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Voices from the river: exploring digitally inclusive tools with marginalised fishing communities in Bangladesh

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Abstract

Introduction. This study investigates how small-scale fishing communities in Bangladesh, often excluded from digital initiatives, articulate their priorities for inclusive tools. Using digital inclusion and intersectionality frameworks, it examines how gender, age, and livelihood contexts shape digital aspirations.

Method. Sixteen participatory ideation workshops were conducted in two districts with 128 participants stratified by age and gender (elderly men, elderly women, young men, young women). Sessions involved community mapping, problem identification, persona-building, and co-design of digital futures. Data were transcribed, translated, and thematically analysed, guided by Jia et al.'s five-dimensional digital inclusion model.

Analysis. Thematic coding and intersectional comparison revealed both shared priorities and subgroup-specific visions. Findings were aligned with digital inclusion and participatory design literature to identify theoretical and practical implications.

Results. Across all groups, participants emphasised accessible tools for livelihoods, regulation, and service access. Gendered differences emerged, with men prioritising occupational and market-based tools, and women focusing on caregiving, health, and small-scale entrepreneurship. Generational divides also shaped digital imaginaries, with older participants seeking stability and safety, while youth highlighted skills, autonomy, and transformation.

Conclusion. Digital inclusion is a situated, intersectional process requiring participatory, context-sensitive approaches. The study underscores the need to recognise intra-community diversity when designing equitable digital futures.

Introduction

As digital technologies continue to reshape access to information, services, and economic opportunities around the world, critical questions remain about who is included in and who is left behind by these transformations (Parsons and Hick, 2008; Warschauer and Matuchniak, 2010). The concept of digital inclusion, defined as the capacity of individuals and communities to access, understand, and meaningfully engage with digital tools and services (Nguyen, 2022), has emerged as a key lens through which to examine equity and justice in an increasingly digitised world (Gangadharan, 2017; Lal, 2021; Perera et al., 2023) and deeply shaped by social, cultural, and political structures that determine access, usability, and relevance (Madon et al., 2009; Mariën and Prodnik, 2014).

Within the Global South, marginalised communities that are geographically remote, economically vulnerable, and socially excluded often remain underserved by mainstream digital initiatives (Heeks, 2022; Kivikuru, 2019). One such group is small-scale fishing communities, which are vital to local economies and food systems, yet face entrenched marginalisation due to a combination of precarious livelihoods, limited access to formal education, poor infrastructure, and environmental risks (Arthur et al., 2022; Kanij et al., 2023). Research has shown that these communities are often excluded from digital services and governance platforms that could enhance their resilience and participation in public life (Dos Santos Da Silva and Cruz Rodrigues, 2023; Lopez-Ercilla et al., 2021). Within these communities, women, elderly people, and youth face further exclusion based on intersecting factors such as gender norms, generational divides, and access to resources (Frangoudes and Gerrard, 2018; Nyantakyi-Frimpong, 2020; Selvaraj et al., 2022).

Bangladesh, with its extensive coastline and a large population engaged in small-scale and artisanal fishing (Hossain, 2014; Mozumder et al., 2023), presents a particularly relevant setting for examining the intersections of marginality, livelihood, and digital inclusion (Aziz, 2020; Islam, 2024). While the country has made significant strides in digital infrastructure development under its 'Digital Bangladesh' vision (Ahmed et al., 2023), access to and meaningful use of digital technologies remain uneven, especially in rural and coastal areas (Ahmed et al., 2020, 2021). Fishing communities in these regions often operate outside the scope of targeted digital development policies and are seldom consulted in the design of digital platforms, services, or content relevant to their lives (Ahmed et al., 2021; Qureshi et al., 2014).

This paper reports findings from research investigating how members of fishing communities in coastal Bangladesh articulate their priorities for digitally inclusive tools. The research draws on both the digital inclusion framework and intersectionality literature to examine how identity, context, and structural inequalities shape the kinds of digital tools these communities find most valuable.

By focusing on an underrepresented group in digital inclusion scholarship and policy, and by using participatory methods to elicit community-driven insights, the study contributes to ongoing efforts to make digital transformation more inclusive, equitable, and responsive to the lived realities of marginalised populations.

Literature review

This literature review situates the study within key academic conversations on digital inclusion, intersectionality, participatory design, and the digital engagement of marginalised livelihoods. It first outlines the evolution of digital inclusion frameworks, moving beyond basic access toward issues of meaningful use. It then draws on intersectionality to explore how gender, age, and socio-economic status intersect to shape unequal digital experiences, particularly in rural and resource-poor settings. Finally, it discusses the specific challenges and opportunities facing fishing communities and other marginalised livelihood groups in the Global South.

