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Gavin Brett Melles *Editor*

Designing Social Innovation for Sustainable Livelihoods

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Designing Social Innovation for Sustainable Livelihoods

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Preface

We live in times of major disruption and change. The most recent 6th IPCC report paints a worrying picture about the global and regional consequences of a warming world, the COVID pandemic continues to destabilize societies and economies and nationalist, and populist and fundamentalist politics and government are on the rise. In this context, it is particularly the most vulnerable and increasingly excluded rural and urban poor who struggle and pay the price for decisions made by a political and economic elite about how development should proceed. While globally there has been progress on achieving some of the Sustainable Development Goals (SDGs), inclusive development for all remains an enormous challenge, which mainstream economic approaches have not been able to deliver. Changed perspectives and institutions are needed, and this book is a small contribution to that project.

The sustainable livelihood framework (SLF) has for thirty years proved a robust framework for understanding the many dimensions of poverty and exclusion while also identifying the particular social and institutional innovations that can enable inclusive development at the household level (Chambers & Conway 1991). The SLF is a common denominator for all the case studies in this book, which in addition looks at how the present livelihoods are and how future livelihoods might be designed by everyone (Manzini 2015). Thus, this is less a book about particular design solutions or projects—although these are discussed—and more a conversation about how livelihoods are and might be designed. It invites readers with interests in development and design to consider how we might collectively move from understanding livelihoods to intervening and redesigning the structures and processes that currently limit inclusive development. As a result, this is a book authored by researchers and practitioners trying to identify better ways of doing development.

This book looks at design writ small and large as a perspective to enable the material, social and institutional innovations that might help lead to sustainable livelihoods. In doing so, the book is oriented towards design as the broad 'liberal art' of the twenty-first century for applied development (Buchanan 1992). In relation to this, over the last 50 years there have been two movements in relation to design—an expansion of the expert design landscape into the fields of service, co-design and social design (Sanders & Stappers 2008) and simultaneously recognition that design

as a diffuse mode of thinking applies to many fields and practices including policy, social planning and institutional design, which are concerned with materiality and social purpose (Simon 1996). Both developments have implications for inclusive innovation, and we treat this wide design continuum in this book as relevant for sustainable development and livelihoods. We invite readers to position their current and future work in relation to the concepts and contexts discussed here.

I have been fortunate over the last decade in particular to work in various capacities as an educator, mentor and practitioner in India, Germany, Australia and more recently Nepal. Many of the organizations represented in this book have hosted me in one or other capacity over the years, and although impossible to name them all, I must include colleagues at the Centre for Social Innovation and Entrepreneurship (CSIE) at IIT Madras, and at the Department of Management IIT Madras where I have been a fellow, the Centre for Social Initiative and Management (CSIM) in Chennai—where I trained and worked as a social auditor, the Srishti Foundation and National Innovation Foundation (NIF) in India, where the support of Professor Anil Gupta has been invaluable over the years, participation in the urban green dialogues of the Indo-German Centre for Sustainability (based at RWTH Aachen and IIT Madras) and an Indian Government-Sponsored GIAN Fellowship at NIT Silchar in Guwahati. It is through these and other experiences—including postgraduate education at SOAS also—that I developed my particular interest in relating SLF to design as described above.

The book begins with a more detailed orientation to the concepts outlined above before individual co-authored case studies analyse and then propose material and institutional innovations for sustainable livelihoods. I hope you enjoy the journey as much as I did!

Hawthorne, Australia Gavin Brett Melles

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Chapter 1
Designing Social Innovation for Sustainable Livelihoods

Gavin Brett Melles

1 Designing Development

Without a broad theory of change, the idea that employment, technology, social enterprise business models, infrastructure or other resources and capitals will lead to development is inadequate. While other approaches to design for development exist, including capabilities design (Oosterlaken 2009), this book takes the sustainable livelihoods framework (SLF) as an analytic framework and a broad theory of change, which defines the elements, e.g. capitals, institutions, processes, vulnerabilities, that enable and disable sustainable livelihood outcomes. Livelihood assets—products, services and other capitals—and institutional structures and processes—can be designed to enable desirable livelihood strategies and outcomes. This is a project that requires simultaneously top-down institutional and bottom-up social innovation initiatives.

2 The Sustainable Livelihoods Framework: A Framework for Understanding and Promoting Change

Thirty years ago, Chambers and Conway (Chambers and Conway 1991) proposed the sustainable livelihoods framework (SLF) as a way of analysing the contexts and possibilities for rural development. The work of Robert Chambers and later DFID adoption and development of SLF as the framework of choice for first rural and then all development analysis and action is a story well told elsewhere (Ashley et al. 1999; Chambers and Conway 1991; Solesbury 2003). With its basis in participatory approaches, focus on sustainability and influenced by Sen's notions of capabilities

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(Sen 2000), the framework quickly became the default approach for development agencies in the UK, Europe and elsewhere through the nineties (Davies et al. 2008; Krantz 2001; Neely et al. 2004). Over time, the model has experienced revisions to address critique with respect to the politics of development and the necessary institutional changes that development requires (Banks 2016; Baumann 2000). Despite criticism, the framework remains a 'comprehensive analytical device that prioritizes the interests of those rural groups traditionally neglected by mainstream modernization policies' (Hall and Midgley 2004, p. 87). SLF is moreover no longer limited to a rural focus but applies more broadly to both urban and rural contexts (e.g. Farrington et al. 2002).

Below the SLF diagram shows the interdependent elements of vulnerability contexts, capitals, transforming processes and structures, livelihood strategies and outcomes. At the core of the model is the link between capitals and transforming structures and processes—this is where social and institutional innovation can enable strategies and outcomes. The model immediately shows how a project focus on a particular product or service as a source of new capital or assets is only valuable to development in the broader context of variables identified. Without simultaneously transforming structures and processes in markets (Dorward et al. 2003), governments (Mok and Lau 2014), environmental commons (Lienert and Burger 2015) and elsewhere for social outcomes, social products and services will fail to deliver sustainable change (Fig. 1). Positive livelihood outcomes and strategies arise when structures and processes are transformed, e.g. gender, autonomy and local knowledge integrated as fundamental to change and enable access to the capitals, which themselves are the product of new livelihood outcomes. For example, access to affordable housing and the related infrastructures requires institutional changes. The reduced

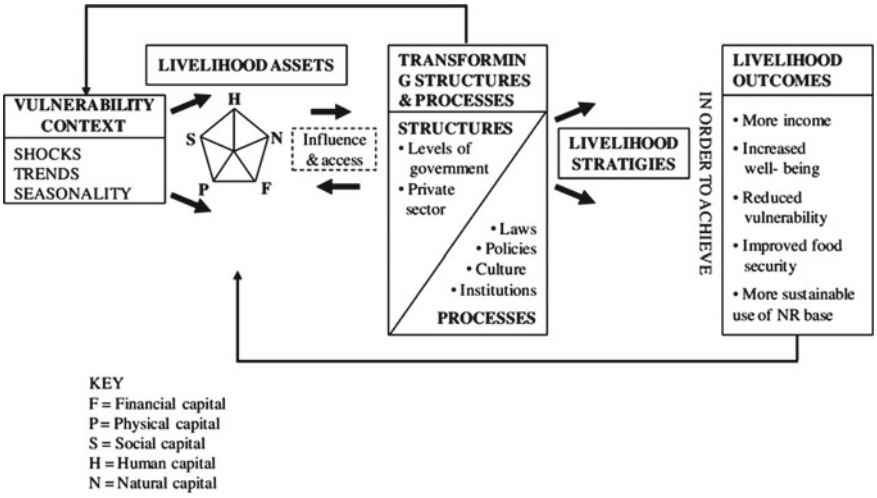

Fig. 1 *Source* Carney (Ashley et al. 1999)

vulnerability and increased well-being that can result leads to increased capitals in a self-reinforcing loop.

3 Democratizing Social Design: Little Design and Big Design Merge?

The concept of design has always lived a double life of expert and more diffuse interpretations, including with respect to social goals. Manzini (2015) usefully distinguishes between conventional design work—*expert design*, e.g. industrial design—and a broader agenda—*diffuse design*, e.g. policy design as two ways of understanding this double life. Here, I want to suggest that both expert and diffuse senses relative to social innovation and design have their origins in two works from fifty years ago. On the one hand, modern design professions experienced a turn to the social in development contexts through the work of Viktor Papanek. Papanek in *Design for the Real World* (Papanek 1971) proposed that industrial designers create socially responsible solutions, rather than being handmaidens to the unsustainable consumption projects of mainstream design. These solutions included product innovations adapted to affordability and need.

While much has been achieved and written since in the fields of social design (Margolin and Margolin 2002), Papanek's agenda remains a marginal professional activity in design (Melles et al. 2011). In the decades since Papanek, design fields have expanded their methodological landscape (Sanders and Stappers 2008)—to include the social through the creation of subfields such as social design and co-design methods, including in the social innovation space (Britton 2017). Recent attempts by designers to define social design, identify multiple strands, including a focus on activism or action research, methodological sociality, e.g. co-design, and critique of the limits of the field in understanding the wider ideological contexts to which it has shifted (Chen et al. 2016). However, design discussions of the wider issues remain unsubstantial. Thus, Kuure and Miettinen (2017) in their framework for social design identify but do not discuss in any detail culture, participation, community focus as core elements, while alluding to creating equal relations and empowering community.

Designers often appear to focus especially on the design process (and tools and methods) in projects and are somewhat fixated on the uniqueness of democratic and empowering design approaches (e.g. Docherty 2017) for achieving major social change. With their narrow project and process orientation and inability to see ideological and institutional factors, they tend to collapse different terms together. Chick (2011), for example, equates social innovation design with the social side of sustainable development while Selloni and Corubulo (2017) seem to conflate social enterprise (a business model concept) with social innovation and see active community participation as essential to both; for some important differences between these terms, see, for example (Davies and Simon 2013). Thus, there is need for new frameworks

to situate design projects in institutional context as well as a need to update the scope of design in light of its democratic spread to other fields.

Thus simultaneously with Papanek's work, Herbert Simon's *The Sciences of the Artificial* (Simon 1996), originally published in 1969, argued that the search for solutions to human problems in many disciplines, including management, engineering, architecture and social planning, should be characterised as design. Subsequent application of this idea to the design of organizations (e.g. Romme 2003), public policy (e.g. Considine 2012), even business models (Joyce and Paquin 2016), claims that it pays to think of problem solving in socio-technical domains as designing institutions. Simon's allusions to design subsequently became a popular touchstone for expert design as it expanded its reach to services, systems and beyond (Buchanan 1992).

As a result, there has been something of a defacto merging of diffuse and expert senses of design, which is also relevant to design for development. For exmaple, the democratization of design has meant that it is now common to find non-designer groups including design approaches in their community and development projects, especially co-design as an inclusive method (Parsons et al. 2016; Sarmiento Pelayo 2015). The crossover is complete in development fields where diffuse design of urban slum redevelopment, for example, includes expert design methods such as co-design (Kumar et al. 2016). The expansion of the design discourse into other discipline spaces concerned with the social has helped reinforce a blurring of boundaries between expert and diffuse design.

4 From Social to Social Innovation Design

Given that design for social purposes may involve product, service and institutional innovation, it is not surprising that the design thinking movement claims to solve social innovation problems. Brown and Wyatt (2010) exemplify product and service projects in developing countries, arguing that although enterprises use elements of design 'most stop short of embracing the approach as a way to move beyond today's conventional problem solving' (Brown and Wyatt 2010). The authors focus on the process methods and tools, e.g. prototyping, co-design, storyboarding, that play a role in the creation of product and service innovations with social purposes. Such discussions allude vaguely to a range of concepts, including social enterprise, social innovation, social design and empowerment with little precision.

Social innovation refers to 'innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly diffused through organizations whose primary purposes are social' (Mulgan 2006). This widely cited definition focuses on activities and services designed with social ends in mind. This terms has recently become a competing term to social design for designers wishing to engage in 'a gamut of new social and political contexts very different from the majority of their peers' (Chick 2011). From the perspective of SLF such innovations constitute new capital formations that might also be transformational in the relevant

sense if the organisational form challenges the status quo and scales (Alvord et al. 2004). In other words, if it concerns the valuing of local knowledge, gender, community and other institutions as a solution to inclusive development contexts then this will lead to new capital formations.

Manzini (2014) in particular, who has been a protagonist of design for social innovation,[1] includes the slow food movement, community gardens and other projects developed and implemented by non-designer creative communities, 'who cooperate in inventing, enhancing, and managing viable solutions for new (and sustainable) ways of living' (Manzini 2014, p. 62). This democratization of design where everyone designs is central to the current social design innovation discourse (see especially Manzini 2015). Responding to the critique of design approaches to social innovation, Hillgren et al. (2011) meanwhile suggest that it is the longer term design of infrastructure not product or service projects which creates a sustainable platform for social innovation design. In addition, they observe that the future of design in social innovation contexts depends on design' stepping back' recognising its limitations and collaborating and learning from other fields.

Thus, the democratization of design has led to a practical merging of expert and diffuse design concerns in social domains. From an SLF perspective, designing social innovations refers particularly to the enhancing of capitals by organisations seeking to promote change. If the initiative scales and incorporates institutional innovations relative to gender, financial access, cooperative and collective logics, then social innovation so understood may lead to sustainable transformation and change (Alvord et al. 2004). Institutional innovation, however, is not just driven by bottom-up project-level initiatives that scale but through institutional innovation, including through policy design, that enable the conditions for relevant SLF growth in capitals. In fact, a strict separation of both processes is impossible to draw definitively. We leave you, the readers, to judge how the case studies in this collection exemplify these two interdependent bottom-up and top-down design potentials.

5 Following Chapters: Case Studies and Discussions

Resisting the urge to see design thinking and projects as the answer to social innovation and development problems (see Blyth and Kimbell 2011), this book sees design principles for resilient livelihoods and meaningful change as depending on detailed analysis, collaborations and collective knowledge processes and structures (Ostrom 2009). To explore inclusive development contexts and designing institutional innovation for sustainable livelihoods, I invited colleagues to write illustrative case studies of their work and examine their work in the light of relevant frameworks, i.e, SLF, social design. I am grateful for the wonderful responses of all my co-authors who in a time of significant disruption delivered inspiring and insightful stories about their work towards enabling sustainable livelihoods. This book of course is itself a dialogue

[1] Especially through the global DESIS network. https://www.desisnetwork.org/.

about commonalities and differences in the hybrid space of diffuse and expert design. Space does not permit me here to acknowledge all the support from foundations in India and Germany, as well as Swinburne University over the years that enabled me to meet many of the authors face to face over the last decade. In this section, I briefly introduce their chapters and how they address the overall agenda of the book.

Chapter 2: Designing Sustainable Livelihoods for Informal Markets in Dhaka, S. Rafsana Hossain, Gavin Brett Melles, Aisling Bailey

In the first case study, Rafsana Hossain, Melles and Bailey explore informal street markets in Dhaka, Bangladesh, as livelihood opportunity and challenge in context of official visibility and invisibility. Hossein, with a background in critical analysis of urban planning projects (Hossain and Fuller 2021), Bailey, who writes on community sustainability initiatives (Kingsley et al. 2019) and I met during our time together at Swinburne University Centre for Urban Transitions. Basing the analysis on an ethnographic survey of street markets, which Hossein undertook, we argue for the significance of street markets as an adaptive livelihood system and argue for more responsible policy design based on this idea. This first chapter, therefore, sets the scene for the book with an account of the significance of design for rural–urban sustainable livelihood policy making, and importantly a more adaptive approach to local and official needs and constraints. Through the allusions to Ostrom's work on socio-ecological solutions to common's pool resource problems (CPR), we also make the case for the importance of theory in seeing livelihood policy and practice design from broader perspectives.

