

Whose Participation Counts? Towards Technology-Mediated Equitable Futures of Development Work

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Participatory approaches may empower community members toward their development; however, structural and identity-based factors may impede equitable participation. It, thus, becomes imperative to critically examine the politics, dynamics, and rhetoric of participation in development contexts. We deconstruct the meaning, means, and need for participation by situating our study in the Indian government's growing efforts to digitalize a nationwide scheme implemented to support rural farmers' participation in natural resource management (NRM) to achieve secure employment while building climate change resilience. Capturing the situated essence through field studies that include observations, interviews, and focus groups, we systematically analyze challenges to participation in NRM and uncover the technological gaps affecting its workflow digitalization. We discuss sociotechnical considerations to meaningfully design and integrate digital technologies toward supporting just participation in achieving sustainable development.

Additional Key Words and Phrases: Participation; Sustainable Development; Natural Resource Management; Future of Work; ICTD; HCI4D; Environmental Justice

ACM Reference Format:

Vishal Sharma, Shivani A. Mehta, Neha Kumar, and Aaditeshwar Seth. 2024. Whose Participation Counts? Towards Technology-Mediated Equitable Futures of Development Work . 1, 1 (July 2024), 31 pages. <https://doi.org/10.1145/nnnnnnn.nnnnnnn>

1 INTRODUCTION

The design of a development intervention is often conducted by bureaucrats and practitioners without the active involvement and participation of beneficiaries [103, 104, 165]. Largely due to the complexity arising from structural factors (e.g., political, economic, and social) and identity-based factors (e.g., class, caste, gender), development interventions may not respond quickly to emerging issues, failing to achieve the targeted development outcomes [104]. Addressing these concerns, researchers within Computer-Supported Cooperative Work (CSCW) [75, 146, 147, 178, 189] and adjacent fields of Human-Computer Interaction (HCI) [53, 119, 131] and Information and Communication Technologies and Development (ICTD) [135, 164, 170, 185] have studied, developed, and employed participatory approaches to involve beneficiaries in the design and management of

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XXXX-XXXX/2024/7-ART \$15.00

<https://doi.org/10.1145/nnnnnnn.nnnnnnn>

development interventions. Despite these approaches, what it means to be participatory, including how the complex interactions and labor of multiple stakeholders affect their participation, remain active areas of research [11, 96]. In this paper, we critically examine the politics, dynamics, and rhetoric of participation in a development context, asking (a) *how participation occurs*, (b) *who gets to participate*, and (c) *the scope, gaps, and impending challenges of digitalizing¹ equitable participation in development*.

We situate our study in the context of the Mahatma Gandhi Rural Employment Guarantee Act (MGNREGA) in Bihar and Jharkhand, India. The act aims to offer secure employment to unskilled workers, including farmers, to create income-generating natural resource management (NRM) assets, such as farm ponds, tree plantations, canal repairs, check dams², and cattle shelters. NRM assets planning is specifically designed to be participatory [60, 122, 123, 169]: workers can put forth their demands in village-level governance forums called the *gram sabhas*³; the demands are aggregated and put up to sub-district level government officials, who then sanction a technical review of the proposed NRM works; then, the funds are released, and the asset construction is initiated with regular reviews until the completion of the construction. However, the workflow might not always be straightforward and linear as powerful stakeholders may influence the outcome, marginalizing already disenfranchised populations [57, 193]. We ask, *RQ1: how is MGNREGA NRM work executed, i.e., what are the planning, implementation, and monitoring operations* and *RQ2: how does participation actually play out in the MGNREGA NRM workflow, i.e., what are the structural and identity-based factors impacting who gets to avail of the benefits*. Several aspects of MGNREGA workflow have been digitalized [110, 181, 182] and additional digitalization plans have been proposed [35, 110, 180]. We examine the ongoing efforts and implications of this digitalization, asking *RQ3: how does digitalization support stakeholders' participation in the MGNREGA NRM work*.

To answer the questions, we conducted multiple field visits, observing, interviewing, and performing focus group discussions with stakeholders who affected or were affected by the MGNREGA workflow. The stakeholders included workers, such as farmers seeking funds for NRM activities, and bureaucrats, such as *mukhiyas*⁴ who register and forward the funding requests to sub-district level administrative officials for approval, technical assistants who review proposed NRM field sites, *rozgar sewaks* who keep track of worker employment and payments, and volunteers of local community service organizations (CSOs) working in the geographies of our study. We report our findings, discussing the MGNREGA NRM workflow in practice, systematically examining challenges to workers' participation in NRM, and highlighting sociotechnical gaps impacting MGNREGA's digitalization.

Our study contributes to the ongoing focus within CSCW and adjacent fields on work digitalization and the need to support the broader sociotechnical ecology of a diverse set of workers and their work practices [87, 121, 159, 160]. Taking a multi-stakeholder perspective [93, 145], this study expands the CSCW's increasing engagement with the ICTD and Human-Computer Interaction for Development (HCI4D) scholarship to gain a deeper understanding of digitalizing workflows in low-resource and under-served development contexts, impacting the livelihoods of workers already encountering marginalization [85, 112, 138, 146, 183]. It further complicates the notion of participation, analyzing how it is constructed, operated, and affected by the identity-based and structural

¹Digitalization is distinct from digitization: digitalization denotes “the way many domains of social life are restructured around digital communication and media infrastructures,” and digitization is “the material process of converting analog streams of information into digital bits” [25].

²A small dam across a drainage channel to store water that reduces flow velocity for sediments to settle and for water to percolate into the ground.

³A village assembly conducted regularly by locally elected representatives.

⁴Mukhiya, also called *sarphanch* or *pradhan*, is the head of a panchayat, i.e., a village council, elected by the villagers.

factors that need to be accounted for when designing technologies mediating participation [71, 188] or employing participatory approaches in technology design [24, 46, 75]. Finally, our paper presents four sociotechnical considerations to promote more meaningful design and integration of digital technologies to support participation in development work: *considering contextual politics, evaluating economic and policy implications, supporting human infrastructures, and mediating informal and invisible cooperative work*. These considerations can be mapped to other work contexts with limited digital infrastructures as well as with marginalized, under-served, and under-represented communities of workers, toward realizing more inclusive, equitable, and participatory futures of work in development contexts.

2 BACKGROUND

In India, workers in rural areas, with livelihoods primarily dependent on agricultural activities, often suffer seasonal variabilities, such as droughts, extreme temperatures, and deficit rainfalls [128, 179]. Due to these irregularities, many farmers have migrated to cities to seek secure work [179]. In 2005, the Indian government introduced MGNREGA as an Act of Parliament, providing social security by guaranteeing up to 100 days of paid work to every rural household [169, 176]. Workers can construct and maintain NRM assets, rural infrastructure, and other public works [60, 88, 179], e.g., water conservation structures, land development, renovation of water bodies, drought-proofing, flood control, and tree planting [58, 102]. NRM assets can be constructed on village commons lands, such as grazing areas, private land owned by households, or government-owned lands. In NRM work sanctioned on private land, the same household may often get paid to create the asset [6, 122], typically the case with small farmers, owning 2.5–5 acres of land, and marginal farmers, owning less than 2.5 acres of land [80, 137]. Large farmers, who usually own over 5 acres of land, may employ workers, including small and marginal farmers, to create assets.

MGNREGA is meant to be a demand-driven scheme both in terms of rural communities being able to put up a demand for the NRM assets they want funding for and rural households being able to register an employment demand which the government is liable to provide in a timebound manner [6, 122]. Requests for sanctioning of funds for the creation of NRM assets need to originate through decentralized community-based planning via the *gram sabha* and then aggregated to a *gram panchayat*⁵ [60, 169]. The block program officer⁶ (BPO) then reviews the requests and appoints a field technical assistant to conduct a feasibility review of the proposed NRM works. Then, a Gram Panchayat Development Plan is built and sanctioned for implementation. The subsequent implementation of NRM works is managed by “lower-level bureaucrats [180];” for example, the *rozgar sewak* is responsible for meeting employment demands from rural households by matching them with the NRM assets sanctioned for implementation, helping allocate work, and generating payment orders.

MGNREGA has supported the creation of ecologically useful NRM assets, improving the climate resilience of rural agricultural households, and providing them with employment. From 2013 to 2014, MGNREGA employed 48 million people, around 24.4% of the rural households [43]. In 2017, the scheme paid over 6.4 billion to more than 77 million people [35]. From 2019 to 2020, 130 million workers found employment via MGNREGA. MGNREGA mandates at least one-third of wage seekers to be women [66]. In 2017, 47.5% of the workforce was women [174]. The act offers equal pay for female workers and provisions for worksite facilities for children [30]. Despite all this, beneficiaries may face challenges in availing of MGNREGA benefits because of the underlying

⁵A locally elected governance unit comprising about 10 villages to implement various government schemes, including MGNREGA.

⁶A government official at the sub-district level who manages MGNREGA funds for NRM projects.

structural and identity-based politics and imbalances [15, 157, 180], which is our paper's topic of investigation.

