Commoning as a Strategy for HCI Research and Design in South Asia

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ABSTRACT

Commons emerge and are reclaimed through collective, shared, and self-organized practices known as commoning. Despite their historical embeddedness in South Asian communities, commoning practices have succumbed to enclosure and destruction due to region-wide privatization and development schemes implemented over the past century. Certain HCI and ICTD research has critiqued such schemes for undermining community autonomy and well-being. To advance the development of alternative models, we conducted a literature review of HCI research involving the commons, considering both natural and digital resources, in South Asia. Additionally, we examine the social practices, rules, and institutional arrangements described in the corpus through the lens of Elinor Ostrom's design principles for commons governance. Based on our findings, we formulate a commoning framework by synthesizing three areas of HCI research — infrastructuring, participatory design, and assets-based design — proposing it as an alternative to neoliberal development paradigms for future HCI research.

CCS CONCEPTS

• **Human-centered computing → HCI theory, concepts and models**.

KEYWORDS

Meta-Analysis/Literature Survey, commons, commoning, HCI for development

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1 INTRODUCTION

The intersection of HCI and development discourse has been a focal point for academic communities such as ICTD, HCI4D, and region-specific groups like Asian CHI. In this paper we focus on South Asia context, one of the most populous (1.92 billion as of 2022 [1]), culturally diverse, and economically constrained parts of the world. South Asia consists of eight "majority world" countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Given the historical emphasis of HCI scholarship within the region [25, 36, 48, 99, 110], this paper aims to further the understanding and implementing of practices that surface and address local community needs, support collective action, and contribute to the management of shared resources i.e., the commons. In doing so, the paper aims to draw together HCI literature on design for development contexts and the commons through a review of how HCI research in South Asia engages with commons-based approaches. We suggest *commoning* as a transformative cultural practice for HCI researchers to engage with as an alternative to prevailing models of private property in international development.

Historically, international development initiatives have operated under the assumption that small communities lack the means and capacities to sustainably manage collective resources. As a result, the prevailing approach has been to resort to either privatization or management by a centralized institution such as the State. This perspective was most popularly elaborated by outspoken racist and eugenicist Garret Hardin as the 'tragedy of the commons' [38]. Counter to this perspective are commons-based management systems that prioritize collaboration, self-governance and local practices around shared resources [73]. Groundbreaking early research by Elinor Ostrom and others into the commons focused on small-scale communities that organize around, and govern natural resources (fisheries, forests, and rivers). However, the advent of the internet gave rise to a new form of commons – the knowledge commons - which are online, shared, and often geographically distributed [40]. Knowledge commons are manifested through distributed forms of community organizing for e.g., peer-production communities such as Wikipedia and open-source projects like Linux. Advocates and scholars of the knowledge commons have demonstrated how engagement with decentralized information-sharing initiatives enable communities to produce and reclaim bottom-up or marginalized perspectives [40]. In recent years, HCI research into the knowledge commons has examined these arrangements, offering insights that facilitate community collective action and democratized participation towards the same social and environment issues which large institutions claimed to address [65, 102–104].

The eight countries within South Asia region share a common history of being subjected to political, economic, and cultural restructuring as part of international development programs. These programs enforced institutional arrangements that prioritized economic development, often at the expense of environmental and social considerations [92]. Recently, these arrangements have been

[1] World Bank Data

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manifested through the proliferation of digital technologies [1], such as those which prioritize the division of labor and computerization of human services in micro-work crowdsourcing platforms run by large private companies [45], and well as the rearticulation of development as innovation within the entrepreneur cultures in South Asian countries [46]. Such transformations are a result of combined efforts of governments, NGOs, and private institutions, and often led by international actors. Despite the pressures created by the demands of privatization and development, the making and remaking of the commons through alternative systems including everyday practices, social relations, and community collective action i.e., commoning, has always been integral for communities across South Asia. These practices have historically been a part of daily life in many rural and indigenous communities across the South Asian region [49, 50, 57, 71].

This paper offers a review of HCI literature focusing on commons and commons-based approaches in South Asia. The research questions guiding our study were: 1) What is the current status of commons-based HCI research in South Asia? and 2) To what extent does this research align with Ostrom's design principles? In similar vein to Dell and Kumar's review of HCI4D literature [25], we examine when and where the research has been conducted, identify the commons, explore the technologies employed, examine the participants of these projects, and assess how sustainability is addressed within the corpus (See Section 4). In addition, we employ Ostrom's Design Principles of Natural Resource Management [73] as a framework to evaluate how the corpus aligns with each principle (Section 5). This framework, developed through empirical research on commons worldwide, provides a robust set of principles that are particularly relevant to assessing the sustainability and equity of governance systems in the context of shared resources (Table 1) [73]. With regards to HCI research, particularly community-centered approaches, Ostrom's principles align well with the ethos of participation and community engagement. This alignment enhances the relevance and applicability of the framework to the corpus being reviewed, offering insights into how HCI research in South Asia incorporates to principles known to foster successful governance of the commons.

As researchers concerned with the social impacts and environmental degradation of unsustainable development practices, we were inspired by the potential of commoning as an alternative to the prevailing paradigm of neoliberal privatization [31]. Drawing on the Findings of this review, in the Discussion (Section 6), we consider how HCI researchers of South Asia can support commoning practices over the use, creation, and governance of collective resources in a sustainable manner. We highlight three areas of work from HCI that collectively lay the groundwork for future HCI research and design into commoning. We argue that South Asian HCI research can advance sustainable commoning activities by leveraging the lens of infrastructuring, a closer engagement with prior research and practice in participatory design (PD), and emphasizing existing community strengths and assets. Finally, we discuss emerging governance challenges that arise from the application of Ostrom's principles to knowledge commons projects in South Asia, while proposing cooperative arrangements as potential solutions. Altogether, our study serves as a reference for HCI research, offering a starting point for the design of interventions aimed at addressing societal and environmental issues within communities. We advocate for further attention to commoning practices in future HCI/HCI4D research, emphasizing their collaborative resource governance and communal approaches to self-management that enables communities to co-create a sense of meaning and ownership while addressing important societal needs.

2 RELATED WORK

2.1 Private Property Reform and Development in South Asia

The historical trajectory of neo-liberalism, development, and private property within South Asia is complex, and characterized by large-scale economic shifts, changing social dynamics, and policy reforms that together have destabilized and eroded longstanding traditions of commons-based practices in the region. Vandana Shiva, renowned environmental activists and eco-feminist, argues that *development* was a systematic strategy to "combat scarcity and dominate nature" in order to create material abundance. However, this pursuit led to two interconnected crises that have weakened integral components of democratic participation in communal systems across the region [93] - damage to the environment and the erosion of locally-specific collective social contracts that governed the management of natural resources. Development in South Asian countries has been generally pursued through privatization and economic liberalization schemes, initially crafted during colonial rule and further refined post-independence. Land reforms implemented in Pakistan [111] and Nepal [52], along with rural development policies in India [93], were aimed at equal land distribution and decolonization but resulted in marginalized communal land ownership. Although instituted to safeguard individual property rights over natural resource commodities, these policies undermined collective rights to the commons- the foundational resources essential for the sustenance, livelihoods, and cultural identities of indigenous and local communities.

Despite these trends, discourse surrounding development in South Asia is contested and resists reduction to a singular meaning or coherent set of practices. As such, it's forms, interpretations, and actors involved cannot be homogenized to a "monopolistic, hegemonic, and monolithic connotation". Sivaramakrishnan uses the term 'regional modernity' to re-conceptualize development through the varied social networks, site-specific conflicts and negotiations, and bi-directional flows between the 'local' and the 'global' that lead to environmental and social problems, along with movements towards "counter-development [98]". For example, the Chipko movement in Uttarakhand, India emerged in the 1970s as a resistance movement against tree felling and the enclosure of common land resource by private property reforms and state-led forest management initiatives [94]. Shiva's analysis on the Chipko movement and Sivaramakrishnan's "Regional Modernities" [98] (p. 286-312) reveal that development in the Indian Himalayan region was characterized by conflicting motivations and unexpectedly shared goals among State reforms, local communities, and environmental activists towards aspirations of economic growth, ecological conservation, and community livelihood. As a result, the notion of "development" in South Asia is no longer a homogenous ideology being enforced by Western globalists but rather a heterogeneous

and conflicted interplay between individuals and institutions that reside within the grey area of the 'local' and 'global' [98].