Digital inclusion: beyond access

While early debates on digital inequality focused on the '*digital divide*' in terms of physical access to technology, such as the availability of internet infrastructure, devices, and electricity (van Dijk, 2006), recent scholarship emphasises a more nuanced understanding of what it means to be digitally included. Access, while necessary, is only a starting point. Research has increasingly shown that meaningful digital inclusion requires attention to a range of interrelated factors, including digital literacy, affordability, relevance of content, institutional support, and cultural appropriateness (Lloyd and Wilkinson, 2016; Selwyn, 2004; Wang and Si, 2024; Warschauer, 2004). Without these, individuals may technically be '*connected*' but remain excluded from substantive digital participation.

In development contexts, digital inclusion is now widely recognised as an enabler of broader socio-economic transformation (Djarmiko et al., 2025; Mahlangu et al., 2022). It underpins initiatives aimed at improving livelihoods, education access, e-governance, health information systems, and financial inclusion (Djarmiko et al., 2025; Doloi, 2025; Madon et al., 2009; Molla and Al-Jaghoub, 2007). However, the promise of inclusion is often tempered by persistent structural inequalities. For rural populations, especially those in the Global South, digital interventions are often introduced without adequate attention to context, leading to marginal uptake or unintended consequences (Gurumurthy and Chami, 2019). Factors such as poverty, gender-based exclusion, low levels of literacy, and lack of trust in institutions often intersect to limit participation in digital spaces (Gupta and Kiran, 2025; Ojanperä et al., 2019).

Moreover, digital inclusion should not be viewed as a neutral or one-size-fits-all process. Critical scholars argue that many digital interventions assume a linear path from access to empowerment, without interrogating who defines the terms of inclusion and whose knowledge systems are valued (Couldry and Mejias, 2019; Mariën and Prodnik, 2014; Pandey and Zheng, 2023). Technologies often embed assumptions about users' needs, capacities, and ways of interacting with information, which may not align with the lived realities of marginalised communities (Hossain et al., 2025; Bhowmik et al., 2025). For instance, the proliferation of mobile-based agricultural advisory apps may not benefit small-scale farmers who lack formal education or whose practices are informed more by collective wisdom and experience than by external expert knowledge (Magesa et al., 2023; Ofosu-Ampong et al., 2025).

To provide a more structured articulation of the multifaceted nature of digital inclusion, Jia et al. (2024) propose a five-dimensional model that complements and deepens existing understandings. Their framework identifies (1) Access, including infrastructure, affordability, and readiness; (2) Skills, comprising both basic literacy and digital competencies; (3) Usage, related to frequency, diversity, and relevance of digital activities; (4) Acceptance, involving trust, motivation, and psychological readiness; and (5) Impact, referring to the tangible outcomes of digital engagement, such as improved livelihoods, empowerment, or social inclusion. These dimensions offer a comprehensive analytical lens through which to evaluate the real-world effectiveness of digital initiatives, especially in marginalised settings.

In the case of small-scale fishing communities, which often face geographic isolation, seasonal mobility, and institutional invisibility, the barriers to digital inclusion are particularly acute. These communities may lack stable internet access, but more importantly, they are frequently excluded from the design and governance of digital interventions that affect their lives (Kanij et al., 2023; Lopez-Ercilla et al., 2021). As digital inclusion must consider whether technologies are usable in both practical and cultural terms, it is important to include supporting oral communication traditions, designed for users with low literacy and aligned with the knowledge-sharing practices already embedded in the community (Robinson et al., 2015).

Furthermore, digital inclusion in such contexts must account for the collective, rather than individual, nature of technology use. In many rural settings, mobile phones and digital tools are shared resources, used within households, cooperatives, or peer groups (Burrell, 2010; Wesolowski et al., 2012). The concept of inclusive design must therefore go beyond accessibility to consider social dynamics, language pluralism, and forms of agency that matter to the users themselves (Persson et al., 2015).

Our research builds on these expanded conceptualisations by centring the voices of fishing communities, asking not only whether they are included in digital initiatives but how they would define and shape inclusion on their terms. It moves from a technocratic framing of inclusion toward a more grounded, community-driven understanding of what digital empowerment entails, deploying Jia et al. (2024) 's five-dimensional model as a comprehensive analytical lens through which to evaluate the real-world effectiveness of digital initiatives, especially in marginalised settings.