Chapter 3: Designing Livelihoods Responsibly: Insights from Seed Conservation and Management Practices Among Farming Communities in India, Sunil D. Santha, Devisha Sasidevan, Sanchita Das, Santosh Kadu

The TASA Institute for Social Sciences (TASA) is one of the leading institutions focused on inclusive innovation in India. Sunil Santha's work with colleagues on rural livelihoods (e.g. Santha 2020) based at the Centre for Livelihoods and Social Innovation, School of Social Work—Mumbai Campus—was familiar to me. In his work, he and colleagues argue for an adaptive innovation model, which accounts for local contingencies, agency and structures. In the second case study, Santha and colleagues examine how traditional farming communities make use of their local knowledge systems and resources to design adaptive solutions to diverse environmental and livelihood uncertainties. Based on insights gathered from three distinct ethnographic qualitative researches conducted among traditional farming communities in Kochi, Purulia and Ahmednagar, respectively, they identify the purposeful design of seed management practices in local contexts of uncertainty and change. Among the many contributions of this case study is the insight that externally promoted projects can disrupt the balance of social-ecological systems and worsen the vulnerabilities of marginalised communities dependent on these resources, if they fail to follow an integrated design-cum-development practice at the local level.

Chapter 4: 'Designerly Ways' for Sustainable Livelihoods, Sharmistha Banerjee, Pankaj Upadhyay, Ravi Mokashi Punekar

I have been long aware of the work of Banerjee and colleagues on Design for Sustainability (DfS) based at IIT Guwahati (Punekar et al. 2020). Following some 'accidental' meetings at conferences in India, it was a pleasure to meet face to face at IIT Guwahati while I was on an Indian Government GIAN teaching fellowship at the neighbouring NIT Silchar. Banerjee and colleagues report on the development and implementation of 'design supports' for livelihood making. They see the sustainable livelihoods approach (SLA) in conjunction with their own framework of design for sustainability, as a potentially strong lens for designers and to aid designers in designing sustainable solutions. In this chapter, they discuss their experience of developing, evaluating and validating design supports for three different problem typologies: (1) 'design for sustainable livelihoods' wherein the community's economic activities are deeply rooted in their social and cultural ways of living, (2) 'design for marginal contexts' (sustainable agricultural mechanization of small farms of developing countries) and (3) 'frugal design' for the lower-income strata to improve their livelihoods. The chapter therefore illustrates a context in which taking sustainable social design as a starting point the overlap of expert and diffuse social design is significant.

Chapter 5: One Size Does Not Fit All: Heterogeneous Groups and Digital Training for Women in Tamil Nadu, India, Arun Kumar Gopalaswamy and M. Suresh Babu

During a 2019 sabbatical as research fellow at the Department of Management, IIT Madras, I was fortunate to meet Professor Kumar and colleagues—their warm welcome over tea breaks and insights into life and history in India remain enduring memories. Hence, it was with great pleasure that I could accept Prof. Kumar's offer to discuss his and Prof Babu's work on ICT training for women entrepreneurs in Tamil Nadu. Digital training for women micro-entrepreneurs can help overcome systemic institutional barriers to their financial inclusion and livelihoods development. They report on the benefits of a program dedicated to training women particularly in key aspects of enterprise digitalisation. Following analysis of their survey results, they discuss several methods for measuring change and provide a mapping of their results to a theory of change (TOC) model. This case study is a reminder of the value of measurable models of evaluating change towards the sustainable livelihood strategies that can lead to positive outcomes. Critical discussion of the overall strengths and weaknesses of the program for gender inclusive development and the need for a social and business environment where digital literacy can create measurable benefits. This chapter, therefore, adds to the body of work in this book pointing to the need for contextual adaptation and where necessary institutional innovation.

Chapter 6: Indo-German Cross-Cultural Collaboration: Sharing Experience and Co-creating Knowledge for Sustainable Urban Livelihoods Design, Christoph Woiwode, Lisa Schneider, Erach Bharucha, Shamita Kumar, Jenny Lay-Kumar, Avinash Madhale, Sanskriti Menon, Petra Schweizer-Ries, Peter Volz, Kranti Yardi, Ulrike Zeshanh

Wowoide and colleagues from the Indo-German Centre for Sustainability (IGCS)—a joint initiative of RWTH Aachen and IIT Madras—point to the important of joint knowledge creation for promoting Green Urban Practices. I have been fortunate during visits at RWTH Aachen and IIT Madras to interact with the IGCS and participate in two of their collaborative dialogues on urban green spaces (https://www.igcs-chennai.org/research/igd/), and know first-hand how important the joint conversation is for developing transdisciplinary knowledge and action (Hackenbroch and Woiwode 2016). In general, the authors note that transnational, cross-cultural sharing of local experiences gathered in processes of social innovation is an important factor in global learning. This can be enhanced by the co-design of the event allowing for emergence of topics relevant to the delegates and their work. Wowoide and colleagues highlight the value of co-creative dialogues for social innovation, including especially as part of a reform of higher education towards such transdisciplinary initiatives. The multi-authored chapter, reflecting contributions from multiple institutions from Germany and India reinforces this sense of dialogue and has lessons for other cross-national collaborations towards social change and impacts.

Chapter 7: Importance of Forest and Non-forest Environmental Resources to Sustainable Rural Livelihoods: Insights from a Case Study in Nepal, Bir Bahadur Khanal Chhetri, Santosh Rayamajhi and Sony Baral

During a short stint as Teaching Fellow for Australian Volunteers International (AVI) at the Institute of Forestry, Tribhuvan University (Nepal), in 2021, I met Profs Chhetri, Rayamajihi and Baral and learned of their work on community forestry and livelihoods (Chhetri et al. 2013; Yadav et al. 2020); the opportunity to include their work in this volume was a welcome way of developing our professional relationship. As the authors point out, forest-derived income is particularly important for the poor in meeting their subsistence needs, bridging seasonal gaps, providing a more diversified livelihood base and reducing and spreading risks over space and time. Building on forest-based livelihood perspectives and socio-ecological resiliency, in their survey study, they examine the importance of forest-based income for rural livelihoods. They conclude with a call for more appropriate policy and practice design to enhance the socio-ecological resilience of forest-based communities. Similar to other chapters in this book, there is a call for more appropriate and adaptive forest-related policy for sustainable livelihoods—a call that echoes across this collection.

Chapter 8: Grassroots Innovation-Based Sustainable Livelihoods: Role of Intermediaries. Anamika Dey, Anil Gupta

The honey bee network is a well-known grassroots oriented initiative developed by Professor Anil Gupta and now furthered by a team of colleagues including Anamika Dey (Dey et al. 2017). I have been fortunate to participate as a mentor in SRISTI student workshops for inclusive innovation (https://www.ss.sristi.org/mentors) as well as National Innovation Foundation (NIF) events lead by Prof. Gupta. The success of enabling grassroots innovation depends on intermediary organisations, such as honey bee but also others, in creating the networks and environments for change. In this chapter, Dey and Gupta exemplify both the challenges and the role

of intermediaries in effecting change. From the perspective of SLF, social capital is essential to enabling access to transforming structures and processes and intermediary organisations such as honey Bee help create these linkages between grassroots entrepreneurs and the organisations creating technology access to markets, often a missing element in analyses (Dorward et al. 2003).

6 Summary

For designers working in development contexts and for non-designers engaged in the research and design of policy change for sustainable livelihoods, this book is an introduction to the approaches and concerns from within and beyond design narrowly understood. The book and its authors argue throughout for attention to local contexts and knowledge in understanding and responding to livelihood design but also individually bring particular issues, e.g. intermediation, transdisciplinary dialogues, design for sustainability models and other into focus. Implicitly, the book argues for multidisciplinary teams and perspectives driven by a common aim to discover the capitals, structures and processes that might enable sustainable livelihood strategies and outcomes. In this project, expert design can play a role, but it is a subsidiary one in most cases, and premised on a disposition to learn not lead towards making meaningful change happen. Designing social innovation for sustainable livelihoods suggests that both bottom-up social innovation of products, services and capitals in general may lead to transformational change either through the effects of scale or through top-down institutional innovation, creating access to social, human, financial and other capitals. In both cases, it makes sense to talk about designing for sustainable livelihoods.

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Chapter 2
Designing Sustainable Livelihoods for Informal Markets in Dhaka

S. Rafsana Hossain, Gavin Brett Melles, and Aisling Bailey

1 Introduction

> These are entrepreneurs; treat them as such…
> they had the initiative, but they didn't have the institutions ….
> —Hernando de Soto

The complexities of managing the millions of small informal markets in the busy urban neighbourhoods of the Global South are highlighted in this quote from Hernato de Soto, the founder of the Institute for Liberty and Democracy (ILD) in Peru (Bettcher et al. 2009). Described as 'street-based self-businesses' by Swapan et al. (2017), the informal market provides easy-to-adapt job opportunities for a large number of poor migrants, who serve a significant segment of the population with affordable source of supplies, but are deprived of formal government support. As a result, street vendors engage in a variety of tactics and strategies to challenge their existing informally structured invisibility.

1.1 Defining Informality

Informality is not the complete opposite of formality, nor should it be confused with underdevelopment, illegality or poverty. The term 'informal sector' was coined based on the premise that underpins the formal–informal divide where 'formality' is historically and inextricably central to the notion of development. Despite a typical dichotomy between formality and informality, Chen (2006), Guha-Khasnobis et al. (2006) and many other authors argue that there is a context-dependent grey zone of shades of formality that offers various strategic management options.

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Inadequate understanding of informality and its interconnections has rendered many policy responses, such as regulation of licences, taxation, relocation to markets or dedicated zones unsuccessful so far to bring informal wage-earing and self-employed workers into the formal sector (Ferragut and Gomez 2013). Soto's observation as mentioned above sheds light on these nuances by raising concern about the need for institutional transformation to alleviate their predicament while highlighting the self-reliant, adaptive and innovative nature of the informal enterprises. Selloni and Corubolo (2017, p. 3017) emphasize collaborative forms of governance for such transformation to enable these 'non-experts' designer marketeers to sustain their livelihood system.

1.2 Informal Economy in Bangladesh

According to the International Labor Organization's (ILO) (2017) report, the informal economy in Bangladesh occupies 94.7% of total non-agricultural livelihoods where street vendors, in particular, are deeply embedded in the age-old socio-cultural fabric of Dhaka city (Etzold 2013; Hummel 2017). The city has already expanded 'beyond its administration boundaries' while lacking the financial or jurisdictional capacity to provide the necessary support to all inhabitants (Hasam et al. 2017, p. 159). As Davis (2007) found, it is challenging to manage the oversupply of workers in the informal sector and reduce poverty where social order is at stake. Consequently, the country lacks specific policy or legislation on informal markets that acknowledges their distinctive characteristics and prospects. The recent Five-Year Plan (General Economics Division 2020) acknowledges micro- and small enterprises (MSEs) as the backbone of non-agricultural jobs and includes a skill development programme through registration of both the formal economy and informal economy by 2022. However, it does not particularly address informal markets, despite their wide influence within the urban community. In addition, the plan lacks adequate provision for social protection, inclusion and sustainability of the informal sector which is often more important due to their vulnerability.

1.3 Street Vendors in Particular

Street food vending is addressed in the Five-Year Plan, but regarded as 'a serious health hazard threat' (General Economics Division 2020, p. 732). The vendors' work on the street is thus considered as a nuisance and 'illegal' due to an inadequate and inflexible legislative and policy framework (see Lata 2020). Consequently, the policy framework does not yet consider the sustainability of this livelihood sector because of its characterization as 'low productive' and chaotic and disregard of the livelihood significance of context-specific networks and

interconnections (Chen 2006; Guha-Khasnobis et al. 2006; Khandan 2017; Ohnsorge and Yu 2020).

Street vendors in Dhaka are constantly threatened by harassment, undervaluation of goods, eviction or displacement and the micro-politics of extortion make them one of the vulnerable groups of the city (Etzold 2014; Hussain 2019). This vulnerability is exacerbated by sudden natural or man-made hazards as their income is daily based and most of their financial assets are inadequate to sustain them without work. While there are myriad studies about the socio-economic–political challenges the informal markets in Dhaka face, we know less about how they confront these challenges in the long run and how they respond to sudden risks.

After the first strike of COVID-19 in early 2020, street vendors were particularly affected by 'social distancing' regulations in Dhaka, many suddenly lost their daily income and were forced to return to their rural villages (Irani 2020; Ohnsorge and Yu 2020; Rocky 2020). Vendors who were unable to find alternate forms of income in the city or in their villages, notably food vendors, leveraged their mobile character to deliver food and goods to people's doorsteps. This adaptive approach enabled them to survive, and moreover, aided the local community that struggled to visit local marketplaces due to pandemic restrictions. This may suggest that being adaptive and informal may reflect attributes of value for achieving sustainability. Studies analysing the nature of informal markets in the context of responding to sudden shocks and overall sustainability are quite limited. Despite very limited NGO actions (e.g. CARE) on the governance and policy reform to preserve the right and power of the marginalized groups and reduce their vulnerability (Sandarson 2012), no visible actions have been taken so far to achieve their sustainable livelihood (SL).

1.4 Study Proposal

In this chapter, we argue that informal markets are underpinned by a multidimensional social and environmental intertwinement and can be used to achieve positive livelihood outcomes if the relevant community is engaged in wider policy and institutional design of processes. We have adopted the sustainable livelihood framework (SLF) (see Fig. 1) as a structure for coherent analysis of livelihoods, risk, vulnerability and poverty, a framework keeping people at the centre of development and highlighting their capabilities (DFID 1999). Given the 'natural' innovation capabilities of the vendors, as previously noted, socially responsible design (SRD) can be used to actively visualize preferred transformation of livelihood processes (Melles et al. 2011; Kumar et al. 2016) such as policies and institutions with a critical understanding of preferences and life circumstances of marginalized people (Gutiérrez and Jurow 2016; Jagtap 2021).

In short, SLF is the framework which reveals the institutional re-design through SRD required for livelihood sustainability. However, there is a dearth of studies on SRD in terms of its application within the SLF (but see Melles 2019), where this chapter aims to contribute. Here, we have emphasized collective and participatory

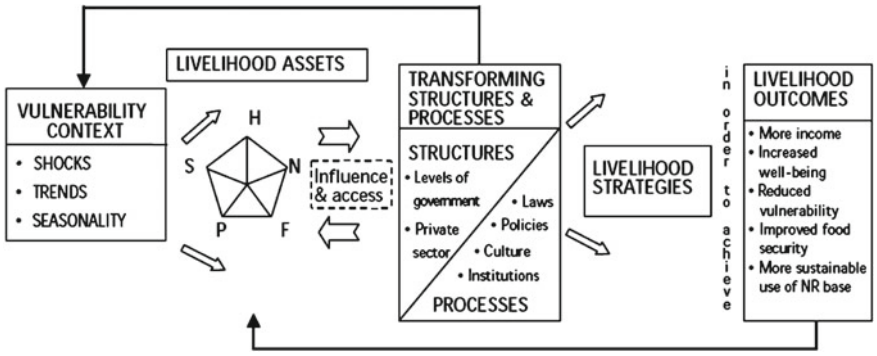

Fig. 1 DFID sustainable livelihoods framework (adopted from DFID 1999)

actions for institutional change on the basis of Ostrom (1990) and her work on design principles for global commons as applied to this local setting (see Stern 2011). Thus, we see such principles as the source of socially responsible re-design for sustainable livelihoods. The chapter is based on an ethnographic study of street vendors around Dhaka city that demonstrates both their barriers as well as their potential nature and connections in terms of designing SL.

2 Design of Livelihood Process

2.1 Sustainable Livelihood Framework (SLF) of Street Vendors

The survival strategies of the street vendors are largely dependent on their connection to the local community (Lyons and Snoxell 2005a; Rahman and Junayed 2017), political bodies (Jakimow 2013; Lata et al. 2019) and their physical environment (Israt and Adam 2019). These are significantly impacted by eviction and relocation as a consequence of formalization policies. Although, in Bangladesh, formalization is often described as a form of empowerment by the Bangladesh Hawkers' Association (BHA) (Prothom-Alo 2017) and international organizations such as the World Bank, the United Nations and the ILO (Lund 2003; ILO 2019) studies show that most often it does not consider social aspects such as social protection and sustainability. Studies such as Adaawen and Jørgensen (2012) and Gandolfo (2013) also demonstrate that the key bureaucratic interest here is the recovery of public space as the vendors are seen as 'disruptions' to regular pedestrian traffic rather than including them into a formal regulatory environment. In such a context, authors like Chen

(2006) and Guha-Khasnobis et al. (2006) emphasized on the necessity of appropriate policy framework that acknowledge the socio-political–economic interactions and capitals of the vendors to assist them in minimizing their vulnerabilities through self-organization and collective actions. SLF can serve the purpose while addressing livelihood strategies for sustainable outcomes.

