JURNAL PENATAAN RUANG Vol. 19, No. 1, (2024) Special Edition, Community and Infrastructure Development in Urban Area ISSN: 2716-179X (1907-4972 Print)
DOI : http://dx.doi.org/10.12962/j2716179X.v19i0.20828
Received : 31/07/2024, Reviewed: 02/08/2024 , Accepted : 06/08/2024

A Systematic Review of Participatory Approaches in Flood Risk Management: Methods and Applications

Gita Rama Mahardhika, Adjie Pamungkas
Departemen Perencanaan Wilayah dan Kota, Institut Teknologi Sepuluh Nopember, Surabaya
e-mail: adjie@urplan.its.ac.id

***Abstract*—Flood risk management (FRM) increasingly integrates participatory approaches to enhance resilience and effectiveness by engaging local communities and stakeholders. This systematic review synthesizes findings from 22 peer-reviewed articles published between 2015 and 2024, highlighting the tools, stakeholders, levels of participation, outcomes, and challenges associated with participatory FRM. The review identifies key engagement tools such as participatory mapping, community workshops, and digital platforms, noting their varied effectiveness in different contexts. Stakeholder involvement spans residents, government agencies, and NGOs, with diverse contributions enhancing the contextual relevance and acceptance of FRM strategies. Levels of participation range from consultative to collaborative and fully empowering, with higher engagement linked to more resilient and adaptive outcomes, albeit requiring more resources and time. Outcomes demonstrate that participatory approaches improve community preparedness, enhance flood management plans, and integrate local knowledge effectively. However, challenges persist, including resource constraints, stakeholder conflicts, and communication barriers, necessitating adaptive management and innovative engagement strategies. The findings underscore the need for policymakers and practitioners to prioritize participatory methods to develop inclusive and robust FRM frameworks. Future research should focus on scalable participatory models, the integration of advanced technologies, and the evaluation of long-term impacts on community resilience, providing a roadmap for the enhanced application of participatory approaches in diverse contexts.**

***Keywords*—participatory approaches, flood risk management, stakeholder engagement, community resilience, systematic review**

I. INTRODUCTION

Floods are among the most devastating natural disasters, causing significant loss of life and property, as well as long-term socioeconomic disruptions [1]. In response, extensive efforts have been made by researchers and practitioners to develop effective flood risk management strategies and techniques to safeguard vulnerable populations and mitigate the impacts of these events. Flood risk management involves a comprehensive approach that encompasses hazard assessment, vulnerability analysis, and the implementation of various structural and non-structural measures to reduce the adverse consequences of flooding [2].

Amidst this evolving landscape, participatory approaches have gained increasing recognition as a critical component of flood risk management [3]. A growing recognition of the limitations of traditional top-down, expert-driven flood risk management approaches has led to an increased emphasis on the importance of participatory approaches [3]. Participatory approaches involve the active engagement of local communities, stakeholders, and diverse actors in the planning, decision-making, and implementation of flood risk management initiatives [4]. These participatory approaches have been recognized for their ability to leverage local knowledge, build community resilience, and foster a sense of ownership among the affected populations, all of which can contribute to more effective, sustainable, and equitable outcomes in flood risk management [3].

This shift has been influenced by the broader recognition of the value of inclusive, collaborative approaches in environmental and disaster management [4]. Participatory approaches have become increasingly relevant in the context of sustainable development, as they align with the principles of community empowerment, environmental sustainability, and equitable resource allocation [5]. This review paper aims to provide a overview of the role of participatory approaches in flood risk management, highlighting the tools utilized, subject involved, level of participation, outcomes and effectiveness, and the challenges to provide an overview of the implementation of the participatory concept in flood risk management.

II. RESEARCH METHOD

Conduct systematic literature review is crucial for synthesizing and analyzing the existing research on participatory approaches in flood risk management [3]. This methodology section outlines the steps taken to rigorously gather and evaluate relevant studies, with the goal of providing a comprehensive understanding of the methods and applications of participatory approaches in this domain.

A systematic literature review is an essential tool for academic research, as it allows for a structured and comprehensive examination of the available literature on a particular topic[4]. The review process involves formulating research questions, developing a comprehensive search strategy, selecting relevant studies, and synthesizing the findings to draw meaningful conclusions.

In the context of this research, the systematic review aims to identify and analyze studies that explore the use of participatory approaches in flood risk management [6]. To

JURNAL PENATAAN RUANG Vol. 19, No. 1, (2024) Special Edition, Community and Infrastructure Development in Urban Area ISSN: 2716-179X (1907-4972 Print)

facilitate the literature search and data collection process, the study utilized Publish or Perish, a software tool that allows researchers to search and analyze academic publications from various databases, including Scopus. Publish or Perish provides a range of functionalities, such as extracting citation data, analyzing citation metrics, and enabling the scraping of publication sources.

The decision to use Publish or Perish was based on its ability to efficiently gather and synthesize relevant academic literature, which is essential for conducting a thorough review of the field (Mercer et al., 2008). The search query used in Publish or Perish was: ("Participatory approaches" OR "Stakeholder engagement" OR "Public participation" OR "Community-based management" OR "Collaborative management") AND ("Watershed management" OR "Flood risk management" OR "Environmental management"). This query was designed to capture a broad range of studies that address participatory approaches in the context of flood risk management, watershed management, and environmental management more broadly. The rationale behind the chosen keywords is to ensure a comprehensive and relevant search, capturing studies that explore various participatory methodologies and their applications in addressing flood-related challenges across different domains.

The data collection process involved using the free version of Publish or Perish, which restricts the number of articles retrieved to 200. The data collected covers publications from 2015 to 2024, providing a recent and relevant snapshot of the research in this field. The collected data was analyzed to identify and select the most relevant studies for the review. The selection criteria focused on studies that explicitly examined participatory approaches in the context of flood risk management, including methodologies, case studies, and assessments of the effectiveness of such approaches. The analysis also involved synthesizing the key findings and insights from the selected studies to develop a comprehensive understanding of the current state of research in this area.

While Publish or Perish is a useful tool for gathering a large amount of literature data [7], it's crucial to remember that not all data retrieved will be relevant to the specific research question. To ensure relevancy, a process to screen the articles is compulsory. The screening is conducted by checking the accessibility and relevance based on the abstract.

