing flooding in transboundary basins, and to make recommendations for how governance may be improved to support flood management. Throughout the brief, the Ciliwung River Basin in Indonesia is used as an example to illustrate the key challenges faced in governing complex urban river basins.

The brief will be useful to policy makers and researchers operating in the field of river basin management and risk reduction, and particularly for those working in transboundary urban contexts.

2. Why do we need to address flooding now?

Floods are the most frequent natural hazard worldwide and are likely to become more widespread and severe in the future, owing to climate change. The frequency and intensity of rainfall events is expected to increase, with heavy and extreme rainfall becoming more frequent².

In coastal areas, relative sea levels are increasing and are expected to continue to rise in the future, contributing to heightened coastal flood risk. The combined impact of rising sea levels and increased rainfall is likely to lead to more compound flood events, especially in vulnerable, low-lying coastal cities³.

While there has been considerable progress made in reducing flood risks, the anticipated increases in flooding require continued efforts to ensure effective flood management. The focus of this brief is on transboundary basins, as they present uniquely complex governance situations, and are where governance challenges related to flood management are most pronounced.

3. Why do we need effective transboundary river governance to manage flooding in urban basins?

There are two primary reasons why transboundary river governance is needed to tackle flood risk. The first is that there are many drivers of flooding, both physical and human, that need to be managed in an integrated manner. The second is that river basins are interconnected systems and are therefore often best managed as a whole.

3.1. Multiple interrelated flood drivers

Flood risk management in urban basins can be complex, due to the number of (often interrelated) flood drivers to be considered. The multitude of flood drivers (both physical and human) means that there is no single solution to flood risk, and the interconnectedness of the drivers often means that they need to be addressed together. This means that a range of different solutions will be needed, and subsequently, different expertise is required. As such, many different organisations across different sectors will need to work together.

There are a range of physical factors that contribute to flood risk. The weather and climate of a region drive flood risk through influencing the frequency, intensity, and spatial extent of rainfall. Heavy precipitation may cause pluvial (surface water) flooding, or contribute to river flooding⁴. In addition, the morphological

characteristics of the river basin and channel, such as the basin size and shape, amount of vegetation cover, and rates of sedimentation, also influence flood likelihood⁵.

In coastal locations, flooding from the sea presents an additional risk. Coastal storms, for example, can generate wind, wave and surge conditions that result in sea water inundation. Coastal delta cities that suffer from land subsidence are at particular risk of flooding, as the land surface is lowered relative to sea level, worsening inundation⁶. Delta cities may also be prone to compound flooding events, where river and coastal flooding occur simultaneously⁷.

Climate change is altering many of the hydrometeorological drivers of flooding. With this, some locations are likely to receive more frequent and/or more intense precipitation events, resulting in increased flood risk^{8,9}. Sea level rise is contributing to increased coastal flooding, with the greater risk of coastal defences being breached⁴. This is a challenge for low lying coastal cities where there are concentrated numbers of people and assets^{3,10}.

In urban locations with large populations, the risk of flooding is also influenced by human actions. Population growth drives urbanisation, which has several implications for flood risk. Urbanisation changes the land surface, and subsequently, how water moves through the catchment⁴. Removal of vegetation and use of impermeable surfaces reduces interception and infiltration leading to the rapid transfer of water into drainage systems. Urban development that is not carefully planned may lead to insufficient drainage and open green space to manage such volumes of water¹¹. The operation and maintenance of drainage systems and flood control infrastructure are also of importance. Degraded infrastructure is less effective, thereby contributing to increased flood risk.

Growing populations have increased the demand for land, and urban areas have expanded into flood prone areas, placing more people at risk. It is predicted that there will be many more people exposed to flood risk in the future owing to urban expansion, even without considering climate change¹². People living in coastal delta cities are often particularly vulnerable. Densely populated delta cities are often found in less economically developed countries, where socio-economic conditions place people at greater risk³.

3.2. Transboundary management

River basins are interconnected systems, and actions conducted in one part of the basin can have knock-on effects elsewhere. This has led to the widely recognised notion that river basins should be managed as a whole, and that strategies from upstream to downstream need to be consistent (e.g. Watson 13). Without this, flood issues may be exacerbated. To achieve integrated management, a supportive and enabling governance system is required, that allows the many stakeholders involved to work together.

However, the governance arrangements in place for flood and river management often do not conform with the holistic basin level management ideal. There may be multiple administrative areas through which the river crosses, whether these be international or areas within a country. This often leads to flood management being implemented separately by the individual administrations. There are not only political 'boundaries' in transboundary settings, but also 'organisational' ones¹⁴. Flood management requires the involvement of different sectors and organisations who may have different interests in the basin, and diverse ways of working.

3.3. Case study: Flood drivers in the Ciliwung River Basin

FLOOD DRIVERS IN THE CILIWUNG RIVER BASIN

The Ciliwung River Basin (CRB), Java, Indonesia, presents an example of a flood prone urban river basin, and is used to demonstrate the complexity of the flood drivers at play.

The CRB covers an area of approximately 446 km². The river runs from the source near Tugu Puncak in West Java, through Indonesia's capital city of Jakarta. In South Jakarta, the river is diverted into the Western Flood Canal, which carries water from the Ciliwung to where it discharges into the sea at the Maura Angke estuary¹.

From a climatological perspective, the CRB is prone to flooding owing to the tropical monsoon climate and associated wet season in the region, which brings heavy precipitation. Climate change is likely to exacerbate such precipitation events, with an upward trend in the most extreme rainfall events having been observed¹⁵.

