

Review of Problems on River Basin Integrated Management Policies; Study Case Ternate City

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Abstract— Indonesia's rivers and watersheds are quickly degrading. Watershed land use functions have been changed because of population and economic expansion. This has increased peak flood flows and erosion along rivers. This problem demands a multi-stakeholder approach to minimize harm. Ternate is a medium-sized island city with a small land area and minimal water supply. Flood control is still in its infancy. There will be a water shortage in 2030 if the 150 liters per person per day need is not met. This paper conducts a literature evaluation on the problems surrounding the implementation of the Integrated Policy on River Basin Management. Until now, a few groups or stakeholders have controlled the implementation process. Monitoring and evaluation (monev) operations are still undervalued, resulting in underachieving river management objectives. In water resource management, failures can occur owing to a lack of collaboration and teamwork. Neither party wants to reinforce the other's responsibilities and actions. Working together has not yet produced ideal synergy. Flood and drought forecasting technologies are lacking, as is an early warning system to avoid fatalities. Technical and non-technical river management financing strategies are not effectively controlled. The lack of funds for operations and maintenance typically results in poor river basin management.

Keywords— Flood, Management Policy, Ternate, River Basin.

I. INTRODUCTION

The observed behavior indicates that the state of rivers and watersheds in Indonesia, such as the Citarum river, is deteriorating rapidly. Population growth and economic growth have resulted in the conversion of watershed land use functions, which has resulted in many river problems, including increased peak flood discharges, erosion, landslides, reduced base/mainstream discharge leading to drought, water allocation conflicts, increased pollution, growth of invasive vegetation, and the extinction of flora and fauna native to the river, as well as problems in the river space, such as accumulation of garbage, sedime, and sedimentation [1].

Urban areas are often affected by this flood calamity. The floods that transpired caused significant damage. For instance, the flooding in the capital at the beginning of 2020 was believed to have caused losses of around Rp 1 trillion. In order to minimize damages, this phenomena of flooding requires a specialized response involving several stakeholders. In dispute are not only economic sector losses, but also social and environmental damages [2].

The government has attempted to address this issue by technical (river engineering) and non-technical (education) preventative and control methods (community participation, and others). However, these two acts do not seem to have slowed the pace of river degradation, as river conditions continue to deteriorate and get farther apart from the optimum state required to offer optimal river functions for human life and environment. In addition, the lack of integration of planning documents across regions and the misalignment of these plans with the policy orientations outlined in the RPJMN (National Mid-Term Development Plan) are obstacles in and of themselves. In general, flood control is incomplete and not yet integrated.

Integrated river management, a component of integrated water resource management, is required to preserve the varied functions of rivers (IWRM) [3]. First, since the beginning of human civilization, rivers have served as a provider of water for domestic, urban, agricultural, industrial, and transportation infrastructure; as a source of electricity; as a tourist destination; and as a venue for sports, among other functions related to sociocultural life.

Based on Design Investigation Study Data and Details of Groundwater Utilization for Raw Water for Drinking Water in Ternate City 2017 from the River Basin, Ternate is classified as a medium-sized island city with an area of less than 200 kilometers and a width of less than 10 kilometers, and below-average water availability. If it is anticipated that the 150 liters per person per day water need applies to a population of more over 100,000 people, there will be a water shortage in 2030.

According to PDAM Ternate data, the company has 34 deep wells. One second of groundwater is pumped to a volume of 330 liters per second. So, one day, 30,000 cubic meters of water is drawn, which is equivalent to a football field six meters tall. If increased by a month, the volume of water taken in is equivalent to thirty 6-meter-tall football field-sized tubs.

The actual production capacity of PDAM Ternate is 425 liters per second, or around 1 million cubic meters per year. Customers of PDAM use an average of 28,250 connections per month, with a wasteful consumption rate of 29 cubic meters per connection per month. Using a family of five as an example, the average daily usage is 190 liters per person.

This demonstrates the need for more consistent management of water resources to minimize long-term effects such as prolonged droughts, river ecological degradation, etc. This research examines existing challenges in the field and

provides solutions for water resource management issues in the City of Ternate based on a literature review.