Participatory approaches have become increasingly recognized as a critical component in community-based planning and decision-making processes. These approaches aim to actively engage local stakeholders, integrate their knowledge and perspectives, and foster shared ownership of outcomes. To better understand the dynamics of participatory planning, this research paper examines six key variables:

A. Tools of Engagement;

The methods and tools used to facilitate community participation and gather local knowledge are critical to the success of the process. These may include surveys, focus groups, participatory mapping, workshops, community meetings, and online platforms, among others. The choice and implementation of these tools can significantly impact the breadth and depth of community involvement [8], [9]

B. Subject Involved;

The types of stakeholders and community members involved in the participatory process are also a key factor. Indicators include the demographics, representation (e.g., local residents, government officials, NGOs, experts), and the specific roles they play in the process. Ensuring diverse and inclusive participation is essential for capturing a range of perspectives [8], [10].

C. Level of Community Participation;

The extent and depth of community involvement in the process is crucial that can be assessed through indicators like the number of participants, the diversity of stakeholders, the frequency of engagement activities, and the overall inclusiveness. The level of participation may range from simply informing the community to fully empowering them in decision-making [8], [10].

D. Outcomes and Effectiveness;

The tangible results and impacts of the participatory approaches are important to evaluate (Prins, 2005; Lladó et al., 2014). Success metrics, improvements in plans or actions, community satisfaction, and feedback are all indicators of the effectiveness of these methods [9], [10]

E. Challenges And Limitations.

The difficulties encountered in implementing participatory approaches must also be considered [10], [11]. Reported obstacles, limitations in community engagement, and areas needing improvement provide insights into the challenges of putting these methods into practice.

JURNAL PENATAAN RUANG Vol. 19, No. 1, (2024) Special Edition, Community and Infrastructure Development in Urban Area ISSN: 2716-179X (1907-4972 Print)

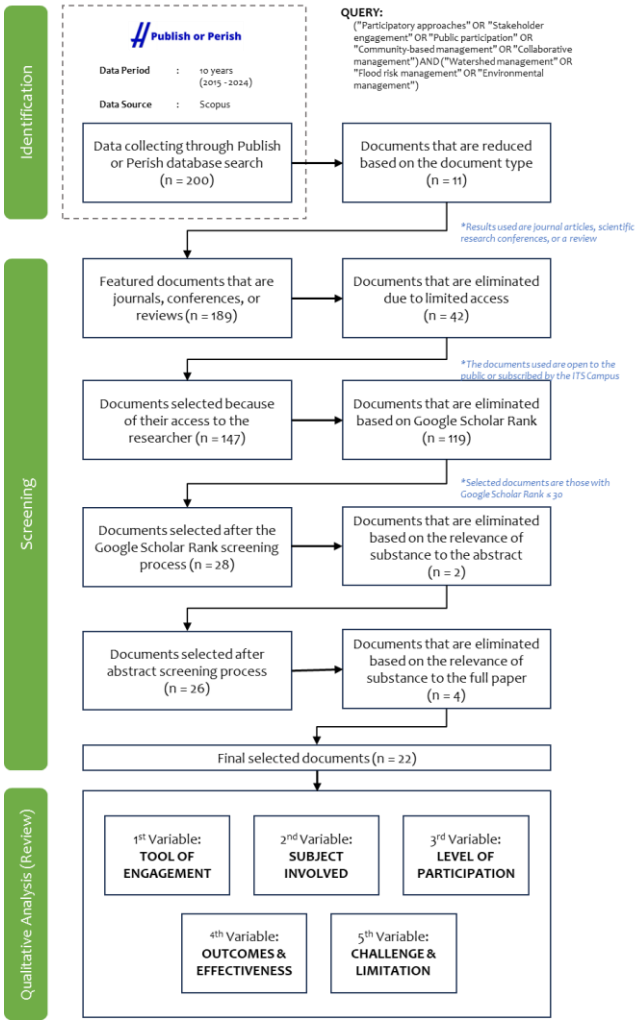

Figure 1. Systematic Literature Review Process

III. RESEARCH ANALYSIS

The search results on the Scopus database using Publish or Perish resulted in 200 documents with 164 documents in the form of journal articles, 15 review documents, 10 conference documents, 9 book chapter documents, and 1 conference review and editorial document each. Within 10 years, the published documents collected tended to be evenly distributed with the year with the most results in 2018 as many as 32 documents.

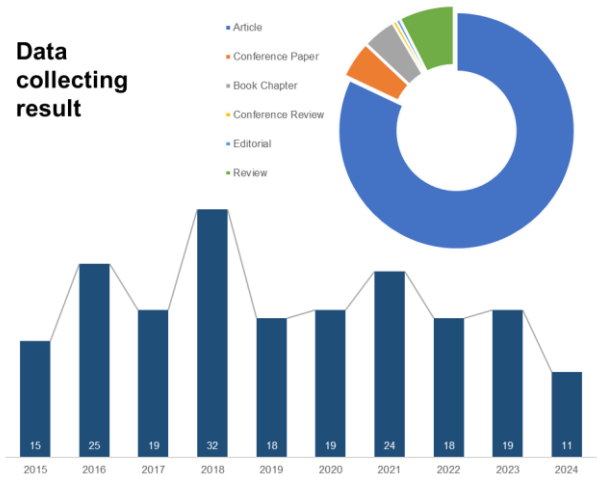

Figure 2. Data collecting result

Based on the selection process carried out, the original 200 documents were reduced to 26. The reduction process is divided into 4 stages, namely: (1) reduction based on the type of document type; (2) reduction based on the disclosure of document access; (3) reduction based on article quality based on Google Scholar Ranking; and (4) reduction based on topic relevance from abstract substance. The 26 articles were then reviewed based on the six variables selected.