As a coastal city, Jakarta is also at risk of flooding from the sea. Bennett and colleagues¹ identified that coastal storms in Jakarta Bay result in increased wave heights and water levels, and surge conditions which threaten low-lying areas. It was found that the presence of a coastal storm significantly impacts on the severity of the flooding observed in the study area of Muara Angke (Figure 1). Much larger increases in flood inundation area and depth were found with increases in the severity of the coastal storm, compared to increases in river discharge in the study area. While much of the city is protected by sea walls, the coastal storm influences flood severity through generating elevated water levels that prevent the Western Flood Canal from draining into the sea. Sea levels are expected to continue to rise in the future with climate change¹⁰, which is likely to increase wave heights and water levels further¹.

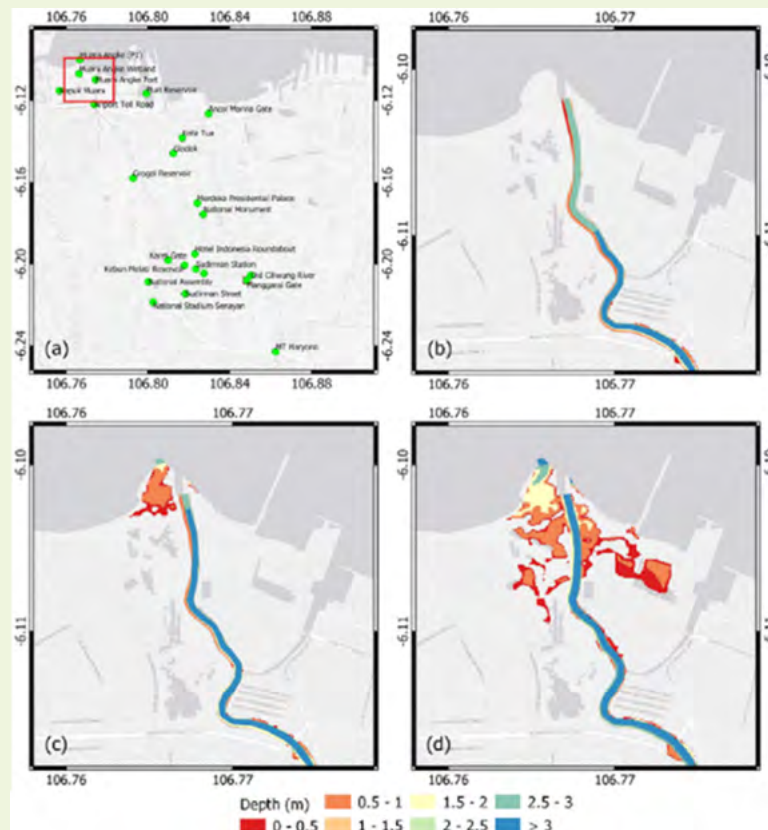


Figure 1. Flood depth and extent in the Muara Angke study area (a), arising from regular river discharge ($Q2^*$) in combination with (b) no coastal storm; (c) regular coastal storm (W1); (d) severe coastal storm (W100). All cases are with 0m storm surge. From Bennett and colleagues¹

FLOOD DRIVERS IN THE CILIWUNG RIVER BASIN *continued...*

Land subsidence is an additional challenge in northern Jakarta, where over 40% of the land is below sea level¹⁶. Subsidence is occurring at an average rate of 3-10 centimetres per year¹⁷ and is caused by several factors, such as natural compaction of alluvial soils, as well as excessive groundwater extraction¹⁸. Modelling of future conditions suggested there could be widespread

inundation of large parts of Jakarta by 2100, assuming a continuing rate of land subsidence, sea level rise, and no upgrades to coastal defences¹ (Figure 2). While this is an extreme scenario, it indicates the severe impacts that could arise from combined sea level rise and land subsidence should no action be taken.