Intersectionality and digital marginalisation

Understanding digital inclusion also requires an intersectional approach. Coined by Crenshaw (2013), intersectionality draws attention to how multiple social identities, such as gender, age, class, ethnicity, and geography, interact to produce overlapping systems of advantage and disadvantage. This framework helps reveal how structural inequalities are not experienced in isolation but are compounded for individuals and groups situated at the intersection of multiple forms of marginality. In digital contexts, intersectionality has been instrumental in explaining why access alone is insufficient, as people's ability to engage with and benefit from digital tools is shaped by a matrix of social power relations (Al Dahdah and Mishra, 2020; Eubanks, 2018; Gurumurthy, 2018).

In the field of digital inclusion, intersectionality highlights how access, skills, and benefits from digital technologies are mediated by interlocking structures of power and identity (Al Dahdah et al., 2020; Gurumurthy and Chami, 2019). Rather than treating fishing communities as a homogenous group, this study uses intersectionality to unpack intra-community diversity across gender and age, including elderly males, elderly females, young males, and young females. Each group brings unique life experiences, access levels, and livelihood responsibilities that influence their digital preferences and needs.

For example, women in rural or coastal communities often face mobility constraints, time poverty, and socio-cultural expectations that limit their ability to interact with digital technologies independently (Bibi, 2019; Gurumurthy and Chami, 2019). These gendered constraints are further amplified when intersecting with poverty, lack of education, or linguistic exclusion (Dixit and Banday, 2022). Elderly people, on the other hand, may encounter physical or cognitive barriers to using mobile devices, as well as social ones, such as younger relatives assuming control of digital interactions or decision-making processes (Fortunati, 2017; Wildenbos et al., 2018). Meanwhile, youth are frequently positioned as digital natives (Helsper and Eynon, 2010), yet this assumption obscures important differences among them. Young women, in particular, may face scrutiny or surveillance around their digital engagements (Bhatia et al., 2021), while young men might lack pathways to channel their digital engagement into livelihood opportunities due to limited institutional support (Alao and Brink, 2023).

In the context of fishing communities in Bangladesh, intersectionality plays out in distinct ways, shaped by local gender norms, livelihood patterns, and intergenerational dynamics (Galappaththi et al., 2021; Hossain and Anwar, 2023). Women are often restricted to informal or unpaid roles that make their information needs invisible to mainstream digital systems (Selim et al., 2025; Shuva, 2017). Older community members may rely on oral transmission of knowledge and resist externally driven digital formats (Bhowmik et al., 2025; Kanji et al., 2023). Younger community members may

be more adaptive but still lack relevant platforms that reflect their socio-economic realities (Bhowmik et al., 2025). Educational qualification and geographical location may further stratify access and comfort with digital technologies (Siddiquee and Islam, 2024).

By employing intersectionality as a conceptual lens, this study attends to the differentiated aspirations, constraints, and knowledge systems within fishing communities in Bangladesh. This approach challenges one-size-fits-all digital interventions and critiques digital policies and platforms that often privilege literate, urban, male populations while neglecting those who occupy multiple marginal positions. Ultimately, it enables a more nuanced understanding of what inclusive digital transformation means in practice and guides the design, implementation, and governance of digital tools that reflect overlapping axes of identity and exclusion. Although this study focuses on age and gender, other axes of identity, including disability, sexuality, diverse gender identities, and ethnicity, may also shape digital exclusion; their limited visibility reflects both the scope of the workshops and the sensitivities of the local research context.

Participatory and community-driven digital design

Traditional models of digital innovation often adopt a top-down approach, in which technologies are designed and deployed without substantial input from intended users (Heeks, 2002). However, there is a growing recognition of the value of participatory design, particularly in marginalised or low-resource settings (Singh et al., 2023). Participatory approaches centre the voices of community members as co-designers rather than passive recipients of technology, thus enabling more contextually grounded and sustainable solutions (Hossain and Anwar, 2023; Hussain et al., 2012).

Research has shown that community-led innovation processes lead to greater ownership, higher adoption rates, and increased relevance (Dearden et al., 2011; Heeks, 2018). Participatory digital interventions have enabled women to design mobile apps for maternal health in Uganda (Musiimenta et al., 2022) and agricultural workers to co-create platforms for market access in Kenya (Wyche and Steinfield, 2016). Our study adopts this participatory orientation, using ideation workshops not only as a data collection tool but as a space for empowering fishing community members to imagine their digital futures.