3 RELATED WORK

We discuss the notion of participation, its challenges and opportunities, as described in development, CSCW, and NRM scholarship. Then, we present some efforts taken to digitalize development work and their impact on participation.

3.1 Participation and Development

Participation, as a concept, emerged in the development scholarship with the work of Freire [61], Borda [144], Chambers [32, 34], and Rahman [136], arguing the importance of beneficiaries' participation in development work. Freire [61] argued that "development can only be achieved when humans are 'beings for themselves,' when they possess their own decision-making powers, free of oppressive and dehumanizing circumstances; it is the 'struggle to be more fully human.'" Chambers [32, 34] brought the concept of participation into mainstream development discourse through the Participatory Rural Appraisal (PRA) process. PRA is a family of participatory methods (e.g., participatory mapping, transect walks, seasonal calendars, and ethnobiographies), enabling participants to access their requirements to influence the design of a development intervention [32, 33, 79]. It suggests practitioners learn rapidly and progressively from participants while triangulating the learning [32]. Through open dialogue and active engagement, such participatory approaches bring forth relevant information, foregrounding people's voices while supporting transparency and openness [83, 172].

To understand who gets to participate and the extent, development scholars have classified participation as a "means" versus an "end" [126] and "weak" versus "strong" participation [26, 42]. Participation as a means involves using the act of participation to achieve predetermined goals by harnessing participants' existing resources [126]. Participation as an end is about strengthening the capabilities of participants so they could intervene more directly in their development process [126]. Weak participation includes "consulting" or "informing" participants to take into account their needs, capabilities, and aspirations [42]. In strong participation, however, participants identify their problems and needs, mobilize their resources, and plan, manage, control, and assess their actions [42].

Weak and strong can be categorized into nominal, passive, consultative, activity-specific, active, and interactive [5, 90, 177]. In nominal participation, participants are given a membership in the group to show they are a part of the development process; however, they might not even attend the meetings [90]. The development process is planned, implemented, and assessed completely by outsiders [90]. In passive participation, participants attend the meetings without participating in decision-making [90]; they usually get informed about a decision ex-post facto [90]. In consultative participation, participants are asked to share their opinion, even if it might not influence the decision [38]. In activity-specific, participants are asked to perform specific tasks to aid the development process [90]. In active participation, participants can express their opinions and take additional initiatives to implement a control mechanism more effectively [90]. In interactive participation, participants can raise their voices and influence the decision [90].

ICTD researchers have asked to critically examine participation in development work [13, 53, 75, 84]. For example, Bailur [11] questioned "What participation constitutes and how it can be undertaken? ... Is participation a free and fair process—indeed, what does it involve? ... To what extent does genuine participation occur in ICT for development projects?" Kendall and Dearden [96] posed similar questions: who participates, with whom, in what, and why? Many noted that people may not participate because of a lack of technical adeptness or access to technical

infrastructure [81, 91, 98]. Participatory approaches might be subjected to structural factors (e.g., political, social, economic, institutional) or identity-based factors (e.g., wealth, gender, class, caste, social standing), often benefiting a certain group in unequal ways [57, 132, 193]. Strong community orientations, hierarchical social organization, and/or patriarchal norms also impede people from participating [75, 171, 187]. Hickey and Mohan [78] reported that when participation, which is explicitly political, is depoliticized, development efforts become completely technical; incorporating local factors as technical inputs to planning, as opposed to responding to wider social structures, leads to a superficial understanding of the power dynamics, restricting the formation of a more sophisticated comprehension of how empowerment may occur, what is the role of structure and agency in social change, and how does power operate in development contexts [78]. Not acknowledging power dynamics leads to “participatory exclusion” [5] of those already marginalized, with participation merely ending up becoming an institutional mechanism to deliver a project and reduce cost [77, 107].

Within CSCW [24, 147, 188, 189] and HCI [28, 53, 108, 184], there has been an increasing focus on participatory approaches to consider participants’ perspectives and experiences in technology design and evaluation as technologies “thrown over the wall” or “parachuted in” from afar are less likely to succeed [50]. Greenbaum and Halskov [67] argued that people whose lives will be affected have the right to influence the design. Designers and users often do not share the same context, ideologies, or preferences, which could limit designers’ ability to understand users’ needs and experiences to incorporate into the design [67, 76, 147]. By involving users in the design process, designers could learn from communication, collaboration, and cooperation [67, 75]. Several CSCW and HCI researchers working in the development contexts have employed participatory approaches [1, 75, 146, 147]. Tuli et al. [1] conducted participation design activities to investigate how menstruating women in India deal with periods, factors influencing their choices, and their desired safe spaces. However, the politics of participation still remain implicit, and the assumptions behind participation are often taken for granted, thus becoming tyrannical, harming instead of empowering people, especially from marginalized and minoritized communities (see [36, 37, 163, 190]). We deconstruct the meaning, means, and importance of participation, examining its politics and (re)configuration in digitally mediated MGNREGA NRM workflow.

3.2 Participation and Natural Resource Management

To manage natural resources judiciously, governments across the globe have implemented top-down NRM projects [19, 152]. However, such centralized projects often exclude community members in the decision-making process and miss local knowledge, thereby causing harm to already vulnerable populations, disempowering them, and rendering them agent-less recipients [9, 39, 78]. To address the issues, numerous decentralized NRM mechanisms have emerged, considering participation as a way to enhance collective management by promoting dialogue between stakeholders to integrate local knowledge, establish rights, and facilitate civic education [7, 117, 141]. Participation promotes fair distribution of resources, responsibilities, benefits, and consequences of NRM [63]. It transfers influence and power from those who usually have it to those who do not [62], leading to just distribution [62].

Sociopolitical structures impact participation in NRM. Managing natural resources usually involves groups with different interests [12, 130], impacting participation—more powerful groups drive the agenda towards issues of their interest [9]. These dynamics cause “elite capture” with powerful people taking advantage of institutionalized benefits [140]. For example, Saito-Jensen et al. [149] have found that village elites in India occupy the most powerful position within collective managerial bodies because of existing social hierarchies. People who are marginalized tend to be less involved [10], may arrive late to participation [140], or cannot afford sustained participation [142].

To ensure fair participation in NRM, researchers have suggested viewing the goal of participation as leading to an equitable distribution of benefits [134], ensuring a sufficient quality of life for all [29], or establishing projects in vulnerable areas [162]. Zafra-Calvo et al. [193] have emphasized that participation is fair if the cost of the most vulnerable people is compensated, benefits are provided to everyone as agreed, and traditional knowledge is “equally or more represented than statutory ones.” Other scholars have argued that participants should decide what just participation means in their context [64, 70]. However, fair participation in NRM activities remains vague, with scholars suggesting diverse ways to evaluate fairness [117]. Akbulut and Soyly [9] have reported that participation in NRM is based on the “implicit assumption that the mere establishment of such mechanisms will provide all stakeholders with similar opportunities to influence decisions that affect their lives and bring an equitable solution to the conservation problem at hand, regardless of pre-existing power structures.” This paper uncovers factors impeding participation in NRM.

3.3 Digitalization and Development Work

Alongside a recognition for greater community participation in ICTD, an almost converse trend of digitalization of development work has also emerged, aiming at building systems for tighter control and coordination [157]. Such systems may restrict participation, as in the case of the digital identity system of *Aadhaar*⁷ in India [97]. *Aadhaar* uses biometric-based authentication to validate the identity of beneficiaries for them to claim welfare benefits, such as subsidized food, to which low-income households in India are entitled. While the idea behind the use of *Aadhaar* is to prevent unauthorized claimants, larger leakages may happen, as was evident in the case of quantity fraud where fewer food grains were given than what people were entitled to [97]. The *Aadhaar* system takes away the community’s agency to demand accountability from local institutions as they now have to negotiate with ICT operators who lack local stakes and are only answerable to administrators [52]. Consequently, new rent-seeking intermediaries may emerge, acting as mediators between citizens and the state, impacting the participatory process [97].

Similar issues have been documented with the digitalization of other government-led development schemes [111] and the lack of suitable grievance redressal processes to allow citizens to interface with digitalized systems [158]. Scott [156] discussed a “high modernism” mindset in the state’s actions, leading to failed development schemes because participation is not suitably incorporated in their plans and operations. Veeraraghavan [182] studied the Management Information System (MIS), a digital tool that assists with information collection, storage, and dissemination of MGNREGA-related work, noting that the primary motive for building the system was for “upper-level bureaucrats” to oversee the actions of “lower-level bureaucrats” to prevent corruption. MIS improved transparency as upper-level bureaucrats used it to discover fraud, avoid local politics, and assist workers in claiming unpaid wages and other benefits [114, 192]; however, lower-level bureaucrats found different, novel pathways to use it for corruption [180]. For example, the upper-level bureaucrats introduced the digital muster roll, a document that assigns and records work days to track who showed up to work on a specific date. The lower-level bureaucrats who maintained the document, however, assigned work to some, telling others that “the computer has not assigned them work” [180]. The system was not easily accessible to all because it was web-driven, requiring English and high-tech literacy; the means to make it accessible have not been adopted yet [31, 167]. Taking a critical approach, we examine the current efforts to digitalize MGNREGA workflow, investigating how such efforts impact equitable participation in development work.