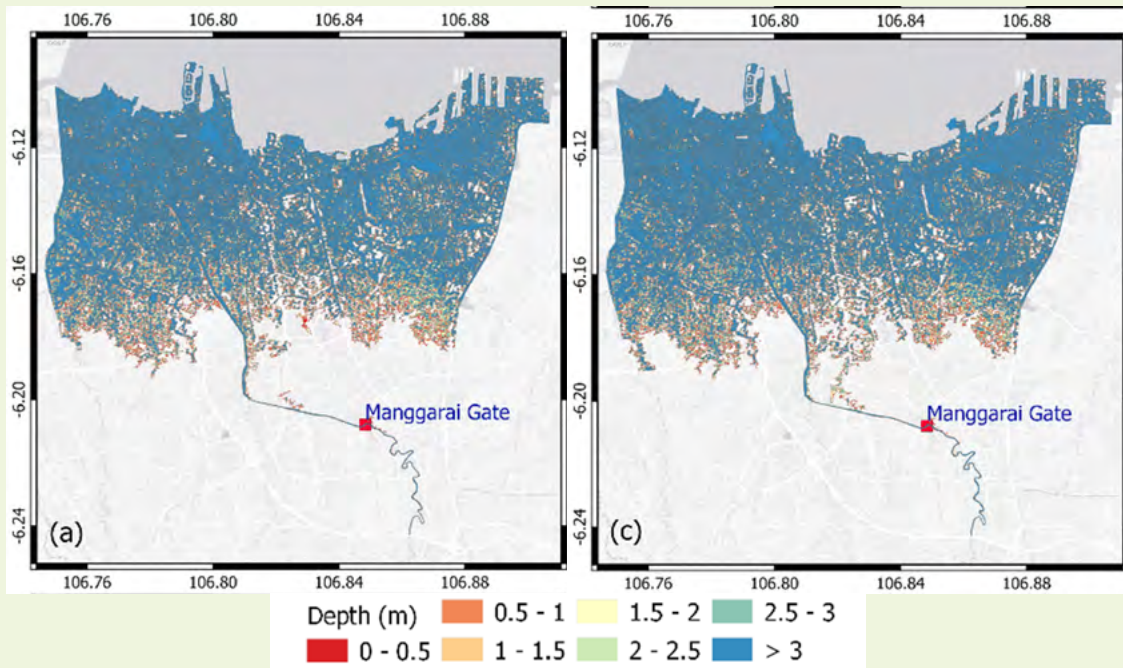


Figure 2. Flood inundation maps for the year 2100 considering sea level rise under climate change and a continued rate of land subsidence (10cm/year), with a 1m surge. Maps (a) and (b) show regular river discharge (Q2) combined with a regular coastal storm (a) and a severe coastal storm (b) under a moderate emissions scenario (RCP4.5). Maps (c) and (d) show the same compound flood scenarios under a high emissions scenario (RCP8.5). From Bennett and colleagues I.

Human actions have also had significant impacts on the CRB environment. In recent decades, the CRB has undergone large scale urbanisation that has impacted upon the basin's function. For example, urbanisation has reduced infiltration and increased run-off, which has intensified the basin's response¹⁹. Land use change continues to occur in the upstream, where urbanisation and land clearance for agriculture are common²⁰. Such actions have reduced the capacity of the upstream area to retain water, thereby increasing flood risk²¹.

Human actions have further impacted upon the capacity of the river channel and drainage system. Land clearance and reduced vegetation cover have increased sedimentation, and subsequently reduced channel width and depth¹⁹.

Poor waste management practices have led to waste materials clogging the drainage channels²⁰, and in the downstream, inadequate drainage system capacity to manage large amounts of water during the wet season further contributes to flood risk^{20, 21}.

While various structural flood control measures have been implemented to manage flooding, the functionality, operation, and maintenance of the measures can impact their effectiveness. Flood control structures are not always well maintained, they may be damaged during floods, as well as being at risk of failure in other systems. For example, power outages impacted on the operation of water pumps during the 2015 floods²².

FLOOD DRIVERS IN THE CILIWUNG RIVER BASIN *continued...*

Lastly, socio-economic conditions in the CRB have also contributed to increased flood risk. The population of Jakarta has grown rapidly, owing to economic growth and migration, and there are now more than 33 million residents in the Greater Jakarta area²³. The large population in the basin means that more people are exposed

to flooding. Moreover, development in the river basin has not always been equal, and many poorer residents have established informal settlements in marginalised spaces, such as the banks of the Ciliwung, where residents are highly exposed and vulnerable to floods^{24, 25}.



4. Governance challenges

The combination of the need for many organisations to work together to address the causes of flooding, and the need to manage basins as a whole necessitates effective governance systems to be able to mitigate flooding successfully. There are, however, many challenges facing successful river basin governance.

4.1. Legal/Institutional

4.1.1. Legal frameworks

Legal frameworks are often used to set out the way transboundary basins are managed²⁶, and can provide a basis for integrated management²⁷. They may also stipulate requirements or incentives for cooperation.

Challenges may arise when there are multiple sectoral frameworks, and where these frameworks are not complementary. This is a common challenge, particularly for flood management due to its cross-cutting nature. Unclear linkages between related but independent frameworks have the potential to reinforce or create separation²⁸.

4.1.2. Horizontal integration

It is well acknowledged that river basins can be best managed at the basin scale, as reflected in principles of Integrated Water Resource Management (IWRM)²⁹, and Integrated River Basin Management (IRBM)¹³. However, it can be difficult to achieve basin-wide management, especially when basins are intersected by political borders. Political administrations often implement their own approaches to addressing river basin problems like flooding, which can result in fragmentation. There can be many reasons why neighbouring areas cannot, or will not, collaborate on basin management, such as different systems, priorities and approaches, or a lack of political will. Coordinating the large number of actors involved can also present a challenge²⁸.

While the transboundary management challenge is well acknowledged in international basins, horizontal integration may still be a challenge in decentralised national contexts, where local districts follow their own approaches³⁰.

4.1.3. Vertical integration

In multi-level governance systems, it is common for responsibilities for flood management to be distributed between governance levels, from the international or national, to the local level³¹. A common challenge is the ability to coordinate plans and action throughout these levels. A lack of vertical coordination can hinder implementation by creating a disconnect between the setting out of plans at a large scale, and implementation, which often takes place at the local level.

Ensuring approaches from the large-scale basin to the very local feed into one another is a particular challenge when the scales may be very different. Other reasons why vertical integration may be a challenge include unclear roles and responsibilities, and unbalanced responsibility and resources²⁸.

4.1.4. Coordinating institutions

To support horizontal and vertical integration within the river basin, coordinating institutions, such as a river basin organisations (RBOs), are often employed³². However, there are several challenges associated with such organisations, and their presence does not necessarily mean that integrated management will be achieved in practice.

One challenge is that they may be acting in contention with existing governance arrangements. For example, they may lack power relative to the individual administrations, who are often ultimately responsible for decision making and implementation. Furthermore, resourcing these additional governance arrangements can also be a challenge. Overall, RBOs vary in their power and capacity, therefore some are more effective than others²⁸.

4.1.5. Participation

Public participation is often considered as a key aspect of good governance, as it can help to achieve sustainable and equitable solutions and help to ensure that local needs are met²⁷.

The importance of participation for river basin and flood risk management is generally recognised. However, the degree to which it is implemented, and the effectiveness of approaches varies. In some cases, participation is a requirement in river basin and flood management related laws, but details of how it should be conducted are often not prescribed²⁸. This is due to the need for contextually specific methods, but this can lead to a variety of approaches with varying successes. On the other hand, prescribing participation methods may be ineffective in meeting local needs. As such the challenge remains to achieve participation that contributes to basin management, while being meaningful for participants³³.