Participatory design also allows for the articulation of needs and values that might otherwise be overlooked in conventional development programs. Inclusive design must emerge from the lived experiences of marginalised people, who bring critical insights into how technologies interact with their daily lives (Costanza-Chock, 2020). In contexts like rural Bangladesh, this includes navigating gendered spaces, working with seasonal livelihoods, or adapting to low-literacy environments (Uraguchi, 2025). By foregrounding local knowledge systems, participatory approaches can facilitate shared technology use and strengthen informal decision-making structures, which should inform the design of digital tools (Escobar, 2001; Nogueira et al., 2017; Rowell, 2002).

Moreover, involving communities in early-stage ideation helps challenge assumptions embedded in digital systems, such as individual device ownership, linear information flows, or formalised user identities (Harvey, 2017). Researchers who work closely with communities have pointed out that design is never completely fair or neutral. The ideas, values, and power of the people creating a tool or system often shape how it works and who it benefits. This means that when designing technologies, we need to think carefully about whose voices are included and whose are left out (Costanza-Chock, 2020; Suchman, 2002).

In this study, ideation workshops served as generative spaces for collective sensemaking, enabling participants to reimagine the role of digital technologies in ways that align with their aspirations, constraints, and community priorities. This approach contributes not only to more inclusive digital

systems but to a broader paradigm shift in how technological futures are co-envisioned and co-produced.

Livelihoods and situated pathways to digital inclusion

Fishing communities in coastal Bangladesh engage in livelihoods that are increasingly precarious due to a convergence of ecological, economic, and institutional challenges. Seasonal fishing bans, climate-induced disruptions, and limited access to alternative employment make these communities particularly vulnerable (Galappaththi et al., 2021; Kanij et al., 2023). Although digital tools have been introduced in some areas, for example, apps providing weather forecasts, fish production or fish marketing, such tools are often poorly integrated into the lived realities of fishing households and tend to suffer from usability issues, lack of linguistic or cultural adaptation, and institutional mistrust (Adikari et al., 2024; Islam et al., 2013; Tilley and Roscher, 2020).

Research from other regions of the Global South highlights that when digital tools are co-developed with users and embedded within broader livelihood strategies, they can enhance economic participation and resilience. For example, mobile platforms have supported rural artisans and agricultural producers in India and East Africa to access new markets, organise collective action, and amplify their voices (Aker and Mbiti, 2010; Deen-Swaray et al., 2013; Wyche and Steinfield, 2016). However, such success stories are often rooted in sustained engagement with communities, attention to gender and literacy dynamics, and the alignment of technological tools with existing social practices (Gurumurthy and Chami, 2019; Mutsvairo and Ragnedda, 2019).

In Bangladesh, studies on digital development tend to focus on large-scale policy initiatives or infrastructure deployment, with limited attention to informal economies or low-literacy livelihood groups such as small-scale fishers (Ahmed et al., 2021; Qureshi et al., 2014). Where fishing communities are mentioned, it is often through a technocratic lens that frames them as passive recipients of innovation rather than active agents in shaping digital futures. This overlooks the creativity, resilience, and situated knowledge these communities bring to livelihood innovation and digital engagement. It also fails to account for the differentiated ways in which individuals, particularly women, youth, and older adults, navigate digital possibilities and constraints within their socio-cultural environments (Dixit and Banday, 2022; Frangoudes and Gerrard, 2018).

There is an urgent need to explore digital inclusion through a lens that takes seriously the intersection of marginality and livelihood strategy. As technology amplifies existing human intent and capacity (Toyama, 2011), its role in supporting marginalised groups depends heavily on context, participation, and alignment with local goals. A growing body of ICT4D research advocates for co-design approaches that build on community assets and aspirations (Dearden et al., 2011; Costanza-Chock, 2020), yet few studies have applied this lens to fishing communities or examined how sub-groups within them articulate their digital priorities across both traditional and alternative livelihood pathways.

By engaging fishing communities through ideation workshops, this study contributes to ongoing rethinking of digital inclusion not as a uniform goal but as a dynamic process rooted in local meanings, economic strategies, and collective agency. It foregrounds how digital technologies can be envisioned as tools for livelihood security, gender-responsive opportunity, and community cohesion when designed with and for the people they aim to serve.