II. LITERATURE REVIEW

A. Flood Risk Management

The government's approach to flood management has not evolved from the early approach, which proposes a highly technical method of management in the shape of a flood control building structure [4]. By decreasing the water level, constructing sheet piling or embankments, and constructing water reservoirs to minimize river water runoff, this strategy is essentially merely attempting to treat the symptoms (symptoms) without addressing the causes fully [5]. The outcomes of structural handling seem genuine, and the influence may be witnessed rapidly, but safety assurances are restricted to the amount of discharge given by the design. Depending on the quantity of excessive precipitation that will fall from the sky, a water discharge larger than the design discharge may occur at any moment [6].

Non-technical or non-structural activities must acknowledge that they are insufficient to be a concern, lack a priority, are still restricted to discussion, and have not been systematically and massively implemented in the field [7]. The operations that develop in many sectors are sometimes inconsistent and frequently contribute to the escalation of flooding issues. Frequently, construction or development occurs in regions that are genuinely situated in floodplains, which should be regulated in line with the spatial use characteristics of the floodplain [8].

Frequently, the technological method to flood control is implemented without publicizing the limits of the structure's capabilities, and with the promise of being free of floods. With a structural strategy, conditions that seem secure lead to a tremendous increase of investment in the floodplain region [9]. When the technical handling capacity limit is surpassed, a flood destroys the invested assets, resulting in far bigger losses than prior to the technical handling [10].

It has never occurred to me to address the flood issue by gradually returning the floodplain to its original role, in line with the idea of managing space according to the floodplain's characteristics [11]. In reality, many flood plains have not been or have not been defined on the development plan map (Detailed Spatial Planning), resulting in persistent flooding issues in several regions [12].

The deployment of an early warning system for flood control is presently unavailable or has not been used adequately [13]. People often disregard the flood predictions and early warnings issued by the BMKG and other organizations. Informational-educational efforts to strengthen community resilience to floods have not been extensively implemented and must be enhanced [14].

Insufficient public awareness exists on the significance of safeguarding rivers. There must be an improvement in comprehension, followed by heightened public awareness, of

the fact that conserving rivers is not just the responsibility of the government [15]. The most important factor in influencing the state of the river is the community [16].

B. Drought Risk Management

Currently, the government's drought risk management is not anticipatory and is mostly reactive. The government's response is often sluggish, moving only when a drought is imminent (a drought of water resources) [17]; waiting for the complaints of farmers whose rice fields are puso and many people scavenging for water in dry rivers [18]. The therapy is not based on long-term planning, i.e., when the first signs of a meteorological drought become apparent. Not all interested parties were involved in the anticipation activities [19].

The lack of coordination and collaboration amongst stakeholders has resulted in unproductive and inefficient technical and non-technical activities [20], which are often even counterproductive. The activities automatically concluded when rain came and the drought situation was resolved. The nature of the handling performed in this manner will be repeated on a yearly basis as a normal exercise [21].

Important information concerning drought early warnings was either never sent, or it came late, after farmers had already planted rice in their fields, which perished as a result of the drought [22]. Due to a lack of coordination, a group of farmers often disobeys information concerning drought, resulting in confrontations over water quotas and crop failures, such as those caused by puso rice [23]. Accusations that the government is not working in a systematic way to combat drought based on recognizing the unique characteristics of drought in a region well in advance are readily triggered by such conduct [24].

C. River Pollution Control

Diverser and more abundant pollutant sources often end up flowing into rivers, resulting in chronic and progressively severe river pollution [25]. Numerous sources of pollution from activities in different sectors of the watershed may be categorized as point sources of pollution or non-point sources of pollution, which are managed reactively and sectorially [26]. As a consequence, the treatment of river pollution is limited to cleaning the river, with very little reaching the sources of pollutants emanating from diverse watershed activities [27].

With a relatively high pace of population expansion, both point and diffuse sources of pollution are also on the rise [28]. Before entering the river, nearly none of these contaminants undergo proper treatment or preventative measures, producing contamination along the riverbed [29]. In addition to not addressing the issue at its root, the integration of river management is hampered by the absence of stakeholder empowerment [30].

In addition, the ability of river management authorities for the prevention, control, and mitigation of indoor pollution is still quite limited [31]. Similarly, community knowledge and engagement in initiatives to reduce river water contamination remain very low [32].

III. METHODOLOGY

This study examines prior research on the issues surrounding the implementation of the Integrated Policy on River Basin Management through a literature review. Inferences may also be made on the methods that can be used to resolve problems with River Basin Management. The methods used in this study are Observation, Literature Study, Focused Group Discussion and In-Depth Interview with the community and stakeholders.