Contemporary debates, particularly relevant to HCI and the commons, have drawn attention to how the innovation culture employs similar policies of enclosure that attempt to accelerate development narratives. Immaterial forms of property, such as intellectual property (IP), aimed at commodifying knowledge, culture and technology, have played a pivotal role in shaping notions of development, innovation, entrepreneurship, and private ownership in South Asia [22, 46, 58]. Stringent IP rights based on international agreements have been widely critiqued for enforcing oppressive trade laws that enclose common held resources and altering existing socio-cultural practices. Such IP reforms, driven by extractive profit regimes and visions of scalability, labelled existing, indigenous, and often communal, practices within South Asian countries as 'primitive' [46, 93]. In their study of entrepreneurial citizens in India, Irani shows how IP regimes, driven by privatization of state projects and capital accumulation, not only commodified traditional knowledge and indigenous resources but also reshaped 'needs, hopes, and histories' of citizens into commodities that can be traded [46].

2.2 Traditional Commons

Research in the field of commons emerged during the global adoption of neoliberal modes of development, and assumptions regarding the 'tragedy of the commons'. These modes favored centralized state and private control over natural resources such as forests, fish, and land. However, Ostrom's work seminal work, "Governing the Commons" [73], demonstrated that certain small-scale communities could organically develop sustainable management of common pool resources (CPRs) through bottom-up communal decisions, free from external institutional influence. Of relevance to our research topic, Ostrom highlighted institutional failures resulting from centralized control over communal forests in India (p. 23) and Nepal (p. 178), and fisheries in Sri Lanka (p. 149-157) resulting of private property schemes [73]. Ostrom's critique of such schemes arose from evidence that such prescriptions advocated for oversimplified institutions, overlooking essential considerations such as local agency over CPRs, limits of centralized control, selection criteria for users, motivational factors, and processes of monitoring, rewarding, and sanctioning [73] (p. 23). Ostrom's multi-year, multi-site study addressed a missing facet of policy and property reforms at the time, focusing on the various settings and complex environments within which small-scale, enduring, and self-governing CPR institutions functioned.

Despite the socio-cultural differences between the CPR settings studied by Ostrom, they outlined a set of eight design principles to describe fundamental similarities within co-operative CPR management strategies (see Table 1. They defined 'design principle' as "an essential element or condition that helps to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of appropriators to the rules in use" [73] (p.90). The identified design principles not only signify core, underlying "best practices" but also play a paramount role in shaping our comprehension of effective community-based governance for shared resources. Ostrom's field study leveraged these principles to explore the disparities between successful and unsuccessful instances of community governance. This examination, in turn, illuminated the diverse forms of participation by commons users and appropriators in activities such as establishing boundaries, formulating rules, monitoring, and engaging with encompassing institutions to ensure the sustainability of communities that rely upon CPRs. While these design principles were not specifically crafted as a model for commons design, they prove invaluable for designers by deepening their understanding of design's impact on agency and its connection to collective action processes. They address critical questions about the design and participatory nature of self-governance, management, and inclusion processes [66]. Collectively, Ostrom's work on the commons, which won her the Nobel Prize in 2009, has been essential in understanding effective community-based governance mechanisms and management of extractable resources.

2.3 Knowledge Commons

The advent of the internet and network infrastructures led to the expansion the concept of the commons beyond natural resources. The mid-1990s witnessed the rise of value of digital information and subsequent challenges of their enclosure, commodification, and increased patenting. Consequently, scholars began to study knowledge i.e., ideas, information, or data, as a form of commons that is intangible and immaterial [40]. The knowledge commons manifest in various institutional arrangements and sectors, such as intellectual property rights, internet/network infrastructures, peer-production, open-source software, libraries, science, and the public domain [41]. Unlike traditional commons, knowledge commons are predominantly non-rivalrous, meaning their use by one individual does not necessarily diminish the benefits available to others; in fact, sharing and utilization can enhance the quality of the commons [40]. Nevertheless, knowledge commons do face threats of enclosure, degradation, and non-sustainability [40]. The conceptualization of knowledge as a commons, mediated through digital infrastructures, highlighted the need for new forms of collaboration, governance, and management of digital environments as they face a unique challenge of being immaterial yet susceptible to enclosure [34, 40].

The term 'Commons-based peer production' (CBPP) rose in popularity to describe collaborative participation of making, sharing, and experiencing information within the knowledge commons [21]. Coined by Yochai Benkler in 2001, CBPP proposes a new mode of organizing production within the networked environment- decentralized, collaborative and non-proprietary [21]. CBPP combines three core characteristics: (a) decentralization of conception and execution of problems and solutions, (b) harnessing diverse motivations, and (c) separation of governance and management from property and contract [5]. Software or tools that utilizes these core characteristics implement structural processes where the authority to act resides with individual agents faced with opportunities for action, rather than in the hands of a central organizer [6]. Social cues and motivations, instead of prices and commands, are used to motivate and coordinate the action of participating agents [6]. Notable examples of CBPP include Wikipedia, OpenStreetMap, and

Table 1: The Design Principles for Community-based Natural Resource Management [73]

1	**Clearly defined boundaries** Effective management of a CPR establishes clear boundaries for access and restriction. A mechanism must exist to effectively include the entitled parties and exclude the peripheral unentitled parties. This helps prevent disputes and ensures a shared understanding of resource use.
2	**Congruence between rules and local conditions** Management processes must be adapted to align with local contexts, fostering a more seamless integration of rules into the community's existing practices and needs.
3	**Collective-choice arrangements** Operational rules are subject to modification by participating individuals, ensuring that decision-making reflects the diverse perspectives and needs within the community.
4	**Monitoring** Monitors are accountable either to the other users of the CPRs or are users themselves, promoting transparency and a sense of shared responsibility for resource stewardship.
5	**Graduated sanctions** Preference should be given to low-cost punishment mechanisms for initial violators, encouraging a fair and proportional response to rule violations that helps maintain social cohesion.
6	**Conflict-resolution mechanisms** Effective long-term CPRs must incorporate informal mechanisms for amendment and conflict resolution among participants.
7	**Minimal recognition of rights to organize** Enduring and sustainable CPRs should minimally acknowledge legitimacy by external bodies, such as governments, regarding the capacity to devise their own institutions.
8	**Nested enterprises** To have a complete and effective system of CPRs, they must be integrated within multiple levels of government, promoting coordination and support from higher governance structures while maintaining local autonomy.

Free and Open-Source Software like the Linux kernel. CBPP networks bring forth a decentralized take on community knowledge production.

2.4 Commoning

The ongoing processes that aid the creation, governance, and sustainability of the commons and allow for their collective use are known as commoning [31, 62]. The term commoning was introduced by Linebaugh in 2009 to describe the activities of people living in close connection to the commons [62]. Commoning draws attention to the processual social elements surrounding CPRs to make visible collective social traditions and practices that help in producing, reproducing, and democratizing the use and management of collectively held resources [62]. The activities and social elements present within commoning are inherently part of the community which manages the commons. Therefore, the relationship between commons, community, and commoning is mutually constitutive [33]. In other words, the commons are not given but are continuously produced through the constitute social practices and relations i.e. commoning [16]. These relations and practices are enacted by and in turn shape the communities that manage the commons [33].

Commoning is characterized by a collectively managed process that operates autonomously from and as an alternative to existing market-based economies [31]. Commoning is increasingly being looked to as not only an active form of resistance to contemporary capitalist economies but an integral component of post-capitalist frameworks. This is because, as scholars argue, commoning holds the potential to unveil communal relations within and across communities that can act as resources in efforts to counter capitalist regimes. In this framing, 'commoners' i.e., individuals actively engaged in commoning practices, are advocates seeking to reverse unwarranted enclosures of shared resources and reclaim the "common wealth" while asserting collective participation in their management [14]. Fournier [31] elucidates three aspects of commoning which are i) organizing in common i.e. collective management of a commons ii) organizing for the common i.e. the collective use of a commons and iii) organizing of the common i.e. creating community and solidarity through sharing of the commons. They further boldly state the sustaining the commons and commoning activities are not only "an alternative to market economies but also a necessary condition for escaping from the market".