Table 1. List of reviewed documents

No	Title	Year	Cites
1	A participatory system dynamics modeling approach to facilitate collaborative flood risk management: A case study in the Bradano River (Italy) [12]	2020	45
2	Building climate change resilience through bottom-up adaptation to flood risk in Warri, Nigeria [13]	2015	43
3	Coproducing flood risk management through citizen involvement: Insights from cross-country comparison in Europe [14]	2016	83
4	Current flood risk management practices in Ghana: Gaps and opportunities for improving resilience [15]	2020	40
5	Exploring the potential impact of serious games on social learning and stakeholder collaborations for transboundary watershed management of the St. Lawrence river basin [16]	2016	74
6	Flood Risk Management as a public or a private good, and the implications for stakeholder engagement [17]	2016	67
7	Flood hazard assessment and the role of citizen science [18]	2019	37
8	Flood vulnerability, local perception and gender role judgment using multivariate analysis: A problem-based “participatory action to Future Skill Management” to cope with flood impacts [19]	2017	43
9	Governing for integrated water and flood risk management: Comparing top-down and bottom-up approaches in Spain and California [20]	2016	44
10	Modelling the complexity of the network of interactions in flood emergency management: The Lorca flash flood case [21]	2017	40
11	Multi-level stakeholder engagement in flood risk management-A question of roles and power: Lessons from England [22]	2016	103
12	Participation in flood risk management and the potential of citizen observatories: A governance analysis [23]	2015	145

No	Title	Year	Cites
13	Participatory early warning and monitoring systems: A Nordic framework for web-based flood risk management [24]	2018	47
14	Participatory modelling for stakeholder involvement in the development of flood risk management intervention options [3]	2016	67
15	Recurrent Governance Challenges in the Implementation and Alignment of Flood Risk Management Strategies: a Review [25]	2016	58
16	Resilience in Flood Risk Management - A New Communication Tool [26]	2016	40
17	Stakeholders' views on natural flood management: Implications for the nature-based solutions paradigm shift? [27]	2021	46
18	The influence of tailored risk communication on individual adaptive behaviour [28]	2020	36
19	The role of local stakeholder participation in flood defence decisions in the United Kingdom and Germany [29]	2018	37
20	Typologies of citizen co-production in flood risk governance [30]	2018	39
21	Using causal loop diagrams for the initialization of stakeholder engagement in soil salinity management in agricultural watersheds in developing countries: A case study in the Rechna Doab watershed, Pakistan [31]	2015	147
22	"We can't do it on our own!"—Integrating stakeholder and scientific knowledge of future flood risk to inform climate change adaptation planning in a coastal region [32]	2020	37

A. Tools of Engagement

The tools of engagement used in participatory FRM activities vary widely across the 22 papers. The following is a list of tools used in the identified participatory process:

Table 2. Tool of engagement in participatory FRM

Tool	Frequency
Community Meetings and Workshops	12
Participatory Mapping and GIS	8
Mobile Applications and Online Platforms	5
Collaborative Decision-Making/Scenario Planning	10
Focus Group Discussions	3
Social Learning Platforms/Serious Game	2
Public Hearings	1
Surveys and Questionnaires	6

From the tool options in the table above, media surveys and questionnaires are the most common tools that many people know. Surveys and questionnaires can be valuable tools for collecting data and insights from a broad range of stakeholders, including community members, local authorities, and experts [33]. This information can inform the identification of flood-related priorities, the assessment of risk perceptions, and the evaluation of the effectiveness of participatory approaches. Surveys and questionnaires are generally considered less interactive compared to tools like workshops, simulations, or focus group discussions.They are best used in participatory flood risk management to gather structured feedback from a large number of stakeholders, understand risk perceptions, or evaluate the effectiveness of implemented strategies. For example, you can use surveys to gather widespread community input on flood experiences, concerns, and preferences for mitigation measures; assess the level of awareness about flood risks and preparedness measures within the community; or even evaluate the effectiveness of past flood management projects or communication campaigns.

This tool could be improved by the adoption of online platforms with interactive elements, one of them could be in the form of mobile applications and online platforms. Mobile applications and online platforms can serve as effective tools for participatory flood risk management, enabling real-time data sharing, communication, and collaborative problem-solving. These digital tools can empower communities to collectively monitor, analyze, and respond to flood-related issues [34]. Mobile technology facilitates continuous contact and transforms communication [35]. The integration of mobile applications and online platforms into conventional data collection methods, such as surveys and questionnaires, presents an exciting opportunity to enhance engagement and gather more insightful responses from participants. Mobile technology enables continuous contact and transforms communication, which can be leveraged to make data collection more interactive and user-friendly [36].

Aside from survey and questionnaires, in participatory FRM activity in the form of meeting is also utilized, they might have different nomenclature such as community meeting and workshop, public hearing, or focus group discussion (FGD).

Community meetings and workshops are a fundamental component of participatory flood risk management, providing a platform for stakeholders to come together, share knowledge, and collaboratively identify and address flood-related challenges [4]. These forums enable the integration of local knowledge and perspectives into the risk assessment and decision-making processes, fostering a sense of ownership and empowerment among community members [5]. The other format is FGD which provide an intimate setting for stakeholders to engage in in-depth discussions, share their experiences, and collectively explore flood-related challenges and solutions that can unveil nuanced insights that may not emerge in larger public forums [33]. Meanwhile, public hearings is a platform for community members to

JURNAL PENATAAN RUANG Vol. 19, No. 1, (2024) Special Edition, Community and Infrastructure Development in Urban Area ISSN: 2716-179X (1907-4972 Print)

voice their concerns, share their knowledge, and actively participate in shaping decisions related to flood risk management. The critical role of public in FRM [37] can be facilitated by a public hearings that provide a structured setting for incorporating these firsthand experiences and community insights into the development and implementation of flood mitigation strategies.

While public hearings, focus group discussions, and community meetings/workshops all involve public participation, they differ in format, level of interaction, and overall goal. Public hearings are generally formal events with a structured format, often dictated by legal requirements [38]. They primarily serve as a platform for stakeholders to publicly voice their opinions or concerns to decision-makers. The level of participation is often limited to one-way communication, with individuals presenting their views and decision-makers listening. For FGD, there are more intimate and interactive [39] where they involve a smaller, carefully selected group of participants engaged in a guided discussion on a specific topic. The focus is on gathering in-depth qualitative data and understanding participants' perspectives and experiences. Meanwhile community meetings/workshops are designed to be more collaborative and solutions-oriented where they bring together community members, sometimes with local authorities and experts, to discuss issues, share information, and work together to generate ideas or solutions. These meetings encourage active participation and two-way communication [40]. Therefore, the level of participation increases as we move from public hearings, which are generally more formal and one-sided, to focus group discussions that allow for more in-depth interaction, and finally to community meetings/workshops, which emphasize collaboration and joint problem-solving.