This framework is useful not only for identifying vulnerabilities, but also proposing changes that would allow street vendors to earn a livelihood through an 'economically, environmentally and socially sustainable' process (DFID 1999; Begum and Mohiuddin 2018). The large urban population who are involved in informal markets have their own mechanisms for survival; their own capital and informal institutions as raised by multiple scholars (e.g. Lyons and Snoxell 2005b; Jakimow 2013; Rahman and Junayed 2017; Begum and Moinuddin 2018). The focal point of this framework is the capital asset that is made up of a 'stock' that offers a 'flow' of products or services that individuals may utilize to help them accomplish their goals and aspirations. Within the five types of capitals (see Fig. 1), social capital is developed by social interpersonal networks, norms and trust, collective action and shared expectations (Putnam, 2001) . However, Lyons and Snoxell (2005b) emphasize particularly family-based ties and marketplace-based wider networks (i.e. savings groups, welfare association, etc.) in case of informal markets. Other authors such as Husain et al. (2015), Mondal (2017) and Begum and Moinuddin (2018) stress on the influence of social capital over the overall capital available to the vendors by affecting the financial and human capital. Because, the more surplus income they make per day, the more they can contribute to financial capital, and the more opportunity they get to educate their children and improve their lifestyle for increasing human capital. The establishment of these social networks is also dependent on the particular public spaces or neighbourhoods the street vendors work in over a longer period of time (Lyons and Snoxell 2005b). This is also the reason why vendors frequently return after relocation. The studies mentioned above do not clearly state any pragmatic considerations to ensure consistent access to the capitals.

In some regions, for example, in Mexico city, street vendors attempt to achieve a greater degree of certainty over this physical asset through collective negotiation and resistance (Pena 1999). Jakimow (2013) identifies power asymmetry and corruption as the key drivers in many jurisdictions which influence the whole process of such informal negotiation, building certain norms and strategies to protect their existence from eviction. In such a way, these drivers can act as 'informal institutions' according to the definition given by Ostrom and Polski (1999). Etzold (2014) and Lata et al. (2019) highlight the politics of coercion as more prominent in the context of Dhaka than any collective action where local politicians guide government initiatives based on their own interests rather than formal policy. Thus, the 'legality' and 'illegality' of the subsistence of the street vendors are determined by the municipality in an inconsistent manner (Keck 2012). There is a limitation within the SLF in terms of addressing underlying power and interaction patterns that influence the livelihood strategies. As this analytic framework is generally applied, it often lacks consideration of the actual nature and needs of marginalized people as well (Lyons and

Snoxell 2005a, b) which is crucial to predict the impact of the institutional transformations. Most of the studies acknowledging the SLF towards informal markets are either legalistic (focusing on law and regulation) or structuralist (focusing on equity and justice) while there is still a gap of identifying scope for more inclusive strategies to overcome the everyday challenges and sudden shocks. This is where Ostrom's (1990) design principles for resilient socio-ecological systems including: rule congruent with conditions, user participation in rule making, graduated sanctions, low interference from external authorities and other principles help achieve SLF change as a form of designed policy and practice change (Stern 2011).

In this chapter, by 'achieving sustainable livelihood (SL)' we refer to developing strategies for increasing the access to livelihood capitals, particularly social and financial capital and building capacity to utilize those collectively to reduce regular vulnerabilities to sudden shocks. Even though SL methods emphasize the need for structural and process change, they may not be successful in facilitating that change. However, meaningful principles for transformation and resilient outcomes do exist and we consider these below. We will now proceed to discuss how design thinking can be effective for such interventions.

2.2 Socially Responsible Design and Ostrom's Philosophy

'Design Thinking' often embraces a user-centric participatory approach that satisfies user needs through innovation with an emphasis on 'empathy and observation' according to Brown (2008). Hall and Vredenburg (2003), Röschenthaler and Schulz (2016) and Nyamnjoh (2020) argue that the nature of adapting to risk and uncertainties regarding their access to various forms of capital, responding quickly to new opportunities and working with a wide range of stakeholders, pushes street entrepreneurs toward social innovations. In fact, researchers (e.g. Melles et al. 2011; Meroni and Manzini 2012) are now looking at the role and possibilities of design in bringing social innovation to reality, i.e. offering 'new ideas that work in meeting societal goals' (Mulgan 2006) in a long-term approach. In support to this argument, Ruzek (2015) states that the vendors have the capacity to dramatically adapt to the changing needs of the community as a means of their survivalist endeavour. These adaptive innovations, according to Selloni & Corubolo (2017) can shape their relationships and roles to improve access to forms of capital and support mutual negotiations for a design-driven approach.

Socially responsible design (SRD) is thus an approach that can reconsider the roles of informal markets to promote policy and institutional change through their adaptive and innovative nature. It can act here for mediation between 'non-expert' local knowledge and professional skill (Selloni and Corubolo 2017), between informal institutions and formal policies. In the case of policy design, Meroni and Manzini (2012) argue that through a bottom-up and human-centred approach, SRD approaches such as co-design can reduce the gap between marginalized individuals and the administrative bodies, help them to re-build their social ties and to reinforce the capacity

to solve issues though a nested governance system. However, due to certain socio-political barriers mentioned earlier, the capacity of street vendors to self-organize and collaborate with authorities is limited. To address this challenge, our study is informed by design principles reflected in the work of Elinor Ostrom and her fellow researchers that have influenced research on governing collective actions.

Ostrom's (1990, 1992) research established eight design principles (see Table 1) to govern collective actions in managing natural (e.g. river, canals, forests) or human-made (e.g. land and infrastructure) common pool resources (CPR). Her ideas concentrated on mostly interconnected groups where their identity and boundaries were defined (P1). Here, the governance framework for communities to manage a CPR is built on social management/monitoring and social sanctions for these groups (P4 and P5). As an outcome, norms of user collaboration should be created or amended by people who will be entrusted with both the obligation to comply and the responsibility to execute them (P3). Since these norms would be developed by the same community of users who would utilize them, some leeway for adaptation to local needs and situations would be required (P2). These institutions and norms would be recognized by a higher authority to ensure communities' right to self-govern the asset (P7). Ostrom also understood that for more complex resources, this governance role or power should be shared with other players, resulting in nested enterprises (P8). Despite the above mentioned, she anticipated that conflicts would emerge because even the most unified communities will have internal divisions, necessitating the employment of accessible, low-cost methods to resolve their own problems (P6).

If the contested streets and other public spaces occupied by the vendors are regarded as the human-made CPR and both informal and formal markets as well as the communities are considered 'appropriators' (users), Ostrom's principles have a wide application in promoting collective governance of the informal markets (Stern 2011). However, as these markets are a complex system associated with economic and political challenges, her theory may need major adaptation for such an informal context. Although there are significant potential applications of Ostrom's theory, some concerned with SLF as well, a focus on informal markets is rare. This chapter contributes to exploring this area.

Table 1 Design principles of collective actions (Ostrom 1992)

No.	Design principle
P1	Clearly defined boundaries
P2	Rules governing the use of collective goods compatible with local needs and conditions
P3	Collective choice arrangements
P4	Monitoring
P5	Graduated sanctions
P6	Conflict resolution mechanisms
P7	Minimal recognition of rights to organize
P8	Nested governance for larger groups

3 Research Methodology

3.1 Method Considerations

Street vendors in Dhaka city were chosen as a focus group to do in-situ observation of their daily life, offering the opportunity to identify and analyse unexpected challenges they face not typically explored. To better understand existing barriers faced by vendors and to consider how their inherent nature can be beneficial for designing SL, an ethnographic methodological approach was well suited as it provides critical understanding of the socio-cultural context of the group under focus (Hammersley and Atkinson 2019). Many anthropologists, sociologists and design researchers are employing ethnographic techniques to understand the organization and processes of design and how they shape everyday experiences (Costall and Dreier 2006; Henare et al. 2007; Ingram et al. 2007). This approach was chosen given its potential for critical engagement of the researcher with the target group while merging their appearance within them (see (Madden 2020). The key benefit of ethnography is that it represents not only what people say about their lives, but also adds critical insights of what they do, how they interact with people, institutions and with authority (Grills 1998). In this case, ethnography provided the methodological, and theoretical resources needed to question prevailing justifications for designing SL for informal markets while SLF is used for framing data collection themes and analysing exiting efforts to reduce vulnerabilities (DFID 1999).

3.1.1 Role of the Corresponding Author

Ethnography stresses the researcher's active involvement in the research process, which necessitates an ongoing process of reflection on the decisions and interpretations made. As the lead researcher, this study allowed me to explore a social phenomenon in my home country, using my mother tongue (Bangla?), in an urban context quite familiar to me due to working here for several years. I felt that I would not have to be overly concerned with otherwise common issues, such as understanding or even gaining access to the specific culture and the specific context. However, it should be acknowledged that this local position may provide me with a biased understanding of the context experienced by street vendors. Therefore, in this study I adopted Agafonoff's (2006) framework that combines both non-participant observation and participant observation to observe social phenomena from outside and inside. In the two phased fieldwork process, as a non-participant observer leading eight undergraduate urban design students, we sought to first engage in casual conversations with vendors to build up primary acquaintance and identify respondents who could participate actively in informal interviews. In the later phase, with a broader perspective of the daily lifestyle of the vendors, I actively participated in informal interview sessions as a participant observer to develop further critical understanding (Fig. 2).

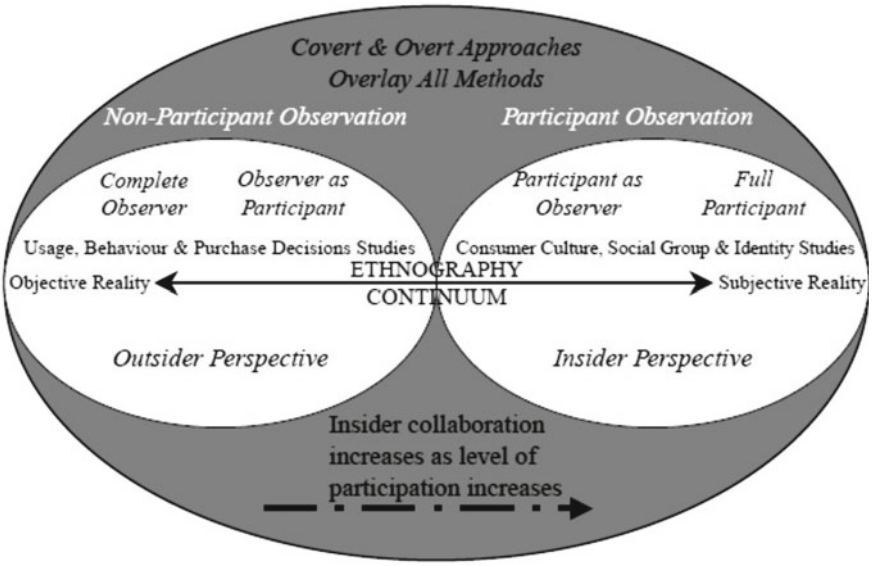

Fig. 2 Multidimensional ethnographic framework (Agafonoff 2006)

In this chapter, I have not only written about what I achieved from the interviews, but to some extent this has been informed by my own experiences as well (see Denshire 2014). From my personal experience, I had clear idea about the locations of vending, the general characteristics and types of vendors. From the literature review, I developed a broad understanding of their access to various forms of capital and institutions, and the ethnographic study helped me critically understand how these aspects work together in context. I have sought to critically reflect on the influence of my own position, maintaining an openness to the possibility of multiple interpretations best characterizing the experiences of vendors.

3.1.2 Study Area and Target Group Selection

This ethnographic study largely focused on the existing forms of capital street vendors accessed from the socio-political–physical-economic intertwinement and the informal institutions that underpin the system. To serve this purpose, the study areas were concentrated alongside the Mirpur road in Dhaka (see Fig. 3) which is significant as it connects Dhaka's mostly populated areas, from Mirpur to Dhanmondi and contains vendor hotspots. Informal markets experience different degrees of regulatory controls (Chen and Beard 2018). In this study, a focus was placed on mobile street vendors operating beyond any form of regulatory framework due to having no stable location to operate from. Mobile vendors are more frequently threatened by harassment and eviction and thus find it more challenging to develop

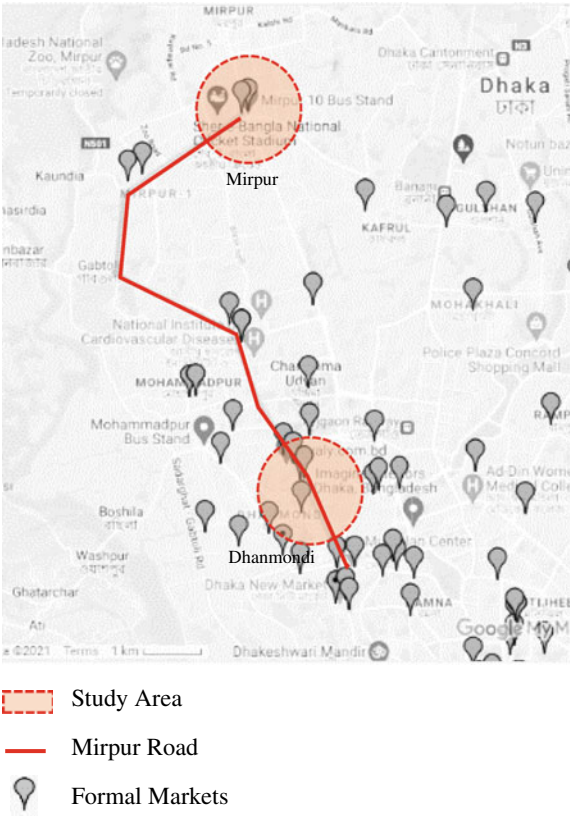

Fig. 3 Study area and formal marketplaces around Dhaka (Google Map 2021)

collective action. Mobile vendors constantly change positions from pedestrian walkways running alongside formal markets, public spaces such as parks, public building premises and often in neighbourhood streets. However, it is important to note that mobile vendors are limited to particular locations due to the influence of their informal ties with individuals and institutions.

3.2 Data Collection

3.2.1 Phase 1

The study was conducted in two phases. In first phase, as a non-participant observer, I collected data in two ways: first from my personal experience during the years I had worked in Dhaka (2013–2021), and secondly, from a series of conversations with 25 street vendors conducted by a group over the course of a month. Having limited experiences of formal analysis yet more trustworthy communication with the vendors due

to being part of their local community as regular customers, it was possible for the students to receive comparatively unbiased narratives from the vendors. To prevent internal perspective bias, I observed the daily life and work patterns with the ethnographic 'gaze' (Madden 2020) as a distant observer. I took photographs, fieldnotes and did some mind-mapping in this stage to have an overall picture of the practical context. From this stage, the following themes emerged: (a) work motivations and aspirations (b) socio-economic vulnerabilities and daily challenges (c) innovative and adaptive survival strategies. Data were analysed through applying SLF, identifying vulnerabilities, capitals and institutions. Thirteen vendors who showed a higher level of interest and engagement with the research were selected to be a part of a further informal interview session.

3.2.2 Phase 2

In the second phase, I combined the data from the non-participant observations with another month of intense field study as a participant observer, informally interviewing 13 respondents' at least twice. Observation of vendors' practices took place across the course of a day, and over many days, talking to them about their needs, aspirations and challenges, recording their narratives. The narratives were later translated into English, coded according to opportunities and barriers and later analysed their relationships with (a) the community, (b) local politicians and administrative bodies (c) informal unions (d) NGOs and financial organizations (i.e. bank, microfinance etc.) and (e) formal markets in terms of Ostrom's design philosophy for collaboration.