Martilla et. al. introduced commoning to the HCI and PD communities in 2014, evoking the term 'commons design' [66]. They proposed that commoning practices and the commons movements can "provide inspiration to PD to rethink practices' and the role of the designer" [66]. Since then, commoning has been explored through various dimensions such as environment sustainability [61], democratizing design [104, 105], care work [35, 91], collaborative digital tools [67], platform cooperativism, and the sharing economy [32]. Design scholars have argued the active nature of commoning practices can be used to rethink the emancipatory potential within PD, noting the importance of each for community activist movements [63, 66]. For example, Teli et. al. have explored

how activists engage in commoning activities within grassroots initiatives to resist the State and capitalism narratives of urban development [105]. Recent explorations such as Fritsch et. al.'s critique of techno-solutionism elucidate the affective nature of commoning practices and their relationship to technological interventions [35]. This work, along with other HCI and PD research on commoning, has allowed researchers to more carefully consider the relationship between HCI research(ers), resistance movements, and sustainable development.

Of particular importance to HCI4D research, resistance movements across the 'majority world' have envisioned a pluralistic world of communities with many similarities to commoning practices. For example, movements such as the indigenous Andean ideology of 'Buen vivir'/'living well' advocate for harmonious coexistence and robust mutually beneficial relationships between humans and nature [60]. Such movements actively reject the concentration of power and extraction of resources that critics have argued are inherent to techno-managerial development initiatives. Unsurprisingly then, debates within the HCI commoning literature over techno-solutionism [7, 35] bear striking similarities to debates surrounding the necessity, forms, and sustainability of interventions within HCI4D projects [25]. In opposing techno-solutionism, HCI4D scholars have emphasized the role of social relationships in creating sustainable interventions within development contexts [89]. Similarly, commoning practices are dependant upon effective social relationships and knowledge sharing practices [66]. Efforts to support commoning thus require attention to the intricacies of intersecting social relationships within communities of the 'majority world,' encompassing differences in gender, race, ethnicity, caste, and other facets of identity or social position [12, 71, 91]. In this study, we examine the socio-political and economic contexts surrounding South Asian commons-based HCI research through the lens of Ostrom's design principles to understand the factors that either facilitate or impede the success of self-governing communities.

3 METHODOLOGY

A systematic review was used to identify prior literature for analysis. To do so, we started by developing a corpus of 'commons-based' papers through the searches of the ACM Digital Library (DL) in May 2023. The methodological approach for our review is influenced by previous HCI literature review studies that limited their scope to the ACM DL [26, 27, 100]. We acknowledge that, by limiting our scope to the ACM DL, we have excluded other important research on the knowledge commons within South Asia (for e.g. [9]). Nonetheless, our decision to concentrate solely on the ACM DL stems from the recognition that, despite significant advancements in commons and commoning spanning various disciplines, our primary focus as HCI researchers was to explore the current engagement of our field with these concepts. The search included three categories 1) papers focused within the South Asian geography, 2) papers that incorporated commons terminology and 3) papers within the field of HCI. The final search included all three categories. Table 2 presents the search query and rationale for identifying papers on the commons in South Asia.

The search presented within Table 2 returned 609 unique results. The first author conducted two passes on the search result to narrow down the corpus to papers relevant to the research questions. In the first pass, we read the abstracts and skimmed the papers to examine how the search terms were used within them. We then removed papers from the corpus that did not fit within the criteria of the study. For example, several papers, unrelated to the research topic, that were caught in the search for including the Creative *Commons* attribution were removed. In this pass, criteria for excluding papers were papers that: 1) used the term commons in limited ways, for example in the bibliography or attribution; and 2) did not substantially focus on South Asia, for example those that mentioned a South Asian country in passing.

In the second pass, we carefully read each paper to examine the extent to which they discussed, designed, and used technologies in relation with commons-based approaches. The specific criteria for the papers included in the corpus: are commons-based approaches explicitly or implicitly used or discussed by the paper? The criteria for exclusion in this pass varied and conflicts were resolved through multiple discussions between the first and second author. Within this pass, we removed, for example, the paper "Karamad: A Voice-based Crowdsourcing Platform for Underserved Populations" [85] since the paper focused on a crowd-sourcing approach rather than a participatory community engagement which is better aligned with a commons approach. Other reasons for exclusions in this pass included (1) projects that used a commons-based technology as an intervention without significant engagement on why the technology was needed for the project (2) research with participants, such as migrants, that had moved out of a South Asia country. In this pass 16 papers were removed. Our first and second passes eliminated 559 and 16 papers, respectively, and helped us tighten our focus and narrowed the final set to 34 papers. Table 3 shows the name of the venues and the final number of papers from each venue after completing two passes.

To review the remaining 34 papers, we prepared a rubric that consisted of ten themes. The rubric was developed based on principles found within commons and CBPP strategies. The rubric was organized in 4 categories: *(1) general information* (including paper title, author, year of publication, and proceedings), *(2) connection of the paper to commons-based approaches* (including the form of commons being discussed, the participants and their relationship with the commons, and the development domain of the research), *(3) sustainability* (including the ways and forms of sustainability discussed in the paper) and *(4) relationship to Ostrom's design principles* (including governance strategies, forms of sanctions in place, and the kinds of boundaries the projects function within). The decision to employ Ostrom's framework added depth and rigor to the analysis of commons in the corpus, enabling the identification of strengths, gaps, and areas for improvement in commoning practices. For each paper, we analyzed how its content fit into the criteria set within the rubric. We present our systematic literature review findings in two sections based on our research questions: Section 4: What is the status of HCI research in South Asia focusing on the commons? Section 5: How does commons HCI research in South Asia align with Ostrom's design principles?

Table 2: Search Criteria and Rationale for Systematic Review

Search Category	Search Query	Search Rationale
Geography	[[Full Text: "south asia"] OR [Full Text: "india"] OR [Full Text: "bangladesh"] OR [Full Text: "sri lanka"] OR [Full Text: "bhutan"] OR [Full Text: "maldives"] OR [Full Text: "nepal"] OR [Full Text: "afghanistan"] OR [Full Text: "pakistan"]]	To narrow down papers focused within the South Asian region
Commons Terminology	[[Full Text: "commoning"] OR [Full Text: "commons"] OR [Full Text: "peer production"] OR [Full Text: "open source"]]	We searched for HCI papers in which these occurred anywhere within the text including title, abstract, keyword, and the body.These terms were chosen as they offer a comprehensive corpus exploring research at the intersection of HCI and collaborative, community-driven endeavors that are pivotal within commons-based approaches.
Relevance to HCI	[[Full Text: "hci"] OR [Full Text: "hci4d"] OR [Full Text: "ictd"] OR [Full Text: "ict4d"]]	We used these terms to identify HCI papers. HCI research in South Asia has frequently focused on the topic of computing within developing regions [25], and so the inclusion of terms such 'HCI4D', 'ICTD' and 'ICT4D' aided in retrieving papers particular to the South Asian region.

Table 3: The total number of commons-based HCI publications pertaining to South Asia at each publication venue between 2011 and 2023

Publication Venue	Number of Publications
CHI	6
ICTD	4
CSCW	4
ACM DEV	3
COMPASS	2
TOCHI	1
Telecommunications Policy	1
PDC	1
PCI	1
OZCHI	1
Mobisys	1
LIMITS	1
IW3C2	1
Information and Organization	1
IEEE	1
ACM Web Science	1
ACM SIGCOMM	1
ACM iConference	1
ACM Human Computer Interaction	1
ACM C&T	1

4 FINDINGS: OVERVIEW OF COMMONS-BASED HCI RESEARCH IN SOUTH ASIA

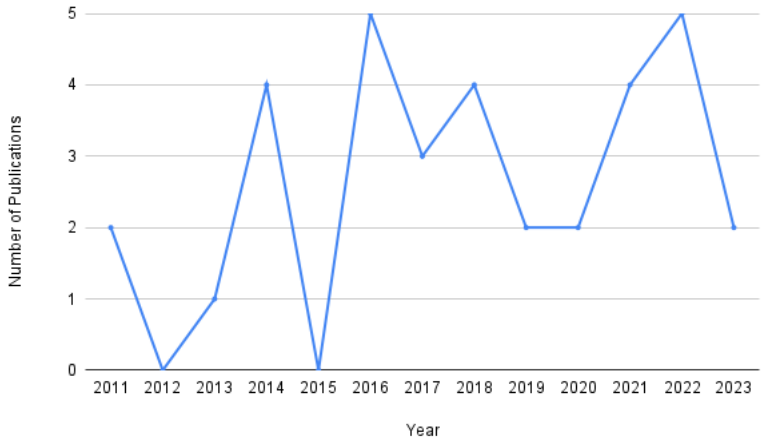
4.1 When was commons HCI research in South Asia conducted?