The other tools that appear in the review such as participatory mapping in GIS, social learning platforms/serious game, collaborative decision-making, are variation that utilized within the community meeting/workshop to create a better discussion to facilitate the different understanding and interest of each stakeholders. The variety of tools used indicates a trend towards integrating both traditional and modern methods to engage communities effectively. While community meetings and workshops remain popular for their direct interaction benefits, technological tools like participatory GIS and mobile apps are gaining traction for their ability to gather and disseminate information efficiently. The choice of tools often depends on the context, available resources, and the specific objectives of the participatory process.

B. Subjects Involved

In the process of reviewing 22 documents, it is known that the variations of stakeholders that emerge are as follows:

Figure 3. Word cloud of participatory FRM's stakeholders

There are 31 terms that found in the review process. The inclusion of a wide range of stakeholders is crucial for comprehensive flood risk management. Effective participatory FRM requires coordination and collaboration among all these groups to address the multifaceted nature of flood risks. Coordination and collaboration need to be formed through the fulfillment of pentahelix aspects, including academia, government, industry, civil society, and media [41]. Not all studies involve the five pentahelix elements, the majority of the case studies reviewed involve elements of civil society and government so that the FRM paradigm shifts from top-down to bottom-up. The elements of academia, industry, and media can only be seen from a few cases, even though in terms of their respective contributions, they have their own significance.

Firstly, the academic stakeholders play a crucial role in providing scientific expertise, research, and technical knowledge to inform the decision-making process [3]. In this category, the actors found within the document are researcher, technical expert, environmental scientist, and urban planner. Researchers can contribute by studying the causes and impacts of floods, developing flood risk assessment methodologies, and evaluating the effectiveness of different flood risk management strategies. Technical experts can provide their expertise in areas such as hydraulic modeling, flood forecasting, and engineering design to support the development and implementation of flood mitigation measures. Environmental scientists can assess the ecological impacts of floods and flood management interventions, and provide guidance on nature-based solutions for flood risk reduction. Urban planners can incorporate flood risk considerations into land use planning and urban design, promoting flood-resilient development and reducing exposure to flood hazards. All of these roles fall under the broad category of "academia," which plays a crucial role in flood risk management by providing scientific expertise, research, and technical knowledge [1].

Secondly, the government stakeholders are responsible for policymaking, regulation, and coordination of flood risk management efforts [42]. They can leverage their authority and resources to facilitate stakeholder engagement, implement flood mitigation strategies, and ensure the equitable distribution of resources and responsibilities. Identified actors in the review process that fall into the government category are infrastructure authorities, flood management agency/flood authority, local government,

JURNAL PENATAAN RUANG Vol. 19, No. 1, (2024) Special Edition, Community and Infrastructure Development in Urban Area ISSN: 2716-179X (1907-4972 Print)

national government, municipal authority, government official, water agency, local water department, public administraion, decision-makers, emergency services, and environmental agency. This variety of nomenclature is influenced by actors who have flood management authority in each location/country.

Thirdly, the industry stakeholders, such as infrastructure providers and private businesses, can contribute their technical and financial resources to support flood risk management initiatives [41]. Their involvement can lead to the development of innovative solutions and the identification of cost-effective measures. The industry stakeholders that identified are farmer, agricultural agency, tourist complexes, healthcare, and school.

Fourthly, the civil society stakeholders, including community organizations, non-governmental organizations, and individual citizens, play a crucial role in representing the concerns and needs of the affected populations [42]. Their participation helps to ensure that the decision-making process is inclusive and responsive to the local context. Finally, the media stakeholders can contribute to raising public awareness, disseminating information, and facilitating dialogue among the various stakeholder groups [43]. By effectively communicating the complexities and challenges of flood risk management, the media can help to mobilize public support and promote collaborative action. Unfortunately, in the 22 reviewed documents, there is no actor that directly relates to journalism/media. The lines between the pentahelix stakeholders can become blurred, particularly when considering the role of information dissemination and awareness raising. While "media" traditionally refers to journalistic outlets, every stakeholder within the pentahelix model can engage in "media-like" activities.

C. *Level of Participation*

In the context of participation levels in FRM, there is a concept called Arnstein's ladder [44] which formulates the level of participation as follows:

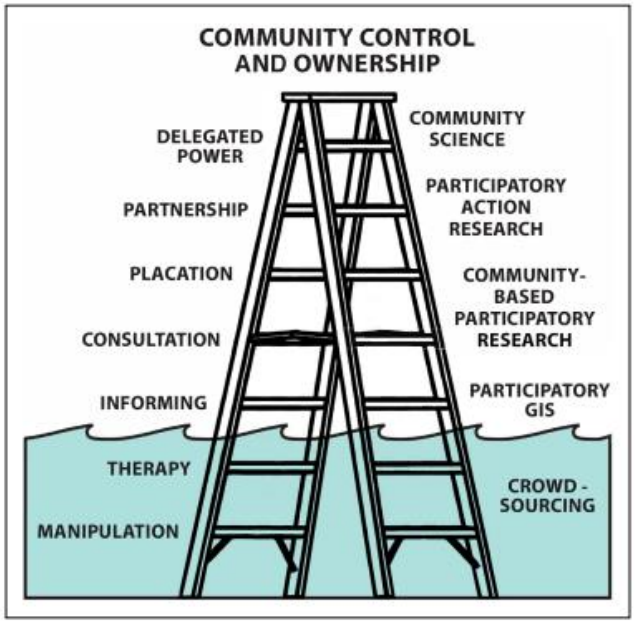

Figure 4. Ladder of participation by Arnstein (1969) adopted from Hendricks (2022)

Table 3. Arnstein's Ladder of Citizen Participation

Class	Description
Manipulation	The highest level of non-participation, in which the holders of power do not allow the public to actively participate.
Therapy	Non-participation in which the holder of power seeks to educate or 'cure' citizens from their ignorance of a particular issue
Informing	The public can voice opinions, but they do not have the influence to ensure follow-up or guarantee of a change in decision
Consultation	The public hears and becomes the head, but they do not have the power to ensure that their views will be considered by decision-makers
Placation	The public has the right to advise, but does not have the right or power to make decisions
Partnership	The public is allowed to negotiate and engage in trade-offs with traditional power holders
Delegated power	Some powers are delegated to institutional decision-makers as well as the public
Citizen control	The public gains a majority of decision-making seats, or full managerial power