4 Findings: The Overall Picture

This picture (Fig. 4) may be, for some, simply an image of chaotic underdevelopment, but it is much more one of entrepreneurial flexibility, adaptation and innovation. The picture was taken during the 2020 pandemic, when the vegetable vendors from local markets came to people's doorsteps. It may appear as street disturbance to many, but in reality, these mobile vendors occupied these spaces only temporarily making the streets congestion-free most of the time while providing goods and supplies to a large number of urban low to middle income residents.

As the lead researcher, one of my early assumptions of street vendors was frequent occupation changes due to their vulnerability and exclusion from Government support in general. However, this study revealed that despite regular harassment, extortion from local political bodies, police officers, guards and others, around 90% of the vendors we talked to were running their enterprises for several years and are not very interested in finding alternative livelihood options. They consistently perform this role for a variety of reasons including financial necessity, a lack of educational and skill support to enter the formal job sector, an ancestral job they have familiarity

with and also because of the entrepreneurial nature of this livelihood which many consider capable of generating 'enough' resources for their daily living requirements.

This is one of the significant narratives that offered me the opportunity to observe the daily struggles and aspirations of the vendors from a different perspective:

> During early lockdown (during pandemic in 2020), I went to my village, worked hard in others' agricultural land and my income was almost double than I do now. Yet I came back here, because this is what I used to do for years to serve my family…. I do not have to pay any bribe to anybody, because here, I decide who will stay in this area.
>
> —Mr. Khaleq, 60, snacks seller (fieldnote from February 2021) (Fig. 5)

People like Mr. Khaleq had spent a larger portion of their life in street vending, with the aim of raising and educating their children to a tertiary level. Many with significant experience eventually take the lead in informal area-specific unions, where they

Fig. 4 Mobile vegetable vendors in neighborhood roads (captured by corresponding author during 2020 pandemic)

Fig. 5 Mr. Khaleq, an age-old experienced mobile food vendor in Dhanmondi Lake area (captured by the corresponding author during survey)

act as a mediator between local politicians and the vendors, arrange weekly payment for local-level political leaders, manage conflict among this group, and support new migrants in vendor roles. Others, particularly the newcomers to informal employment, are the most marginalized group and face more challenges not due to inadequate experience, but due to a lack of strong relationships with the vendor community and local politicians. Besides these two groups: the leader and the newcomer, there is a transitional group of vendors whose involvement typically spans between 10 and 30 years. For the purpose of this chapter, our findings are organized around two key dimensions: the underlying barriers resultant from their vulnerabilities, and the other is the potential for the vendors to actively participate in designing sustainable livelihoods. The outcome is represented here in terms of SLF components (capital, structures, institutions and livelihood strategies).

4.1 Key Barriers

4.1.1 Barriers to Access the Financial and Human Capital

The key reason behind the vulnerability of street vendors are their limited access to financial assets. Conversations revealed insight for why most of them cannot

not overcome this vulnerability. All of the respondents we interviewed were rural migrants who came to Dhaka for three key interrelated reasons: (a) losing their agricultural lands due to natural calamities or debt (b) to pay a significant debt and (c) having an insufficient level of customers to run small enterprises in their villages—each relating to a lack of access to financial capital. Interestingly, the work they perform in Dhaka may seem sufficient for daily living from their perspective, but in most cases, they cannot save much to survive for very long if they lose their work due to illness or any kind of government restrictions. Additionally, as their income varies frequently due to changed circumstances, it is challenging for them to plan for the future. As consequence, I found almost all of the respondents had taken out loans of up to five lacs BDT, and more than once in their lifetime for diverse reasons. They mostly manage these loans through their social connections and 'somiti'(union), with a few obtained from local banks. Among the 13 respondents I talked to, seven said they would have to take out a loan if they wished to educate their children, upgrade their business or treat significant illness.

However, the informal sources for taking financial assistance are inconsistent because these sources also do not have constant flow of wealth. So far, they do not get any fixed amount from government or non-government organizations either. Although there are existing banking services for the poor such as microfinance from the Grameen bank, I found only three vendors who took support from these local banks. In response to why street vendors prefer their informal sources over the banks, one of the vendors said that 'It takes a lot of paperwork, time and much stress to take bank loans….'. In our observation, a key reason may be the easier access to loans from their social network and a knowledge gap of formal banking mechanisms. It is also interesting to note that such assistance often operates as a form of maintaining informal connections with small industries that allow them to borrow food and other goods required for their enterprises and not necessarily money.

Like other urban poor, street vendors also rely on their spouse or children to increase family income. There were four respondents who told us that their children were going to university for a better career, facilitating higher social status for the next generation. However, the grown-up children of other respondents joined their ancestral profession to contribute to family income before completing their schooling. Five of the respondents said they had a second earning member in the family, which was typically either their spouse or eldest son, with some supporting their business or undertaking other informal labour. However, around 60% of the vendors we interviewed cannot afford to keep their families in the city, given their status as the only earning member of families with five to seven members. They either keep their families in the villages or engage their children into work to enhance their human capital.

4.1.2 Dependence Over Formal Counterparts

Our observations found a direct social and commercial connection between informal markets and their formal counterparts, that is also supported by authors including

Chen (2006), Guha-Khasnobis et al. (2006) and Dovey (2012). This connection is informed by their shared objectives and is characterized by mutual support which at the same time can be a barrier and opportunity for those within informal markets. The formal markets allow street vendors to operate in close proximity to their premises, while some small industries supply the additional portion of their daily production to the vendors. Street vendors who usually sell similar goods to their formal counterparts were seen to choose their premises, sometimes in exchange for a small 'rent' as the location attracts more customers. Simultaneously, this makes the many street vendors largely dependent on formal markets. When there is a competing situation, the informal vendors' existence can be threatened by their formal counterparts. In both ways, the formal markets have visible influence over the informal markets, making them act as a potential structure of the informal livelihood system.

4.1.3 NGOs Interventions

NGOs could be a potential structure by motivating and advocating the vendors for collective actions and strengthening their voice towards 'formalization' approaches and act as a mediator between government and the informal sector as we have seen in many cases in many neighbouring countries (Chen and Beard 2018; Parris et al. 2018). In contrast to a very limited intervention on SL initiatives by CARE (2021) which are more focused on rural sector and research activities on identifying vulnerabilities by BRAC (Ahmed et al. 2011), this study did not find any visible interventions improving the conditions of the street vendors. A perspective shared by one of the street vendors in this study highlights the cynicism felt towards such interventions:

> they (NGOs) come for money. All they work is to support the elites who fund them.

Although this narrative may not represent the vendors' overall perspectives, it does highlight trust issues on which NGOs may need to focus if they are to engage street vendors in any type of collaborative development activities. During an emergency, the vendors depend more on their internal unions and local community with whom they have stronger relationships rather than taking support from the NGOs as they regard them as outsiders.

4.1.4 Micro-politics as a Negative Institution

A common phenomenon our empirical study found is the micro-politics of extortion experienced by street vendors, previously identified by academic scholars (e.g. Jakimow 2013; Etzold 2013; Lata et al. 2019). It has been a frequent power practice by local politicians and administrative bodies (i.e. police, security guards, etc.) due to their economic interest and influence over street vendors who feel obliged to provide 'fees' in order to protect their position in public spaces. However, with a change to strategic actions or policy decisions, such a form of 'social protection' proves

unsustainable long-term. This is quite evident in vendors' narratives as illustrated here:

> We had to remain alert and on run, due to several eviction action almost every day. However, we have already managed our own way (mutual negotiation with local politicians) to avoid this harassment and in fact, we have become habituated to this……
>
> —Mr. Amin, 31, Vegetable seller

The underlying reason for extortion that we identified is the weakness of the administrative and policy structures for informal street vendors due to their unauthorized occupation of public space and the desire of local politicians and members of administrative bodies to exploit this weakness for personal gain. Street vendors provide a weekly payment to secure their places while that informal agreement is frequently disrupted by political instability and improper law enforcement. The majority of respondents claimed that they must continue fleeing in order to escape being beaten by the police. Micro-politics act as a stronger institution than formal policy creating barriers to potential policy implementation. According to Morange (2015), in such cases, There is a legal grey area, often maintained purposively, underpinning inconsistent law enforcement, usually due to unethical power practices by local politicians and larger industries. Due to this fact, street vendors are frequently forced to move away from their regular network that otherwise supports their livelihood assets. However, according to the vendors, those who are either in a leadership position of their informal unions or simply have stronger relationships within their socio-political network due to being several years in this profession, can avoid providing fees to secure their places as evident in the narrative of Mr. Khaleq mentioned earlier.

4.2 Key Potential

4.2.1 Social Capital and Informal Institutions

From our conversations with the vendors, it is evident that their key survival strategy is to rely on their social and commercial networks to run their enterprises and collective activities. This network, which is built up with trust and norms, becomes essential and effective for their ability to earn in the urban area where they have forms of capital. The area-specific vendor unions are stronger in urban contexts as vendors gain financial and moral support and to some extent a kind of security from this group through a negotiation with local politicians. In this sense, these unions informally govern the activities of the vendors through a set of shared norms and values that resonate with Polski and Ostrom's (1999) definition of informal institution. Although these unions do not hold sufficient power to promote wider collective action for their right and justice can still serve as a potential institution for SL by acting as mediator between the vendors and the local municipalities and NGOs, as well as motivating the vendors in participating in collective governance.

Social capital and informal institutions offered street vendors a level of confidence about their most fundamental needs being met without significant hardship prior to the COVID-19 pandemic. During the pandemic, as their daily work was drastically limited over a long period of time, existing social support street vendors typically draw upon was insufficient in meeting their needs., Additionally, the unavailability of institutional support for street vendors remains, leaving them vulnerable to potential future challenges. To gain an overarching understanding of their challenges and aspirations, the street vendors were asked about their plan to upgrade their enterprises to reduce their socio-economic vulnerabilities. Surprisingly, all of them agreed not to change their work pattern or working territory to enter the formalized market for securing permanency as a way of upgradation. For example, Mr. Siddique, a snack seller in Dhanmondi stated that he does not want to get a permanent location because it may restrict his flexibility and freedom of work:

> I do not want to do any other job because this gives me freedom and flexibility. Here, I manage my own business and I don't have to ask anybody if I need break due to sickness.
>
> —Mr. Siddique, 45, Snack seller

This is due to their independent and entrepreneurial mindset, which is a manifestation of their informality. During this conversation, two of the local community members joined Mr. Siddique and contributed to his story within that particular neighbourhood over the last 20 years. It indicates how strong their social connections are, which apparently underpin their daily income. It also reflects how that particular neighbourhood is important for maintaining these connections and how being self-employed and mobile provides them with the opportunity to survive despite such barriers. One of the key reasons why relocation or other formalization strategies initiated by the government are not much appreciated by street vendors is the lack of trust and collaboration they have with government, unlike the relationship they have with those in their informal networks.

There is a mismatch between the demand of BSA (see Daily Prothom Alo 2017) and the preferences of marginal street vendors. While the street vendors embrace their impermanent and flexible patterns, their representatives somewhat agree with the government's strategy of rehabilitation and taxation. This led us to an important insight that even though the vendors are strongly connected to area-based unions and their local communities there is a gap when it comes to the larger union like BSA. Given this, the small-scale, area-specific collective action could be more effective where union leaders could assist in developing their own norms and regulations, rather than having others impose a central policy or act over them.

4.2.2 Innovation and Adaptation as Livelihood Strategies

Strategic innovation is a key practice for poor urban migrants to negotiate and maneuver their economic activities (Nyamnjoh 2020). Likewise, street vendors have their own strategies to sustain their enterprises and grow within the urban structures. The strategies are either economic (changing selling patterns or items) or physical

(multi-use of spaces and their carts). One of the key examples is the 'door-to-door' service by the mobile food vendors during the COVID-19 pandemic as discussed earlier. The streets got crowded for a while due to their operation, but as the vendors kept changing their positions, it did not create long-term congestion. However, when this initiative became widespread, congestion became an issue to solve strategically. We also found a handful of vendors selling emergency equipment such as masks, face shields andsanitizers in a side business due to changing demand. The act may not be safe and legitimate, but it does represent how they adapt to changing circumstances. The story of Mr. Farid, a snack seller in Dhanmondi lake area, is another example of how street vendors innovate:

> I came here (in Dhaka) after losing our house in '98's flood…. I tried many things from rickshaw pulling to day laborer and finally after five years of struggle, I started my own enterprise. I found the cheapest option is to sell 'muri makha' (a local snack) as the indigents were available at my house. The income was poor, so I changed the food item to a more popular one. I go to school premises during the class starting and closing hours, go to the park when people usually gather there in the afternoon…… I do not earn much to save something, but somehow manage to reduce my expenses… I do not have to pay rent where I am living for last five to seven years, because my wife works as a caretaker of that house…. I do not have a shop or even a cart, which is helpful to flee quickly (from being charged weekly) ….

People like Farid keep adapting to new strategies to earn for their living which can be innovative but not sustainable. When Mr. Farid was asked how he would plan to survive if his wife loses her caretaker job or someone becomes ill, he had no answer. Overall, our observations found that although street vendors have financial barriers, they can reinvent and reposition their business to adapt to significant changes in order to survive, yet such changes are not sufficient for long term security or resolution. There is significant capacity for designers to contribute by integrating specialized knowledge with their inherent skills.

5 Discussion and Conclusion

In this chapter, the relevance of formal-informal intertwinements and the necessity for policy change are addressed through an SL perspective. The study for this chapter explored the life stories of street vendors at different stages of their working life and revealed that while they have strong informal ties with their local unions and the community while they have a substantial gap in their relationship with the formal organizations (e.g. local government, NGOs, banks etc.) due to power asymmetries and lack of trust. It can create a potential barrier to any collaborative governance approach to improve their condition. The outlined barriers to financial and human capital indicate towards a greater problem: a lack of social protection within this community. The government evicts street vendors without understanding their needs, connections and employment patterns. The existing social security benefits (e.g. social insurance, provident fund, gratuity, pension) are still out of reach of

the street vendors given their illegal operating status. Many vendors stated that government emergency assistance is also quite limited and not fairly distributed. For instance, as Mr. Ali, 45, a vegetable seller from Rayer Bazar, Dhanmondi state about the pandemic:

> We spent days starving as both of us husband and wife do this business which was closed during lockdown. We did not have enough money to feed ourselves without coming to work…. Could not arrange loan as everyone was in similar position, did not get any official support either.

Therefore, even though the vendors try to keep political connections as a form of social security, they simultaneously do not trust local governmental and political bodies. Micro-politics due to the imbalance of power in relationships widens the gap and persists as a pseudo-institution that controls vendors' extent of work while benefiting other specific groups. As a consequence, while many nations within Asia are acknowledging the contribution of informal markets and promoting social protection schemes such as the Vendors Protection Act in India, job creation programmes in Nepal, and a range of relief and subsidies in Pakistan and Sri Lanka (ADB 2016), in Bangladesh particularly, a fair distribution of these benefits is still challenging. Therefore, any policy reform must address these pseudo institutions to gain SL outcomes.

5.1 Employing CPR Design Principles for Change

These complexities raise an important questions about how to enable collaboration between the government and the informal markets which led us to adopt Ostrom's design principle for informal markets. However, to merge those principles within this complex system, a number of issues need attentions as well. First, the design process of 'commoning' that refers to shared use of CPR involves collaboration of all stakeholders including the local governments which can be difficult if the significance of the problem is not understood by them. Ostrom herself agreed that an effective mode of communication is needed to build up trustworthy relationships among the stakeholders. Second, any attempt to introduce the commons in an urban context must deal with the city's legislation and politics. Thus, co-occupation of public spaces most often requires amendment of public and private property regulation and engaging the local government administrative branches to facilitate that. Constructing the commons necessitates institutional and property innovation. Third, in developing context where the government is often dominated by the market due to asset constraints or corruption, it struggles to act as an enabler of nested governance. In such cases, if adequate legal institutions and participatory mechanisms are in order, and urban space occupiers have sufficient social and political capital to negotiate with market participants, the formal market can act as a strong social structure. All these complexities mentioned above require a critical analysis of existing informal ties and institutions of the street vendors to determine the potential and

barriers of their livelihood system in terms of collaborative design. Yet some principles can be directly implied in this case, For example, defining the boundary by promoting collective actions in different scales; city, district or neighbourhood—can act as the 'boundary' of Ostrom's (1990) first principle. Besides, the recognition by higher authorities (principle 7), the importance of nestedness (principles 8) and the arrangements of collective governance (principle 3) can be explicitly adapted into it.