We started by searching for the earliest match of HCI research in South Asia using the commons. The initial papers identified in this search date back to 2011. Figure 1 provides a visual representation of the annual publication trends. Notably, the peak of publications occurred in 2016 and and 2022, totaling 5 papers in each of these years. Based on the final list, it appears that the number of publications has fluctuated over the years, without a discernible upward or downward trajectory. The lack of a clear trend may be attributed to the varying frequencies of conferences for e.g., ICTD takes places every 18 months. Additionally, conference locations and themes may also be an attributing factor to the number of publications related to commons-based approaches [25]. What can be said is that HCI commons research within South Asia is at a nascent phase, yet harbors significant potential for future expansion and development.

4.2 Where has the research been conducted?

Our exploration of commons HCI research in South Asia involved a thorough review of publications referencing any of the eight countries in the region: Afghanistan, Pakistan, Maldives, India, Nepal, Sri Lanka, Bangladesh, and Bhutan. The analysis revealed

Figure 1: Total number of commons-based HCI papers focusing on South Asia published between 2011-2023



a notable concentration of research on India, with 27 out of the 34 published papers either exclusively focused on the country or incorporating an Indian perspective. In contrast, other countries had a significantly less volume of commons-based HCI research – Pakistan (3), Nepal (2), Bangladesh (2), while there was no related scholarship from Sri Lanka, Afghanistan, Bhutan and the Maldives. The prevalence of research in India can be attributed, in part, to its large population, as highlighted by Dell and Kumar [25] in their HCI4D literature review. They suggest that the abundance of accommodating government and non-government organizations that are usually easy for English speakers to access plays a pivotal role in influencing the concentration of scholarship in India. The HCI community has also been steadily growing in the past decade through conferences such ICTD, which publishes numerous studies on India, and specific communities focusing on India (IndiaHCI) or aspects of HCI4D e.g., COMPASS. The presence of an engaged and active HCI community along with the ease of cultural and linguistic accessibility to the country reveal, quite obviously, why most of the papers were pertinent to India. Conversely, the lack of research in Sri Lanka, Afghanistan, Bhutan, and the Maldives could be attributed to limited or absent funding for HCI research, insufficient research infrastructure, and cultural or societal factors that discourage or hinder such research.

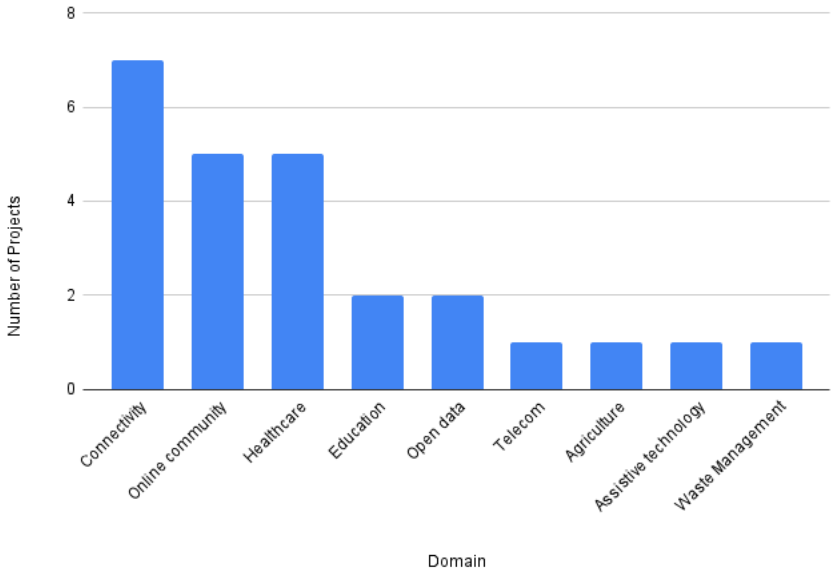
4.3 Domains within the corpus

Within the final corpus of 34 papers, 25 were project based, i.e., they described or evaluated certain practices related to commons, and nine were programmatic in nature i.e., they discussed the theoretical underpinnings of research that utilized the commons. The 25 project papers explored a spectrum of commons-based approaches applied and studied in South Asia, spanning from the invisible labor of frontline health workers [47, 68] to traditional agricultural practices [83]. We identified the domains from the project-based papers based on author and classification keywords, themes, and application areas of the conducted research. As shown in Figure 2, connectivity emerged as the most prevalent domain, with nine papers [2, 10, 15, 20, 78, 79, 82, 86] focusing on this aspect. Connectivity was mentioned through hardware/software systems or network infrastructures that aid in information transfer [20, 78, 79]. Additionally, it was explored in challenging contexts, such as the examination of regional gender dynamics while maintaining community networks [10, 11] and development of data-saving mobile applications in network constrained environments [15]. The nine programmatic papers although diverse in their topics, shared similar themes of suggesting for the need of community participation in HCI, ICTD, and open-source research. Key themes included the emphasis on participatory methodologies and designs [54, 59] and the role of technology in addressing societal challenges [43, 75, 96, 112].

4.4 What is being held in common?

Traditional commons, such as natural resources, and contemporary forms of knowledge commons differ significantly in terms of their governance. The distinction lies in their approaches to exclusion; natural commons allow exclusion, whereas knowledge commons exhibit non-exclusionary characteristics. Additionally, the concept of rivalry plays a crucial role, as the use of natural commons diminishes availability to others, while knowledge commons are non-rivalrous. Here, we sought to understand the nature of commons and their relationships with the technologies in use. We focused on two scenarios within the papers: instances where digital assets are held in common and cases where digital assets facilitate the management of physical or natural resources within commons-based frameworks. In all cases except one, we found that digital assets themselves are treated as a common resource. This includes open-source software, peer production communities, and network infrastructures accessible to communities without restrictive private ownership (Section 4.5). Noteworthy discussions in several papers emphasized the role of digital tools in supporting organized advocacy efforts, collaboration, and democratization—concepts that align with the principles of commoning [12, 47, 53, 83]. Only one paper [112] from the corpus explored how digital tools and technologies can support the management of natural commons. The

Figure 2: Domains of 25 project papers in the corpus



existence of just this solitary paper suggests potential avenues for exploring how digital tools, governance and organizing through online communities, and participatory data practices could be used to augment or support commoning practices around natural resources in South Asia.

4.5 What are the technologies used?

Building upon the findings from Section 4.4, we analyzed the technologies utilized within the corpus. Projects across the domains (see Table 2) leveraged a range of technologies such as mobile phones, technologies (screen readers), USB devices, web-based technologies (such as online peer production communities, social platforms), blockchain, and network infrastructures. Notably, mobile phones and network infrastructures were the most frequent used technologies among the project papers in the corpus. The prevalence of mobile phones in these studies raises intriguing questions about the dynamic intersection between technological affordances and regional contextual factors. The adaptability of mobile phones to various intervention forms suggests a responsiveness to the diverse needs of the projects. The heightened adoption of mobile phones in South Asia, as evidenced in the corpus, invites scrutiny into the complex interplay of factors driving this trend. Beyond the general regional trends of increased smartphone accessibility and internet connectivity, specific regional factors such as the improvement of technical infrastructure, the availability of affordable smartphones, and the implementation of state-led digital initiatives (e.g., the Unified Payment Interface and Aadhar in India and the Nagarik public services app in Nepal) come to the forefront. Certain projects in the corpus used mobile phones either to improve connectivity amongst the targeted users [42], for data collection and dissemination [15, 78], or as a medium for deploying an open-source applications.