⁷A unique identification number issued by the Indian government, serving as a proof of identity and residence.

Participant (Gender)	Role	Village\Panchayat\Block	District
P1 (M)	Local volunteer	Maura panchayat	Bihar (BH)
P2 (W)	Local volunteer	Hazaribagh	Jharkhand (JH)
P3 (M)	Local volunteer	Hazaribagh	JH
P4 (M)	Geologist	Hazaribagh	JH
P5 (M)	NGO volunteer	Harhu village	Ranchi, JH
P6 (M)	Ward member	Kulhi village	Ranchi, JH
P7 (M)	Block Program Office Computer Operator	Ratanpur panchayat	Jamui, BH
P8 (M)	Farmer	Ratanpur panchayat	Jamui, BH
P9 (M)	Block Program Officer	Ratanpur panchayat	Jamui, BH
P10 (M)	Deputy director, Watershed Management, Soil Conservation Department.	Ratanpur panchayat	Jamui, BH
P11 (M)	Engineer, Watershed Management, Soil Conservation Department	Ratanpur panchayat	Jamui, BH
P12 (M)	Worker, Watershed Management, Soil Conservation Department	Ratanpur panchayat	Jamui, BH
P13 (M)	Engineer, NGO	Atki panchayat	Girdih, JH

Table 1. Interview participants' demographics

4 METHODS

4.1 Data Collection

With approval from the <name of the university> Institutional Review Board, we collected data in April and July 2022. We visited the field sites in rural areas in the states of Bihar and Jharkhand and conducted 30 hours of participant observations, 13 semi-structured interviews, 17 focus groups, and numerous ice-breaking activities with multiple stakeholders. Stakeholders included government officials (e.g., BPO), locally elected representatives (e.g., *mukhiya* and ward members⁸), volunteers of CSOs, daily-wage workers, farmers, and personnel from non-governmental organizations. During observations, we specifically focused on understanding who participates in MGNREGA NRM planning and implementation processes, how they participate, to what extent they participate, and how participants reach consensus during meetings. We conducted interviews and focus groups to better understand different stakeholders' attitudes, perspectives, and experiences when participating in the MGNREGA NRM workflow.

All interactions with participants and data collection were mainly in Hindi, but the participants spoke in diverse Hindi dialects. When they did not know the Hindi vocabulary, participants sometimes code-switched to Indian English⁹ and regional/tribal languages, such as Bhojpuri and Khortha. All authors are proficient in Hindi and Indian English but not the regional/tribal languages. Researchers have suggested seeking assistance from local volunteers to better connect with community members and understand local nuances [20, 49]. Following the advice, we sought the help of volunteers—two men and one woman—to recruit participants and help us with language localization [101]. Volunteers from a local non-governmental organization, which the last author was also a part of, and a CSO with several years of expertise in NRM work assisted us with recruitment. They helped us navigate the sites, converse with participants using the regional/tribal vocabulary, interpret the dialects, build rapport, and understand our participants' experiences.

Most of our interview participants were men. Studies in rural India are overrepresented by men; there is often more reliance on male informants because of deep-rooted patriarchy and high gender inequality in public and official settings [94, 99]. It was significantly easier for us to obtain access to and directly converse with men who were usually willing and were not restricted to converse with

⁸Gram Panchayat, a basic village-governing institute, is divided into wards. A Ward Member represents each ward and is elected by the villagers.

⁹Indian English is a distinct dialect of English with its own set of words (e.g., matchbox, key bunch, timepass) not used in conventional English [148].

Focus Group	Participants	Village/Panchayat/Block	District, State	Gender
FG-1	7 farmers, 5 labor, 2 NGO volunteers	Kebal village, Guguldi panchayat	Jamui, BH	8M, 6W
FG-2	2 mukhiyas, 1 MGNREGA engineer, 9 MGNREGA workers	Ratanpur panchayat, Gidhaur	Jamui, BH	12M
FG-3	20 farmers and laborers, 2 NGO volunteers	Kodasi village, Sabal-bigha panchayat	Jamui, BH	22 M
FG-4	13 farmers, Mukhiya, 2 NGO Volunteers	Maura panchayat	Jamui, BH	16 M
FG-5	8 farmers, 2 village volunteers, 2 NGO volunteers	Kulhi village, Ormanjhi block	Ranchi, JH	4M, 8W
FG-6	15 NREGA volunteers, 2 NGO volunteers	Kulhi village, Ormanjhi block	Ranchi, JH	17M
FG-7	7 NGO volunteers	Kulhi village, Ormanjhi block	Ranchi, JH	7M
FG-8	6 farmers	Harhu village, Ormanjhi block	Ranchi, JH	6M
FG-9	2 and 9 farmers, 1 Ward member, 1 NREGA engineer, 2 NREGA officers	Kulhi village, Kuchu panchayat	Ranchi, JH	6M, 9W
FG-10	Former and current Mukhiya, 2 Gram Pradhans, and 3 Ward members	Kulhi village, Kuchu panchayat	Ranchi, JH	6M, 1W
FG-11	6 farmers	Banadi, Ratanpur panchayat, Gidhaur	Jamui, BH	6M
FG-12	5 farmers	Banadi, Ratanpur panchayat, Gidhaur	Jamui, BH	5M
FG-13	Mukhiya and 11 local volunteers	Banadi, Ratanpur panchayat, Gidhaur	Jamui, BH	12M
FG-14	Block Progam Officer, 1 Engineer, 2 Ward members	Ratanpur panchayat, Gidhaur	Jamui, BH	4M
FG-15	7 farmers, 1 mukhiya	Bishnugarh	Hazaribagh, JH	8M
FG-16	3 NGO volunteers	Atki panchayat, Dumri block	Giridih, JH	2M, 1W
FG-17	15 Village Development Committee members	Atki panchayat, Dumri block	Giridih, JH	5M, 15W

Table 2. Focus group participants' demographics

an outsider, as Kumar [100] has also noted while studying mobile technology adoption in rural India. In focus group discussions, we were able to recruit some women participants with the help of the woman volunteer. More women participated in focus group discussions organized in Jharkhand as they were usually involved in MGNREGA NRM works because their male counterparts had migrated to cities for work (see [73]). However, in Bihar, this migration was not prominent in the contexts we visited. Men worked locally and were more involved in MGNREGA. In the Indian context, accounting for caste, corruption, and the political-economic situation in technology design becomes crucial; however, these factors are hard to probe directly [41]. De [41] has suggested that such factors could be asked subtly or inferred from participants' non-verbal cues, for example, how they react in the presence of others or the questions they avoid. We looked for such cues when conducting observations and discussions with participants.

With the participants' consent, we audio-recorded our conversations, clicked pictures, and took extensive field notes. The first and last authors collected the data in 230 pages of field notes, 15.5 hours of audio recordings, and 68 photographs. Interviews ranged from 30 to 60 minutes. Focus group discussions ranged from 50 to 90 minutes. See Table 1 for more information about interview participants' demographics and Table 2 for more information about focus group participants' demographics. We have anonymized the data.

4.2 Data Analysis

The authors met periodically to discuss the data and adjusted the questions accordingly to inform subsequent interviews and focus groups. The first author translated (to English) and transcribed the audio recordings for analysis. The quotes presented in the findings were translated from Hindi to conventional English while keeping the Indian English that participants used (e.g., "clicked pictures," "earth cutting") [129]. The first author followed the interpretive, inductive coding approach that Merriam and Grenier [113] have proposed to analyze the photographs, transcripts, and field notes. They familiarized themselves with the data, read through the data, and took initial notes. They coded the data, including going through the data and highlighting everything related to participants' perspectives, attitudes, and experiences regarding their participation in different stages of MGNREGA NRM projects. After generating codes, the authors discussed them. The first author then analyzed the codes to identify themes which included organizing, reorganizing,

and combining codes into key themes. Then, they returned to the data to ensure that the themes accurately represented the data. Finally, we formulated three high-level themes, discussing what they mean and how they represent the data.

4.3 Positionality Statement

This work is an outcome of an active collaboration among HCI and Computer Science researchers studying and designing ICTD interventions, individually and together, for years with a focus on the Indian context. All the authors are cisgender and of Indian origin. Two authors are men, and the rest as women. We all come from diverse cultural backgrounds, with experience conducting fieldwork in India. Two of us are in India, while the other two routinely cross borders between India and the United States. All authors work in privileged academic settings at top technical and research institutions. Having conducted extensive research in diverse Indian contexts, we are sensitized to the marginalizations resulting from social, economic, political, and identity-based factors of caste, class, gender, religion, and sexuality; some of us have experienced these marginalizations ourselves. All authors are strong advocates of leveraging an emancipatory mindset in research. We are committed to social change to create a world where people, irrespective of their identities/backgrounds, are empowered to maintain a sustainable livelihood.