With consideration of the critical literature review and ethnographic study, we came up with six principles of design for sustainable livelihoods. While several of these design principles are consistent with Ostrom's, others have been tailored to the informal markets and the practicalities of achieving sustainable livelihoods.

- **Acknowledgements the informal-formal intertwinement**: One of the initial assumptions of our study was the misinterpretation of the informal–formal dichotomy behind reluctant bureaucratic attitudes, ignoring the strong interdependence they have as discussed in this chapter. Therefore, the first principle of design needs to acknowledge the formal–informal intertwinements. In fact where market acts are stronger than government interventions, formal markets could support informal markets through an equitable share of benefits (Chen 2006).
- **Institutional analysis and Innovation**: Although institutions are ubiquitous in governing everyday lives in fundamental ways, policy development has often overlooked the importance of institutions on political economic behaviour until recently. Government can promote small-scale adaptive strategies and capacity building programmes for the vendors rather than adopting a conventional 'legalization' process. Existing institutions such as area-specific vendor unions with whom they have trustworthy relationships, can be a key point of action and serve as a mediator between the marginalized informal vendors and formal agencies to promote more trustworthy and equitable relationships.
- **Small-scale Commoning**: As we see in our study, there is a significant communication and knowledge gap with higher authorities (i.e. central government) and larger organizations (i.e. BSA), which suggests that small-scale union-level collaboration within the vendors may work more effectively to conduct SRD. If any collective design approach is conducted at a smaller neighbourhood level and divided into multiple zones according to their existing territory of work, they can have the opportunity to choose strategies suitable to them as well as addressing government's strategic vision.
- **Nested governance**: The inclusion of an adaptable and nonlinear approach to designing the legal processes and structures that regulate urban commons is referred to as nested governance, as identified in Ostrom's eighth principle. In the presence of such a multi-stakeholder governance structure, power asymmetries could be reduced effectively. In such cases, the user group, the vendors in this stance, can be an active stakeholder collaborating with others.
- **Social Capital-focused Adaptative Strategies**: As found in this study, social capital is the key asset helping those within informal markets tackle their vulnerabilities. Design needs to be focused on increasing access and the capacity of this form of capital. In line with Ostrom's second principle, what is ultimately needed

is policy or institutional transformation that is flexible and adaptive (Swanson and Bhadwal 2009) that accommodates informal processes and enhances the capacity of vulnerable people to sustain their livelihoods.

- **Enabling Government**: Overall, local governments need to act as the key enabler in facilitating the creation of urban commons and supporting collective action arrangements for the management and sustainability of the urban commons.

When policy-makers are unable to understand a problem or identify its root causes, or when they take decisions and assess alternatives based on random assumptions, decisions can be highly unpredictable and 'irrational' without careful deliberation and analysis (Cohen et al. 1979; Dryzek 1983; Kingdon 1984; Eijlander 2005; Franchino and Hoyland 2009). For example, the recent declarations by the Dhaka North City Corporations to give licences to the street vendors (Daily Prothom Alo 2021) cannot escape controversy for two reasons. Firstly, again it comes to corruption that can cause extra burden of cost to the vendors in the name of 'legalization'. The government needs to identify these before taking decisions about any kind of formalization approach. Secondly, we have already seen that marginalized vendors are not very keen to adopt formalization processes like licensing and relocation due to their informal connections and underlying power asymmetries. Therefore, it is necessary for governments to develop awareness of the challenges conventional formalization processes pose and recognise the potential benefits that exist within the informal markets. NGOs and human rights advocates in Bangladesh, as in other nations, should step forward to play this role and establish an adaptive network to promote the collective actions towards designing sustainable livelihoods.

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Chapter 3
Designing Livelihoods Responsibly: Insights from Seed Conservation and Management Practices Among Farming Communities in India

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1 Introduction

Design is a natural and everyday form of human activity that is embedded in the livelihood practices of traditional farming communities. A design thinking lens on sustainable livelihoods could provide insights into how certain socio-cultural, organizational and environmental uncertainties at the local community level could be addressed. Studies have shown that sustainable livelihood interventions facilitated through design thinking and participatory action research processes could enable participants to co-create knowledge, nurture a sense of ownership as well as develop locally and culturally appropriate solutions (Peters 2011). Designing adaptive solutions to diverse environmental and livelihood uncertainties at the local community level is a systemic process that takes into account the intricate linkages between several dynamic components of a social-ecological system. Highlighting the case of indigenous seed conservation and management as a crucial component of rural sustainable livelihoods, this chapter demonstrates how traditional farming communities engage in knowledge production and design of appropriate technologies and practices. It further analyses specific contextual factors that affect such knowledge and practices, which are associated with responsible design problems or solutions.

Livelihood practices in a social-ecological system consist of a complex and diverse set of economic, social and physical strategies that are achieved through the activities, assets and entitlements by individuals, families, or collectives (Singh and Gilman 1999). These practices also provide insights into the structure–agency interfaces in the everyday lives of resource users, the embedded nature of assets within a specific social-ecological system, and the situated or temporal–spatial dynamics of livelihood

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strategies (Sakdapolrak 2014; Santha 2020). Although sustainable livelihood frameworks (SLF) emphasize people-centredness and participatory approaches (Turton 2000), studies show that the parameters for livelihood promotion and implementation by external actors are often conceptualized by donors and policy-makers (Toner and Franks 2006). Instead, if sustainable livelihood (SL) thinking was truly bottom-up in practice, there could have been greater diversity of expression facilitating a participatory and people-centred process (Donovan 2010). The design of a sustainable livelihood programme also requires an intersectional assessment of the risks, assets, entitlements, local knowledge and coping/adaptation strategies found in a particular community. The intersectional element is crucial as it enables us to be aware of the power relations, situatedness and variations among participating and non-participating social actors in terms of caste, gender, class, disability and other aspects. To ensure inclusive livelihood outcomes in a specific society, the concerned actors have to be capable of being an active part of value production, meeting thereby both individual and community needs (Morelli 2007).

A major concern of implementing formal livelihood programmes in India has been inappropriate programme design resulting in the exclusion of the poorest of the poor (Patnaik and Prasad 2014). There was always a gap between the design and implementation of livelihood programmes. Further, the participating experts and practitioners in livelihood projects often failed to collectively comprehend the complex and integrated nature of the rural livelihood system (ibid). The role of community actors and their informal/formal networks in sharing knowledge, resources and practices has often been neglected (Singh and Gilman 1999). Such actors play a significant role in sustaining a culture of shared practices that involves reciprocity, horizontal decision-making and collective sharing norms (Morelli 2007; Matthies et al. 2020). It is the recognition of the cultural contexts within a specific social-ecological system that facilitates the innovation of livelihood adaptation strategies as well as their acceptance at the local level (Davies et al. 2008). Illustrating the case of slum redevelopment in South India, Kumar et al. (2016) demonstrated that such an engagement with local stakeholders very early in the process of designing and seeking culturally appropriate solutions could ensure the sustainability of development interventions. Such an engagement with local actors is crucial as they are the ones familiar with their situation and who have the ongoing commitment to benefit from change (Peters 2011).

2 Methodology

This chapter is based on insights gathered from three distinct ethnographic qualitative researches conducted among three traditional farming communities in Kochi, Purulia and Ahmednagar, respectively. The ethnographic method has been accepted as an appropriate approach in social design, as it enables to gather an in-depth contextual understanding of people's everyday life in a comprehensive way via the use of participatory observation and interviews (Kuure and Miettinen 2017; Margolin and

Margolin 2002). It also enables one to present the local contexts through the narratives of local community actors (ibid). It also helps to create a sense of trust with the local communities and facilitate processes of co-design (Morelli 2007). While modern designers rely on story-telling through storyboards, use cases and other similar figurative techniques, local actors involved in traditional farming practices embed their ideas, imaginations and practices in cultural norms, folk songs, folk tales, rituals and customary practices, proverbs and metaphors too so as to communicate to the present and future generations. Recognizing the local practices of story-telling, singing and shared conversations could also facilitate the exploration of new ideas together (Peters 2011).

Insights into seed conservation, its management and allied livelihood practices that are narrated here are based on three independent doctoral research works that were carried out between 2014 and 2021 (Sasidevan 2019; Das 2021; Kadu Ongoing). These ethnographic research projects focused on understanding local knowledge systems, collective action and livelihood practices among traditional communities in Kochi (Kerala), Purulia (West Bengal) and Ahmednagar (Maharashtra), respectively. The present attempt to draw insights into specific livelihood practices from distinct ethnographic research projects across the three states of India is also based on the belief that innovations through design-cum-development practice would require a mindset for interdisciplinary learning and shared conversations. The authors of these dissertations have therefore come together to move beyond methodological boundaries and rigidities to understand the complexities of everyday livelihood practices and design suitable solutions.

The livelihood practices narrated here relate to seed conservation and its management with specific reference to the (a) *pokkali* wetland farming in Kochi, (b) dryland farming practiced by the Santal community in Purulia, and (c) organic farming practices adopted by a farmers' collective in drought-prone regions of Ahmednagar, respectively. A total of 79, 66 and 20 interviews (which includes a combination of in-depth interviews, oral history interviews and convergent interviews) were conducted with diverse members of the farming community in Kochi, Purulia and Ahmednagar, respectively. In a similar vein, 8, 4 and 2 focus group discussions (FGDs) were carried out with diverse interest groups in Kochi, Purulia and Ahmednagar, respectively. All the tools were developed according to the situatedness and context of each doctoral research project. Field notes were used to capture the everyday practices and discourses embedded in the lives of farmers. Digital recorders were also used to record interviews that were carried out in the local language. Later, these interviews were transcribed into English and further thematically analysed using Atlas.Ti software.

3 Indigenous Seed Conservation and Management: Few Illustrations

The below passages highlight some of the significant insights that we gathered from the respective ethnographic studies with specific reference to indigenous seed conservation and management.

3.1 The Pokkali Wetland Farming in Kochi, Kerala

Pokkali farming is a traditional form of cyclical paddy–prawn cultivation, which is unique to the coastal wetlands of Kerala. Commencing in April, the pokkali paddy is cultivated for six months. The matured paddy is harvested during the month of October, and prawn cultivation is practiced for the next six months. The pokkali farm management practices are coordinated by farmers' collective that are popularly called as *padasekharam.* For the purpose of this chapter, data collected from three padasekharams located in Kuzhuppilly, Kumbalangi and Kadamakudy regions of Kochi were analysed. While the farmers' collective is directly involved in the everyday decision-making of the rice farming practices, it auctions the fields to contractors for prawn farming for a period of six months.

The pokkali paddy cultivation takes a total of 110–120 days and commences with land preparation, seed preparation, sowing, transplanting, followed by weeding, harvesting and post-harvest activities. Each phase of pokkali farming is thus intricately connected with one another. The local design strategists here are not necessarily the land owners or the farmers here, but their land ownership and ability to employ skilled labourers make them a crucial stakeholder in the designing of the whole process. The skilled labourers (especially the head labourer) could be attributed the role of the chief designer of these operations. The shared conversations between the head labourer, other skilled and semi-skilled labourers, women labourers, and the farmers together act as the medium to articulate the design process, ideate, bargain, negotiate and finally arrive at consensus to implement the decided strategy. The situated, local knowledge among these intersectional actors acts as the source of agency for each of these actors to advocate their values and interests into these practices. Nevertheless, all these actors acknowledge the systemic interconnectedness of the pokkali ecosystem and strongly believe that any change in one component of the ecosystem can affect the form and sustainability of other components in the social-ecological system. The head labourer oversees that these systemic linkages are not disrupted while designing the overall processes.

Farmers share that a crucial element for any sowing activity to succeed is that the land has to be prepared in the most efficient manner. Prior to sowing, the water in the fields has to be completely drained away. Traditionally, this was carried out by a manually operated wooden rotary wheel. This was supplemented by the use of baskets and temporary canals in a few places. Thus, the design involved a good

layout of the natural drains and artificial channels that has to be maintained so as to drain water. Be it the water wheel, the basket, the field bunds or the canals, they had their unique designs and most of these were crafted from locally available resources. We need to recognize seed preparation and its management as a crucial component of this systemic design. Farmers believe that not adhering to such designs which is interwoven with their knowledge and practices could result in the disruption of the whole social-ecological system.

The seed preparation activities commence by the end of May and continue till the first week of June. The original and indigenous seed variety of the pokkali paddy has a greater capacity to resist salinity. According to the elderly farmers, there were five seed varieties that were once popular. Farmers categorize these seeds based on their significant characteristics such as saline resistance, resilience to flooding and submergence, height of the stalk, maturity period and productive capacity (Table 1). Nevertheless, these categorizations are not formal categorizations. Instead, these knowledge systems are part of their oral history and were once a significant contributor to their design strategies.

Table 1 Seed typology and characteristics at the community level

Seed characteristics (✔□✔□✔□—Very significant; ✔□—Less significant; ✖□—Not significant	Seed type				
	Cheruvirippu	Chettivirippu	Chootu Pokkali	Mundakan	Pokkali (Regular)
Saline resistant	✔□	✔□✔□✔□	✔□	✔□✔□✔□	✔□
Tolerance to submergence	✔□	✔□	✔□	✔□	✔□
Tolerance to soil acidity	✔□	✔□	✔□	✔□	✔□
Seed Texture	✔□✔□✔□	✔□✔□	✔□✔□✔□	✖□	✔□✔□✔□
Height of the paddy stalk	✔□✔□✔□	✔□✔□	✖□	✖□	✖□
Maturity period	✔□	✔□✔□	✔□✔□✔□	✔□	✔□✔□✔□
Productivity (Volume)	✔□✔□	✔□	✔□	✖□	✔□✔□✔□
Weight	✔□✔□✔□	✔□	✔□✔□✔□	✖□	✔□
Size	✔□✔□✔□	✖□	✖□	✖□	✖□
Non-sprouting of shoots	✖□	✔□✔□✔□	✖□	✖□	✖□
Non-shedding before harvest	✖	✔□✔□✔□	✔□✔□✔□	✖□	✔□
Facilitates mixed sowing	✖□	✔□✔□✔□	✖□	✖□	✖□

After every harvest season, the harvested paddy is threshed by feet, segregated and then dried. Different parameters based on fortnight calculations exist to dry the seed grains. The seed grains are never dried on the ground. For this, a mat made from bamboo plastered with cow dung is used. This is done so as to control pests from attacking the seed grains. The paddy is dried for 3 days and stored as seeds in air tight rooms for the forthcoming sowing season (Fig. 1). The paddy thus segregated will be heavier than the rest of the grains. Prior to the commencement of sowing, the pokkali seeds are mixed with teak leaves and are stored in a palm basket. This palm basket is then immersed in fresh water bodies like ponds for 24 h. Then, it is taken out, dried and stored. At the time of sowing, it is soaked again in water for one or more hours based on the sprout. The seeds are either taken out as the fifth seed (*anjam vithu*) or as the third seed (*moonam vithu*). According to the farmers, the fifth seed would have well developed buds as well as roots, whereas the third seed would have only buds with no roots. The latter therefore does not get washed off during the rains, and therefore, farmers also prefer the third seed. Also, the norm is that everyone who is involved in the seed preparation process is expected to bathe and remain clean throughout the process.