Network infrastructure-based research projects, on the other hand, aimed to either solve internet connectivity challenges [20, 88], or discussed the social dynamics when operating, maintaining, and governing local communication networks [10–12]. Commoning practices find themselves well suited in for studies on the management, implementation, and governance of community network infrastructures [12]. As Bidwell [12] states, "CNs (community networks) are often sited in existing local governance systems and supported by external technical groups from universities and nonprofits." This relationship between community networks and external technical support introduces intriguing questions about power dynamics, decision-making processes, and the potential tensions between local autonomy and external influence [12]. Network infrastructure projects from the corpus that attempted to solve internet connectivity challenges did so through techniques of pooling, intermittent or delayed data transfer [42, 79, 82]. The scholarship here focused on techniques such as the resource pooling of networks and the inherent trade-offs between various forms of network infrastructures, whether distributed or centralized. The examination of alternate network infrastructures for data transfer introduces underscores the importance of aligning technological solutions with socio-economic and environmental contexts, echoing the core tenets of commons theories and their implications for community engagement, governance structures, and the democratization of connectivity.

4.6 Who are the participants?

While categorizing participants in the corpus, we identified two primary classifications: the urban/rural divide (see Table 4), and a

categorization based on the specific types of individuals discussed in the papers. Rural communities emerged as a prevalent participant group, featuring in 11 papers [2, 10–12, 15, 78, 82–84, 86, 106], four papers discussed urban settings [70, 79, 87, 88], while the remainder of the corpus did not specify a rural or urban setting. The concentrated focus on rural populations within the corpus of commons-based HCI research in South Asia signifies a deliberate orientation towards addressing the challenges and opportunities present in low-resource environments such as minimizing technical costs. Of note, we noticed that these projects attempt to minimize technical costs by focusing on the resources already available to increase their adoption within the communities. By doing so, commons-based HCI projects in the region aim to enhance the adoption and sustainability of technological interventions within these communities. This approach challenges traditional models that may prioritize novel technical solutions and underscores a contextual understanding that recognizes the importance of adapting technology to local needs, assets, and capacities.

Of note, the projects, even when addressing particular rural or urban concerns, usually extended beyond a singular thematic focus. The papers aimed to addressed various issues faced by the participants, such as healthcare support [15, 84], gender dynamics [11], education [78, 106] and ICT challenges (see Table 5). This multidimensional approach reflects a nuanced understanding of the complex challenges faced by rural populations and highlights the interconnectedness of various aspects of community well-being in the region. For instance, projects simultaneously exploring gender dynamics within communities signify a recognition of the intersecting social dimensions that influence technology adoption and impact. Other participants groups of notable interest were 'ICTD users', which included papers that either described certain projects or theories that utilized the knowledge commons. These papers seemed to be targeted to a rather ICTD *generic* user, usually by stating a specific country or communities as the target user population of an ICTD intervention.

4.7 How is sustainability considered?

Given the historical significance of environmental sustainability within traditional commons practices, we looked at the ways in which papers in the corpus considered sustainability. In total 14 papers addressed the concept of 'sustainability', through varying lenses such as technical infrastructures, economic stability, environmental, and community. Six papers discussed sustainability in terms of sustaining the use of technical infrastructures and the knowledge commons [43, 59, 70, 77, 83, 88]. For e.g., Mukhtar et al. [70] discuss the need of focusing on sustaining user participation through hyperlocal information systems in India as they can lead to an increase in social capital within communities. Five papers used sustainability directly in connection with environmental concerns such as conservation [112], commoning agriculture practices [83], the sustainable development goals [43], sustainable agriculture [54], and building community resilience by sustaining existing practices [11]. Surprisingly, climate change was not explicitly mentioned in any paper from the corpus. Although sustainability was represented in different ways, commons literature has discussed that long enduring commons projects can bridge broader environmental concerns with local community empowerment by facilitating collecting action, sharing of resources, and strengthening community networks [73].

Several papers from the corpus included relevant discussions of environment issues and commoning. Ziegler's [112] paper on opportunities for technologies to support community-based natural resource management incorporates discussions of environmental sustainability within the design information infrastructures. This paper draws upon examples of commoning practices in South Asia and lists out varying ways by which open data, participatory mapping, and open-source software, have been used in conserving natural resources and building strong relationships within communities. Bidwell [12] discusses commoning practices that produce, reproduce, and use common resources. Their work elaborates on the relationships between commoning activities and the identities of community members (in particular gender dynamics) [11, 12]. Qureshi et. al. [83] discuss how prioritizing top-down, formal expert-led agricultural knowledge and practices not only risks eroding trust and existing commoning practices among the rural communities but also disconnects knowledge inputs from the practical challenges faced by rural farmers. This disconnect, in turn, can hinder environmental sustainability as it may lead to interventions that do not align with the situated ecological and social dynamics of communities areas.

5 FINDINGS: ALIGNMENT WITH OSTROM'S DESIGN PRINCIPLES

For this section, we evaluated the corpus to understand how papers incorporated Elinor Ostrom's design principles (see Table 1) for governing resources in common. We conduct this analysis so to better understand the commons strategies HCI scholarship in South Asia utilizes and opportunities for future work. Evaluating the literature through these principles also provided a means to understand how the participants were involved in the processes of decision-making, monitoring, conflict-resolution, and negotiations.

5.1 Clearly Defined Boundaries

Ostrom's first design principle, "clearly defined boundaries", notes that the participants of the commons must have clear definitions and processes pertaining to the rights of resource withdrawal as well as the boundaries of the resource [73]. This principal also talks about the need for a shared understanding of the collective resource system, community agreements over resource use, and clarity regarding group identity and membership. Five papers explicitly mentioned the necessity of creating boundaries on resource use, and access to the resources [10–12, 68, 112]. For e.g, Bidwell [12] in their extensive multi-site case study on community networks argue that "Community ownership is central to sustaining community networks, in whatever form they take". Defining boundaries within the knowledge commons can be a complex task due to their accessible nature in the networked world. Ming et. al. [68] discuss how loosely defined boundaries can lead to invisible work and the need for technologies to account for unseen nuances. Influence of external actors such as authorities or larger institutions in blurring boundary lines in governing the commons resource was also noted in these papers. The variance in how community participation and

Table 4: Papers within the Corpus that Specified Rural/Urban Communities

Community Setting	Number of Papers	Papers
Rural	11	[2, 10–12, 15, 78, 82–84, 86, 106]
Urban	4	[70, 79, 87, 88]

Table 5: Kinds of users and the number of papers representing them

Users	Number of Papers	Papers
ICTD users	12	[2, 43, 54, 74, 82, 83, 86–88, 95, 96, 112]
Healthcare workers	6	[15, 42, 47, 53, 68, 84]
Online users	6	[55, 56, 59, 70, 72, 77]
Women	4	[10–12, 97]
Students	4	[20, 75, 101, 106]
Low-literacy populations	3	[78, 86, 106]

boundaries were discussed within the corpus can be ascribed to the complexity found within the cultural, linguistic, and socioeconomic contexts of South Asia. We found that this diversity makes it difficult to establish boundaries, especially within online communities that thrive on open collaboration and inclusivity. For example, Khatri et al. explore such conflicts and collaborations within three Wikipedia sub-communities of South India [55].

Having clearly defined boundaries includes knowing who can, and who cannot participate in commoning activities. Participation was a popular topic with 27 papers mentioning the term. Three of the 25 project papers utilized or discussed PD [54, 79, 88]. A couple papers from the corpus juggle with the question of what participation and representation means for ICTD research [54, 96]. While Kendall and Dearden [54] draw attention to the political and ethical entanglements for PD researchers, Singh [96] dissects the forms of discourse concerning participation within technical interventions. Four papers unpacked finer aspects such as the social and cultural factors that impact participation within knowledge commons initiatives [43, 55, 72, 77]. Ziegler [112] provides the example of participatory mapping as an effective strategy to define boundaries through technology, and "shape within-community understanding of the resource system and its current uses, as well as to communicate the resource boundaries to outsiders". Also from the corpus, Qureshi et. al. [83] discuss how their proposed model of knowledge commoning can unearth psycho-social dynamics within communities that influence the extent of participation of certain social groups.