Based on the participatory practice of FRM in the 22 documents reviewed, it is known that the distribution of the level of participation found is as follows:

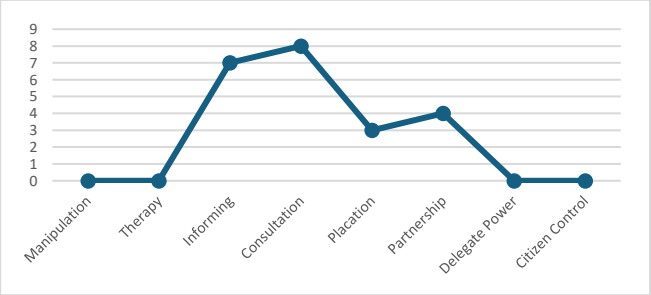

Figure 5. Level of participation

The findings of this study suggest that the majority of cases examined still operate at the lower levels of the Arnstein Citizen Participation Ladder, namely the "Informing" and "Consultation" stages. While these levels allow for some degree of public engagement, they fall short of truly empowering citizens to actively participate in the decision-making process [37].

One of the key challenges in achieving higher levels of citizen participation appears to be the reluctance of traditional power holders to fully relinquish control and share decision-making authority with the public [45]. Additionally, there are often barriers to effective communication and information-sharing, which can limit the public's ability to meaningfully contribute to the process.

However, the emergence of web-based collaboration tools and platforms may help to address some of these challenges by facilitating more interactive and transparent engagement between stakeholders, experts, and decision-makers [41]. Through the use of participatory GIS and other technological solutions, local residents can actively contribute spatial data and narratives, leading to a more inclusive and responsive flood risk management approach [34][42].

JURNAL PENATAAN RUANG Vol. 19, No. 1, (2024) Special Edition, Community and Infrastructure Development in Urban Area ISSN: 2716-179X (1907-4972 Print)

Ultimately, the transition towards higher levels of citizen participation will require a fundamental shift in the power dynamics and a genuine willingness to share decision-making authority with the public. This shift may be challenging, but it is crucial for developing more effective and resilient flood risk management strategies that truly reflect the needs and priorities of local communities. Higher levels of participation are associated with better outcomes in terms of community resilience and sustainability of FRM strategies. However, achieving high levels of participation can be challenging due to resource constraints and varying levels of engagement among stakeholders. Efforts should be made to move beyond mere consultation towards more collaborative and empowering forms of participation.

D. Outcomes and Effectiveness

The outcomes of participatory FRM practices that identified are as follows:

1) Improved Risk Awareness and Knowledge

Involving local communities in flood-related discussions and decision-making processes has been shown to enhance their understanding of flood hazards and improve the flow of information between different stakeholder groups. This leads to a more informed public and more effective communication channels during flood events. Participatory methodologies can empower communities to take proactive steps in mitigating flood impacts by developing local skills and capacities for flood management [3].

2) Capacity Building and Empowerment

The development of local skills and capacities through participatory flood management enables communities to take ownership of local flood management strategies and influence decision-making processes [4]. This sense of community empowerment is a crucial outcome, as it fosters long-term social learning and avoids the loss of trust among stakeholders, which are pivotal for the effective implementation of flood risk management plans. Participatory modelling techniques, in particular, can facilitate the identification of intervention options by a wide range of stakeholders and prioritize a subset for further investigation, supporting a broader move towards active stakeholder participation in local flood risk management.

3) Enhanced Collaboration and Trust

Collaborative efforts in flood risk management have been found to build stronger trust among stakeholders, which is crucial for the effective implementation of flood risk management plans [46]. Participatory approaches also foster better relationships among different stakeholders, leading to more integrated and coherent flood management strategies [34].

4) Development of Practical Tools and Solutions

Participatory modelling and stakeholder engagement have led to the creation of innovative solutions, such as serious games that aid in social learning and collaborative flood management, as well as the development of frameworks and methodologies that are grounded in stakeholder input [41]. These approaches have also contributed to advancements in early warning systems and communication tools, enhancing the overall effectiveness of flood risk management.

Participatory FRM allows greater public involvement and improved communication with inter-stakeholder, utilize the local knowledge that led into effective plan and sustainable solution, and empower the community to improve the capacity. Despite the positive outcomes, FRM participatory practice certainly has various challenges that need to be faced.

E. Challenges

Berikut ini merupakan identifikasi permasalahan penerapan participatory FRM:

1) Limited Participation and Engagement

One significant challenge is the limited participation and engagement of the public. Difficulties in engaging residents due to apathy, lack of interest, or mistrust towards authorities [37], [41] can undermine the inclusivity and effectiveness of the participatory process. Additionally, ensuring adequate representation of all relevant community groups, particularly marginalized or vulnerable populations, remains a persistent challenge [34].

2) Communication Barriers:

Another key issue is the presence of communication barriers. The effectiveness of communication strategies between stakeholders and the public can be undermined by language and cultural differences, leading to misunderstandings or misinformation [47]. It is crucial to have a clear and accessible communication in participatory processes for successful stakeholder engagement [48]. It argues that stakeholders need to understand the context of their participation, including the purpose, their potential influence, and the overall process. This suggests that adjusting communication strategies to avoid technical jargon and ensure clarity is crucial for stakeholder understanding and effective participation

3) Resource Constraints:

Resource constraints also pose a significant challenge, with a lack of funding and insufficient technical and human resources limiting the ability to sustain participatory initiatives over time [47]. In the participatory process, it is necessary to carry out activities such as (1) workshops/meetings that often involve venue or subscription for the teleconference meeting platform; (2) developing materials; and (3) facilitating ongoing engagement and dialogue that require online platform, dedicated staff, and travel expenses. With strict state funding conditions, financing for these activities will be constrained.

4) Institutional and Policy Barriers:

Rigid institutional structures and a disconnect between local participatory initiatives and broader policy frameworks can undermine the effectiveness of such approaches [34]. Participatory approaches often require significant resources and coordination, which can be difficult to sustain within existing institutional arrangements. [9] Additionally, the context-specific nature of participatory methods makes it challenging to standardize and institutionalize them across different settings.