Research methodology

This study adopted a participatory qualitative research approach, using community-based ideation workshops. Given the study's aim to surface locally generated ideas for inclusive digital solutions, a participatory methodology was most appropriate, allowing community members not only to share their perspectives but to actively co-create visions of digital futures relevant to their lived realities. Our research foregrounds agency, contextual knowledge, and aspirations that

conventional top-down approaches often overlook by engaging participants as co-creators rather than passive informants.

This study was guided by three exploratory research questions: how do different sub-groups within fishing communities articulate their priorities for digitally inclusive information tools; how do gender and age shape these priorities and digital imaginaries; and how do community-generated ideas extend dominant digital inclusion frameworks. These questions informed the design of the ideation workshops and the thematic analysis.

Research design

The research combined traditions of participatory design and intersectional inquiry, ensuring that diverse perspectives shaped the study outcomes. Central to the design were ideation workshops and methods rooted in design thinking and community co-creation (Dearden & Rizvi, 2008; Sanders & Stappers, 2008). These workshops moved beyond documenting current practices to enabling participants to imagine alternative digital futures. This approach is especially relevant in low-literacy and collectivist contexts, where traditional interviews or surveys may fail to elicit creative and situated visions of digital solutions (Costanza-Chock, 2020).

We stratified our study participants by age and gender, reflecting an intersectional rationale (Crenshaw, 2013; Gurumurthy & Chami, 2019). This approach perceives participants as co-creators of knowledge, facilitating a more ethical and inclusive interaction with community realities and lived experiences (Gaventa and Cornwall, 2001).

Study sites

Research was conducted in two riverine districts of Bangladesh: 1) Kurigram (Brahmaputra River basin), characterised by recurrent flooding, erosion, and high dependence on small-scale inland fishing; and 2) Chandpur (Meghna River basin): home to large communities of artisanal Hilsa fishers facing seasonal bans and market vulnerabilities. Both locations represent contexts where fishing is central to livelihoods but where communities experience compounded marginalisation due to poverty, displacement, and exclusion from mainstream digital initiatives. Located along the Brahmaputra and Meghna rivers, respectively, these districts are home to large communities of small-scale fisherfolk whose access to services, markets, and information is deeply shaped by environmental vulnerability, infrastructural deficits, and social marginalisation (Hossain et al., 2022; Rijon and Hossain, 2024). These districts provided diverse yet comparable contexts to examine how environmental and socio-economic vulnerabilities intersect with digital exclusion.

Participants and demographics

Participants were selected purposively to capture diversity in age and gender, recognising these as central axes of digital marginalisation. Workshops were stratified into four groups: 1) Elderly men; 2) Elderly women; 3) Young men; and 4) Young women. Across both sites, sixteen workshops were conducted (two for each subgroup per district), with a total of 128 participants (8–12 per session). Participants included small-scale fishers, fish vendors, fishers' spouses, youth involved in supporting fishing households, and elderly community members reliant on fishing-related livelihoods.

This stratification was designed to create homogeneous spaces where participants could speak freely, especially women and elderly individuals who may otherwise remain silent in mixed-gender or intergenerational groups. The demographic breakdown allowed systematic comparison of how gendered roles, generational perspectives, and livelihood responsibilities shape digital needs and imaginaries.

Ideation workshop procedure and data collection

In each district, eight workshops were conducted (two per demographic group), resulting in a total of sixteen sessions. Each workshop included 8–12 participants and lasted approximately six hours. Sessions were facilitated by bilingual researchers and local facilitators trained in participatory methods, with gender-matched facilitation wherever possible to enhance comfort and openness. The workshops followed a progressive, multi-stage design:

1. **Community mapping:** Participants identified where and how they currently access livelihood-related, health-related, and governance information.
2. **Problem and gap identification:** Discussion shifted toward barriers to accessing relevant information and unmet needs.
3. **Persona-building:** Groups created fictional yet representative community members (e.g., a young fisher, an elderly widow) to surface shared experiences and challenges.
4. **Journey mapping:** Participants mapped these personas' interactions with existing information systems, highlighting points of exclusion or breakdown.
5. **Co-creation of digital futures:** In the final stage, participants sketched, role-played, or verbally described potential digitally inclusive tools and systems they considered relevant to their needs.

This process encouraged both reflective critique of present realities and imaginative projection into desired futures. To ensure ethical rigour, all participants provided informed consent, confidentiality was maintained, and additional care was taken to encourage equitable participation from women and elderly groups.