5.2 Congruence between Rules and Local Conditions

Ostrom's second design principle, "congruence between appropriation and provision, rules, and local conditions", identifies the need for rules that govern time, place, technology and the extraction of resources based on local conditions. In the corpus, we noted an emphasis on resource scarce locations and interventions that addressed socio-economic and technological challenges that are frequent in such areas. 12 papers called attention to either 'low resource' or 'resource constrained' conditions [15, 20, 47, 55, 74, 78, 79, 82, 86, 88, 101, 112]. Resource constraints can impose challenges onto the access to technologies and participation within a commons. We found that resources in South Asia are identified in different ways such as network connectivity [78, 82, 86], financial resources [20], human resources and skilled labor [15], technical infrastructure [79] and cultural resources like social networks [55]. These papers proposed technological solutions that attempted to address these constraints such as through open data [15], physical web devices [79, 88], or network resource pooling strategies [82]. Several papers discussed the necessity of enabling local resource users to devise and use systems that match local conditions [11, 12, 53, 54, 70, 83, 97, 112]. In particular, Sipos & Wenzelmann [97] discuss the potential of localized democratization through critical making methods and Mukhtar et. al. [70] elaborate on the processes that users take in obtaining, using, and searching hyperlocal information. Although not mentioned explicitly, Mukhtar et. al. also note the importance of commoning practices such as shared social networks, social relations, and community practices in nurturing and sustaining engagement within place-specific online communities. In their study within India cities they found that "diversity caused participants to look for affinity" as sub-communities were created over similarities in geographic location, language, caste, and religion [70].

5.3 Collective-choice Arrangements

Ostrom's third design principle, "collective-choice arrangements", states that operational rules for a commons can be contested and modified by participants [73]. For this principle, we searched the corpus for mentions of norms, standards, or rules. The papers under consideration delved into these concepts across various scales. They underscored the advantages associated with community standards while drawing attention to the challenges that may arise when external entities impose standards on a community. Khatri et al.'s study [55] on peer-production communities in India is particularly illuminating. It not only underscores the imperative of sustained engagement between local knowledge producers and consumers for establishing effective online content standards but also provides valuable insights into the intricate decision-making processes within various Wikipedia sub-communities in India. This contextualizes the research within the broader HCI debates on the

commons by highlighting the importance of localized approaches to community policy formulation, user participation dynamics, and diverse user motivations. Brunette et. al. discuss the standards of accessing technologies through the creation of open data tools [15]. Bidwell [12] extends the discussion on community agreements by arguing that shared values can aid grassroots technology initiatives to *re-common* lost resources in order to sustain commoning activities. This perspective injects a critical lens into the discussion, prompting reflection on the role of values in shaping the trajectory of commons-based HCI research and technology interventions in rural contexts. Qureshi et. al.[83] alternatively discuss how dynamic social and cultural norms can, at times, threaten the sustainability of the knowledge commons. The forms of decision-making processes mentioned in the corpus were diverse, and included community dialogue [86], cultural practices [55], and inter-institutional negotiations [96].

5.4 Monitoring

The fourth design principle recommends that monitors should continuously audit the conditions of the commons resource as well as appropriate behaviors of common pool users. Monitors are either accountable to the appropriators or are appropriators themselves [73]. Here, we searched for discussions of monitoring and moderation within the corpus. We found that monitoring approaches differed and depended on the skills required to perform monitoring tasks. Monitoring is critical in sustaining community engagement for e.g. papers from the corpus mention how technologies can reduce monitoring costs [112], are useful in effective care work [53], and can ensure sustaining growth of online communities [55]. Some papers pointed out that monitoring work often requires technical skills to perform monitoring tasks [11, 86]. As noted in Section 5.2, skilled labor is a valuable and, at times, a constrained resource within South Asian contexts, especially for commons-based projects that require technical competence for their sustenance. Contrastingly, Kendall and Dearden [54] present an alternative perspective, emphasizing community members' agency in monitoring tasks through the utilization of existing community assets. They stress the importance of leveraging established community tools and skills to implement monitoring solutions in developing regions, thereby mitigating the unsustainable dissemination of technologies. This dichotomy underscores the multifaceted nature of monitoring responsibilities, which hinge on possessing the skills necessary to maintain the technical infrastructure of the commons. For example, the technical skills required to monitor and maintain a community network [11] starkly vary from the skills required to monitoring a online group [54]. Overall , technologies such as open data [112], open-source software [15], network infrastructures [12], and messaging applications [54] emerged as pivotal mediums for monitoring and moderation within the corpus. The juxtaposition of findings highlights the complexity of monitoring dynamics, requiring a nuanced understanding to inform effective strategies for commons-based HCI research in South Asia.

5.5 Graduated Sanctions

This design principle highlights the need to have escalating sanction measures in cases where appropriators violate operational rules through disruptive self-serving behaviors. Here, we searched for discussions over regulation mechanisms within the corpus to understand how HCI research in South Asia brought up this principle. Surprisingly, only a limited number of papers touched upon regulatory procedures or sanctions. This scarcity may be attributed to the fact that certain online communities like Wikipedia (as seen in Khatri et. al. [55]) prefer utilizing a combination of collective-choice arrangements, monitoring processes, and conflict-resolution mechanisms as alternatives to sanctions for managing operational rule violations." Nevertheless, several papers did mention the potential benefits of empowering communities and increasing solidarity by allowing them means to identify problematic actors [12, 68]. Bidwell's study [12], conducted across multiple villages in India and other sites, delves into how structural inequalities towards women can surface when the regulation of collaborative community technologies is dictated by external authorities, such as mobile network operators in this instance. The study also sheds light to how regulation procedures, when imposed by external entities, may deviate from actions aimed at cultivating community solidarity and instead align with the financial and technical innovation interests of these external groups.

5.6 Conflict-resolution Mechanisms

The sixth principle focuses on the need for conflict resolution mechanisms, which are usually informal and low-cost, in order to effectively sustain resources in the long term [73]. We found that discussions about conflicts and their resolution in the corpus could be divided into either their 1) necessity and benefits [56, 96], or 2) challenges and concerns of inadequate conflict resolution mechanisms [11, 47, 68]. Kim [56] and Kendall and Dearden [54] discuss how the use of technologies in collaborative work environments can lead to the emergence of useful conflicts. Kim [56] explored using an appointed leader to manage coordination and conflict resolution in an online collaborative community. Ismail et. al.[47] elaborate on the varying conflicts that show up in care work between healthcare workers, community members, and the Indian healthcare system while proposing commoning as an alternative approach to prevent the enclosure of care work. Few papers discuss how poor or missing conflict mechanisms can result in a demotivating collaborative work environment [55] and, further subjugation and distancing of marginalized groups from fair participation within the commons [12].

5.7 Minimal Recognition of Rights to Organize

This principle underscores the crucial necessity for governments and external entities to genuinely acknowledge the rights of communities managing commons. To ensure sustainability, these communities must have the autonomy to establish their own institutions, whether informal or formal. In examining this principle, we explored themes of community advocacy, recognition, and collective action within the corpus. Several papers within our research corpus delve into the intersection of technology and community organization [68, 77, 95, 97]. They explore how technologies can serve as tools for community advocacy and action. Conversely, some papers discuss socio-economic factors that impede such efforts [11, 12, 77]. Ziegler [112] highlights the potential of ICTs to protect community

resource institutions from external threats and foster collaboration with external entities. They cite instances of social media activism and indigenous knowledge documentation in enhancing social capital and enabling effective community organization. Karusala et. al. [53] emphasize the utility of communication apps like WhatsApp for community advocacy in providing platforms for members to express concerns and establish safe spaces for women in healthcare settings. In health, Ismail et. al. [47] illustrate how Indian social health activists utilized digital technologies to advocate for improved working conditions and addressing systemic inequities for frontline health workers. Bidwell [11, 12] cautions that enclosures and commodification of common resources can reduce the rights of marginalized sub-populations, particularly women. Additionally, they note that advocacy movements for collective resource management may unfairly sideline discussions on gender inequalities within communities.