Another barrier is the lack of clear linkages between participatory research projects and national research organizations. Without these linkages, the institutionalization of participatory approaches remains elusive, as the knowledge and lessons learned from local initiatives often fail to inform higher-level policy and decision-making [47]. To overcome these challenges, innovative management strategies and new working procedures are required within institutions to facilitate the integration of participatory methods

5) Power Dynamics and Decision-Making:

Power dynamics and the distribution of power among stakeholders can present significant obstacles in participatory decision-making processes [49]. Unequal power relations can affect the fairness and inclusivity of these initiatives, with traditional authorities or decision-makers often resistant to sharing power or accommodating participatory inputs [50], [51]. This can result in the exclusion or co-option of less powerful stakeholders, leading to outcomes that do not adequately reflect their interests and needs. To address these challenges, scholars suggest the importance of establishing effective power balancing mechanisms and ensuring adequate resources are allocated to the policy formulation process [51]. Moreover, the management of multiple, and often conflicting, interests through communicative action, social negotiation, and the empowerment of the underprivileged is crucial for achieving more sustainable and equitable outcomes [52].

6) Technical and Logistical Issues:

One of the primary challenges is the complexity involved in the technical and logistical aspects of implementing participatory tools and processes, particularly in diverse or large-scale settings [3]. Diverse stakeholder groups, varying levels of technical expertise, and the need to integrate diverse data and knowledge sources can create significant hurdles [41]. Logistical complexities, such as coordinating schedules, managing group dynamics, and ensuring equitable participation, can also impede the effective deployment of participatory approaches [53].

IV. CONCLUSION

This systematic review explores the diverse range of participatory approaches in flood risk management, emphasizing the tools that utilized, crucial role of stakeholder engagement, community involvement, and the integration of local knowledge in enhancing flood resilience. The review reveals that participatory methods, while varied in their application and effectiveness, consistently contribute to more adaptive and inclusive flood management strategies.

Key findings of this research are as follows:

1. Tools of Engagement: Participatory tools such as community workshops, participatory mapping, and digital platforms foster greater local involvement and awareness. Their effectiveness often hinges on the context, with participatory mapping and workshops being particularly impactful in cohesive communities.
2. Subjects Involved: Successful participatory approaches typically engage a broad spectrum of stakeholders, including local residents, governmental agencies, and NGOs. Inclusive participation is linked to improved management outcomes and heightened community satisfaction.
3. Level of Participation: Higher levels of community engagement, ranging from consultation to full collaboration, generally result in better planning and preparedness. However, achieving deeper engagement requires more time and resources.
4. Outcomes and Effectiveness: Participatory approaches lead to improved flood management plans, increased community resilience, and better integration of local knowledge. Effective engagement strategies correlate with enhanced preparedness and more robust response mechanisms.
5. Challenges: Despite their benefits, participatory approaches face challenges such as resource constraints, stakeholder conflicts, and barriers to effective communication. Addressing these challenges involves adopting adaptive management practices and fostering continuous stakeholder dialogue.

The findings underscore the importance of adopting participatory methods in flood risk management to enhance the inclusivity and effectiveness of flood response strategies. Policymakers and practitioners should prioritize the integration of local knowledge and stakeholder engagement to develop more adaptive and resilient flood management frameworks. Future research should focus on the development of scalable participatory models, the use of advanced technologies for broader and more inclusive engagement, and the long-term impacts of participatory interventions on community resilience and flood preparedness. Additionally, addressing the challenges identified in this review requires innovative approaches to resource allocation, stakeholder coordination, and communication.

V. ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my advisor, Prof. Adjie Pamungkas, for their invaluable guidance and support throughout this research. I also extend my thanks to Department of Urban and Regional Planning Institut Teknologi Sepuluh Nopember for providing the resources and environment conducive to conducting this study.

VI. LIST OF REFERENCES

[1] T. M. Ferreira, *Recent Advances in the Assessment of Flood Risk in Urban Areas*. 2021.

[2] H. M. M. Herath and N. T. S. Wijesekera, "Development of a Conceptual Framework to Operationalize the Flood Risk Management," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 563, no. 1, 2020, doi: 10.1088/1755-1315/563/1/012020.

[3] S. A. Maskrey, N. J. Mount, C. R. Thorne, and I. Dryden, "Participatory modelling for stakeholder involvement in the development of flood risk management intervention options," *Environ. Model. Softw.*, vol. 82, pp. 275–294, 2016, doi: 10.1016/j.envsoft.2016.04.027.

[4] M. Pelling, "Learning from others: The scope and challenges for participatory disaster risk assessment," *Disasters*, vol. 31, no. 4, pp. 373–385, 2007, doi: 10.1111/j.1467-7717.2007.01014.x.

[5] J. Mercer, I. Kelman, K. Lloyd, and S. Suchet-Pearson, "Reflections on use of participatory research for disaster risk reduction," *Area*, vol. 40, no. 2, pp. 172–183, 2008, doi: 10.1111/j.1475-4762.2008.00797.x.

[6] M. R. Furqon, I. F. A. Talib, A. Mariany, and N. R. Hanifa,

"Participatory disaster risk assessment (PDRA): A case study on community-based disaster risk reduction in Kelurahan Cigadung (RW09 and RW14), Kota Bandung, Indonesia," *AIP Conf. Proc.*, vol. 1987, 2018, doi: 10.1063/1.5047337.

[7] D. Adams, "Publish or Perish on Microsoft Windows," *Harzing.com*, 2016. https://harzing.com/resources/publish-or-perish/windows.

[8] D. W. C. Naku and S. Afrane, "Local Community Development and the Participatory Planning Approach: A Review of Theory and Practice," *Curr. Res. J. Soc. Sci.*, vol. 5, no. 5, pp. 185–191, 2013, doi: 10.19026/crjss.5.5554.

[9] A. Martin and J. Sherington, "Participatory research methods - Implementation, effectiveness and institutional context," *Agric. Syst.*, vol. 55, no. 2, pp. 195–216, 1997, doi: 10.1016/S0308-521X(97)00007-3.

[10] E. Prins, "The Challenges of Fostering Community Participation: A Case Study of a Community-Based Organization in Rural California," *Community Dev.*, vol. 36, no. 2, pp. 15–34, 2005, doi: 10.1080/15575330509490173.