Data management and analysis

All workshops were audio-recorded, transcribed, and translated into English, then cross-checked against facilitator notes. The data corpus was then subjected to thematic analysis (Braun & Clarke, 2006), conducted in an iterative, multi-stage manner:

1. **Familiarisation:** Repeated reading of transcripts to build contextual sensitivity.
2. **Initial coding:** Extraction of both concrete ideas (e.g., '*fishing regulation app*') and underlying values (e.g., trust, safety, relevance).
3. **Theme development:** Codes were clustered into candidate themes that captured recurring priorities and aspirations.
4. **Intersectional analysis:** Themes were examined across age and gender groups to identify divergent visions of digital inclusion and constraints.
5. **Framework alignment:** Emerging themes were interpreted through the five-dimensional model (Access, Skills, Usage, Acceptance, Impact) of digital inclusion (Jia et al., 2024) and intersectionality literature, ensuring analytical depth.
6. **Collaborative refinement:** The research team engaged in collective review sessions iteratively to check interpretations, strengthen cultural sensitivity, and reduce individual bias.

This process enabled identification of both shared aspirations (e.g., access to livelihood information) and differentiated priorities (e.g., women's emphasis on caregiving tools versus men's focus on market regulation). By triangulating findings across groups, workshops, and analytic lenses, the methodology ensured both rigour and contextual resonance.

Results

Workshops generated diverse and community-rooted visions of digitally inclusive tools. Participants shared concrete ideas for digital tools and platforms that could address gaps in information access, service navigation, and livelihood support. While several common themes emerged across all demographic groups, the findings also revealed marked differences in priorities and design preferences along lines of gender and age.

Core areas of digitally inclusive tools

Across all groups, participants articulated a strong demand for digital support that could enhance their everyday resilience and access to services. The most widely prioritised need, identified in eleven of the sixteen workshops, was orientation on how to access and use existing digital content related to farming, livestock, and poultry rearing. Participants described existing government and NGO resources as either inaccessible or difficult to navigate and expressed interest in training or tools that would simplify the process of finding, understanding, and acting on information. These suggestions cut across male and female participants, highlighting a shared concern for food security and diversified livelihood strategies.

The second most frequently mentioned idea, discussed in eight workshops, was an integrated mobile app offering timely and reliable information on fishing bans, government rules, and relevant services for fishing communities. Both elderly and young male participants, in particular, emphasised the financial and legal risks associated with missing updates on fishing regulations and the need for clear communication channels to seek clarification or lodge complaints. Some participants also wanted such an app to include features related to government benefits, such as the fisherfolk ID card and social protection schemes.

Additionally, six groups, mostly young and elderly men, prioritised the development of a digital platform to facilitate short-term employment during fishing bans. These social-media-style tools were imagined as hyper-local, community-based, and practical platforms, allowing fishers to share or discover available work opportunities in agriculture, construction, or transport. Relatedly, five groups proposed digital tools that could support fish availability forecasting, hatchery planning, and price negotiation functions intended to reduce dependence on middlemen and improve bargaining power in fish auctions.

Women also put forward concrete proposals for income-generating information systems. Six groups proposed applications focused on handicrafts, home-based food production, and textile design. These platforms would support learning (e.g., steps of *Nakshi Katha* embroidery), link users with buyers, and provide information on pricing and quality standards. Five female groups also suggested apps offering access to health and education information for themselves and their children. Topics included maternal care, pregnancy, disease prevention, and children's schooling, as well as guidance on digital learning resources.

While less common, other ideas included GPS tracking of family members involved in fishing (particularly raised by elderly women), digital disaster early warning systems, and digital associations of fisherfolk to enable collective mobilisation. These reflected participants' desire not only for access to information but also for increased safety, coordination, and community solidarity.

Gendered visions of digital inclusion

An intersectional analysis of the workshop data revealed stark gendered differences in both the types of information valued and the imagined functions of digital systems. Male participants, both elderly and young, were predominantly concerned with sustaining and expanding income-generating activities directly tied to fishing. Their ideas were grounded in occupational risk management, technical improvement, and market access. Men frequently envisioned apps that

could reduce their vulnerability to regulatory enforcement, enhance access to natural resources, and increase their ability to find alternative work during fishing bans.

In contrast, women's proposals were more likely to integrate household responsibilities, caregiving duties, and small-scale entrepreneurship. Elderly women prioritised livestock and poultry rearing support and identified digital orientations that would help them participate more fully in existing agricultural initiatives. Young women, while also invested in these sectors, leaned more heavily toward education and reproductive health content, often combining digital aspirations with their ambitions for self-development and greater agency. Their suggestions reflected a strong desire to balance domestic roles with future-oriented opportunities, such as skill-building and independent income generation.