4.2. Political

4.2.1. Political will

The political will to cooperate in transboundary basins can impact whether administrations within the basin work together^{34,35}.

Political will can impact how much coordination takes place between neighbouring areas in the basin. While legal agreements may assure a certain degree of cooperation, political will can influence how well administrations either side of the border cooperate. Political willingness to work with neighbouring areas, and how much emphasis is placed on tackling flood risk may change with leadership, therefore may vary with political cycles²⁸.

4.2.2. Capacity

Lack of institutional capacity to deal with transboundary issues can present a challenge to effective transboundary basin management²⁶.

For flood management in transboundary basins, the capacity of local governments can impact the ability to manage floods at the local level. This is particularly important as local governments are often responsible for the implementation of flood management. Key capacity issues in local governments might be related to funding, staffing or technical ability. As such, inadequate local government capacity can impact the practical progress that is made in flood and river management²⁸.

4.2.3. Sectoral coordination

Many different sectors are concerned with flood management, from environment, to urban development, civil protection and spatial planning³¹. But due to sectoral arrangements, actors often follow their individual work plans with a lack of cooperation with related sectors²⁷.

A challenge facing sectoral coordination is that not all sectors operate at the basin scale. Sectors such as water may make use of the basin scale, while others (such as spatial planning) do not. Nonetheless, both are important in river and flood management. Working to different scales can present a barrier to cross-sectoral working.

4.3. Operational

4.3.1. Data and information sharing

Effective flood management requires a large amount of data from diverse sources³⁶. However, transboundary contexts can present a challenge to accessing and sharing this data between all actors in the basin. For example, there may be a lack of mechanisms for data exchange in place³⁷.

It was found that online data portals can provide useful tools for collating data and providing access to all actors. However, technical and financial capacity issues can present a challenge to the establishment of these systems and acquisition of data to populate them²⁸.

4.3.2. Flood early warning

Effective early warning systems (EWS) are an important aspect of mitigating the potential impacts of floods. However, achieving effective early warning faces several governance challenges. For example, data sharing between basin actors is key for forecasting and warning³⁸, but this can be problematic in transboundary basins (see above). Moreover, stakeholders need to work together to ensure robust linkages between the various aspects of the EWS, from monitoring to communication and preparedness. Hence, EWS can be impacted greatly by basin coordination issues³⁹.

4.3.3. Integrating climate change adaptation

Climate change presents a challenge to transboundary river and flood management as it adds extra pressure to already complex situations. Climate change is an important consideration in flood management plans, in ensuring that they remain effective in the future, and that maladaptive routes are not followed⁴⁰.

However, while there are often plans in place at national level for CCA, CCA has not been widely implemented in transboundary basins so far. It is often only considered sparingly in basin management plans, and often not treated as a transboundary issue. Progress in CCA has been made in pockets, where there have been special initiatives, or where organisations have proactively developed their own plans²⁸.

4.4. Case study: Key governance challenges in the Ciliwung River Basin

KEY GOVERNANCE CHALLENGES IN THE CILIWUNG RIVER BASIN

4.4.1. Enforcement and compliance with spatial planning

Weak enforcement and compliance with spatial plans is a key challenge facing effective flood management in the CRB. Rapid urbanisation in Greater Jakarta has taken place without fully considering spatial plans, owing to weak development control and economic pressures²². Weak spatial planning can have consequences for other flood drivers, such as drainage capacity, catchment area, and flood control development^{22,41}.

4.4.2. Vertical coordination

Indonesia has a multi-level governance system, where flood management responsibilities are distributed between governance levels. However, effective vertical coordination has been a challenge. This has been associated with a lack of clear roles and responsibilities among agencies located at various governance levels, as well as limited mechanisms for coordination⁴². Attempts to coordinate vertically have been hampered by authority and funding issues²².

4.4.3. Coordination mechanisms

Indonesia's decentralised governance system means that the local districts within the CRB have autonomous authority. Coordination mechanisms are needed for the local

governments to coordinate. While coordination mechanisms exist, they face challenges which limit their effectiveness⁴³. Previous coordination forums within the basin have suffered from lack of legal agreement, no clear framework for how coordination should take place, and lack of leadership²². And while coordination mechanisms are in place for water resource management in the basin, flood management is not integrated within this system⁴⁴.

4.4.4. Flood early warning

There is limited cooperation between agencies with flood warning roles in the CRB, and there has also been less consideration for the social aspects of flood warning compared to technical aspects. This has resulted in the flood warning system failing to be fully end-to-end.

Flood warning in the CRB relies on various agencies passing information on, however, they do not directly collaborate with one another. The warning system is based on detection of high water levels, and there is currently no integration of weather or flood forecasting within the system⁴⁵.

Secondly, the public do not always respond to flood warnings in desired ways. For example, residents in vulnerable riverbank communities prioritise remaining in the flood risk area to protect belongings, over direct evacuation⁴⁶. There has been limited attention given to addressing preparedness and response capabilities compared to technical monitoring elements³⁹.

5. General principles and Recommendations

This section provides some general principles for effective flood governance in transboundary basins. These principles are applicable to flood prone river basins, either international or within a single country, with multi-level governance systems. The principles are drawn from a comparative literature review²⁸.

Basin level management with consideration for related non-basin-oriented sectors

A common approach to river basin management is the application of a basin level management unit, and/or basin level planning. This can support greater horizontal integration within the basin. However, a gap can be created between basin-oriented and non-basin-oriented sectors. Therefore, if basin scale management is used, how linkages will be fostered with non-basin-oriented sectors should be considered. This is particularly important for flood management, where non-basin-oriented aspects can be critical for flood risk reduction (e.g. spatial planning).