[11] T. A. Smucker, D. J. Campbell, J. M. Olson, and E. E. Wangui, "Contemporary challenges of participatory field research for land use change analyses: Examples from Kenya," *Field methods*, vol. 19, no. 4, pp. 384–406, 2007, doi: 10.1177/1525822X07302137.

[12] A. Perrone, A. Inam, R. Albano, J. Adamowski, and A. Sole, "A participatory system dynamics modeling approach to facilitate collaborative flood risk management: A case study in the Bradano River (Italy)," *J. Hydrol.*, vol. 580, no. November 2019, 2020, doi: 10.1016/j.jhydrol.2019.124354.

[13] F. O. Odemerho, "Building climate change resilience through bottom-up adaptation to flood risk in Warri, Nigeria," *Environ. Urban.*, vol. 27, no. 1, pp. 139–160, 2015, doi: 10.1177/0956247814558194.

[14] H. Mees *et al.*, "Coproducing flood risk management through citizen involvement: Insights from cross-country comparison in Europe," *Ecol. Soc.*, vol. 21, no. 3, 2016, doi: 10.5751/ES-08500-210307.

[15] A. Almoradie *et al.*, "Current flood risk management practices in Ghana: Gaps and opportunities for improving resilience," *J. Flood Risk Manag.*, vol. 13, no. 4, 2020, doi: 10.1111/jfr3.12664.

[16] W. Medema, A. Furber, J. Adamowski, Q. Zhou, and I. Mayer, "Exploring the potential impact of serious games on social learning and stakeholder collaborations for transboundary watershed management of the St. Lawrence river basin," *Water (Switzerland)*, vol. 8, no. 5, 2016, doi: 10.3390/w8050175.

[17] L. H. Geaves and E. C. Penning-Rowsell, "Flood Risk Management as a public or a private good, and the implications for stakeholder engagement," *Environ. Sci. Policy*, vol. 55, pp. 281–291, 2016, doi: 10.1016/j.envsci.2015.06.004.

[18] B. Sy, C. Frischknecht, H. Dao, D. Consuegra, and G. Giuliani, "Flood hazard assessment and the role of citizen science," *J. Flood Risk Manag.*, vol. 12, no. October 2018, pp. 1–14, 2019, doi: 10.1111/jfr3.12519.

[19] M. A. Rakib, S. Islam, I. Nikolaos, M. Bodrud-Doza, and M. A. H. Bhuiyan, "Flood vulnerability, local perception and gender role judgment using multivariate analysis: A problem-based 'participatory action to Future Skill Management' to cope with flood impacts," *Weather Clim. Extrem.*, vol. 18, no. November, pp. 29–43, 2017, doi: 10.1016/j.wace.2017.10.002.

[20] A. Serra-Llobet, E. Conrad, and K. Schaefer, "Governing for integrated water and flood risk management: Comparing top-down and bottom-up approaches in Spain and California," *Water (Switzerland)*, vol. 8, no. 10, 2016, doi: 10.3390/w8100445.

[21] R. Giordano, A. Pagano, I. Pluchinotta, R. O. del Amo, S. M. Hernandez, and E. S. Lafuente, "Modelling the complexity of the network of interactions in flood emergency management: The Lorca flash flood case," *Environ. Model. Softw.*, vol. 95, pp. 180–195, 2017, doi: 10.1016/j.envsoft.2017.06.026.

[22] T. Thaler and M. Levin-Keitel, "Multi-level stakeholder engagement in flood risk management-A question of roles and power: Lessons from England," *Environ. Sci. Policy*, vol. 55, pp. 292–301, 2016, doi: 10.1016/j.envsci.2015.04.007.

[23] U. Wehn, M. Rusca, J. Evers, and V. Lanfranchi, "Participation in flood risk management and the potential of citizen observatories: A governance analysis," *Environ. Sci. Policy*, vol. 48, pp. 225–236, 2015, doi: 10.1016/j.envsci.2014.12.017.

[24] H. J. Henriksen, M. J. Roberts, P. van der Keur, A. Harjanne, D. Egilson, and L. Alfonso, "Participatory early warning and monitoring systems: A Nordic framework for web-based flood risk management," *Int. J. Disaster Risk Reduct.*, vol. 31, no. February, pp. 1295–1306, 2018, doi: 10.1016/j.ijdrr.2018.01.038.

[25] C. Dieperink, D. L. T. Hegger, M. H. N. Bakker, Z. W. Kundzewicz, C. Green, and P. P. J. Driessen, "Recurrent Governance Challenges in the Implementation and Alignment of Flood Risk Management Strategies: a Review," *Water Resour. Manag.*, vol. 30, no. 13, pp. 4467–4481, 2016, doi: 10.1007/s11269-016-1491-7.

[26] J. Batica and P. Gourbesville, "Resilience in Flood Risk Management - A New Communication Tool," *Procedia Eng.*, vol. 154, pp. 811–817, 2016, doi: 10.1016/j.proeng.2016.07.411.

[27] R. H. Bark, J. Martin-Ortega, and K. A. Waylen, "Stakeholders' views on natural flood management: Implications for the nature-based solutions paradigm shift?," *Environ. Sci. Policy*, vol. 115, no. July 2020, pp. 91–98, 2021, doi: 10.1016/j.envsci.2020.10.018.

[28] M. S. Attems, T. Thaler, K. A. W. Snel, P. Davids, T. Hartmann, and S. Fuchs, "The influence of tailored risk communication on individual adaptive behaviour," *Int. J. Disaster Risk Reduct.*, vol. 49, p. 101618, 2020, doi: 10.1016/j.ijdrr.2020.101618.

[29] C. Begg, I. Callsen, C. Kuhlicke, and I. Kelman, "The role of local stakeholder participation in flood defence decisions in the United Kingdom and Germany," *J. Flood Risk Manag.*, vol. 11, no. 2, pp. 180–190, 2018, doi: 10.1111/jfr3.12305.

[30] H. Mees, M. Alexander, M. Gralepois, P. Matczak, and H. Mees, "Typologies of citizen co-production in flood risk governance," *Environ. Sci. Policy*, vol. 89, no. August, pp. 330–339, 2018, doi: 10.1016/j.envsci.2018.08.011.