These gendered distinctions also extended to the form and tone of the proposed tools. Men generally proposed digital solutions that connected them with other men, peers, traders, or technical advisors, and emphasised control over economic resources. Women, in contrast, imagined platforms that mediated their relationships with the household, children, and local health or education providers. For both groups, trust, cultural appropriateness, and ease of use were key concerns, but the underlying logics of use were shaped by gendered roles, expectations, and constraints.

Generational differences in digital aspirations

Generational positioning also shaped participants' priorities. Elderly men brought deep experience of fishing, governance structures, and local organising, which informed their suggestions for tools that could help manage regulatory information, form associations, and support intergenerational knowledge sharing. They focused on practical, rule-based, and often collectivist tools, including proposals for digital unions of fisherfolk and apps that could help clarify and navigate fishing-related regulations.

Elderly women's visions were grounded in the practical needs of sustaining households and caregiving roles. Their proposals prioritised tangible benefits, such as livestock care guidance and handicraft support, but they also voiced the need for technologies that could enhance their capacity to care for family members, such as GPS tracking apps for relatives working on rivers and early warning systems for disasters.

Young men and women were more likely to articulate forward-looking ideas that connected digital access to life improvement, transformation, and opportunity. Young men suggested technical innovations such as fish-forecasting tools and digital fish markets, reflecting their engagement with competitive market systems and aspirations for modernised fishing practices. Young women presented hybrid digital imaginaries that blended economic self-reliance, social responsibility, and aspiration for recognition. They imagined using digital platforms to learn new skills, support their children's education, and gain access to pregnancy and health information, tools that could support both personal advancement and community wellbeing.

Summary of key patterns

Taken together, the workshop results reveal a strong collective demand for digital tools that provide context-sensitive, accessible, and actionable information. Across all groups, participants identified gaps in their current access to information on regulation, services, income opportunities, and well-being. At the same time, the data shows that ideas for digital inclusion are not monolithic. They are shaped by participants' intersectional positions, particularly age and gender, which influence not only what types of information they value but also how they hope to access and use it. While men focused on occupational and market-based tools, women sought platforms to support caregiving, domestic entrepreneurship, and health. Older participants favoured stability, clarity, and safety, while younger participants prioritised innovation, ambition,

and autonomy. These insights highlight the need for digital inclusion initiatives to engage with the diverse and situated digital aspirations of community members rather than assuming universal solutions.

Discussion

The findings of this study reveal how members of marginalised fishing communities in Bangladesh, differentiated by gender and age, envision digitally inclusive tools in ways that are deeply grounded in their lived realities. This section interprets these community-driven insights about the literature on digital inclusion, intersectionality, and participatory design, offering a synthesis of theoretical and practical implications.

Reframing digital inclusion as situated, relational, and aspirational

Findings from the ideation workshops demonstrate that digital inclusion must be conceptualised not merely in terms of access or technical usability, but as a situated and relational process shaped by livelihood systems, household roles, and community aspirations. Across all groups, participants proposed tools that were oriented toward specific challenges in their daily lives: navigating fishing bans, accessing health care, securing short-term employment, or educating children. These findings resonate with broader critiques in the literature that argue for moving beyond access-based metrics to frameworks that account for the relevance, impact, and cultural fit of digital interventions (Gurumurthy and Chami, 2019; Jia et al., 2024; Mariën and Prodnik, 2014).

The emphasis placed by participants on usability, local relevance, and trusted communication echoes what Warschauer (2004) and Lloyd and Wilkinson (2016) described as the need for meaningful digital engagement. Participants did not simply ask for more technology; they asked for the right kinds of support systems that fit their socio-economic and ecological contexts. These findings reinforce digital inclusion as a socially embedded phenomenon, rather than a technologically determined one (Couldry and Mejias, 2019; Madon et al., 2009).

Moreover, the aspirational dimensions of the proposed tools, especially those put forward by young women and men, highlight how digital inclusion is seen not only as a response to deprivation but also as a pathway to opportunity, dignity, and social transformation. These findings align with the idea that marginalised communities engage with digital imaginaries in ways that reflect both critical agency and forward-looking ambition (Costanza-Chock, 2020; Djatmiko et al., 2025).