Three of us—two men and one woman—were involved in data gathering, which may have impacted participant recruitment. Due to our own backgrounds, research experience, and familiarity with the study contexts and their social, political, economic, and cultural fabrics, we were able to understand the non-verbal cues. Growing up in India has made us knowledgeable in the English dialect spoken in the context; some of us speak the same dialect. These understandings and sensitivities have impacted our ability to comprehend and make more informed inferences during data collection and adjust the questions accordingly. Despite our sincerest efforts to understand and present the perspectives of historically under-served, under-represented, and under-resourced communities in rural contexts, we acknowledge the differences between our lived realities/identities and our participants' which might have impacted data gathering and analysis. We handle these differences (and their implications for our analysis) with care, offering a partial perspective [72].

5 FINDINGS

Our findings examine the MGNREGA NRM workflow for asset construction on farmers' private lands. First, we discuss irrigation-related issues that rural communities faced and how MGNREGA's implementation played out in practice towards addressing these issues. Then, we systematically examine the challenges that affected stakeholders' participation, including farmers from historically marginalized groups, in availing of the scheme. Finally, we present sociotechnical gaps that impacted MGNREGA digitalization efforts aimed at supporting participation.

5.1 MGNREGA NRM Needs and Implementation

A significant goal of MGNREGA was to support the irrigation needs of farmers. We discuss such needs and the MGNREGA operations aimed at meeting the needs to understand how the NRM work gets executed in practice, the stakeholders involved, and the tasks they perform.

5.1.1 Irrigation needs of farmers. Over 60% of Indian agriculture is rain-fed, and more than 70% of the population is dependent on rain for water needs [139]. However, the changing climatic patterns leading to delayed and unseasonable rainfall have impacted many farmers, especially small and marginal farmers [3, 128, 179]. Limited agricultural policies, such as the unavailability of cheap electricity, ecologically damaging deforestation, and extensive illegal sand mining from riverbeds, have resulted in plummeting groundwater levels [2]. More affluent large farmers could dig

borewells¹⁰ for year-round groundwater irrigation access, extracting upper levels of underground water, resulting in wells and ponds drying up. However, such activities affected the irrigation needs of small and marginal farmers dependent on wells and ponds, reducing their ability to cope with climatic variations [143].

The sites we visited were adversely impacted by water shortage. They had three cropping seasons: *Kharif* (June–November), *Rabi* (November–March), and *Zaid* (March–Jun) [16]. Water for irrigation was only available during the *Kharif* season when the monsoons hit the subcontinent. Thus, most farmers usually grew a single crop of either rice, maize, sugarcane, or cotton. During this study, the monsoon rains were delayed, making many small and marginal farmers wait for the rainwater to commence their agricultural activities. P8, a subsistence farmer waiting for the rains to hit the lands in order to transplant¹¹ paddy saplings to his field, shared his predicament, saying, “*Without water, how would we plant? Usually, the pond fills up with rainwater by this time. If it does not rain, then the paddy saplings will die. Whatever money I had, I purchased seeds from it. Now, if by God’s grace rain happens, then I will sow the paddy. If not, around 5,000 Rupees will go to waste.*” P8 was concerned about losing the money he invested in purchasing seeds that he planted in a nursery to become saplings. Without rain, he would not be able to transplant the saplings to his field in time, lose the money spent buying seeds and growing the saplings, and have no harvest to sustain his family year-round.

Watershed management emerged as an important mechanism to improve groundwater levels and provide year-round water for irrigation. Our CSO partner working in the Koderma district in Jharkhand showed us their watershed management work. In lands unsuitable for agriculture due to rugged terrain with uneven sloping, the CSO constructed check dams on a network of naturally created drains and gullies to slow down soil erosion and trap rainwater from percolating into the ground. In more upstream areas, they constructed trench-cum-bunds¹² to slow down rainwater flow and enable more of it to recharge the groundwater. Nearby ponds, which used to dry up soon after the monsoons, now had year-round water for irrigation during different cropping seasons.

5.1.2 MGNREGA in Action. MGNREGA was meant to facilitate small-scale water resources construction, such as check dams, wells, and farm ponds, that helped farmers with irrigation while employing them to construct these assets. To request construction, farmers could attend a *gram sabha*, presenting their demands. Requests were then to be aggregated to the *panchayat*¹³ and thereon submitted to the BPO, to sanction the funds. But the reality was different.

In practice, at the beginning of every fiscal year (April in India), the block office estimated a labor budget for various MGNREGA projects based on the funds allocated the previous year with an additional increment. P9, the BPO, told us, “*we look at the report of last year, that in the last fiscal year how much budget there was and what we allotted. We gave 2 lakhs [200,000] man days last year. So, we increased it by 10%, i.e., 2 lakhs and 20 thousand, and submitted the labor budget this year.*” After all the block offices submitted their budget, a combined report was presented to the state government, which then allocated the money. The BPO then instructed *panchayat* and *gram sabha* to focus on particular types of work, such as farm ponds, tree plantations, cattle sheds, and kitchen gardens, and generate community demand for such works. Once shared, the households wanting NRM assets were noted in *gram sabha* registers, aggregated up to the block level, with the BPO checking funds availability and shortlisting the works.

¹⁰A deep well (100–1500ft) to tap into rock layers deep underground to extract groundwater for irrigation purposes.

¹¹Transplantation is a common method of rice cropping in Asia. Rice seedlings are grown in a nursery until they become saplings and then are transplanted into puddled fields [69].

¹²Small sized embankments usually built across slopes to reduce the flow velocity of rainwater.

¹³A village council, elected by the villagers.

After shortlisting, technical assistants (e.g., civil engineers) visited the site to verify the asset's suitability and check for redundancy. For example, to construct a rainwater harvesting facility, the assistant may check the slope of the land, recommending tree plantation on land with a slope less than 5%, field bunds with a slope between 5 to 10%, and trench-cum-bunds with a slope over 10%. To avoid redundancy, the assistant may verify the construction of a similar project on the site in the last five years. During FG-9, an assistant told us, *“we do a field visit to check what kind of land it is and what kind of scheme will be suitable. Even if they have selected a scheme, we check if that scheme will be successful in that place, or else we implement some other scheme in the area.”* The assistant based their approval on seasonality, e.g., prioritizing tree plantation work during monsoons, as *“it will take less effort because the land will be wet and easier to dig and not much irrigation is required,”* a participant during the FG-13 reported; other assets, e.g., pond construction, might fail, as constant rainfall could cause the excavated earth to fall back into the dug pit.

The *mukhiya* then set up a meeting with the *rozgar sewak* to mobilize farmers to seek work under MGNREGA. Small and marginal farmers requesting NRM assets were often inclined to work on their own land, and the matching of workers to NRM projects became straightforward. However, asset construction on large farmers' lands required work-demand generation. The *mukhiya* employed those looking for employment to construct assets on large farmers' lands. During FG-10, a *mukhiya*, explained, *“if 15 people have demanded work, then according to the scheme work has to be provided to them. Now, mukhiya has to find the work for them to apply for the scheme. They have to be allocated somewhere. Then, we start a project to seek funds. We see what can be done, like constructing a well or cleaning of canals.”*

Work was usually allocated within a 5 km radius of the workers' village so that they did not have to commute since the cost of transportation could become a deterrent for their employment. If work cannot be found nearby, the workers were paid an extra 10% of their pay for every additional 5 km distance they traveled for work.

Then, a *rozgar sewak* processed the requests for wage employment, assisting workers with the registration process to secure a job card¹⁴. They collected the required documentation, which was then verified at the block office before a job card was dispatched. P7, a data entry operator at a block office responsible for digitizing all records, said, *“There is a register in which all the workers' details are mentioned, rozgar sewak brings the register ... We take a photocopy of the documents to include in our records. They also submit an Aadhar card, and account number, and then verification will happen to check if you really are part of that panchayat. After the verification, the job card is made.”* A *rozgar sewak* supervised the assets construction and sent regular updates to the BPO office. They geotagged the construction site and clicked progress pictures via the NREGA MIS system. During FG-9, a ward member¹⁵ told us that, *“a rozgar sewak comes and checks during the construction work to see if it is happening properly and as required under the act. If they do not check that, then the beneficiary might not get the money for their labor.”* After a *rozgar sewak* verified the work, a fund transfer order got generated from the block office, and the wages were transferred to the workers' bank account through the direct benefits transfer (DBT) mechanism. Workers got paid based on the work they performed on an individual basis. P9, a BPO, explained the process of payment, saying:

“The payment is based on the ‘earth cutting’ [excavation]. We pay for every 10x8x1=80 cubic feet (cft)/per day. The new construction cost of a pokhar [small pond] is based on man days, i.e., how many labor days it will cost a man to finish. After 7 days of work, we

¹⁴An official document that entitles workers to seek employment.

¹⁵A village is comprised of multiple wards. Each ward has an elected representative—the ward member—who represents them at the Panchayat level.

measured the earth cutting. If 10 laborers were there, then considering 1 day off, 6 days of work should happen. If we calculate the 6 days of work, we check how much earth cutting was done. Counting has to be done individually, even if they are working in a group. If 10 people are working, then 10x80, 800 cft should be there. For every cft we give INR 210 [...] If we just give payment based on per day, then what if we used all the money and the pokhar was just half done?"