The sowing of seeds takes place in the land earmarked as a nursery within the pokkali fields. The nursery is developed by constructing small mounds on which the seeds are sown (Figs. 2 and 3). It is believed that once the seeds are sowed, it becomes 'unwell'. On the 28th day from the date of sowing, it is believed that the seed will recover and the seeds will sprout. The weeding is done during this time. In the words of an elderly farmer,

> When we say it is unwell, what we mean is that we cannot touch it. We do weeding during this time... when we pluck out the *kuthiraval* (a particular weed), we slightly pamper it. Then

Fig. 1 Pokkali seeds ready for sowing. *Source* Sasidevan, Fieldwork

Fig. 2 Preparing mounds in the nursery. *Source* Sasidevan, Fieldwork

Fig. 3 Pokkali saplings in the nursery. *Source* Sasidevan, Fieldwork

its growth will increase. After this, it does not remain as just a seed. It grows to needle length on the 28th day.

An elderly woman labourer used the metaphor of pregnancy to explain the whole process,

> The whole process of nurturing the seeds is like nourishing a foetus during pregnancy...this is the same way we take care of seeds before transplantation.

During this time, the water in the fields will be regulated. The field has to be maintained and dried. During this phase, it is important to receive intermittent rains to just provide some moisture to the fields. The salinity of the soil declines considerably between the end of May and the beginning of June. Seeds are sown accordingly, when the salinity is very less.

The sowing activities are then followed by the transplantation of saplings. The transplantation processes vary from one site to another. There are practices where the rice saplings are just thrown into the fields in a line. Or else, we could see labourers digging a small hole in the field to place the rice seedlings in it. The seedings for transplantation are usually transported to planting sites in a small canoe. Farmers undertake the whole process of sowing and transplanting in correspondence to the *njattuvela* of August–September.[1] The rains that pour during this time are a mix of both drizzles and heavy showers, which helps in regulating salinity in water, supplying adequate nutrients as well as in controlling pests.

3.2 Dryland Farming in Purulia, West Bengal

Pattanr village in the district of Purulia is located along the Ajodhya hill range surrounded by isolated hills, forests and drylands. The Santals of Pattanr are a traditional farming and forest dependent community whose primary source of survival has been rainfed agriculture, which also makes them the most vulnerable to frequent and severe droughts. Often, their crop productivity and quality of yield are impacted by variations between extreme heat and fog-like conditions, intense precipitation and similar drought-related conditions. These factors have also forced many farmers in the region to leave their fields fallow, which also limits the availability of fodder for their cattle. At the same time, the Santal communities also have developed unique livelihood practices that enable them to cope with the environmental uncertainties. Towards making appropriate farming strategies, they give specific attention to soil moisture condition, soil fertility and micro-climate among others. For example, strategies such as crop fallow rotation, direct seeded cultivation, mixed cropping and growing minor crops are practiced during drought years. Soil moisture condition is also ensured through crop diversification and mixed cropping. Most of the households practice the sowing of two or three pulses, legumes and cereals at the same time. Pulses like pigeon pea and legumes not only address the nutritional security of the households but also consume less water. Lentil seeds and linseed or local black gram are sown in the paddy fields during the kharif season. The lentil seeds are

[1] *Njattuvela* as per the malayalam calendar system refers to the transit and position of the sun across 27 constellations of stars. There are 27 *Njattuvela* every year, each with a duration of thirteen-and-a-half days. It is surrounding the *thiruvathira njattuvela*, farmers commence farming practices, as that period assures adequate rainfall during the year.

broadcasted around fifteen days prior to the commencement of the paddy harvest. This is aimed at effectively utilizing the moisture present in the soil.

Seed management and exchange practices have an important role in sustaining the household economy of the Santals. It was observed that the women in the Santal households play an important role in the conservation and management of seeds. They believe that they have an important role in sustaining the genetic purity and availability of seeds. Seeds for the next sowing season are usually procured from their own farms with utmost care (Fig. 4). Mixing of different varieties of seeds is completely avoided. And, seeds are usually harvested from the yield located at the centre of their farm lands. Harvesting of seeds is halted and avoided if there are signs of pest infestation. They practice unique ways of storing seeds as well. The procured seeds are cleaned and dried properly. Drying the seeds in the sun prevents pest infestation during storage. Seeds like pulses, oilseeds and cereals are dried and protected by coating them with cow dung ash (*bani*). Some varieties of seeds are then stored in *morha*, which is made from straw, dry cow dung and neem leaves. The *morha* is generally hung from the roof to avoid contact with earth. The women believe that these practices would reduce the moisture level inside and thereby increase the shelf life of the seeds. Certain specific varieties of seeds such as pulses and oilseeds are filled in earthen pots to a 3/4th volume and the rest 1/4th is filled with cow dung

Fig. 4 Santal woman procuring legume seeds. *Source* Das, Fieldwork

ash. The seeds are also covered with neem, margosa or sinduari leaves. These leaves have very good insecticidal properties and repel pests.

The knowledge of Santal women pertaining to seed selection is very unique to their resource base and its ecosystem linkages. A group of women shared their understanding as follows,

> There are three types of *kutthi* (horse gram), namely white, black, and red in colour. The texture of the white seed is flat and is not sweet. However, the volume of produce will be high. Farmers prefer the red variety as it grows well in the mid-land and takes less than four months to mature. We do not sow seeds that take more time to mature as it could coincide with our cattle grazing season.

Farmers also practice the sowing of seeds (such as bottle gourd) with their left hand in loose mounds so as to reduce the exertion on these tender seeds. In a similar vein, farmers farm sugarcane only every alternate year in a particular plot of land so as to increase the capillary movement of water and retain moisture in the soil. Farmers also comment that the soil can recognize the seed if continuous farming is practiced and that could result in weak growth of the plant. These farmers also use sugarcane charcoal as mulch to cover the soil and protect the sown seeds. They use lentils and sugarcane extracts, which are burnt and mixed with the soil so as to boost the phosphate content in the soil.

Such knowledge pertaining to seed management and conservation is passed on orally and through practice from one generation of women to the next. More importantly, such knowledge systems are strongly interwoven into the cultural beliefs and practices of the community. For example, the following ritual practiced in the community showcases the significance of seeds in their everyday survival. When there is a new birth in the family, the elderly women in the family tie a seed of the Bhela around the neck of the newborn. According to the elderly women, this seed when chewed also eliminates white worms from the human body. In a similar vein, paddy farming in uplands is considered to be very sacred and certain rituals guide the practices. An important ritual that marks the beginning of sowing paddy seeds is known as '*erok-sim*'. And, when the seeds sprout they practice '*harihar-sim*'. These two rituals are performed to appease the spirits residing in the fields and are prayed for good yield in terms of both quantity and quality of rice. The first yield is then offered to their village deities through a ritual known as *'iri-guldi-sim'*. During this ritual, prayers are offered to gods and ancestors for sustainable consumption of the resource. There are certain cultural norms and practices aimed at sustainable consumption too. For instance, trees in the forest that bear fruits and flowers are never chopped. These norms are supported by myths such as those associated with the Karam tree. It is believed that the goddess of their sacred grove gave birth to the Karam tree and sirom grasses. She is believed to be the protector of all life forms. Villagers celebrate the Bhadra Ekadashi by dancing around the Karam tree to respect and value the power of creation and sustenance on earth. Seeds are soaked during this time for almost three days. On the last day of the festival, the sprouted seeds are all placed in the field and a Karam branch is immersed into the river to cast away the evil spirits that could have disturbed its sacredness.

Seeds are treated as proud possession of family and shared when there is severe scarcity. They are also paid as wages to villagers who do not have access to seeds. Use of local seeds and reciprocal exchange mechanisms between farmers strengthens the adaptive capacity of social-ecological systems. Elderly women farmers believe that they are able to sustain their crop diversity as they have secured access and sovereignty over seeds. According to them,

> No one will be willing to give us small quantities of seeds for such a diverse range of crops. Our requirement will be 100 gm of mustard, 500 gm of black gram, 500 gm of pigeon pea, 1 kg of millets, and a handful of *gunja*…there is no guarantee that we will get good quality seeds, which further depends on whether we have time and money to procure them from the *haat* (market). The only way that we can ensure access to seeds is if we save them from our own harvest.

3.3 Reviving Organic Farming Practices in Ahmednagar, Maharashtra

The district of Ahmednagar in Maharashtra is highly prone to drought like conditions. The region is characterized by hot summers and general dryness throughout the year. Severe water scarcity and poor crop productivity have affected the livelihoods of several traditional farming communities in the district. It is in this context, a group of rural development practitioners established Lokpanchayat, a non-governmental organisation (NGO) in 1993. The NGO strives towards addressing issues of water scarcity, drought and resultant livelihood uncertainties among traditional farming communities. To begin with, they initiated participatory watershed management works through *shramdaan* or voluntary labour. Subsequently, they also began to work towards strengthening organic farming practices in the villages. Towards this, the NGO facilitated the setting up of the Baliraja Krishak Producer Company Limited (BKPCL). The BKPCL has adopted a socially inclusive approach by providing membership to farmers irrespective of their caste, ethnic, class or gender identities. In BKPCL, 35 per cent of members are women farmers. Members also belong to diverse marginalized social groups like Scheduled Caste (Mahar, Chambhar), Scheduled Tribes (Mahadev Koli), Other Backward Classes (Mali, Gurav) and Nomadic Tribes (Dhangar). About 90 per cent of farmers are small and marginal farmers who have access to less than five acres of land. There are members who belong to the Maratha community too. This farmers' collective strives to promote collective action and shared knowledge between farmers and other stakeholders. The members collectively engage in preparing and using organic fertilizers as well as in strengthening farmers' capacity in terms of seed procurement, low-cost production and marketing of produce.

A significant contribution of BKPCL has been towards the promotion and conservation of indigenous seed varieties among their farmers. The indigenous seeds are hardy and drought-resistant suited to the climatic contexts of Ahmednagar. Also, they were able to revive certain endangered indigenous varieties such as the '*kalbhat*'

(black paddy), '*devthan*' (pearl millet) and '*batu*' (buck wheat). The farmers follow certain unique traditional practices to store and conserve seeds. After every harvest, each farmer would pick some of the high-quality grains from their respective yields and store them separately in a bag. For some varieties, they store the seeds in clay pots or pumpkins. These are then plastered inside the walls of the house with an inner layer of ashes and outer layer with either soil or cow dung. Certain varieties of seeds are mixed with ash, wrapped in cloth and tied to the roof of the house. Farmers also use containers made from bamboo and plastered with cow dung to store seeds of black paddy (Fig. 5). They also place neem leaves in seeds and grains to prevent insect attacks. Further, these farmers also realize the significance of cleaning, grading and packaging as per industrial standards.

The BKPCL had also played a crucial role in setting up community seed banks (Fig. 6). These seed banks are run by women collectives. As mentioned above, the seed bank also preserves the seeds based on traditional knowledge. As per the requirement of farmers, the seed banks either exchange or distribute indigenous varieties of seeds. Apart from self-procurement, indigenous seeds are also procured from farmers' exhibitions and reliable wholesale outlets. Nevertheless, BKPCL also acknowledges that in today's world, organic farming initiatives can remain sustainable only if they are able to compete with the mainstream market. The members of BKPCL found out that there was a need to design a 'niche market' for organic produce that can also enable them to maintain economic viability pertaining to their

Fig. 5 Bamboo baskets to store seeds of black paddy. *Source* Kadu, Fieldwork

Fig. 6 Community seed banks. *Source* Kadu, Fieldwork

livelihood choices. They collectively deliberated on the complexities of their need, available ecosystem-based resources and began to ideate on possible solutions with other stakeholders including government, civil society and market actors. Any new intervention, they piloted their ideas on a small-scale and treaded carefully to the next level of scaling with much caution and deliberation. They also realized very soon that the best practices were circulating and getting accepted faster than their failures.

Today, the BKPCL sells their farm produce by the brand name 'Farm First' and forest-based produce by the brand name 'Forest First', respectively. They have also started two retail outlets, namely 'Irjik Organic Spot' in Sangamner city. All kinds of organic grains, pulses and related products are sold in this shop. The BKPCL is able to offer a fair price to the producers and has established market linkages with the distributors and retailers of organic produce in Pune, Mumbai and Nasik. They are also building strategies to connect to the last actor in the value chain, namely the urban consumers in residential societies and let them know the social-ecological value that their traditional knowledge systems are preserving and contributing to.

4 Contextual Factors that Affect Seed Conservation and Management Practices

From the above illustrations, it is evident that farming communities are always involved in a process of anticipation, inclusion, reflexivity and responsiveness, which is similar to the behaviour of design practitioners too (Ludwig and Macnaghten 2020).

These characteristics are ingrained into the farmers' everyday livelihood practices as well. Nevertheless, their traditional knowledge systems and design capacities at the micro-level have limited agency to withstand specific dynamic pressures that are induced by several macro- and meso-level factors. Diverse contextual factors such as changes in land use and water management, commercialization of specific crops, labour scarcity, technological change in crop breeding practices, infrastructure development and urbanization, market penetration of chemical fertilizers and pesticides, pollution, deforestation, climate change and regulatory arrangements have acted as dynamic pressures. Traditional agrarian economies in all the above-mentioned cases have thus undergone drastic transitions disrupting the synergy that social-ecological systems once had. Some of these factors are design-linked systemic issues. For the purpose of this chapter, one such factor from each of the case studies is elaborated in this section.

4.1 Transitions in Water Management

As mentioned earlier, the pokkali seeds were prepared for sowing by soaking them in pond water. The ponds or other sources of freshwater in the area were earlier used for seed preparation. However, today most farming households have access to water supplied through pipelines. The water thus available through taps is chlorinated and does not suit the preparation of pokkali seeds. Nevertheless, the availability of tap water reduces the hard labour that was otherwise required in manually drawing out water. Therefore, many labourers tend to use tap water, even after realizing that the tap water could spoil the seed. A farmer commented as follows:

> Prior to sowing, we place the seeds in a basket and immerse them in freshwater. This will increase the saline resistance of the seed. This year we used tap water to soak a few baskets of seeds and those got spoiled. Though I expressed my concern of using tap water to the head labourer, he did not oblige. I did not argue with him further. Nevertheless, based on this experience, I will never use tap water again!

Similar to the ponds, the bunds and sluices are other critical components of the water management system in the pokkali fields. The bunds are built with clay and mud from the fields. There is an outer bund, which is a large structure that marks the boundary of the padashekharam. It also protects the field from excess water intrusion from the backwater and the sea. The smaller inner bunds demarcate the boundaries of individual farm lands as well as provide room for adequate storage of water in the fields. These bunds also prevent the entry of water weeds into the farm. Over the years, there has been considerable fragmentation in the size of land holdings. There are many landowners today compared to the land holdings seventy years ago. A major driver has been the land reforms enacted by the state in the 1950s. With the land reforms, single large stretches of the land got redistributed, which also resulted in the fragmentation of the land owned by a new class of resource users. Some parts of the wetland also got converted for housing and other allied purposes.

Issues such as provision of clean fresh water and maintenance of bunds are vital when it comes to indigenous seed management. But with land use changes as mentioned above, the provision of fresh water and maintenance of water quality are being affected. For instance, many land owners have withdrawn from paddy cultivation, as they find it non-viable economically to undertake farm operations at a small scale. Bunds in these fallow fields are left unmaintained, often resulting in the breaching of the field bunds. Some other landowners prefer to only practice aquaculture against the traditional cycles of paddy–fish farming. An elderly farmer shared his experience as follows:

> The seeds that I had sown had just sprouted. However, that year due to heavy rains, the water in the fields began to rise. The land owner adjoining my fields had converted his farm into full-time shrimp farms and was reluctant to open the sluice gates to reduce the water level. As the water level increased, it breached my field bunds and spoiled all my sprouted seeds. I was very upset as it resulted in a huge loss.

In this regard, an experienced head labourer shared his observation as follows:

> These days, most of the young farmers and labourers do not understand the significance of integrated water management in the pokkali fields. If the water quality is not good, the land will not remain fertile, and will affect the productivity of the seeds.