[31] A. Inam, J. Adamowski, J. Halbe, and S. Prasher, "Using causal loop diagrams for the initialization of stakeholder engagement in soil salinity management in agricultural watersheds in developing countries: A case study in the Rechna Doab watershed, Pakistan," *J. Environ. Manage.*, vol. 152, pp. 251–267, 2015, doi: 10.1016/j.jenvman.2015.01.052.

[32] U. Pasquier, R. Few, M. C. Goulden, S. Hooton, Y. He, and K. M. Hiscock, "'We can't do it on our own!'—Integrating stakeholder and scientific knowledge of future flood risk to inform climate change adaptation planning in a coastal region," *Environ. Sci. Policy*, vol. 103, no. November 2019, pp. 50–57, 2020, doi: 10.1016/j.envsci.2019.10.016.

[33] R. Rustinsyah, R. A. Prasetyo, and M. Adib, "Social capital for flood disaster management: Case study of flooding in a village of Bengawan Solo Riverbank, Tuban, East Java Province," *Int. J. Disaster Risk Reduct.*, vol. 52, no. January 2020, p. 101963, 2021, doi: 10.1016/j.ijdrr.2020.101963.

[34] M. Meyer *et al.*, "Participatory Action Research: Tools for Disaster Resilience Education Michelle," *Physiol. Behav.*, vol. 176, no. 3, pp. 139–148, 2019, doi: 10.1108/IJDRBE-02-2017-0015.Participatory.

[35] L. S. Pettegrew and C. Day, "Smart Phones and Mediated Relationships: The Changing Face of Relational Communication," *Rev. Commun.*, vol. 15, no. 2, pp. 122–139, 2015, doi: 10.1080/15358593.2015.1044018.

[36] W. A. Cook, "Is mobile a reliable platform for survey taking?," *J. Advert. Res.*, vol. 54, no. 2, pp. 141–148, 2014, doi: 10.2501/JAR-54-2-141-148.

[37] J. K. Wachira and A. J. Sinclair, "Public participation in the emergency response phase of flooding: A case study of the red river basin," *Can. Water Resour. J.*, vol. 30, no. 2, pp. 145–158, 2005, doi: 10.4296/cwrj3002145.

[38] W. H. Baker, H. Lon Addams, and B. Davis, "Critical factors for enhancing municipal public hearings," *Public Adm. Rev.*, vol. 65, no. 4, pp. 490–499, 2005, doi: 10.1111/j.1540-6210.2005.00474.x.

[39] S. Danielson, S. P. Tuler, S. L. Santos, T. Webler, and C. Chess, "Three tools for evaluating participation: Focus groups, Q method, and surveys," *Environ. Pract.*, vol. 14, no. 2, pp. 101–109, 2012, doi: 10.1017/S1466046612000026.

[40] J. M. Bryson, K. S. Quick, and B. C. Crosby, "Designing Public Participation Processes," *Public Adm. Rev.*, vol. 73, pp. 23–34, 2012, doi: 10.111/j.1540-6210.2012.02678.x.Designing.

[41] A. Almoradie, V. J. Cortes, and A. Jonoski, "Web-based stakeholder collaboration in flood risk management," *J. Flood Risk Manag.*, vol. 8, no. 1, pp. 19–38, 2015, doi: 10.1111/jfr3.12076.

[42] M. Evers, "Participation in Flood Risk Management An introduction and recommendations for implementation," no. 1, pp. 1–21, 2012.

[43] A. C. Tyagi, "Civil Society in the Water Sector," *Springer Water*, pp. 303–311, 2019, doi: 10.1007/978-981-13-2700-1_18.

[44] M. D. Hendricks, M. A. Meyer, and S. M. Wilson, "Moving Up the Ladder in Rising Waters: Community Science in Infrastructure and Hazard Mitigation Planning as a Pathway to Community Control and Flood Disaster Resilience," *Citiz. Sci. Theory Pract.*, vol. 7, no. 1, pp. 1–12, 2022, doi: 10.5334/cstp.462.

[45] B. De Marchi, "Learning from citizens: A Venetian experience," *J. Hazard. Mater.*, vol. 78, no. 1–3, pp. 247–259, 2000, doi:

10.1016/S0304-3894(00)00225-9.
[46] M. Buchecker, S. Menzel, and R. Home, "How much does participatory flood management contribute to stakeholders' social capacity building? Empirical findings based on a triangulation of three evaluation approaches," *Nat. Hazards Earth Syst. Sci.*, vol. 13, no. 6, pp. 1427–1444, 2013, doi: 10.5194/nhess-13-1427-2013.
[47] U. C. Nkwunonwo, "Flood Risk Analysis for Critical Infrastructure Protection: Issues and Opportunities in Less Developed Societies," 2020, doi: http://dx.doi.org/10.5772/intechopen.95364.
[48] T. Laktić and Š. P. Malovrh, "Stakeholder participation in Natura 2000 management program: Case study of Slovenia," *Forests*, vol. 9, no. 10, 2018, doi: 10.3390/f9100599.
[49] J. Gaventa, "Finding the Space for Change: A Power Analysis," *IDS Bull.*, vol. 37, no. 6, 2006, doi: 10.1001/jama.1896.02430960015001d.
[50] A. Dewulf and W. Elbers, "Power in and over cross-sector partnerships: Actor strategies for shaping collective decisions," *Adm. Sci.*, vol. 8, no. 3, 2018, doi: 10.3390/admsci8030043.
[51] V. C. Kapilima, "The Impact of Power and Power Relationships in the Public Policy Formulation Process: A Case Study of the Formulation Process of 2014 Tanzania's Education and Training Policy," *Open Polit. Sci.*, vol. 3, no. 1, pp. 220–230, 2020, doi: 10.1515/openps-2020-0020.
[52] M. F. Nkemnyi, "An Analysis of Local Participation in Community Forestry: The Case of Tinto and Bimbia-Bonadikombo Community Forest, Cameroon," *Sustain. Environ.*, vol. 1, no. 2, p. 85, 2016, doi: 10.22158/se.v1n2p85.
[53] S. A. Maskrey, S. Priest, and N. J. Mount, "Towards evaluation criteria in participatory flood risk management," *J. Flood Risk Manag.*, vol. 12, no. 2, pp. 1–14, 2019, doi: 10.1111/jfr3.12462.