5.8 Nested Enterprises

The eighth and final design principle underscores the importance of integrating processes like appropriation, provisioning, monitoring, conflict resolution, and governance activities across multiple government levels [73]. Our search here focused on identifying instances of multi-scale collaborations and the inclusion of communities in broader government discussions. The corpus revealed various strategies for facilitating community participation at different governance levels through collaborative technologies, some are explained as follows. Singh [96] notes that effective participation in ICT4D projects requires mobilizing community members within policy shaping processes. Bidwell highlights existing relationships and processes involving local authorities and institutions in community networks [12]. Few papers mentioned how collaborations in data-collection technologies [77, 112], grassroots organizations [83], and open-source projects [43, 59] can aid in building community trust with larger institutions. In the case of CBPP communities, Khatri et al. [55], show that having centralized agencies for certain standards within Wikipedia can aid in 'effective and widespread adoption' of projects. This paper also points to successful forms of nested enterprising in CBPP where local level rules and practices vary between Wikipedia communities and yet are part of the broader global level online community. Inadequate or hegemonic nested enterprises can result in a loss of local perspectives. For example, within rural agrarian communities, insufficiently established nested enterprises may precipitate the fragmentation and inaccessibility of local Indigenous knowledge over time [83]. Alternatively, they can create spaces for community-based resistance efforts, as articulated by Ismail et al. [47]. Most papers endorse the design principle, affirming that nested enterprises provide a framework for South Asian commons projects. They enable local communities to self-organize and collaborate across multiple scales, fostering effective resource management and adaptive governance in diverse contexts [77, 82, 112].

6 DISCUSSION: SUPPORTING COMMONING THROUGH HCI RESEARCH

Reviewing HCI commons research in South Asian from the lens of Ostrom's design principles allowed us to elicit activities and socio-technical relations that facilitate the creation and maintenance of the commons. These practices, elucidated in Section 2.4 as commoning, were explicitly mentioned in only four papers within the corpus [12, 47, 53, 83]. However, we did find other ways that South Asian HCI commons projects engage with commoning practices. For instance, studying how peer-production communities create their moderation rules [55], designing digital tools to facilitate resource sharing [88] and exploring conflict mechanisms within collaborative online communities [56] are indicative of such practices. In the following sections, we consider the findings of this study alongside prior work in HCI, aiming to provide guidance for future research that can implement commoning practices as an alternative to neoliberal approaches to sustainable development. First, we argue that effective support for commoning practices in the region would be enhanced by drawing upon the theoretical and conceptual lens of infrastructuring. Second, despite extensive discussion of the importance of participation in the surveyed literature, a more involved and direct engagement with prior research and practices in the field of PD is imperative to the inclusivity and sustainability of commoning activities. Third, in contrast to much of the prevailing deficit discourse in ICTD, we suggest for an orientation in commoning HCI research and design practice that emphasizes building upon community strengths and assets. Finally, we consider the emerging governance challenges stemming from the application of Ostrom's principles to nascent forms of knowledge commons in South Asia, proposing alternative cooperative arrangements for the governance of these entities.

6.1 Infrastructuring as Commoning

To begin with, we propose the adoption of infrastructuring as a conceptual framework to engage with tactics of commoning within South Asian HCI commons research. Commoning practices are not limited to a single behavior or moment, they are rather ongoing patterns of activity that shape or (re)create resources toward collective purposes [62]. Similarly, infrastructuring is the "co-construction of socio-material resources for participation" and consists of the ongoing development of relations within and between communities, as mediated through various infrastructures [63, 69]. Certain studies in HCI, PD, and CSCW have discussed aspects of infrastructuring that hold relevance for commoning. For example, prior work has examined infrastructuring can aid with alignment between contexts and conflicting interests, particularly withing collaborative environments [13], a concern which is shared within commoning research [64]. Infrastructuring socio-material relations can also contribute to validating practices of care that are often made invisible due to capitalist ideals of accumulation and enclosure [91]. Several papers in the corpus raised concerns about unpaid labor, gender disparities in work, and the invisibility of care work [12, 53, 68]. Within the context of HCI4D research, a shift towards 'infrastructuring solidarities' centered around care, and supported through information infrastructures, [91] might offer a pathway for communities to engage in collective action and mobilize against neoliberal tendencies.

By applying Ostrom's principles to extract practices, relations, and activities from the corpus, certain overlaps with infrastructuring theory become evident. Infrastructuring emphasizes the

ongoing relations and tensions between practices, social networks, and activities within communities, organizations, and institutions operating at different scales [51]. Similarly, Ostrom notes the tension between scales, arguing that authorities should respect the rule-making rights of local communities (Principle 7) and calling for an interconnected system of nested tiers to responsibly manage the commons (Principle 8)[73]. The infrastructuring lens has proven useful in examining commoning practices of resource use and sharing (Principle 3), monitoring of users (Principle 4), and community governance processes for choosing institutional arrangements (Principle 7) [64, 76]. Several papers from the corpus noted that infrastructures and the social networks surrounding knowledge commons enable collaborative environments for community activism within broader institutions [11, 53, 112], In particular, Bidwell [12] noted that infrastructures around a commons are useful sites for fostering discussions over the preservation, revitalization, and sharing of cultural resources and communal values [12]. Such assemblages of collaboration and sharing across institutions, social movements, and communities are a necessary aspect of commoning activities [18].

Together, the above arguments suggest that commoning may be understood as a particular form of infrastructuring, with both sharing attentiveness to the processual and ongoing character of social and technological life. As a result, infrastructuring offers a rich source of theory and findings from HCI for future commoning research and design to draw upon. Although several papers within the corpus implicitly addressed the interplay between the commoning agenda and infrastructuring by illustrating how communities in South Asia continually negotiate and align their interests [12, 83], we suggest that studies such as Martilla's [64] co-design project of commoning practices within open knowledge commons provide valuable examples for understanding how infrastructuring can support and nurture commoning activities. HCI research delving into infrastructuring in South Asia, such as studies on healthcare systems in India [8] and within refugee communities in Bangladesh [44], underscores that adapting the constructs and models of infrastructuring to the socio-economic context of South Asian communities necessitates an understanding of the local meanings associated with commoning practices. Indeed, scholars have previously discussed the similarities between commoning and infrastructuring pertaining to the relationships between local issues and global needs [13]. One area of HCI research where infrastructuring has been explored in detail, that has been given surprisingly less attention in commons-based HCI research South Asia, is in the context of PD [23]. We discuss this in the next section.

6.2 Participatory Design towards Commoning

In our review, we observed a recurring focus on participation, yet we were surprised to find limited engagement with Participatory Design (PD) literature (see Section 5.1). This finding was surprising, as a key tactic found within both commoning and PD theories has been the creation of a variety of governance rules that match local conditions, aiming to ensure the maintenance of the projects and collective action within communities (Principle 2) [66, 73]. Indeed, researchers in PD have recognized parallels between the objectives and ideologies of commons and PD strategies. Marttila et. al.'s [66] investigation at the intersection of these domains revealed a shared democratic political agenda, emphasizing community self-governance, collective action, and the visibility of social practices and relations. Early commitments in PD towards democracy and worker rights [28] align well with the commons agenda of enabling emancipatory forms of self-organizing and community level governance. From the corpus, Kendall and Dearden argued within the development contexts of South Asia that designing and supporting democratic arrangements through PD necessitates researchers' reflexivity in understanding local issues. This involves a meticulous examination that commences with the establishment of sustainable relationships and social networks [54]—a crucial facet of commoning.

The connections between PD and commoning are not new. Researchers have shown that the two domains have historically intersected on shared goals of understanding the dynamics and relationships between users and designers that lead to the collaborative (re)production of the commons [104]. Teli suggests of a 'new utopia' within PD research supported by focusing on "strengthening social practices and social groups that nourish the common" i.e., commoning [104]. Poderi [81] explores the intersection of PD and the commons in their discussion of how PD can aid in sustaining knowledge commons projects through supporting participation in open-source initiatives. This work suggests that commons approaches may also help address longstanding challenges in the field of PD, such as sustaining the impacts following the end of the project life-cycle. Prior PD studies have shown the advantages of exploring commoning as means to sustaining projects through co-designing and prototyping, for e.g. open-source and collaborative digital tools [3, 4]. Although principles of PD seem to align well with the commoning agenda, implementing such tactics within HCI4D settings requires an intricate understanding of evolving socio-political practices and relations. Indeed, exploring commoning through PD requires that researchers (re)interpret the commons as not merely static resources but as the result of commoning activities that change and evolve over time [104]. This offers useful guidance for how South Asian HCI research can ensure that projects utilizing the commons can be used, re-appropriated, and re-framed beyond the initial involvement of the researchers and in ways that suits the abilities and interests of the communities.