IV. RESULT AND DISCUSSIONS

A. Flood Problem Analysis

Urban regions are seeing a relatively high rate of population expansion, which is boosting the need for housing and urban infrastructure. As a consequence, land cover rapidly transitions from natural land cover to an urban construction stretch. As a result of a reduction in land cover, runoff will grow, making the section of the river downstream perpetually threatened by rising flood levels. Simultaneously, the river channel's capacity decreases owing to siltation caused by sediment deposits and the buildup of solid waste, or rubbish piles. The decrease in river channel capacity is also exacerbated by the pressure of building growth protruding into the riverbed, the construction of bridges with too low a threshold, and culverts whose elevation is too high or whose dimensions are too small and do not account for the potential for flow caused by the occurrence of extreme rainfall. Due to the growth in urban pavement layers, the capacity of the earth to absorb water is also diminishing.

The shift in land cover to become more impermeable to water, particularly in metropolitan areas, caused the annual maximum flood discharge to be surpassed more often as a consequence of the growing annual maximum flood discharge. By adhering to the Zero Delta Q policy idea, which tries to prevent major fluctuations to the yearly maximum discharge via sustainable city design, building layout, and drainage, as well as the creation of infiltration zones and retention ponds, a similar situation may be averted.

The floodplain, which should operate as a flood catchment region, has been used for activities that are not consistent with the floodplain's features. Even if it is to be exploited, the floodplain is only acceptable for a limited designation that corresponds to the features of the floodplain, which will be flooded for a short duration. Existing errors in usage must be rectified and maintained so that the flood scenario does not worsen the issue. It is possible to establish policies and strategies for the use of space in the floodplain that seek to decrease hazards while still allowing for the use of space in the floodplain.

Since the Dutch colonial era, it is believed that flooding has been managed more physically via the creation of

infrastructure or physical structures based on the principle of keeping water away from the population. Included in the constructed infrastructure are diversion, levee, river enhancement, sluice gates and pumps (polder), and reservoir dams. This did not address the issue.

B. Influential Factors

In river management activities, several weaknesses and operational problems can be identified related to institutions, policies, financing, coordination, commitment, and community participation. Flood management aims to reduce the risk that occurs due to flooding. Flood problems basically occur due to four factors, as follows:

1. Natural factors, namely factors that are "given by God", which are formed naturally and are difficult for human intervention, These factors include: climate change; extreme rainfall and storms; prolonged drought; high tides and rob; tsunamis; and the geographical location and condition and topography of the land, as well as the geological character.
2. Anthropogenic factors, namely factors related to human behavior and activities or actions, These factors include: the level of awareness and concern of the community in the use of space and land in the catchment area and in the floodplain; garbage disposal; buildings protruding into the river space; and behavior that results in the effect of global warming.
3. Technical Factors: namely factors related to technological engineering and the consequences thereof These factors are: availability and condition of flood control infrastructure and facilities; irregularities in city utilities; quality of planning; availability of operating procedure systems; and performance of infrastructure maintenance.
4. Administrative and governance factors, including unclear boundaries of the division of tasks and responsibilities between government agencies, capacity of management institutions, and law enforcement performance, as well as the quality of communication and coordination between agencies/institutions

The second to fourth factors above are very possible and should be changed, repaired, or intervened in by humans in order to minimize the potential flood risk that arises as a consequence of the first factor. Intervention actions can be carried out in various ways and forms of structural and non-structural engineering.

On this occasion, the focus of attention will be directed to issues related to coordination, monitoring and evaluation, and stakeholder participation, which are an important part of

integrated water resources management (IWRM at river basin level).

C. Issues in Policy Implementations

The problems in implementing this integrated management policy are as follows:

1. First, the main actors in implementing activities have so far been dominated by a few parties or stakeholders. Generally, the activities carried out do not involve other stakeholders, such as the business world, the community, or universities. Whereas in the management of water resources such as rivers, all activities that have been and will be carried out by each stakeholder should need to be collaborated in an integrated strategy.
2. Second, the water resources management that has been implemented does not yet have a shared vision as a reference or orientation in implementing and developing activities. The intended vision must be developed jointly by the stakeholders through a visioning process. Integration and coordination must be born of awareness built by a vision that has been mutually agreed upon by stakeholders
3. Third, in improving the performance of water or river resource management, so far all experiences experienced and documented by stakeholders, either before or during carrying out activities, have not been learned (lesson-learned). In the multi-stakeholder approach, there is an obligation to conduct joint learning based on the necessity for each stakeholder to share basic knowledge.
4. Fourth, in the various implementations of water or river resource management activities, it seems as if the integration has been implemented when each ministry/institution coordinates at the planning and policy level. It turns out that at the operational level, integration never occurs and the sectoral ego practices actually take place with a vengeance. Integration in the management of water resources should start from the lowest appropriate level.
5. Fifth, monitoring and evaluation (monev) activities are still being underestimated, so that river management activities do not achieve the expected goals. Prior to monitoring and evaluation, all implementing elements should understand in detail the objectives, targets, details of activities, expected results, along with product specifications, all of which are summarized in the criteria and grid for monitoring and evaluation.
6. Sixth, in the management of water resources or rivers, failures are often encountered due to failure to develop cooperation and work together. Each party wants to highlight its work performance, and not reinforce each other's roles and activities of each stakeholder. Cooperation and joint work so far have not been able to produce optimal synergies.
7. Seventh, the problems handled by programs and activities for managing water or river resources are only based on pragmatism, so that only activities that can be realized quickly, can be seen with the naked eye, and which are easy or routinely often implemented. As a result, what is handled is not the cause of the problem but only the symptoms of the problem (symptoms).
8. Eighth, the shared roles and responsibilities are not yet optimal. The implementation of river management carried out by various stakeholders has not been based on the actual division of roles and responsibilities of each party from the top to the lowest hierarchy. Because of this, there is overlapping or duplication of activities, or even a problem that no one handles at all to solve.
9. Ninth, the coordination in the handling and control of floods and droughts as well as pollution has not been effective yet by the relevant agencies. Institutions at the policy level (Ministries and Institutions), coordination level (National Water Resources Council and Provincial Water Resources Council) as well as at the operational level (River Area Hall, TKPSDA/Coordination Team for Water Resources Management, and others) have not implemented duties and roles to the fullest, in this case can be seen from the impact caused by floods and droughts as well as pollution. Procedures for anticipating floods and droughts, as well as an early warning system for floods to prevent casualties and other negative impacts have not been implemented properly.
10. Tenth, river management has not implemented appropriate technology. Structural and non-structural development issues are still a fierce debate between sectors, regions, and stakeholders. Even though both are needed, they must be at the appropriate and appropriate locus. Existing programs in handling floods, droughts, and river pollution have not been balanced between structural and non-structural approaches. In the sense that the water resources infrastructure development program has not been harmonized with social activities such as providing socialization. and educating the public about the importance of maintaining water resources and water resources infrastructure that can reduce losses due to the disaster.
11. Eleventh, the financing in river management is not commensurate with the need to ensure the sustainability of the river ecosystem so that its function is maintained in the long term (sustainability). The limited budget for operations and maintenance is often the cause of neglect of river basin management. Financing mechanisms for river management, both technically and non-technically, have not been adequately regulated. Constraints in smooth financing

will affect the effectiveness of river management to control the risk of flooding, drought, and pollution.

12. Twelfth, the ineffective coordination of planning, management, and control of floods, droughts, and river pollution causes river degradation to continue. Institutional and regulatory instruments that have just been ratified (Law Number 17 of 2019 concerning Water Resources) are still waiting for their derivative regulations to be implemented. As a result, coordination at the National level by Ministries/Agencies and the National Water Resources Council, as well as coordination at the regional level at the Provincial and River Basin levels (TKPSDA) has not run optimally. This can be indicated by the impact caused by floods, droughts, and early warning systems to prevent casualties.

V. CONCLUSIONS

Based on the observation, literature study, focus group discussion, and in-depth interview with the community and stakeholders, the problems in implementing this integrated management policy are; the main actors in implementing activities have so far been dominated by a few parties or stakeholders. Monitoring and evaluation (money) activities are still being underestimated, so that river management activities do not achieve the expected goals. The coordination in the handling and control of floods and droughts as well as pollution has not been effective yet by the relevant agencies.