This comprehensive account of the MGNREGA NRM workflow in practice is essential for understanding the ground reality of how the NRM work actually happened. Next, we discuss why the work did not happen the way it was envisioned and what hindered the bottom-up demand generation and participation.

5.2 MGNREGA NRM Participation Challenges

To understand who gets to participate and why, we first examine five factors that affected farmers' participation in the MGNREGA NRM. Then, we present a case of a successful NRM project by 23 small and marginal farmers, demonstrating bottom-up demand generation and participation supported by the MGNREGA scheme.

5.2.1 Landholding-Related Challenges. Small and marginal farmers had as small as one-tenth of an acre of land, resulting from a multi-generational process of land being continuously divided amongst the siblings in each generation. The fragmentation became a challenge for the farmers to take up NRM asset construction, as a *mukhiya* during FG-17 reported: "1 acre of land is not of a single person. Usually, 2-3 own the land, and then it takes time to create a consensus among them to construct a farm pond. Sometimes it never happens." For small and marginal farmers, sparing some part of their land for asset construction was challenging, as giving a portion of their land meant giving a part of the produce for subsistence. A farmer during FG-11 pointed out, "We do not have enough land to make a well. Where will we farm if we construct a well on our lands?" Those with some more land had it distributed, i.e., not situated at the same place, making it hard to construct NRM assets.

Land fragmentation was not considered in the MGNREGA NRM planning and implementation, as it was not the case in other contexts where the scheme operated. For example, in the Indian states of Punjab and Uttar Pradesh, agricultural lands had long been consolidated to prevent fragmentation and to reserve land for village use [65, 120].

In our study contexts, land fragmentation, in turn, led to a perpetuation of inequalities because large farmers were able to benefit from MGNREGA more easily. When the block office pushed NRM schemes, the *mukhiya* and technical assistants found it easier to convince large farmers with large plots to create NRM assets on their land compared to convincing different small farmers and bringing them to consensus.

5.2.2 Elite Capture-Related Challenges. Farmers from historically minoritized communities based on caste and class suffered marginalization from local elites belonging to dominant castes and classes. During FG-11, some farmers told us about a clever strategy used by a dominant group to get an extra drinking water tank constructed in their neighborhood. A village was divided into wards, with each ward having roughly a population of 800 people. A ward was allotted a drinking water tank. Members from a dominant caste, with the help of the *mukhiya*, who also belonged to the same caste, got their wards divided into two. Consequently, the divided wards got two water tanks, taking from the one allotted to the ward with people from non-dominant castes. P8, a farmer from a traditionally disenfranchised caste, said:

“In every ward, they established a water tank, but not in our ward. The tank which should be installed in our ward was installed in the other ward. That ward [pointing to the ward] has two water tanks now, and in our ward, not even one. Now, that is the choice of the mukhiya. The water tank which should come to us was installed in Ginardi. Ginardi now has 2 water tanks, and we do not have one. Even this ward [pointing to another ward] has a water tank, but not our ward.”

Especially, participants in Bihar from traditionally marginalized communities reported such challenges, as has also been noted by others who have studied caste and class politics in the context [89, 115]. Our insight corroborates with Akbulut and Soyul’s [9] that less powerful groups are often unable to participate, and more powerful groups usually drive the development agenda toward issues of their interest, as the local elites from a dominant caste did by constructing two tanks in their ward. The elites occupied powerful positions because of existing social hierarchies and imbalances, resulting in less participation of those marginalized in availing of the MGNREGA benefits [10].

5.2.3 Wage-Related Challenges. Workers preferred getting paid on a daily basis, in cash [173]. But in MGNREGA, fund transfers occurred only after a project’s completion. Delays happened in wage disbursement depending upon the availability of funds from the government; payments were delayed by several weeks or even months. MGNREGA had provision for a delayed compensation; however, the discretion rested with the government and was hardly exercised [116, 124]. The payments were deposited directly to workers’ bank accounts to prevent leakages, which caused several issues. First, banks were far from rural areas; withdrawing cash placed significant overhead on the workers to commute to the bank. Solutions, such as banking correspondents to provide doorstep cash deposit and withdrawal services, were often unavailable or fraudulent [158]. Second, workers’ bank accounts were linked via *Aadhaar* which was prone to data entry errors. Payments were bounced without the workers’ knowledge, while grievance redressal was complicated [158].

These issues impacted small and marginal farmers to demand MGNREGA work. Large farmers had sufficient working capital and often conducted work via mediators who engaged workers in MGNREGA projects and paid them in advance; once the workers had been paid via MGNREGA, the mediators retrieved the advance payments. This advanced payment led to corruption, where inflated labor estimates were made to engage more workers than necessary to finance the margins for mediators, as Mittal et al. [116] have also reported.

The low wage rate was another deterrent. Workers were paid between INR 210 to 225 per day under MGNREGA, whereas they could earn INR 500-1000 per day doing non-MGNREGA work. Especially in Jharkhand, workers preferred migrating to cities for work [179]. This posed a problem for large farmers who employed workers to implement MGNREGA work on their land. Stating the challenge, during FG-13, a *mukhiya*, told us, *“Tell me which laborer will work for INR 210? Someone working for the entire day, if you give them INR 210, then will they even work? ... When the laborers do work outside MGNREGA, for whatever work they have done, we give them at least INR 350. On top of that, we also give them food, tea, and water.”*

While men migrated to the cities, women in the family stayed back to look after their children and the elderly. They carried MGNREGA work, as during FG-9, a woman participant shared, *“We have young kids, and we need to take care of them. In the morning, we do household chores and then work on the MGNREGA projects.”* Engagement of women participants depended on other factors, including how much time they could spare from domestic work, if their household needed this additional income, the nature of work, and the time flexibility [44].

5.2.4 Policy-Related Challenges. A straitjacketed implementation of MGNREGA across contexts impeded farmers from utilizing the scheme. MGNREGA mandated a 60:40 ratio for fund allocation, i.e., 60% of the funds should be allocated to wage labor and the rest 40% to the procurement of materials needed for construction. When constructing check dams or ponds, the 60:40 ratio was easier to follow because both manual labor in earthwork and material costs, such as bricks for lining the assets, were involved. However, for projects, such as cattle shed construction, where the cost involved was largely of materials, following the ratio became an inconvenient constraint. During FG-13, a farmer explained, *“They have categorized everyone under the same category. They have distributed the same scheme to everyone. They would have done it based on the panchayat and the village, depending on what kind of land the village has. Wherever there is a hilly area, 60:40 can be followed as in plain terrains that would not work.”*

Workarounds were being followed by the *mukhiya* to navigate around this policy limitation. The construction of certain NRM assets, such as a well, mostly involved earthwork, and the funds left for material purchase were then diverted towards material-intensive projects, such as cattle shed construction. A *mukhiya* said, *“In the case of a well construction after digging up the land, the material is used. Whatever money is left from this is then given for cattle shed construction ... In that way, the money for materials from the construction of the well is adjusted in the construction of a cattle shed because in the construction of the shed, only materials money is needed there is no earthwork involved.”*

A uniform, rigid policy implementation impacted farmers’ participation in the MGNREGA process, with a few workarounds being followed to circumvent the constraints, without many getting benefited.

5.2.5 Lack of Trust in the Government. Farmers usually believed that the government offered help with ulterior motives of grabbing their land. During FG-9, a farmer told us, *“We had reservations that our land would be taken. The scheme [MGNREGA] is of the government. So, the owners [of the land] thought that the land would go to the government.”* This mistrust stemmed from prior experiences with outsiders. For example, during FG-15, a farmer mentioned that *“Whoever came, everyone betrayed us somehow. In the name of the development, money was taken which was never given back.”* Another farmer argued that *“The reason was that in this area, a lot of organizations collected money and then left. So many such lootings have happened here that villagers have stopped trusting people from outside.”* For a few participants, this lack of trust was influenced by the anti-state Naxalite¹⁶ ideology. During FG-15, a farmer added:

“There was Naxalite in this area. People were convinced by their thinking. Some of them were also involved. The thinking was that the government was doing wrong to them. It is taking away the land. From 1991 to 2008, so many years were ruled by Naxalite thinking. A certain mindset was developed that when new people come, trusting them is not easy.”

Consequently, anyone from outside the village first had to establish a rapport to gain the community’s trust, as was emphasized by the volunteers from our partner CSO working towards addressing irrigation issues in the area. During FG-16, a CSO volunteer said, *“establishing trust with the locals takes time and effort. We started in January, and it took a lot of time, until April, when we were able to conduct our first community meeting. Gaining the trust of the villagers needs rigorous and continuous discussions with them which takes time.”* Building the trust required time and effort which impacted the government to offer help to farmers via MGNREGA.

¹⁶The Naxalites are a far-left radical communist group rooted in Maoist ideology, claiming to represent the poorest and marginalized against exploitative politicians, the state, and security forces [22].

5.2.6 *The NREGA Park.* In Jharkhand's Ranchi district, 23 small and marginal farmers from historically marginalized castes came together to construct "the NREGA Park." Their plots, adjacent to one another, collectively spanned 11.5 acres. The MGNREGA NRM scheme funded 112 mango saplings per acre, along with wages for digging pits to plant the saplings, the preparation of natural fertilizers, and the creation of assets, such as farm ponds and wells. Timber trees were planted on the periphery to serve as windbreaks, protecting the mango saplings from strong winds. Fencing was also put up around to keep grazing animals away from damaging crops and trees.