River basin organisations with clear roles and power balance

River basin organisations can provide a platform to bring stakeholders together to interact. However, they do not always work optimally, and their operation could be strengthened. Basin organisations should have clear roles that complement, rather than compete with, other governance arrangements, and the level of power held by the organisation should be weighed in relation to the other institutions. It is also identified that there may be multiple coordinating bodies in place operating at different scales. As such it may be necessary to identify how they work together to avoid further siloed working.

Clarity on the roles and responsibilities of relevant actors

Roles and responsibilities of the different actors involved in flood and river management should be clearly set out. This includes national departments and agencies as well as sub-national bodies. This is especially important in multilevel governance systems, where responsibilities are often distributed between actors situated at different governance levels. Clarifying roles can provide a solution to overlaps and gaps in responsibility, and support coordination.

Complementary legal frameworks

Requirements for flood and river management may be set out in national legal frameworks and policies. Such legal frameworks can provide an overarching structure to support integration by setting out common guidance for actors to follow²⁷. However, due to the cross-cutting nature of flood management, there may be multiple relevant frameworks. Where there are multiple frameworks, complementarities and areas of contradiction between them should be identified to raise awareness among actors, and to work towards greater alignments to support coordinated flood management.

Build the capacity of those responsible for implementation

To have an impact, the plans and frameworks that underpin flood and river management need to be implemented. To support effective implementation, those responsible require the capacity to do so. This includes ensuring sufficient resources, but also the development of technical abilities. Those responsible are often local governments who should be the target for capacity building.

Meaningful public participation opportunities

Public participation is considered a key part of flood and river management decision making and opportunities for participation should be available. Participation can be supported by making it a requirement in legal frameworks, although participation that is prescribed may not always meet local

needs. Therefore, participation opportunities should be tailored to the local context. A balance should be sought between having participation that contributes to basin management while being meaningful to participants.

Monitoring and evaluation for compliance and data generation

Monitoring and evaluation of flood and river management planning and implementation can provide multiple benefits. Firstly, monitoring and evaluation can support enforcement and compliance with frameworks through requiring progress reporting. Another potential benefit is the information that is produced through the monitoring and reporting process which can be used to better inform decisions and support transboundary cooperation³⁷. For example, these data may also be used to populate data portals to aid data sharing.

Shared initiatives and coordination for flood early warning

Flood early warning requires a high level of coordination to be effective. Effective examples demonstrate the benefits of shared initiatives, or there should be strong data sharing mechanisms in place and good coordination between the actors involved.

Climate change adaptation as a transboundary issue

Climate change adaptation is currently not considered widely as a transboundary issue. Adaptation should be integrated within river basin management plans to avoid mal-adaptive decisions. Successful examples of CCA implementation show that progress can be made when there is commitment from relevant actors and sources of support available.

5.1. Case study: Recommendations for the Ciliwung River Basin

RECOMMENDATIONS FOR THE CILIWUNG RIVER BASIN

The following recommendations to improve river governance for flood risk reduction in the CRB are proposed⁴⁴:

1. Develop transboundary governance for flood risk reduction in the CRB through synergising local policies, regulations and planning among local governments who share the basin.
2. Synergise local, provincial, and national policies, regulations, and planning between vertical levels of governance.
3. Develop multi-sector and multi-stakeholder governance for flood risk management in the CRB.
4. Integrate flood risk reduction and management into existing basin-oriented governance arrangements for water resource management.
5. Integrate flood hazard assessment into local/provincial policy and regulation for planning.
6. Update data for modelling and make it available for scientific and applied study, and decision making.
7. Formally and informally integrate the role of community groups/volunteers/NGOs and CBOs within the work of other basin stakeholders (government, community, business entity, academia, media).
8. Build community resilience and strengthen community preparedness and response for flood warning.
9. Explicitly address the Sendai Framework for Disaster Risk Reduction actions into development plans.
10. To reflect and draw upon good practices elsewhere in Indonesia and worldwide.

Further reading

The following is a list of reports and peer reviewed papers about the underpinning research that have been published by the project team. These are useful points of references for further, more detailed information about the topics presented within this briefing paper.

Suggested further reading	Description
<p>Vision Paper for Improved Transboundary Governance for Flood Management in the Ciliwung River Basin, Indonesia (2023). A report of the project: Mitigating Hydrometeorological Hazard Impacts Through Improved Transboundary River Management in the Ciliwung River Basin. University of Huddersfield, Institute of Technology Bandung, and Swansea University.</p>	<p>Drawing together work on the Ciliwung River Basin, the Vision Paper sets out the current governance arrangements and challenges, make recommendations to improve river governance for flood risk management and details optimistic and pessimistic visions for the future of the basin depending on whether decisive action is taken to address the identified issues.</p>
<p>Bennett, W.G., Karunarathna, H.U., Xuan, Y., Kusuma, M.S.B. Farid, M., Kuntoro, A.A., Rahayu, H.P., Kombaitan, B., Septiadi, D., Kesuma, T.N.A., Haigh, R, and Amaratunga, D. (2023) Modelling compound flooding: A case study from Jakarta, Indonesia. Under review.</p>	<p>This paper details the coastal and river modelling processes which produced the flood risk maps for the Muara Angke coastal zone in Jakarta.</p>
<p>Clegg, G., Haigh, R. and Amaratunga, D. (2019) River Governance and Flood Management Arrangements in the United Kingdom. November 2019. A report of the project 'Mitigating hydrometeorological hazard impacts through transboundary river management in the Ciliwung River Basin, Indonesia'. http://www.resilientciliwung.com/portal/media/attachments/2020/11/09/uk-report.pdf</p>	<p>This report examines the governance arrangements for flood management in the United Kingdom, to understand the current procedures, and the governance challenges faced.</p>
<p>Clegg, G., Haigh, R., Amaratunga, D. and Rahayu, H.P. (2020) A literature review on community participation in flood early warning. April 2020. A report of the project 'Mitigating hydrometeorological hazard impacts through transboundary river management in the Ciliwung River Basin, Indonesia'. http://www.resilientciliwung.com/portal/media/attachments/2021/06/07/participation-in-ews-report.pdf</p>	<p>This report reviews the literature on participation of the public in flood early warning. It outlines how participatory approaches may support community understanding and preparedness for floods and what incentives and interventions may be necessary when designing such approaches for the Ciliwung River Basin.</p>
<p>Clegg, G., Haigh, R., Amaratunga, D. and Rahayu, H.P. (2020) River Governance and flood management arrangements in Indonesia. July 2020. A report of the project 'Mitigating hydrometeorological hazard impacts through transboundary river management in the Ciliwung River Basin, Indonesia'. http://www.resilientciliwung.com/portal/media/attachments/2020/11/09/indonesia-report.pdf</p>	<p>This report examines the governance arrangements for flood management in Indonesia, to understand the current procedures, and the governance challenges faced.</p>