Intersectional digital needs: gender and age as structuring axes

As Crenshaw (2013) and Gurumurthy and Chami (2019) argued, digital inclusion efforts must attend to how multiple dimensions of identity shape opportunities for participation. This study confirms that age and gender not only influence access to technology but fundamentally shape what kinds of information are valued and how digital systems are imagined.

Men's proposals were often tied to public, economic, and regulatory domains: fishing rules, market information, and employment matching, reflecting their roles as primary income earners and navigators of formal systems. Women focused more on caregiving, health, education, and domestic entrepreneurship, suggesting a different orientation toward digital use shaped by the gendered division of labour and spatial mobility constraints. This echoes findings from Bibi (2019), Dixit and Banday (2022), and Frangoudes and Gerrard (2018), who note that women's digital engagement is often linked to reproductive roles and household responsibilities but can also be a site of empowerment when aligned with their realities.

Similarly, generational divides revealed different orientations toward digital futures. Elderly participants leaned toward digital tools that offered clarity, safety, and continuity, digital unions, GPS tracking, or clear rules for fishing bans, while younger participants emphasised learning, aspiration, and experimentation. These contrasts highlight the need to avoid simplistic

assumptions about ‘digital natives’ (Helsper and Eynon, 2010) and to design age-sensitive digital systems that recognise how life stage, responsibility, and experience shape digital needs and comfort.

The differentiated insights generated by this study provide empirical support for the growing body of scholarship that calls for intersectional approaches to digital inclusion (Al Dahdah et al., 2020; Eubanks, 2018; Selvaraj et al., 2022). Rather than treating fishing communities as a homogenous group, the results show how internal diversity must inform digital policy and design practices.

Participatory imagination as a method and an outcome

A key contribution of this study lies in its participatory methodological approach. Through ideation workshops grounded in participatory design principles, the research not only generated data but also enabled collective imagination and knowledge production. Positioning participants as co-creators of digital futures made visible the capacities, creativity, and critical insights of communities that are often framed as digitally deficient.

The workshops demonstrated that even in contexts marked by low formal education, infrastructural constraints, and institutional neglect, participants articulated coherent and grounded ideas about how digital tools could support livelihoods, well-being, and social participation. This finding aligns with arguments by Heeks (2018), Singh et al. (2023), and Costanza-Chock (2020) for shifting from user-centred to community-driven design. Digital inclusion, in this sense, is not about inserting people into pre-existing systems but about enabling them to define what kinds of systems they need and why.

By enabling each group to articulate its priorities, the workshops also supported micro-level acts of recognition and agency. Proposals ranging from reproductive health apps by young women to digital unions imagined by elderly men reflect perspectives shaped by participants’ social positioning. These contributions should be understood not only as empirical findings but as expressions of digital citizenship, through which marginalised groups assert a voice in shaping technological futures.

Policy and Design Implications

The findings suggest that digital inclusion initiatives targeting fishing communities in Bangladesh and similar marginalised groups should adopt participatory, intersectional, and context-responsive approaches. Rather than prioritising infrastructure or generic digital skills alone, policymakers and development actors should engage communities in co-design processes that reflect local practices, social roles, and aspirations.

The results further indicate that effective digital tools are those that integrate seamlessly into everyday life. Issues of trust, language, local relevance, and offline usability emerged as central concerns and should inform future system design. Modular, multilingual, and visually oriented tools that support oral knowledge exchange may be more appropriate than text-heavy, standardised platforms.

Finally, the study underscores the value of demographic targeting. Interventions designed for specific groups, such as young women or elderly men, are likely to foster deeper engagement than one-size-fits-all solutions. Such efforts should build on existing knowledge systems and social networks, avoiding deficit-based framings of digital capability.

Conclusion

Digital inclusion, as demonstrated in this study, is not about inserting marginalised communities into pre-existing technological systems but about enabling them to define what kinds of systems they need and why. Through participatory ideation workshops, fishing community members articulated priorities for digital tools that support livelihood security, caregiving responsibilities, safety, and collective well-being, shaped by intersecting experiences of gender and age.

The findings contribute to digital inclusion and participatory design scholarship by demonstrating how intersectional positions shape community-defined digital futures. Most importantly, the study affirms that inclusive digital futures must be co-imagined and co-produced with those who are too often excluded from technological decision-making.

Future research can build on these insights by piloting some of the proposed tools in collaboration with community members, evaluating their impact, and scaling up design processes that centre the voices and visions of marginalised populations. Only then can digital inclusion move from rhetoric to reality, grounded in the everyday experiences, values, and aspirations of the people it seeks to serve.

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