The NREGA Park was not a formal collective, and the farmers did not establish a formal or an officially registered cooperative. During the FG-9, a farmer told us, "*There is no concept of a park in MGNREGA. Because farmers came together for a purpose, they named it a park. However, funds are not allocated to a park but to individual farmers for their lands.*" Some knowledgeable farmers first convinced their peers to take up the activity and then collectively proposed it to the *gram sabha*, discussed it with the technical assistant and *rozgar sewak*, and finally implemented the project by providing labor on each other's land. This bottom-up approach resolved various issues impacting MGNREGA implementation: (a) the demand came from the community itself, (b) the on-ground effort of the staff in collectivizing farmers was avoided, and (c) marginalized groups were able to get their demand approved.

The park was not an example of having resolved all issues systemically, but rather a case of many conducive factors coming together because of which the challenges to participation, we discussed earlier, were avoided. First, it was easier for the farmers to collectivize because most of them belonged to the same family tree and had no conflicts with one another. Second, the land had been lying fallow for several years because of its distance from the village habitation; the land closer to a village was often used for farming, reducing the time and effort to commute. Third, farmers did not have to bear any cost in diverting their land (not being used) to tree plantation. Fourth, among the farmers was also the ward member familiar with the MGNREGA workflow who constantly monitored the approval process. Fifth, farmers were apprehensive about losing their land to village elites, and having a government-funded project sanctioned on their land provided a safeguard. Finally, the farmers realized higher income sales that the fruit trees would generate.

5.3 MGNREGA NRM Digitalization Efforts and Challenges

MGNREGA digitalization efforts using geographic information systems (GIS) were underway. We describe the sociotechnical gaps that impacted digitalization.

5.3.1 *Gaps Affecting GIS Intergation.* GIS-based planning of NRM assets has been of interest to many [40, 47, 48]. The planning considers the underlying aquifer mapping, slope of the land, soil type, and amount of precipitation to infer sites suitable for asset construction. Development organizations, including our partner CSO, have used these methods to plan NRM initiatives at micro-watershed scales of 400-500 hectares.

Our discussions with the upper-level bureaucrats revealed that the government was going to introduce GIS-based planning into MGNREGA, which might impact its bottom-up workflow. According to P9, a BPO, GIS-based planning could bring in a long-term perspective to construct assets; however, such top-down planning may not meet the communities' immediate needs. The BPO said, "*If we get everything pre-planned that this is what could be done, then if we go to the gram panchayat, they will look at the immediate needs or benefits only.*" Communities may question the need and implications of such approaches. The BPO added, "*With GIS, the planning is about how can we construct environmental resources so that we can help the people. But when you go inside the villages or inside the wards, the common or primary needs are different. All they see is that this road is not yet constructed, so we take this project.*"

The lower-level bureaucrats did not have the required technical skillset to undertake total GIS-based planning. The BPO reported *“We do not have that kind of expert here with us. I am the program officer so we know a little about this technology. But other people, like JE [Junior Engineer] or other engineers, do not know much about it.”* Although gaining relevant technical literacy was necessary, no efforts were being made by the government on GIS education. Those interested educated themselves. For example, the BPO enrolled in a distance learning program at the National Institute of Rural Development and Panchayati Raj Distant Education to obtain a graduate diploma in GIS.

GIS’s current use was limited to geotagging the NRM assets’ construction and photographing them for verification. *“They [the government] are still loading it for the last 2 years and it [GIS-based planning] will happen in the next 5 years. The GIS system that we are using is in a very, if I say, infant stage, it is not even born yet. A lot of work is left,”* as the P7, a computer operator at the BPO office, reported. The field staff had to visit and geotag the work site at the beginning, while the work was underway, and after its completion. A mobile application was used with an automated check to allow only up to a 10-meter deviation in the latitude-longitude of successive pictures of the same work site. However, computer operators had to manually verify each photograph and upload it to the MIS portal. The operator added:

“Before starting the work, rozgar sewak has to click a photo and send it to us. We check that the work is starting here and this is the first photo. Then, when the work is half finished, for example, the yojana [scheme] is of 1 lakh [0.1 million] and around 40-50,000 INR is spent, they click a picture and send it to us to show that the work is happening which we then upload. Then, once the work is finished, the photo of the final stage with the geotag is uploaded. So, the verification is done before, during, and after.”

Some were excited about the prospects of integrating GIS into MGNREGA. They told us that the GIS could, for example, automate and reduce the labor associated with verification; perhaps remote sensing could also be used. They also believed that GIS would assist in removing human biases and other participation challenges, such as elite capture where powerful people decide which project to fund, as P7 said, *“Previously, mukhiya decides what yojana to take. Then, the issue arose that the mukhiya were doing what they wanted, so the rule came that the gram sabha had to pass the yojanas. Thus, the gram sabha started happening. With GIS, all of this will end.”* However, it was too early to glean any community experiences from the use of GIS systems since no community-facing tools existed, and the digitalization of other aspects of MGNREGA raised concerns, which we discuss next.

5.3.2 Gaps Impacting Digitally-Mediated Participation. Each MGNREGA work was assigned a supervisor called a NREGA mate. They monitored the work progress and maintained a worker attendance record on paper; a *rozgar sewak* had to examine these records to calculate the wage payments to workers. A new digital attendance system with location tracking was introduced. The attendance page opened from 6 to 11 AM for morning attendance and from 3 to 5 PM for evening attendance. To get paid, a worker had to be in the field at both times. Even for tasks, such as tree planting or digging trenches, that only took a few hours, the workers now had to be compulsorily present at the site twice a day to mark their attendance. Specifically, the system impacted women workers’ work flexibility—an incentive for them to work under MGNREGA.

The unavailability of a stable data connection at many rural, remote locations further hampered the attendance process and payments. P7, a computer operator, said, *“[field officer] has to go to the site to click a picture, upload that picture, and take labor attendance. The laborers are working, but their attendance was not marked online due to intermittent or lack of network in the field. To pay*

them, we have to take their muster roll¹⁷ out. Since the attendance was not marked, the muster roll does not open." This insight corroborates with others in the ICTD scholarship, emphasizing the need to consider the lack of digital infrastructure when designing technologies for development contexts [182, 191].

Another digitalization issue was with the direct bank transfer of wages. Earlier workers could decide whether they wanted their wages to be paid in cash or deposited into their bank account. However, after the *Aadhaar* Act of 2016, all welfare payments were mandated to be made via *Aadhaar*-bank linkages; the beneficiary's *Aadhaar* number was attached to their MGNREGA profile, and bank accounts. Payments by the government targeted towards a specific *Aadhaar* number then made their way through a gateway called the National Payments Corporation of India Mapper¹⁸ to the bank accounts of workers. This was meant to avoid leakages that may happen with cash payments where lower-level bureaucrats could extract rent in releasing the payment [97]. Along with several problems that arose with direct payment systems, such as data entry errors and poor accessibility of bank branches, issues related to basic technology and financial literacy also became evident. Many workers lacked the skills to access their bank accounts electronically. To address this issue, evidence-backed proposals were made to notify people through Interactive Voice Response (IVR) systems once their payments were released; however, such solutions were not adopted by the government yet [31, 167]. Computer operators received many queries from workers about their payment status. A computer operator told us, *"We have to monitor everything. Not everyone is educated here to understand everything. The process is good, but it is not easy to understand. They come and fight with us that you are lying, we have updated the passbook, but the money is not there."*

During our visit to a block office in Jharkhand, several workers came to check their payment status. The computer operator team helped the workers, as an act of care. However, answering the queries added additional labor to the operators who were already performing data entry and verification tasks. These insights draw our attention to care and sensitivity in shaping the design of participatory processes in MGNREGA NRM planning and implementation.

6 DISCUSSION

MGNREGA was envisioned to be bottom-up where farmers seeking NRM assets and/or employment can put their demands to the *gram sabha* who then forward the requests to the *gram panchayat*, followed by BPO reviewing the request, conducting evaluations, and deciding to sanction the funds. However, in reality, MGNREGA became centralized and top-down mediated by technology with a BPO instructing lower-level bureaucrats in *panchayat* and *gram sabha* to focus on specific asset construction and generate community demand because the *"money has to be spent"* (*mukhiya*, FG-10). Consequently, participation became (a) a means to achieve predetermined goals of allocating money for development instead of an end where the capabilities of community members are strengthened to drive their own development and (b) weak where workers were informed about the assets' construction instead of involving them in the decision-making.

Several identity-based (e.g., class, caste) and structural (e.g., policy, wage,) factors affected participation in MGNREGA, making it top-down and centralized. For example, some small and marginal farmers suffering socioeconomic vulnerabilities and belonging to historically marginalized castes faced elite capture, impacting them to avail of MGNREGA benefits. Others experienced landholding-related challenges from ongoing fragmentation, leaving them with not enough land to have NRM asset construction. For a few, participation was impeded because of a lack of trust in the

¹⁷An attendance document to record NREGA work.