Several papers from the corpus [43, 53, 72] highlighted social and cultural factors as potential challenges to community practices surrounding commons. Although the recognition of these socio-cultural factors does elucidate barriers to adoption of commons-based technologies and participation within CBPP communities within South Asia, we suggest that researchers look towards PD techniques as a means of designing with socio-cultural factors in mind for achieving the emancipatory potential that inspires so much of the research into commoning. Drawing inspiration from environmental grassroots movements, HCI researchers can learn from initiatives like KHOJ, an NGO in Maharashtra, India, employing participatory methods for inclusive forest governance. Such projects serve as exemplars on how commoning can be utilized towards effective collaborative management of the commons for sustainable development by harnessing cultural assets and community knowledge [37]. Although relatively nascent, the growing literature at the intersection of PD and commoning [66, 104] points

to the importance of examining community participation and social relations with the commons to develop design interventions that engage with novel institutional arrangements surrounding commons-based technologies.

6.3 Assets-based Design as an Alternative to Deficit Models

In HCI, Assets-based Design (ABD) has emerged as an area of research that seeks to highlight community resources as an alternative to so-called "deficit" framings which emphasize scarcity of resources and capacities. The attention to resource scarcity in the literature we reviewed poses unique opportunities and challenges for commoning. We hope to guide attention of HCI research in South Asia to a deeper engagement with this concept and its meanings in the context of communities within the region. Despite the frequent mention of *resource scarcity* within the corpus we found that they rarely unpacked what the resources are, and the implications their scarcity holds for the research and communities. Understanding the specifics of the types of resources and assets communities have or alternatively, the resources which communities have a scarcity of, can aid in sustaining existent or identifying potentially new commoning practices. For example in the corpus, Robinson et al. [88] showcase how identifying the scarcity of technological resources within a community allowed them to understand sharing practices demonstrates that identifying assets and their availability can aid in cultivating commoning. While none of the reviewed papers explicitly adopted ABD, some pointed to strategies of minimizing technical burden upon the communities by utilizing existing assets [70, 82]. ABD's preference towards building community trust and autonomy argues for moving away from techno-centric solutions as a way to address the challenges of technical adoption [39, 109]. Similarly, we suggest that identifying and incorporating existing assets into HCI commons research, especially within development contexts in South Asia, can support sustained community participation and autonomy. And so, in designing for the commons by utilizing existing community assets can potentially create opportunities for alternate arrangements of resource management that minimize dependency on external institutions and subvert hegemonic narratives [30, 109].

ABD's recent exploration on fostering collectives to assess and manage community assets [109] holds significance for future commons-based HCI research. This argument aligns with the Ostrom's design principles that describe the role of appropriators when managing a shared resource (see Table 1: Principle 1, 3, and 5). While commoning practices through ABD remain unexplored in HCI research, clear connections emerge based on the shared objectives of minimizing community dependence on external entities and prioritizing existing knowledge and practices in research and design. Particularly relevant research includes identifying community practices such as cultural traditions, rituals, or environmental management techniques based on local-knowledge as assets [19, 80]. Beyond HCI, studies have examined how adopting commoning and assets-oriented perspectives toward marginalized urban collectives in Bangladesh can be instrumental in recognizing community capacities to address inadequacies in public and private sector provisions for essential well-being support, such as affordable housing and employment [108]. Such work can prove valuable for HCI researchers within and beyond the scope of development in understanding the self-organizing logistics of precariously positioned communities.

As mentioned above, ABD and commoning theories share similar commitments, emphasizing the importance of local knowledge, the sharing of assets, and reducing dependencies on external actors. However, the distinctive potential of commoning lies in its ability to not only acknowledge but also reclaim lost assets, positioning it uniquely in strategies for community collective action towards sustainable development. While recent ABD work has alluded to collectivist approaches [109], the political and economic potential of commoning, particularly as a means to escape capitalist enclosures [31], remains largely unexplored within the ABD framework. Moreover, commoning, viewed as a processual concept, underscores the significance of continuous engagement and the maintenance of relationships and resources. This is in contrast to ABD, which primarily focuses on the early recognition of existing assets in the design process and, at times, can include privately-held individual assets. Despite these differences, we contend that ABD approaches can be instrumental in designing commoning arrangements that center community assets and capacities to address social and environmental issues.

6.4 Governing the Commons

As per Ostrom, effective governance of the commons is most likely achieved when all criteria of the design principles are met, a condition we did not find for any project from the literature we surveyed. Nonetheless, we found that Ostrom's design principles, as similarly noted by other prior work [17, 107], were valuable in untangling the variety of institutional arrangements, conflicts, and governance mechanisms of a project. Ostrom's principles (Principle 7 and 8) highlight that in order for community management of commons to be sustainable, their authority must be recognized by and be incorporated within the governing structure of broader governmental institutions [73]. The challenge for commoners has always been to identify, formalize, and reclaim institutional arrangements, relationships, and social practices that empower them to responsibly manage the commons without the threat of enclosure of resources and degradation of local social networks. From the corpus, Qureshi et. al.'s [83] discussion of how top-down models of creating and disseminating agricultural knowledge silence local community narratives and [47], highlight that South Asian HCI research utilizing the commons must question how the participation of communities with the commons might conflict with the ideologies of larger institutions in the region, and how that might create limitations upon the effectiveness of these projects.

In response to the threats of enclosure and exploitation, we found papers within the corpus [47, 96] that argued for commoning in nurturing cooperative practices and arrangements that empower agency, prioritize care care, and create spaces for resistance against hegemonic governance. Ismail et. al. [47] discuss the potential within cooperative practices around care in organizing from within state-led initiatives. These discussions suggest a turn towards platform cooperatives which offer alternative imaginaries of co-ownership, distributed democratic governance, autonomy

and independence, and a sharing economy [90]. Platform cooperatives create opportunities to cultivate commoning practices and socio-economic activities, particularly benefiting South Asian communities that have historically endured extractive interventions from external institutions. Crafting interventions that conceptualize platforms as cooperative commons, holds potential to generate social, economic, and environmental value for these communities [32]. This approach provides an alternative organizational structure designed to be more responsive to the needs and interests of local community members. It fosters shared use, allowing people to coordinate, acquire, and distribute resources, thereby countering the concentration of power, monopolization, and potential violations of worker rights—areas that have consistently captured the attention of commons research [90]. SEWA, an Indian cooperative since 1971, focuses on women's rights and runs platform cooperatives for fair market access. Their grassroots model addresses the needs of rural women, advocating policy changes [24]. Exemplars like SEWA merit exploration in South Asia HCI commons research in exploring cooperative arrangements and commoning practices as alternative governing mechanisms to private property-centric models.

7 CONCLUSION

This paper examines HCI research related to the commons in South Asia. Notably, our observations reveal that while commons research in South Asia is still in its nascent stages, it encompasses a wide array of domains, indicating substantial potential for future impact. Our decision to map the South Asian commons HCI research to Ostrom's design principles provided us a framework to elicit the forms of practices, social relations, and governance mechanisms enacted and implemented by communities, institutions, and researchers within South Asia. Drawing from these insights, we propose that future research and design into commoning in the region would benefit from drawing on the lenses of infrastructuring, assets-based design, and PD. Together, these areas of research provide a rich foundation to guide future efforts to identify strategies that help to ensure that commons projects, as stated by Ostrom [73], are long enduring, self-governed, and can adapt to changing social and environmental factors. We argue that supporting commoning practices within HCI research in South Asia may provide an alternative orientation that focuses on collective stewardship of resources instead of the models of development that prioritize enclosure and private property regimes which have historically been subjugated upon the region [29, 93]. While our primary objective in this study was to gain insights into the landscape of commons HCI research in South Asia, we anticipate that our evaluation through the lens of Ostrom's principles and our contributions to commoning practices can support future research endeavors, not only within South Asia but also for other regions grappling with similar concerns.

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