The above issues get complicated further when pollutants from nearby industrial firms, slaughter houses and households enter these water bodies. Lack of a comprehensive design for waste disposal and management that takes into account the intricate networked nature of ecosystem services is a serious issue that requires attention. A farmer responded to this issue,

> The waste water enters the fields at odd hours. We try to prevent the entry of polluted water by shutting down the sluice gates. However, there are circumstances when we have to open the sluice gates, such as during the prawn cultivation season. The polluted water affects the growth of our prawns as well as the paddy seeds.

Further, this also throws light on another important but linked issue, which is the non-availability of skilled sluice workers. The engineers from the state irrigation department have tried to address the scarcity of sluice labourers by promoting the construction of concrete sluices. The engineers opine that the concrete sluices are also more effective than the wooden sluices (largely in terms of reducing maintenance costs). Nevertheless, the elderly farmers believe that the wooden sluices were better suited to the ecosystemic nature of pokkali wetlands. In their own words,

> We used to feel that the wooden sluices were alive!...Care was given as to what the sluice was made of, how it is built and what adjustments have to be made for water management.

Concrete sluices have disrupted both these practices and the ecosystemic linkages that were also crucial for indigenous seed conservation and management. Farmers today comment that the paddy is not growing tall as it used to grow decades back. According to them, it is not a problem with the seed as such. Instead, they believe that the larger disruptions in the ecosystem linkages without recognizing the need for a comprehensive and integrated design has made the seeds incapable of producing

better yields. Nevertheless, the state actors including experts and officials in the agricultural department tend to sideline these knowledge systems and discourses. Instead, they strive to improve crop productivity by providing a scientifically improved variety of pokkali seeds. They are critical of farmers' hesitance to procure these modified seed varieties and also believe that the indigenous seeds would end up being unsustainable due to climate changes and other related factors. This knowledge gap between the state actors and the farmers should also be studied as a design problem.

4.2 The Public Distribution System and the Erosion of Local Food Security

The public distribution system (PDS) was set up in India to address food scarcity by distributing food grains at affordable prices. Today, PDS is a significant welfare-oriented policy measure operated under the joint responsibility of the central and the state governments to ensure food security among marginalized populations in the country. The PDS through the network of fair price shops or PDS outlets distributes essential commodities, namely wheat, rice, sugar and kerosene to households below the poverty line. Some states also distribute additional items of mass consumption through the PDS outlets such as pulses, edible oils, iodized salt, spices and so on. Nevertheless, there is limited literature that examines the public distribution system (PDS) from a design thinking lens.

Most households in Pattanr are affected by drought and rely on government-subsidized food for sustenance. Rationed stocks are affordable compared to the cereals traded in the open market. Our observations among the Santal community in Pattanr shows that with the secured supply of rice, wheat and sugar (not very frequent) at Rs 2/kg per person via PDS outlets, people have food to eat during all seasons. In this regard, elderly women in the village comment that the shift in dietary intake from coarse grains and millets to polished rice as the most consumed cereal has impacted the health of Santals in a negative way. While reflecting on the dietary changes over the past few years, women observe,

> The rice we get, neither it gives us energy nor does it taste good. Our children like them. This is because they have not had the *mandua* (ragi), *jonar ghata* (maize porridge) or the *goradhan* (upland rice). You don't get them in the local haat either. Moreover, the preparation time was more too! As the food changed our health problems have also increased, now every second people complain of illnesses that we have never heard before.

These women also believe that a reduction in the cultivation of traditional cereals has made them less autonomous in deciding upon household nutritional choices. They are now more dependent on their availability in the market and related institutions. Further, as food supply is guaranteed through the PDS, families are less willing to grow traditional food crops. Instead, they are diversifying towards the cultivation of vegetables and other cash crops, which are necessarily not suited for dryland regions. The practice of cultivating short-term high-yielding vegetables like brinjal

and tomato has gained momentum over the last decade. In the words of an elderly Santal man,

> Earlier we had finger millet, bajra and maize flour khichdi. Though we continue the maize cultivation, we sell the corn now and do not process them into maize flour any more. No one is willing to eat that traditional food. Earlier we travelled to forests and stayed in our farms for a longer time. Those grains also kept us filled for very long. Now options are more and the cultivation process has also changed…now everyone has taken up short-term vegetables for easy cash.

The elderly population believe that this shift of cultivating vegetables commercially in the uplands has affected the indigenous genetic diversity of their crops. Moreover, it has also disrupted the procurement of good quality seeds and induced seed scarcity at the local level. Field observations also reveal that shortage of pulses makes the families depend more on the market. Despite the emphasis of the PDS to ensure nutritional security, there is only polished rice that beneficiaries have access to and no local staples. Often the rice provided is of low quality as well. Few households who do not require subsidized food grains often sell them at a higher price in the open market or they return them to the dealer for cash. As wheat flour was never part of their staple diet, some women in households exchange them for cash and sometimes purchase more rice with that money. The dealer also benefits from trading the surplus food grain that is not procured by the beneficiary.

4.3 Patriarchy, Intersectionality and the Market

The BKPCL was able to recognize that their survival depends on reviving ecosystem linkages through traditional organic farming practices. At the same, they had to align themselves to the needs and requirements of the present organic agrarian market too. Unlike the farming communities in Kochi and Purulia, they also recognized the need for social inclusion and accepted the fact that diverse social inequalities existed in traditional farming systems as well. To tackle these needs and challenges, the adaptive pathway that these farmers engaged in was to adopt a modern institutional framework such as the farmer producer company, which has scope to practice more inclusiveness, equity and at the same time compete with the market. However, they are facing certain unique challenges that a design thinking lens could offer an alternate perspective.

Over the years, there have been considerable transitions in the cropping pattern in surrounding villages of Ahmednagar. From the beginning, BKPCL was not able to mobilize membership and support among the big farmers who were also involved in commercial crop cultivation using chemical fertilizers. Some of the big farmers joined the company so as to draw personal benefits from the company's market network. In recent years, there has been a tremendous push on the rest of the farmers in these villages to cultivate cash crops, which is not an accepted practice in BKPCL. Since the company does not deal with cash crops, farmers oriented towards the cultivation of cash crops have begun to distance themselves from BKPCL. The BKPCL has to

face new forms of factional politics at the local level. This disintegration has further weakened the solidarity among farmers, weakening seed procurement, storage and exchange through community seed banks. They are also facing new challenges in setting up seed banks at the village level such as non-availability of permanent space.

Alongside, yet another challenge that BKPCL currently faces is to tackle the forces of patriarchy and caste-based intersectionality. Women from different caste groups are the primary members of the BKPCL. Nevertheless, mere membership alone does not bring inclusiveness or equality. The intersectional dynamics and politics of caste and gender is very much evident in the collectives. A woman of a particular caste decides to be part of a collective that is dominated by members of her caste. However, such a decision would entail that women from other minority caste groups may get excluded and will not have a chance to be part of the collective. We also found out that women managing the seed banks were restricted by their husbands to attend meetings and similar programmes held outside their village. This often resulted in marital disharmony, and when the community comes to know about such conflicts, they tend to criticize the character of the woman. A woman from a ST community expressed her concern as follows,

> In our village, people comment badly about us women that we wander here and there and do something or the other. There are some well-educated women in our village. But they are not allowed to step out. Though I was less educated, I was able to learn a lot after becoming part of the collective.

Power relations are thus central in any form of livelihood practice (Jakimow 2012). The design has to be therefore understood as 'an inherently politicized process involving choices about whose voice is listened to, who is invited into spaces, who is excluded, whose power is respected and whose is challenged within a time frame and agenda that is governed by a political process exogenous to the context' (Brocklesby and Hobley 2003: 907). These processes also depend on how diverse actors would pursue different analytical starting points in a design exercise. Design-cum-development practitioners should recognize that their contexts of intervention are not to be guided by a single objective as the truth and are instead shaped by multiple realities (Tatum 2004). Often they have to manoeuvre and negotiate with diverse heterogeneous actors and structural barriers to ideate and implement a livelihood strategy (Long 2001; Brocklesby and Hobley 2003). In their everyday social encounters, these design spaces are also sites for social actors to showcase their knowledge and power relations (Jakimow 2012). Each involved actor would possess the agency to implement the designs according to their situated knowledge (Brocklesby and Hobley 2003; Santha 2020). It is these experiential and situated knowledge that becomes relevant while designing sustainable livelihood strategies (Goodrich 2019).

From the above discussions, it is also evident that while well-intended interventions such as land reforms or PDS tried to address inequities in land ownership or food scarcity, respectively, the accompanying policies and practices did not think of an integrated design in terms of local social-ecological systems. Each resource was considered to be separate objects distanced from the other. The same logic prevailed even while providing piped water supply without taking into account the integrated

nature of resources in the pokkali wetland ecosystem. Development models that are imitated via a universal logic of scale prevent the possibilities of context specific innovations (Buchanan 1992). In this regard, Melles et al. (2011) observed that the interacting dimensions in the context of each of these development interventions may not recognize social responsibility and sustainability as key virtues. These can be visualized as 'irresponsible' design problems, which have considerably disrupted indigenous seed conservation and management practices as well. Similar issues and their underlying complexities were also highlighted by Cleaver and Franks (2005) in their analysis of water resource management institutions and practices in Tanzania. Instead of empowering and creating self-reliant farming communities, these interventions (though with good intentions) have resulted in the emergence of communities who are always dependent on outside expertise for problem solving (Melles et al. 2011). A holistic design thinking lens could have helped in addressing some of these wicked problems (Buchanan 1992), where regular top-down approaches of planning have failed to address the systemic connections (Owen 2007; Kumar et al. 2016). Such planning and designing approaches have to be culturally appropriate (Owen 2007) taking into account the systemic interconnections of the social-ecological system (Garcia and Zazueta 2015; Buchanan 1992) as well as engaging with diverse actors who are familiar with the local contexts (Kumar et al. 2016).

Development interventions have to be designed in such a way that they are meaningful to local people and their social-ecological system (Davies et al. 2008). Their impacts can be felt at three levels, namely individual, systemic and institutional levels (Kumar et al. 2016). At the same time, there could be multiplier effects with both intended and unintended consequences. Over a period of time, certain planned actions to improve a set of livelihood practices could impact the livelihood contexts of other vulnerable groups (Chambers and Conway 1992; Scoones 1998; Mabon et al. 2021). The net effects of implementing a particular livelihood intervention therefore needs to be assessed, with future impacts discounted appropriately (Chambers and Conway 1992). Designing to deal with livelihood uncertainties as mentioned above therefore requires a perspective that engages with epistemological pluralism. In this sense, Nightingale (2016) uses the metaphor of interdisciplinary designs presented as a kaleidoscope. As and when the kaleidoscope is turned, a new perspective and understanding that are partial and situated would emerge transforming the original design as well. Such an approach requires a knowledge environment that facilitates shared conversations and continuous negotiations with diverse social actors in the social-ecological system (Santha 2020; Scoones 1998). Further, design should be capable of creating empathic experiences that are people-centred and relational (Devecchi and Guerini 2017). Empathy, in this context, refers to an interpersonal and connective experience with the other. It is not a process of becoming the other; instead, it is the skill to be with another and actively involve in a face-to-face encounter with the concrete other and accepting the other with their differences or the otherness. These encounters are shaped by intersubjectivity, dialogue and sociability (ibid).

Our belief is that design thinking can help predict unintended consequences in social-ecological systems in advance and design projects accordingly. Applying a

sustainable livelihood framework, design-cum-development practitioners could integrate multi-stakeholder perspectives and simultaneously account for diverse social-ecological outcomes (Davies et al. 2008). We need to account for the variability and dynamism of institutions and practices in specific social-ecological contexts and development interventions have to be designed accordingly (Cleaver and Franks 2005). At the same time, we need to be self-aware and control our urge as design or development experts to impose solutions from outside to improve the situation of local actors (Peters 2011). Studying development interventions along the Thang Binh coast in Vietnam, Mabon et al. (2021) argue that the recognition of local knowledge and local governance systems are crucial for ensuring the sustainability of livelihood practices (Mabon et al. 2021). Such a strategy is crucial to build trust with participant actors, understand the cultural appropriateness of the solution and what locally available resources could be mobilized for the implementation of the same (Peters 2011). However, it will still remain a challenge to work with market-based institutions and simultaneously counter the forces of patriarchy and intersectionality. The road to social inclusiveness, solidarity and equity in agrarian economy is still farther away awaiting appropriate designs and integrated interventions.

5 Conclusion

Livelihood practices of poor and marginal farmers will remain sustainable only if they are able to cope with and recover from stresses and shocks by enhancing their capabilities and assets and without eroding their natural resource base (Chambers and Conway 1992; Scoones 1998). Socially responsible planning and design could restore equity and enable people to meet their needs, including secondary ones like supporting other ecosystem services (Donovan 2010). Nevertheless, we need to realize that there is a messy complexity embedded in the framing and implementation of sustainable livelihoods and related development projects (Cleaver and Franks 2005). The idea of locating design practices in everyday livelihood contexts could be a way forward to recognize the interlinked and complex relationships between humans, resource use, politics, culture, weather and climate in unique ecosystems (Nightingale 2016). Local actors in traditional farming communities take into account the dynamics of social-ecological systems while designing livelihood practices. Their decisions are based on their localized understanding which design strategy will work and who has what ability to implement the same (Kumar et al. 2016). The components of culture and community engagements are crucial elements in social design. Nevertheless, these are highly context specific (Goodrich 2019). In today's context of complex economic and environmental challenges, it is the capability of local actors to generate context-related solutions through a collaborative network of institutions and actors across the value chain that make livelihood practices viable and sustainable (Morelli 2007).

Traditional farming communities frame ideas, images and practices that are largely divergent from those of external experts; and be it farming or any other livelihood

option in present-day is a complex interface of local and external actors with diverse values, interests, knowledge and power. Indigenous knowledge and local design strategies tend to be sidelined in these complex interfaces. Moreover, such approaches could end up creating band-aid solutions instead of sustainable solutions (Melles et al. 2011). In countries like India, the conceptualization and practice of design and development are considerably influenced by growth-oriented, modernist and managerial knowledge systems rather than the recognition of local and traditional knowledge systems. Such an approach does not recognize the everyday realities of the local context and neither mediate with the ideas and imaginations of the local. And even locally, the knowledge systems and design practices are shaped by intersectional contexts of gender, caste, class, ethnicity and so on. It is therefore very essential also to be critically aware of the diverse roles of the social actors and the embedded power structures involved in its design process.

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Chapter 4
'Designerly Ways' for Sustainable Livelihoods

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Abbreviations

SL	Sustainable livelihoods
SLA	Sustainable livelihoods approach
DfS	Design for sustainability
S.PSS	Sustainable product-service system
PSS	Product-service system
DS	Design support
SAM	Sustainable agricultural mechanization
D-SAM	Design for sustainable agricultural mechanization
G-SAM	Guidelines for sustainable agricultural mechanization
FDC	Frugal design conceptualization
FLOW	Frugal Solutions Workbook

1 Introduction

The British Department for International Development says—'*A livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks*

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and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base' (DFID 2001) (Chambers and Conway 1991). The sustainable livelihoods (SL) approach (SLA) is centred around the development of people by building their strengths and bringing relevant aspects of their lives and livelihoods into the development process. The SL framework (SLF) consists of five core components: vulnerability context, livelihoods assets, policies-institutions-processes, livelihoods strategies and livelihoods outcomes (DFID 2001). It revolves around examining and balancing the five capitals: human, natural, financial, physical, and social (DFID 2001). Researchers, organization and practitioners have used and adapted the base SLF from various viewpoints and for various problem typologies and contexts (e.g. strategizing sustainable tourism (Tao and Wall 2009), impact evaluation of agricultural research (Mahalaya 2010), urban life poverty (Hossain 2005), SL security (Bohle 2009), assessing climate change vulnerability and adaptability (Pandey et al. 2017). This paper presents our experiments with 'designerly ways' (Cross 2001a) of approaching SL as there are several parallels between the SLF and design for sustainability (DfS) approaches.[1] The inspiration for this comes from the work of Jagtap, Larsson (Jagtap et al. 2014) and Scoones (Scoones 2019), Scoones, Stirling (Scoones et al. 2018). Jagtap, Larsson (Jagtap et al. 2014) argue that designing for the (economic) top of the pyramid and the bottom are different. In the latter case, designing products must be looked at in conjunction with poverty alleviation and business development. Scoones (Scoones 2019), Scoones, Stirling (Scoones et al. 2018) suggest that the United Nations Sustainable Development Goals be looked at from a livelihoods perspective to bring in an integrated approach rather than a sectoral approach.