Suggested further reading	Description
<p>Clegg, G., Haigh, R., Amaratunga, D. and Rahayu, H.P. (2020) Transboundary river and flood governance: a comparison of arrangements in Indonesia and Europe. August 2020. A report of the project 'Mitigating hydrometeorological hazard impacts through transboundary river management in the Ciliwung River Basin, Indonesia'.</p>	<p>This report reviews the flood and river governance arrangements in Indonesia and the European Union, and compares them to examine the similarities, differences, and draws out lessons learned.</p>
<p>Clegg, G., Haigh, R., Amaratunga, D. and Rahayu, H.P. (2021) 'Transboundary River Governance Practices for Flood Risk Reduction in Europe: A Review', in Amaratunga, D., Haigh, R. and Dias, N. (eds.) <i>Multi-hazard Early Warning and Disaster Risks</i>. Springer Nature, Switzerland.</p>	<p>This book chapter examines the governance arrangements for flood management in the European Union, to understand the current procedures, and the governance challenges faced.</p>
<p>Clegg, G., Haigh, R., Amaratunga, D. and Rahayu, H.P. (2021) Flood Risk Early Warning and Decision Making in Indonesia and Europe. April 2021. A report of the project 'Mitigating hydrometeorological hazard impacts through transboundary river management in the Ciliwung River Basin, Indonesia'.</p>	<p>This report identifies the concepts relevant to end-to-end flood early warning, details and compares the current approaches taken in Indonesia and Europe, and examines how they are governed, based on a literature review.</p>
<p>Clegg, G., Haigh, R., Amaratunga, D., Rahayu, H.P., Karunarathna, H. and Septiadi, D. (2021) A Conceptual Framework for Flood Impact Mitigation Through Transboundary River Management. <i>International Journal on Advanced Science Engineering and Information Technology</i>. Vol 11 No 3, p 880-888. http://ijaseit.insightsociety.org/index.php?option=com_content&view=article&id=9&Itemid=1&article_id=14329</p>	<p>The conceptual framework presents the key concepts and ideas that provide a basis for understanding transboundary river management, flood drivers, and flood impacts in the Ciliwung River Basin.</p>
<p>Clegg, G., Haigh, R., Amaratunga, D. and Rahayu, H.P. (2023) 'Coordination challenges facing effective flood governance in the Ciliwung river basin', in: Triyanti, A., Indrawan, M., Nurhidayah, L. and Marfai, M.A. (eds.) <i>Environmental Governance in Indonesia</i>. Springer Nature. https://link.springer.com/book/9783031159039</p>	<p>This book chapter provides insights into the challenges facing coordinated flood governance in the Ciliwung River Basin, based on a literature review.</p>
<p>Rahayu, H.P. et al. (2022) Faktor Kunci Penyebab Risiko Banjir DAS Ciliwung (Key Flood Drivers for the Ciliwung River Basin). ITB Press. Institute of Technology Bandung, Indonesia. ISBN: 978-623-297-229-2.</p>	<p>This report details the primary drivers of flooding in the Ciliwung River Basin, based on a literature review and focus group discussions with river basin stakeholders.</p>

Suggested further reading	Description
<p>Rahayu, H.P. et al. (2022) Peran Instansi Dalam Pengelolaan DAS Ciliwung Bagian Hulu dan Tengah untuk Pengurangan Risiko Banjir (Upstream and Midstream Government's Role in Flood Risk Management Along Ciliwung River Basin). ITB Press. Institute of Technology Bandung, Indonesia. ISBN: 978-623-297-222-3.</p>	<p>This report describes the roles of key agencies involved in flood and river management in the middle and upstream reaches of the Ciliwung River Basin based on literature review and focus group discussions with key basin stakeholders and provides recommendations for more effective river governance.</p>
<p>Rahayu, H.P. et al. (2022) Peran Instansi dalam Sistem Peringatan Dini Banjir Pada DAS Ciliwung (Role of Institutions in Ciliwung Flood Early Warning System). ITB Press. Institute of Technology Bandung, Indonesia.</p>	<p>This report provides details on the roles key institutions play in flood early warning for the Ciliwung River Basin, Indonesia.</p>
<p>Rahayu, H.P., Zulfa, K.I., Khoirunnisa, D., Haigh, R. and Amaratunga, D. (2023) Unveiling Transboundary Challenges in the Ciliwung River Flood Management. Under peer review.</p>	<p>This paper identifies the flood risk drivers in the Ciliwung River Basin based on basin stakeholder's perspectives using MICMAC analysis. The paper identifies lack of development control and weak stakeholder coordination as critical flood drivers that subsequently impact on other flood drivers.</p>
<p>Rahayu, H.P., Zulfa, K.I., Khoirunnisa, D., Haigh, R. and Amaratunga, D. (2023) Closing the Gap in Flood Early Warning System using Structural Equation Modelling (SEM) with the Case Study Ciliwung River. Under peer review.</p>	<p>This paper uses Structural Equation Modelling (SEM) to identify causal relationship to identify the significant variables that impact people's responses after receiving a flood warning. The most influential factors identified were individual preparedness and the early warning source.</p>