REFERENCES

- [1] M. Parés, Q. Brugué, ... J. E.-E. P., and undefined 2015, "The strengths and weaknesses of deliberation on river basin management planning: analysing the water framework directive implementation in Catalonia (Spain)," *Wiley Online Libr.*, Accessed: May 13, 2022. [Online]. Available: <https://onlinelibrary.wiley.com/doi/abs/10.1002/eet.1662>
- [2] F. J.-W. policy and undefined 2003, "Institutional arrangements for integrated river basin management," *iwaponline.com*, vol. 5, pp. 77–90, 2003, Accessed: May 13, 2022. [Online]. Available: <https://iwaponline.com/wp/article-abstract/5/1/77/11565>
- [3] A. Grindlay, M. Zamorano, M. Rodríguez, E. M.-L. use policy, and undefined 2011, "Implementation of the European Water Framework Directive: Integration of hydrological and regional planning at the Segura River Basin, southeast Spain," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0264837710000670>
- [4] T. Giakoumis and N. Voulvoulis, "The Transition of EU Water Policy Towards the Water Framework Directive's Integrated River Basin Management Paradigm," *Environ. Manage.*, vol. 62, no. 5, pp. 819–831, Nov. 2018, doi: 10.1007/S00267-018-1080-Z.
- [5] U. Förstner, H. Hollert, M. Brinkmann, K. Eichbaum, R. Weber, and W. Salomons, "Dioxin in the Elbe river basin: policy and science under the water framework directive 2000–2015 and toward 2021," *Environ. Sci. Eur.*, vol. 28, no. 1, Dec. 2016, doi: 10.1186/S12302-016-0075-8.
- [6] K. Blackstock, C. R.-W. policy, and undefined 2007, "Evaluating stakeholder involvement in river basin planning: a Scottish case study," *iwaponline.com*, Accessed: May 13, 2022. [Online]. Available: <https://iwaponline.com/wp/article-abstract/9/5/493/31235>
- [7] F. Wang, X. Mu, R. Li, L. Fleskens, ... L. S.-S. of the T., and undefined 2015, "Co-evolution of soil and water conservation policy and human–environment linkages in the Yellow River Basin since 1949," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0048969714016374>
- [8] M. Lemos, J. D. O.-W. development, and undefined 2004, "Can water reform survive politics? Institutional change and river basin management in Ceará, Northeast Brazil," *Elsevier*, doi: 10.1016/j.worlddev.2004.08.002.
- [9] J. Sendzimir, Z. Flachner, C. P.-W.-... S. & Policy, and undefined 2010, "Stalled regime transition in the upper Tisza River Basin: the dynamics of linked action situations," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S1462901110001152>
- [10] T. Giakoumis, N. V.-E. management, and undefined 2018, "The transition of EU water policy towards the Water Framework Directive's integrated river basin management paradigm," *Springer*, Accessed: May 13, 2022. [Online]. Available: <https://link.springer.com/article/10.1007/s00267-018-1080-z>
- [11] H. Nielsen, P. Frederiksen, H. Saarikoski, A. R.-L. use policy, and undefined 2013, "How different institutional arrangements promote integrated river basin management. Evidence from the Baltic Sea Region," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0264837712000725>
- [12] J. A. Gómez-Limón, M. Arriaza, and A. J. Villanueva, "Typifying irrigated areas to support policy design and implementation: The case of the Guadalquivir river basin," *Irrig. Drain.*, vol. 62, no. 3, pp. 322–329, Jul. 2013, doi: 10.1002/IRD.1747.
- [13] D. Te Boekhorst, T. Smits, X. Yu, L. Li, ... G. L.-E. and, and undefined 2010, "Implementing integrated river basin management in China," *JSTOR*, Accessed: May 13, 2022. [Online]. Available: <https://www.jstor.org/stable/26268137>
- [14] J. Tippett, B. Searle, C. Pahl-Wostl, Y. R.-E. science & policy, and undefined 2005, "Social learning in public participation in river basin management—early findings from HarmoniCOP European case studies," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S1462901105000389>
- [15] M. Barbosa, S. Mushtaq, K. A.-E. S. & Policy, and undefined 2017, "Integrated water resources management: Are river basin committees in Brazil enabling effective stakeholder interaction?," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S1462901116302477>
- [16] K. A. Mourad, L. Ribbe, O. George, M. Metobwa, and K. A. Mourad, "Water demand simulation using WEAP 21: a case study of the Mara River Basin, Kenya," *Kenya. Int. J. Nat. Resour. Ecol. Manag.*, vol. 3, no. 1, pp. 9–18, 2018, doi: 10.11648/j.ijnrem.20180301.12.
- [17] X. Song, W. Ravesteijn, ... B. F.-W. S. and, and undefined 2010, "Managing water resources for sustainable development: the case of integrated river basin management in China," *iwaponline.com*, Accessed: May 13, 2022. [Online]. Available: <https://iwaponline.com/wst/article-abstract/61/2/499/16088>
- [18] Ş. Delipinar, M. K.-E. S. & Policy, and undefined 2017, "Policy, legislative and institutional assessments for integrated river basin management in Turkey," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S1462901116301149>
- [19] F. Bouckaert, Y. Wei, K. Hussey, ... J. P.-C. O. in, and undefined 2018, "Improving the role of river basin organisations in sustainable river basin governance by linking social institutional capacity and basin biophysical capacity," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S1877343518300046>
- [20] C. C. Flores, V. Vikolainen, H. B.- Water, and undefined 2016, "decentralisation and river basin management reforms in hierarchical systems: do they work for water treatment policy in Mexico's Tlaxcala Atoyac Sub-basin?," *mdpi.com*, 2016, doi: 10.3390/w8050210.
- [21] C. Flores, G. Özerol, H. B.-U. Policy, and undefined 2017, "'Governance restricts': A contextual assessment of the wastewater treatment policy in the Guadalupe River Basin, Mexico," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S095717871630>