¹⁸The mapper associates a Bank with an *Aadhaar* number for Direct Benefit Transfer.

government, stemming from their past experiences of dealing with other extractive entities as well as the prevalent Naxalite ideology traditionally dominant in the contexts. At the same time, the technologies introduced to support MGNREGA workflow disrupted the ongoing participation of women farmers and created new issues with direct payment systems. These identity-based and structural factors were not considered in MGNREGA planning and implementation, and certainly not during its digitalization; digitalization disrupted the already working parts of MGNREGA workflow.

We now situate our findings in scholarship from CSCW, HCI, and ICTD to further discuss the factors affecting participation to be accounted for when designing technologies supporting development work while simultaneously being critical of the digitalization efforts to avoid technosolutionism [4, 95, 109].

6.1 Considering Contextual Politics

The local politics impacted the participation of farmers/workers belonging to traditionally non-dominant castes and lower socioeconomic classes in availing of the MGNREGA benefits. This marginalization became evident during the elite capture when the ward with a dominant caste group got two water tanks, while the ward with marginal caste groups could not even get one. Development researchers have reported such social hierarchies and dynamics affecting development efforts [75, 149, 171]. For example, Saito-Jensen et al. [149] noted that in Indian villages, local elites occupy the most powerful managerial positions, driving the development agenda based on what suits their interests. Our research insights corroborated with Saito-Jensen et al. [149]; the *mukhiya* belonged to the dominant caste group and took advantage of institutionalized benefits of constructing two water tanks favoring the group [140]. Such contextual politics or power imbalances based on identity-based factors need to be considered when designing technologies supporting development work to avoid “participatory exclusion” [5] of those already marginalized, vulnerable, and disenfranchised.

Not considering such factors may render any attempts to support equitable development futile, making such efforts tyrannical which harms local communities rather than empowering them [36]. It may also lead to the design of development interventions, technical and others, that are “thrown over the wall” or “parachuted in” [51] perpetuating unjust traditional social inequalities. Thus, this “implicit assumption that the mere establishment of [participatory] mechanisms will provide all stakeholders with similar opportunities to influence decisions that affect their lives and bring an equitable solution to the conservation problem at hand, regardless of pre-existing power structures” [9] needs to be questioned in and through the technologies we design for development. Technologies can certainly be designed with critical and reflective dialogue, as Baumer and Silberman [17] suggested, by carefully teasing apart practices that perpetuate inequalities, including foregrounding such inequalities and carefully disrupting them.

Care is important; otherwise, the community members’ needs may get sidelined or even silenced. When the allocation of funds for NRM asset construction happened in April, farmers requested funds to construct a pond to fulfill year-round irrigation needs. However, the technical assistant prioritized asset constructions based on the suitability of the work, the existence of similar work, and seasonality. While technical assistant employed their expertise and skills to inform asset construction better, their decision disregarded the needs of the farmers. Assets construction requests were not carried forward to the next year, and farmers eventually became dissatisfied and gave up. Technology design for development could ensure that the claims of bureaucrats are not prioritized; instead, the needs of the community members are understood, foregrounded, debated, and considered, ensuring that those sidelining the needs are held accountable.

Technologies could be designed to allow community members to share their needs and voice their opinions, nurturing equitable and respectful participation in their own development [8]. For example, *Mobile Vaani*, a mobile-based social media platform for rural communities, has integrated an interactive voice response system allowing less technologically adept community members to dial in to share local updates and convey their needs drawing administrative attention to challenges, such as starvation of funds, single-cropping irrigation problems, the absence of a canal network in many villages, and many others [118, 153]. But, at the same time, we should also ask, “[w]hat do we do if, despite our best intentions, the systems we deploy continue to marginalize people ... or even exacerbate discrimination?” [159].

Digitalization efforts could consider that technology implementation may lead to unintended consequences [17, 133]. Such consequences became evident to us during the use of a digital worker attendance system and direct wage transfers. Although the digital attendance tool was designed to support the MGNREGA workflow, it disadvantaged workers, pressuring them to be compulsorily present on the field both times to mark their attendance even when they had finished the day tasks. MGNREGA incentivized some flexibility to women workers to manage their domestic work along with working on the scheme; however, the attendance tool took this flexibility away as the women workers now had to be present on the field twice for attendance. Electronic direct bank wage transfer was implemented to avoid leakages in the payment process, which disproportionately impacted technologically inept farmers who could not check/withdraw money electronically and had to depend on lower-level bureaucrats. These cases demonstrate the value of not designing technologies just as we value technology design [18]. To avoid unintended consequences, during design we can ask, “Could the technology be replaced by an equally viable low-tech or non-technological approach to the situation? ... Does a technological intervention result in more trouble or harm than the situation it’s meant to address? ... Does a technology solve a computationally tractable transformation of a problem rather than the problem itself?” as Baumer and Silberman suggested [18].

It is of course hard to foresee unintended consequences during technology design; all the implications of technology design and use cannot be predicted until deployed and used for some time [157, 161]. However, measures can be taken to address the unintended consequences as they appear during technology use. For example, when such troubles come, technology designers could be open to redesigning technologies. Veeraraghavan [182] called this redesigning of development interventions “patching,” suggesting sending new “patches” to resolve an issue as a part of incremental changes to the implementation whenever new information (and limitation) of an intervention is uncovered [182]. Blind spots are inevitable, but tech shouldn’t be. Redesigning existing technologies to mediate work practices better can be made an integrated part of CSCW.

6.2 Evaluating Economic and Policy Implications

The wage-related challenges impacted equitable participation of workers in availing of MGNREGA benefits. For example, workers from lower socioeconomic groups preferred getting paid daily and directly. While the banks were involved to avoid leakages, they added additional labor to the workers who had to commute to the banks located at a distance, and door-set cash delivery was not available; electronically direct bank transfer was also prone to data entry errors [116, 124, 158]. MGNREGA wages were substantially low compared to what workers could earn outside. Consequently, lower-level bureaucrats, such as *mukhiya* and *rozgar sewak*, faced challenges in recruiting workers in MGNREGA schemes. The economics of the scheme and its implications affected any attempt to digitally mediate MGNREGA practices. When designing technologies for development, designers could consider the implications of digitalizing development workflows on local economies and workers’ economic needs.

Designers may have to gain some economic literacy, understanding how local economies work in relation to the local sociocultural dynamics which are always in flux, and how such economies interact with the larger political economy [161]. As CSCW professionals, we have drawn our knowledge and approaches from other disciplines (e.g., psychology, anthropology, engineering, and the humanities), allowing us to understand cooperative work and design technologies supporting it better. Similarly, we can draw from the discipline of economics. For example, we can learn from the area of institutional economics that examines the norms, rules, and power institutions, both formal and informal, that shape economic activities and how such activities, in turn, influence the institutions; also, material analyses of power, literature on race, caste, and labor, and critical approaches to political economy. Gaining such economic literacy could assist us in designing technologies that support existing local work economies instead of ignoring or disrupting them and even work to challenge unjust power dynamics positively.

Considering policymaking and its implications also becomes crucial. The uniform and rigid implementation of policies impeded participation in MGNREGA. The 60:40 ratio for fund allocation—60% of the funds for wage labor and 40% for procuring construction materials—did not always meet the needs of the farmers/workers who were interested in constructing assets with less manual labor involved and more material cost. While lower-level bureaucrats attempted to find ways to circumvent such policy constraints, they were not always successful and could not provide for the broader needs. Addressing such challenges requires making policy-level changes which is often considered outside the scope of CSCW and HCI. However, considering that digital infrastructure underlies our global society [166] and policies are socially, culturally, and *technologically* mediated [161], as CSCW designers, we can design tools that highlight the implication of policies and push for policy-level changes [21]. For example, a visualization map-based tool could demonstrate the policy implications, including foregrounding who is impacted by the policies in an area and how such policies are circumvented. CSCW researchers working in development contexts could also share their insights and participate in policy-making, especially when attempts to digitalize such policies are being undertaken. With Sharma et al. [161], we emphasize that “[w]e can begin learning how policies are designed, altered, and implemented at the scale closest to us, in institutions that may be within our reach and engage to have an impact.”

Often times developmental schemes are implemented at scale [180]; this planning happens elsewhere, and implementation happens somewhere else, as Juarez and Brown [90] have also noted. Although such schemes are considered to be launched at scale, their instantiation is necessarily local. For example, MGNREGA’s planning and implementation were universalized without incorporating the specificity of context and making adjustments to meet the local needs. Land fragmentation, evident in our study contexts but not across the contexts where MGNREGA operates, was not considered which affected many farmers to avail of the scheme. It generated additional labor for lower-level bureaucrats to bring small and marginal farmers to a consensus; the bureaucrats, thus, ended up favoring large farmers who did not require collectivization efforts. When designing technologies to mediate developmental schemes, how can we alter the planning and implementation workflow not to prioritize universality but to respond to and prioritize localization? This may include acknowledging, challenging, and problematizing that digital technologies are themselves designed to achieve scale, “to scale technology, reach new users and geographies, and fit more processing power into smaller hardware” [161], often making them inattentive towards local nuances [106]. Considering and prioritizing localization would require understanding where our motivation and values, as technology designers, lie: scaling for universality or prioritizing localization. This is a question that we need to ask and answer through our work to design technologies relevant to the contextual politics and economics towards supporting equitable development.