References

1. Bennett WG, Karunarathna HU, Xuan Y, Kusuma MSB, Farid M, Kuntoro AA, et al. Modelling compound flooding: A case study from Indonesia. Under peer review. 2023.
2. IPCC. Climate Change 2021: The Physical Science Basis. Contributions of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, M. Pean, S. Beger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzel, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekci, R. Yu and B. Zhou (eds.)]. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press; 2021.
3. Edmonds DA, Caldwell RL, Brondizio ES, Siani SM. Coastal Flooding will Disproportionately Impact People on River Deltas. *Nature Communications*. 2020;11(4741).
4. O'Donnell EC, Thorne CR. Drivers of Future Urban Flooding. *Philosophical Transactions of The Royal Society A*. 2020;378(20190216).
5. Asinya EA, Alam MJB. Flood Risk in Rivers: Climate Driven or Morphological Adjustment. *Earth Systems and Environment*. 2021;5:861-71.
6. Cao A, Esteban M, Valenzuela VPB, Onuki M, Takagi H, Thai ND, et al. Future of Asian Deltaic Megacities Under Sea Level Rise and Land Subsidence: Current adaptation pathways for Tokyo, Jakarta, Manila, and Ho Chi Minh City. *Current Opinion in Environmental Sustainability*. 2021;50(June 2021):87-97.
7. Bevacqua E, Vousdoukas MI, Zappa G, Hodges K, Shepherd TG, Maraun D, et al. More Meteorological Events that Drive Compound Coastal Flooding are Projected Under Climate Change. *Communications Earth and Environment*. 2020;1(47).
8. Tabari H. Climate Change Impact on Flood and Extreme Precipitation Increases with Water Availability. *Scientific Reports*. 2020;10(13768).
9. Arias PA, N. Bellouin, E. Coppola, R.G. Jones, G. Krinner, J. Marotzke, V. Naik, M.D. Palmer, G.-K. Plattner, J. Rogelj, M. Rojas JS, T. Storelvmo, P.W. Thorne, B. Trewin, K. Achuta Rao, B. Adhikary, R.P. Allan, K. Armour, G. Bala, R. Barimalala SB, J.G. Canadell, C. Cassou, A. Cherchi, W. Collins, W.D. Collins, S.L. Connors, S. Corti, F. Cruz, F.J. Dentener CD, A. Di Luca, A. Diongue Niang, F.J. Doblas-Reyes, A. Dosio, H. Douville, F. Engelbrecht, V. Eyring EF, P. Forster, B. Fox-Kemper, J.S. Fuglestedt, J.C. Fyfe, N.P. Gillett, L. Goldfarb, I. Gorodetskaya, J.M. Gutierrez RH, E. Hawkins, H.T. Hewitt, P. Hope, A.S. Islam, C. Jones, D.S. Kaufman, R.E. Kopp, Y. Kosaka, et al. Technical Summary. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, USA; 2021.
10. Oppenheimer M, Glavovic BC, Hinkel J, Wal Rvd, Magnan AK, Abd-Elgawad A, et al. Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. Cambridge UK, and New York; 2019.
11. Jha AK, Bloch R, Lamond J. *Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century*. Washington DC: The World Bank; 2012.
12. Generalp B, Generalp I, Liu Y. Changing global patterns of urban exposure to flood and drought hazards. *Global Environmental Change*. 2015;31(March 2015):217-25.
13. Watson N. Integrated River Basin Management: A Case for Collaboration. *International Journal of River Basin Management*. 2004;2(4):243-57.