- 2880
- [22] M. Parés, Q. Brugué, J. Espluga, J. Miralles, and A. Ballester, "The Strengths and Weaknesses of Deliberation on River Basin Management Planning: Analysing the water framework directive implementation in Catalonia (Spain)," *Environ. Policy Gov.*, vol. 25, no. 2, pp. 97–110, Mar. 2015, doi: 10.1002/EET.1662.
- [23] R. Srinivas, A. P. Singh, and D. Shankar, "Understanding the threats and challenges concerning Ganges River basin for effective policy recommendations towards sustainable development," *Environ. Dev. Sustain.*, vol. 22, no. 4, pp. 3655–3690, Apr. 2020, doi: 10.1007/S10668-019-00361-0.
- [24] N. Sommerwerk, J. Bloesch, ... M. P.-M. and, and undefined 2010, "Managing the world's most international river: the Danube River Basin," *CSIRO Publ.*, Accessed: May 13, 2022. [Online]. Available: <https://www.publish.csiro.au/MF/MF09229>
- [25] Y. Meng, M. Liu, X. Guan, and W. Liu, "Comprehensive evaluation of ecological compensation effect in the Xiaohong River Basin, China," *Environ. Sci. Pollut. Res.*, vol. 26, no. 8, pp. 7793–7803, Mar. 2019, doi: 10.1007/S11356-019-04208-Z.
- [26] J. Liu, X. Zhao, H. Yang, Q. Liu, ... H. X.-J. of C., and undefined 2018, "Assessing China's 'developing a water-saving society' policy at a river basin level: a structural decomposition analysis approach," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0959652618312307>
- [27] P. Quevauviller, D. Barceló, ... M. B.-S. of the T., and undefined 2012, "Integration of research advances in modelling and monitoring in support of WFD river basin management planning in the context of climate change," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0048969712010005>
- [28] R. Srinivas, A. Singh, D. S.- Environment, D. and, and undefined 2020, "Understanding the threats and challenges concerning Ganges River basin for effective policy recommendations towards sustainable development," *Springer*, Accessed: May 13, 2022. [Online]. Available: <https://link.springer.com/article/10.1007/s10668-019-00361-0>
- [29] J. Sendzimir, P. Magnuszewski, ... P. B.-E. M. &, and undefined 2007, "Anticipatory modeling of biocomplexity in the Tisza River Basin: first steps to establish a participatory adaptive framework," *Elsevier*, 2006, doi: 10.1016/j.envsoft.2005.12.032.
- [30] J. Gómez-Limón, ... M. A.-I. and, and undefined 2013, "Typifying irrigated areas to support policy design and implementation: The case of the Guadalquivir river basin," *Wiley Online Libr.*, Accessed: May 13, 2022. [Online]. Available: <https://onlinelibrary.wiley.com/doi/abs/10.1002/ird.1747>
- [31] F. Hüesker, T. M.-L. U. Policy, and undefined 2015, "The politics of multi-scalar action in river basin management: implementing the EU Water Framework Directive (WFD)," *Elsevier*, Accessed: May 13, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0264837714001495>
- [32] B. Hooper, *Integrated river basin governance*. 2005. Accessed: May 13, 2022. [Online]. Available: <https://library.oapen.org/handle/20.500.12657/30983>