6.3 Supporting Human Infrastructures

In resource-constrained development contexts, “human infrastructures” become significant and can be leveraged [151]. We noticed that MGNREGA’s human infrastructure was comprised of lower-level bureaucrats managing asset construction, upper-level bureaucrats approving funds, and community volunteers. For example, members of *panchayat* and *gram sabha* worked closely with farmers/workers to generate demands, while the BPO worked with technical assistants to verify the suitability of the demand, followed by sanctioning the funds. When digital infrastructures failed, the human infrastructures kept the operations going. Actors forming the MGNREGA’s social infrastructure acted as “intermediaries” [150] helping farmers/workers to navigate the digitally-mediated aspects of MGNREGA. For example, when farmers/workers could not access their bank accounts electronically, or data entry errors occurred, computer operators and community volunteers assisted. CSCW and HCI researchers have suggested identifying such “invisible” groups [27], often residing “out there” [175] assisting technology use, especially in development contexts [56, 159, 186]. Designing technologies to support development work could consider such groups that became visible to us because of the ecological perspective [14] we employed to understand how the scheme was planned and implemented. Similarly, taking an ecological perspective may make designers sensitive to the *socio*-technical infrastructure that supports development work and its shared social practices, norms, creative processes, and informal flow and exchanges. This understanding is needed to design technologies that mediate development workflows, practices, and interactions.

Community members developed a lack of trust in the government-led schemes, which impacted their participation in MGNREGA. By constructing NRM assets, farmers thought that they would lose the rights to their lands; and that it would become a government-owned property. This lack of trust stemmed from prior interactions with outsiders who stole from community members in the name of development. It was also rooted in the Naxalite ideology which was fundamentally anti-state and far-left radical communist. Consequently, establishing connections and building rapport for development took time and effort, ensuring community members that an organization is genuinely interested in their development, as our partner CSO did over months. When designing to support development, community members’ narratives and histories could be considered to understand how development efforts are perceived by the community and how digitalizing the efforts could impact this perception. Technology designers could understand the beliefs that impact the everyday activities of communities and design within the context, upholding the agency of the users while disrupting the preconceived notions that people may have formed, affecting them to participate in their development. For example, digital storytelling could be used to alter the narratives and experiences of community members to nurture trust-building in government-led schemes for development. Actors of human infrastructures trusted by the community could be involved in storytelling. Local organizations working in contexts that have established rapport with the community members can be involved in communicating, promoting, and infrastructuring trust [186].

As efforts to digitalize development increase and new, high-tech is introduced, the technical literacy of actors forming human infrastructure becomes a challenge. We noticed that lower-level bureaucrats lacked the technical skillset to undertake GIS-based planning. No arrangements were yet made by the government to educate them. If newer, high-tech systems were to be introduced, the bureaucrats may face challenges and falter to keep the development work going. It, thus, becomes critical to periodically enhance and strengthen the technical skills of the actors forming human infrastructure. For example, integrating GIS properly and holistically would include providing digital training to bureaucrats interfacing with the technology; this might include conducting regular sessions and making it accessible for all, irrespective of their current technical capabilities.

However, even with training, stakeholders might face challenges using complicated, high-tech systems because of the large learning curve involved [59] which can be addressed by, for example, designing worker-centered systems based on intuitive user experiences [68, 127].

6.4 Mediating Informal and Invisible Cooperative Work

A cooperative is “an enterprise where there is mutual ownership and control of the enterprise by either those employed by it or using its services” [105]. CSCW and HCI researchers have studied cooperatives [82, 105, 155]; for example, Lampinen et al. [105] investigated labor, purpose, and technology use of 24 cooperatives. Our study provided the case of an informal cooperative, i.e., not an officially registered cooperative [23], suggesting how some of the structural and identity-based challenges can be addressed through community-led efforts. The NREGA park started as an effort by farmers to take advantage of the MGNREGA scheme. They did not establish a formal cooperative; each of them owned their land and the produce from only their land instead of mutually owning the park and democratically sharing its produce. However, they came together in the sense of collectively proposing tree plantation on their lands, putting the demand to the *gram sabha*, working with field staff, and constructing the asset. The case presented an ideal implementation of the MGNREGA workflow as envisioned: bottom-up and decentralized. Several factors made the implementation conducive and ideal, specific to the case: (a) the land was located far from the village habitation, making it inaccessible for farmers to attend to it on a daily basis, (b) it was not being used for agriculture which made it easier for farmers to divert their land to tree plantation, (c) the ward member who knew the ins and outs of the scheme had his land in the collective and was involved throughout, initiating the cooperative and constantly monitoring the process, and (d) the collectivization reduced the labor for MGNREGA bureaucrats. Researchers designing technologies to support development work could consider such informal cooperatives that may exist outside the periphery of work formalization and study their construction and dynamics which might be different from the politics dominating the formal collectivization efforts usually rooted in a top-down centralized push. Supporting such collectives is essential to promote bottom-up, decentralized, community-led, participatory development. Schmidt [154] emphasized, “CSCW’s phenomenon of research is not work but cooperative work,” arguing that carrying in-depth analysis of cooperative work is crucial to design technologies to mediate coordinative practices. Work can also be informally coordinated, and thereby, this informal social construction of work can be studied and mediated by computer-supported informal cooperative work technologies.

CSCW researchers [54, 92], for example, Star and Strauss [168], Nardi and Engeström [125], and more recently Sharma et al. [159, 160], have emphasized that automating or digitally mediating cooperative work could introduce new or reshape existing forms of work, and the relationship between them. Our analysis of the ongoing digitalization of MGNREGA revealed that the integration of digital technologies into the workflow introduced new work and reconfigured the existing workflow. For example, electronic direct bank wage transfers added additional labor for workers who had to commute to the banks located at a distance to check/withdraw money. Such labor was often not accounted for in the MGNREGA workflow digitalization. Additionally, the wage transfers were prone to data entry errors [116, 124] and there were no grievance redressal processes available for workers to voice their challenges to the upper-level bureaucrats [158]. Without any other alternative, workers interacted with and sought assistance from lower-level bureaucrats, such as technology operators and field staff. Consequently, this reconfigured the operators’ work who were already performing data entry and verification tasks; they now had to listen to the queries about workers’ payment status and provide clarification because “*if not here, then the villagers have no other place to seek help*” (P9). Thus, digitalization “alter[ed] the current distribution of invisible work ... by creating a system that supports one form of work, new work for others

[were] created” [155]. However, such new forms of care work [55, 74, 92, 159]—maintenance work to find workarounds to navigate the policy limitations, relational work to avoid cancellation or delay in payment to workers, and repair work to address payment-related issues once they occurred—that the lower-level bureaucrats performed largely remained unrecognized because of being “unproductive” labor. Such forms of labor need to be considered in work technology design as they “remediate traditional relations of dependency and social inclusion, sometimes amplifying these and sometimes ameliorating them” and can be facilitated through work technologies as such “new forms of distributed collective work that can further goals of economic, social, and environmental sustainability and justice” [86]. For example, a visualization component can be designed to foreground the additional and often invisible care work that stakeholders perform to keep the system going, similar to what Dhaundiyal et al. [45] did in order to make invisible domestic work that working women perform visible to “provoke and thus enable reaction, reflection and hopefully subsequent change in the society.”

7 CONCLUSION AND FUTURE WORK

Our study examined the challenges to availing of a government-sponsored development scheme, investigating who gets to participate, how participation happens, and the opportunities of digitally mediating participation. Conducting field studies that included observations, interviews, and focus group discussions in the context of MGNREGA NRM operating in the states of Bihar and Jharkhand in India, we reported its planning and implementation processes in practice, the structural and identity-based factors impeding workers’ participation, and the existing sociotechnical gaps that affected the efforts to digitalize the workflow. Our study contributes to CSCW scholarship on digitalizing work economies in low-resource and under-served contexts while complicating the notion of participation affecting such economies. We discuss four sociotechnical considerations: *considering contextual politics, evaluating economic and policy implications, supporting human infrastructures, and mediating informal and invisible cooperative work*. These considerations can be mapped to other contexts with limited digital infrastructures to nurture a more inclusive, equitable, and participatory technology-mediated development.

Future work can investigate (a) how different identity-based factors, such as class, caste, and gender, intersect and the impact of this intersection on community members’ participation in availing of development benefits, (b) the political economy of development that governs the responsibilities, participation, labor, decision-making process, and actions of lower-level (e.g., *mukhiya* and *rozgar sewak*) and upper-level bureaucrats (e.g., BPO officer and engineers) in development work, and (c) the interactions between policy, technologies, and human actors, and how this interaction impacts lives and livelihoods of community members seeking development. Gaining this understanding could assist the design of worker-centered technologies that support more equitable futures of work in development contexts.

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