14. Bracken LJ, Oughton EA, Donaldson A, Cook B, Forrester J, Spray C, et al. Flood risk management: an approach to managing cross border hazards. *Natural Hazards*. 2016;82(Supplement 2):217-40.
15. Siswanto, van Oldenborgh GJ, van der Schrier G, Lenderink G, van den Hurk B. Trends in High-Daily Precipitation Events in Jakarta and the Flooding of January 2014. In: Stephanie C. Herring, Martin P. Hoerling, James P. Kossin, Thomas C. Peterson, Peter A. Stott, editors. *Explaining Extreme Events of 2014 from a Climate Perspective*: American Meteorological Society; 2015.
16. World Bank. Jakarta: Urban Challenges in a Changing Climate. Jakarta: World Bank; 2011.
17. Abidin HZ, Andreas H, Gumilar I, Brinkman JJ. Study on the Risks and Impacts of Land Subsidence in Jakarta. *Proceedings of the International Association of Hydrological Sciences*. 2015;372(2015):115-20.
18. Abidin HZ, Andreas H, Gumilar I, Fukuda Y, Pohan YE, Deguchi T. Land Subsidence of Jakarta (Indonesia) and its Relation with Urban Development. *Natural Hazards*. 2011;59:1753.
19. Remondi F, Burlando P, Vollmer D. Exploring the Hydrological Impact of Increasing Urbanisation on a Tropical River Catchment of the Metropolitan Jakarta, Indonesia. *Sustainable Cities and Society*. 2016;20:210-21.
20. Rahayu et al. Faktor Kunci Penyebab Risiko Banjir DAS Ciliwung (Key Flood Drivers for the Ciliwung River Basin). Institute of Technology Bandung; 2022.
21. Kodoatie RJ, Sugiyanto. *Banjir, Beberapa Penyebab dan Metode Pengendaliannya dalam Perspektif Lingkungan*. Yogyakarta: Pustaka Pelajar; 2002.
22. Rahayu et al. Peran Instansi Dalam Pengelolaan DAS Ciliwung Bagian Hulu dan Tengah untuk Pengurangan Risiko Banjir. Indonesia: Institute of Technology Bandung; 2022.
23. BPS. 2020 Census. In: Statistik BP, editor. 2020.
24. Hellman J. Living with Floods and Coping with Vulnerability. *Disaster Prevention and Management*. 2015;24(4):468-83.
25. Padawangi R. Forced evictions, spatial (un)certainities and the making of exemplary centres in Indonesia. *Asia Pacific Viewpoint*. 2019;60(1):65-79.
26. UNEP-DHI, UNEP. *Transboundary River Basins: Status and Trends*. Nairobi: United Nations Environment Programme; 2016.
27. Savenije HHG, van der Zaag P. Conceptual Framework for the Management of Shared River Basins; with special reference to the SADC and EU. *Water Policy*. 2000;2(2000):9-45.
28. Clegg G, Haigh R, Amaratunga D, Rahayu HP. *Transboundary River and Flood Governance: A comparison of arrangements in Indonesia and Europe*. Unpublished Project Report University of Huddersfield 2020.
29. Varis O, Enckell K, Keskinen M. Integrated Water Resources Management: Horizontal and Vertical Explorations and the 'Water in All Policies' Approach. *International Journal of Water Resources Development*. 2014;30(3):433-44.
30. Clegg G, Haigh R, Amaratunga D, Karunarathna HU, Rahayu HP, Septiadi D. *A Conceptual Framework for Flood Impact Mitigation Through Transboundary River Management*. Unpublished; 2019.

31. Akhmouch A, Calavreul D. Flood Governance: A Shared Responsibility. Organisation for Economic Co-operation and Development (OECD); 2019.
32. Schmeier S, Gerlak AK, Blumstein S. Clearing the muddy waters of shared watercourses governance: conceptualizing international River Basin Organizations. *International Environmental Agreements: Politics, Law and Economics*. 2016;16(4):597-619.
33. Clegg G, Haigh R, Amaratunga D. Citizen Participation in Early Warning Systems for Natural Hazards: A Literature Review. 9th International Conference on Building Resilience (ICBR09); Nusa Dua, Bali, Indonesia 2020.
34. Ganoulis J, Skoulikaris C. Interactive Open Source Information Systems for Fostering Transboundary Water Cooperation: UNESCO Publishing 2013.
35. Baranyai G. European water law and hydropolitics: an inquiry into the resilience of transboundary water governance in the European Union. Budapest: Pázmány Péter Catholic University; 2019.
36. Girons Lopez M. Information Needs for Water Resource and Risk Management: Hydro-meteorological data value and non-traditional information. Uppsala: Uppsala Univrsitet; 2016.
37. Skoulikaris C, Zafirakou A. River Basin Management Plans as a Tool for Sustainable Transboundary River Basins' Management. *Environmental Science and Pollution Research*. 2019:1-14.
38. Luther J, Hainsworth A, Tang X, Harding J, Torres J, Fanchiotti M. World Meteorological Organization (WMO) - Concerted International Efforts for Advancing Multi-hazard Early Warning Systems. In: Sassa K, Mikos M, Yin Y, editors. *Advancing Culture of Living with Landslides WLF 2017*. Ljubljana: Springer; 2017.
39. Clegg G, Haigh R, Amaratunga D, Rahayu HP. Flood Risk Early Warning and Decision Making in Indonesia and Europe. Unpublished project report; 2021.
40. Zeitoun M, Goulden M, Tickner D. Current and future challenges facing transboundary river basin management. *Wiley Interdisciplinary Reviews: Climate change*. 2013;4(5):331-49.
41. Rahayu HP, Zulfa KI, Khoirunnisa D, Haigh R, Amaratunga D. Unveiling Transboundary Challenges in the Ciliwung River Flood Management Under peer review. 2023.
42. Clegg G, Haigh R, Amaratunga D, Rahayu HP. Coordination Challenges Facing Effective Flood Governance in the Ciliwung River Basin. In: Triyanti A, Indrawan M, Nurhidayah L, Marfai MA, editors. *Environmental Governance in Indonesia*. Environment and Policy: Springer Nature; 2023. p. 313-27.
43. Clegg G, Haigh R, Amaratunga D, Rahayu HP. River governance and flood management arrangements in Indonesia 2020.
44. Vision Paper. Vision Paper for Improved Transboundary Governance for Flood Management in the Ciliwung River Basin, Indonesia. University of Huddersfield, Institute of Technology Bandung and Swansea University; 2023.
45. Rahayu et al. Peran Instansi dalam Sistem Peringatan Dini Banjir Pada DAS Ciliwung (Role of Institutions in Ciliwung Flood Early Warning System). Indonesia: ITB Press; 2022.
46. Rahayu HP, Zulfa KI, Khoirunnisa D, Haigh R, Amaratunga D. Closing the Gap in Flood Early Warning System using Structural Equation Modelling (SEM) with the Case Study Ciliwung River. Under peer review. 2023.

BRIEFING PAPER:
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This project is supported by the UK Natural Environment Research Council (Project Reference: NE/S003282/1), the Newton Fund, the UK Economic and Social Research Council, and the Ministry of Research, Technology & Higher Education of the Republic of Indonesia (RISTEK-BRIN)

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