1.1 The Parallels

A DfS problem needs the designer to deal with complex, interrelated issues. That requires cross-disciplinary and transdisciplinary knowledge and expertise (Jerneck et al. 2010), like an SL problem (Knutsson 2006). Both need to factor in the impact of various development decisions on different groups of people and highlight the significance of understanding the relationship between decisions and activities. They rely on bringing together various relevant stakeholders (DFID 2001). The starting point of SLF is developing a thorough understanding of the livelihoods of poor people in a given context, followed by identification of the contextual constraints that block

[1] DfS approaches can be classified to be targeting product level innovation, product-service system level innovation, social innovation and socio-technical innovation. The product level is more insular and hence its sustainability potential is lower. The other three levels are more systemic in nature and require social and technical innovation. Thus, their sustainability potential is higher, and they cater to all three dimensions of sustainability. 9. Ceschin, F. and I. Gaziulusoy, *Evolution of design for sustainability: From product design to design for system innovations and transitions.* Design Studies, 2016. **47**: p. 118–163. In the context of this paper, we take into consideration these three levels.

the realization of their rights and consequently the enhancement of their livelihoods in a sustainable manner. A DfS approach starts with understanding the stakeholders and their needs, desires, aspirations, capabilities, capacities and pains (Ceschin and Gaziulusoy 2016). Both build on stakeholders' definitions of constraints and opportunities and aim to help them address and realize these. SL does not suggest that its stakeholders necessarily adopt a system-oriented problem-solving process (DFID 2001). However, SLA is designed keeping in mind a systems approach (Gutierrez-Montes et al. 2009). DfS requires system-oriented thinking and problem-solving to improve the sustainability potential of a solution (Ceschin and Gaziulusoy 2016). Both start with an analysis of the inherent potential of the people involved rather than just their needs. Thus, both target to put an effort to eliminate the constraints in the path of realization of those potentials.

SLA stresses the need to bridge the gap between macro-level policy and institutions and the influence of the same on livelihood options of grassroots-level communities and individuals (DFID 2001). DfS gains strength when such thinking is incorporated into it. While conducting DfS, a designer needs to bring forth many stakeholders together and map their needs, wants, desires, aspirations, inhibitions, capabilities, capacities and pains. Through effective communication with the stakeholders, the designer reaches a sustainable solution on all three dimensions (social, economic and environment), contextually appropriate, and has mutually agreed trade-offs (e.g. 15 case studies from (Bacchetti et al. 2016).

Sustainability in SLA is looked at from two different perspectives. One is the sustainability of the livelihoods, and the second on the four dimensions of sustainability—environmental, economic, social and institutional. Therefore, trade-offs and choices within livelihood outcomes and between them and dimensions of sustainability are an integral part of SLA (DFID 2001). In the context of DfS, the dimensions of sustainability under consideration depend on the specific subject area. For example, circles of sustainability, which focuses on designing sustainable settlements, uses four dimensions of sustainability—environmental, economic, cultural and political (James 2014). MSDS, a sustainable product-service system (S.PSS) design methodology, uses three dimensions of sustainability—environmental, economic and social (Vezzoli et al. 2017).

1.2 The 'Designerly Ways'

Accordingly to Cross (Cross 1982), 'designerly ways' signify how designers navigate through real-world, ill-defined problems, approach them through a 'solution-focused' lens, think constructively and 'use codes that translate abstract requirements into concrete objects'. These abstract requirements can be in the form of needs, wants, desires, aspirations, inhibitions, capabilities, capacities, pains, system sustainability, etc. Design thinking involves adopting a systems approach wherein designing the interplay between these abstract parameters and their relationships results in innovations (Cross 2011b). That is very different from a piecemeal approach, like designing

a singular product. Thus, bringing in 'designerly ways' can strengthen the SLA. Design thinking can aid in creatively studying and balancing the five capitals and integrating the five core components. A designer is also trained in effectively bringing together a plethora of stakeholders and helping them perform participatory design for social innovation (Manzini 2015), a key to unlock the true potential of the SLA.

1.3 Design Supports

Traditionally, designers were bred as craftsmen, tasked with creating a new artefact with established skills and processes. From there, the designer evolved into a master of process and creator of novel solutions. Now, the designer is also a facilitator who enables others to come and work together and be creative. Consequently, through collaborative endeavours, designers create novel, culturally appropriate and contextually sensitive solutions. The task is challenging due to the involvement of many stakeholders and the large number of parameters to be considered for achieving sustainability. Thus, appropriate design supports (DS) can be helpful for a designer. A DS can be a design methodology, set of methods, guidelines and tools (Blessing and Chakrabarti 2009). The DS discussed in this paper are aimed to enable and aid a designer in DfS when the problem context in hand is 'design for SL,' 'design for marginal contexts' and 'frugal design'. In these contexts, the design process needs to consider livelihood opportunity generation, enhancement and sustainability. In addition, they need systems thinking, social and technical innovations (Ceschin and Gaziulusoy 2016; Khadilkar 2017) and should follow the guiding principles of SLA. Furthermore, these solutions are not simply concerned with a single artefact or service design; instead, the aim is to co-establish a novel value chain with local context stakeholders (Aurich et al. 2006).

1.4 Designing DS

Design of supports for design projects targeting social and technical innovations follows a fairly consistent process (Culén et al. 2016; Wang 2020; Peters et al. 2020a; Hoolohan and Browne 2020; Clatworthy 2011a; Brown 2021) (Fig. 1). Firstly, the research team understands the problem domain and the specific design scenario for which the DS needs to be designed. Then, the research team focuses on a specific aspect of the design process for which they wish to develop it (e.g. an ideation tool (Logler et al. 2018), a tool to uncover specific behaviour (Hoolohan et al. 2018), for facilitating a particular type of solution generation (Clatworthy 2011b). The process of understanding the requirement and the specific problem domain for which DS is needed can be done by identifying requirements for it through a study of the state of the art (Brown 2021) or be a by-product of experience obtained through practice (Clatworthy 2011b) or a combination (Reubens 2016). Finally, understanding the

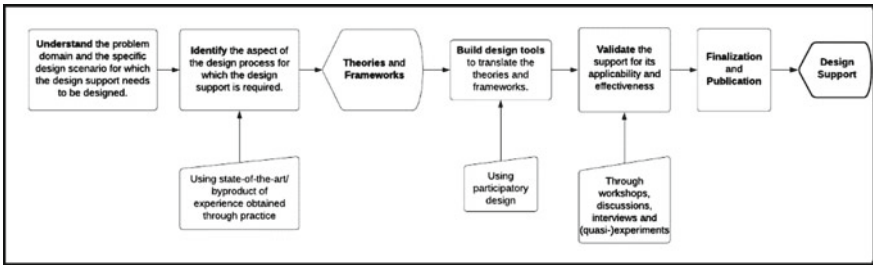


Fig. 1 Process of designing design supports

problem domain and the design scenario leads to theories and frameworks that the researcher develops to make sense of the design process needed for the scenario.

In the next step, the theories and frameworks are translated into design tools following an iterative design process (Peters et al. 2020a; Clatworthy 2011b). The goal here is to develop a physical artefact that operationalizes the theories and framework so that non-experts can apply them easily. More often than not, the iteration is done through participatory workshops (Peters et al. 2020a; Hoolohan and Browne 2020; Clatworthy 2011a). Finally, the iteration process is considered complete when the research team is satisfied with the results.

In the subsequent step, the research team validates the DS's applicability and effectiveness through workshops, discussions, interviews and experiments. There are also some instances where researchers have tried using (quasi-) experimental set-ups for the evaluation and validation of toolkits (Cardoso and Clarkson 2012). The final step typically consists of finalizing and publishing the toolkit in appropriate avenues like design conferences and workshops (Vitali and Arquilla 2018). Some authors make such tools freely available online as well (Hoolohan et al. 2018; Lockton et al. 2010; Hossain 2018).

The process of designing DS is rigorous and scientific, but their evaluations are rarely statistical. Despite this, there is ample evidence to show that such DS benefits their process positively (Culén et al. 2016; Clatworthy 2011a; Peters et al. 2020b). Therefore, we can argue that since the development and evaluation process is 'rooted in reality', they are valuable for design professionals and are easier to implement in design practice.

In this paper, we discuss our experience of developing, evaluating and validating DS for three different problem typologies: (1) 'design for SL' wherein the community's economic activities are deeply rooted in their social and cultural ways of living, (2) 'design for marginal contexts' (sustainable agricultural mechanization of small farms of developing countries) and (3) 'frugal design' for the lower-income strata to improve their livelihoods.

2 Methodology

We followed the methodology, as discussed in the previous section and represented in Fig. 1. For the DS 1 (Banerjee et al. 2019a) and 2 (Banerjee and Punekar 2020), the methodology for system design for sustainability (MSDS), an S.PSS[2] design methodology (Vezzoli et al. 2017), is used as the base. MSDS was identified as an appropriate methodology to start with through a study of the state of the art. It is then applied to real-life case studies, and from the experience of the application, appropriate modifications have been done. Next, we tested version 1 of the DS 1 on another case study to refine it further. For DS 2, version 1 was developed and tested on a case study, then enhanced using literature research. Version 2's effectiveness and validity were evaluated through a quasi-experimental approach. DS 3 version 1 (Upadhyay and Punekar 2019) was developed using literature research and experience from three real-life case studies. Again, we used a quasi-experimental approach to validate the effectiveness of the first version of the toolkit. Following this, a detailed version of the toolkit was developed and iterated twice. In the following sections, we discuss the design process, the steps used to validate and evaluate the DS and the challenges faced.

3 DS 1—Design for Socioeconomic Ecosystems (SEE)

3.1 The Context and Its Challenge

Banerjee et al. (2019a) We define a SEE as a context wherein the community's economic activities are deeply rooted in their social and cultural ways of living. Examples of the same abound in the craft and the handloom sector of India. The first design challenge here is to ensure sustainability on the socio-ethical dimension in a fashion that it is in the system stakeholders' economic interest to achieve the same. The next challenge is to build avenues for achieving environmental sustainability so that it is in the system stakeholder's economic interest to do the same. Two distinguishing key characteristics of a SEE are the multitude of stakeholders who co-own the system and the inherently distributed nature of the economy. All or some of the key activities like design, manufacturing, knowledge generation and distribution follow the principles of distributed economy, as defined by Johansson, Kisch

[2] PSS design is a design approach where a product and its associated services are designed together as a system offering to satisfy customers' needs. As ownership and consumption are de-linked, the sustainability potential of a PSS is high, if designed appropriately. 42. Vezzoli, C.A., et al., *Product-service system design for sustainability*. 2014: Greenleaf Publishing, 43.Tukker, A. and U. Tischner, *Product-services as a research field: past, present and future. Reflections from a decade of research.* Journal of Cleaner Production, 2006. **14**(17): p. 1552–1556, 44. Tukker, A., *Eight types of product–service system: eight ways to sustainability? Experiences from SusProNet.* Business Strategy and the Environment, 2004. **13**(4): p. 246–260.

(Johansson et al. 2005). SEE also has a long history of existence. Consequently, the stakeholders might have explored and perfected ways to achieve social, economic, environmental and livelihood sustainability to a certain extent. Hence, a designer must analyse the existing traditional, ecological and social knowledge systems and integrate the new design interventions into the local cultures. Hence, the central challenge here for a designer and a DS is: How to understand, explore and design for sustainable socio-ethical orientating of a SEE?

3.2 The 1st Case—Bordowa Tourism Industry

A sixteenth-century saint (also an artist, dramatist and the founder of Vaishnavism in Assam, India), Sankardeva, was born in Bordowa, a village in the Nagaon district of Assam. Thus, the place is a local tourist destination and attracts thousands of them during the weeklong festivities of Holi and Janmasthami. The rest of the year finds tourists in lower numbers. The place is a living embodiment of the saint's teachings who propagated a religion marked with 'simplicity,' 'openness' and 'without rules or restraints'. It only advocates for love and devotion for God, expressed through chanting and Bhaona (a theatrical performance) (Goswami 2018). Although it does not host restaurants and hotels, temporary eateries, mobile toilets and other shops crop up during the festivities. Due to religious beliefs propagated through folklore, the local lake (Akashi Ganga) is never polluted, irrespective of the large influx of tourists.

Tourism and agriculture are the major economic activities here, and traditionally, several sustainable practices are part of the trade and the way people live here. For instance, homes usually have two ponds, one for disposing of compostable waste and another for potable water and growing fish. The compost is used for the homestead garden, in farms and as fish feed. A farmer of Bordowa won acclaim from the President of India for his innovative sustainable farming technique by using the natural annual flood cycle of the place. The offering to God, which the people later consume, consists of sprouts and other fresh fruits. The idea of healthy eating is thus ingrained in the devotees. However, the influx of modern life is causing specific disruptions in sustainable practices. For example, wrappers and plastic bottles have no disposal system and end in the composting pond. Tourism, if not well organized and designed for can lead to various unsustainability. Local crafts like Kuhila are dying due to a lack of recognition and support (Majumdar and Banerjee 2017).

3.3 The Design Support—SEE

Post the preliminary study of Bordowa, we concluded that an S.PSS approach could be used to design sustainable systems for Bordowa to attain SL. MSDS was selected as the suitable DS base to build upon (Banerjee Unpublished results). MSDS's defines

S.PSS as: *"an offer model providing an integrated mix of product & services that are together able to fulfill a particular customer demand (to deliver a 'unit of satisfaction') based on innovative interactions between the stakeholders of the value production system (satisfaction system), where the economic and competitive interest of the providers continuously seeks both environmentally and socio-ethically beneficial new solutions"* (Vezzoli et al. 2014). It consists of four main stages: *strategic analysis*, *exploring opportunities*, *designing system concepts* and *system designing and engineering*. It is designed for contexts where there is an identifiable project proposer who will own the S.PSS. For SEE, the ownership of the S.PSS will be a group of stakeholders who will have similar influence and stake in it. MSDS also does not cover the aspects of SL for low-income contexts. Hence, there is a need for contextualization of the strategic analysis stage of the MSDS for the other stages to succeed (Banerjee et al. 2019b). Thus, the DS should aid the designer in

- identifying all stakeholders, their needs and motivations. (Awesome actors tool and value opportunity tool)
- identifying the available infrastructure capabilities to suggest required transformations or use them to their highest potential. (KFPS tool)
- helping the stakeholders in co-defining the scope of design by considering its implications on each other (economic and socio-cultural). (Frog Collective Action Toolkit)
- identifying the competitors for the co-defined scope of design. (Competitor analysis tool.

Thus, a new DS called strategic analysis tool (SAT) (Banerjee et al. 2019a; Banerjee et al. 2019b; Vezzoli 2021) was designed (Fig. 2) and added to the base MSDS methodology (Banerjee et al. 2019a). Student designers applied SAT to design several S.PSS options for Bordowa. The students reported that the DS helped them navigate through the complex challenge of SEE and DfS. In order to further evaluate the efficacy of SAT to the problem class, we tested it on another SEE, the Sualkuchi Silk handloom industry.

3.4 The 2nd Case—Sualkuchi Handloom Industry

Sualkuchi, the Manchester of Assam, is a silk handloom weaving town in Assam. The weaving history here can be traced back to the works of Kautilya, who lived from 371 to 283 BC. It took its current form during the patronage of the Ahom kings (1228–1828 AD). Most households here own a loom and engage in weaving. However, the industry saw a boom from the 1980s, and the average number of looms per household increased from 2 to 6 (Saikia 2011). Also, many households shifted from being weavers to entrepreneurs, owing more than 50 looms and engaging weavers to run them rather than family labour. Owners, weavers, reelers, helpers are the main production stakeholders. The owners own the loom. Small owners (<5 looms) primarily run their production using family labour. The weavers learn the art

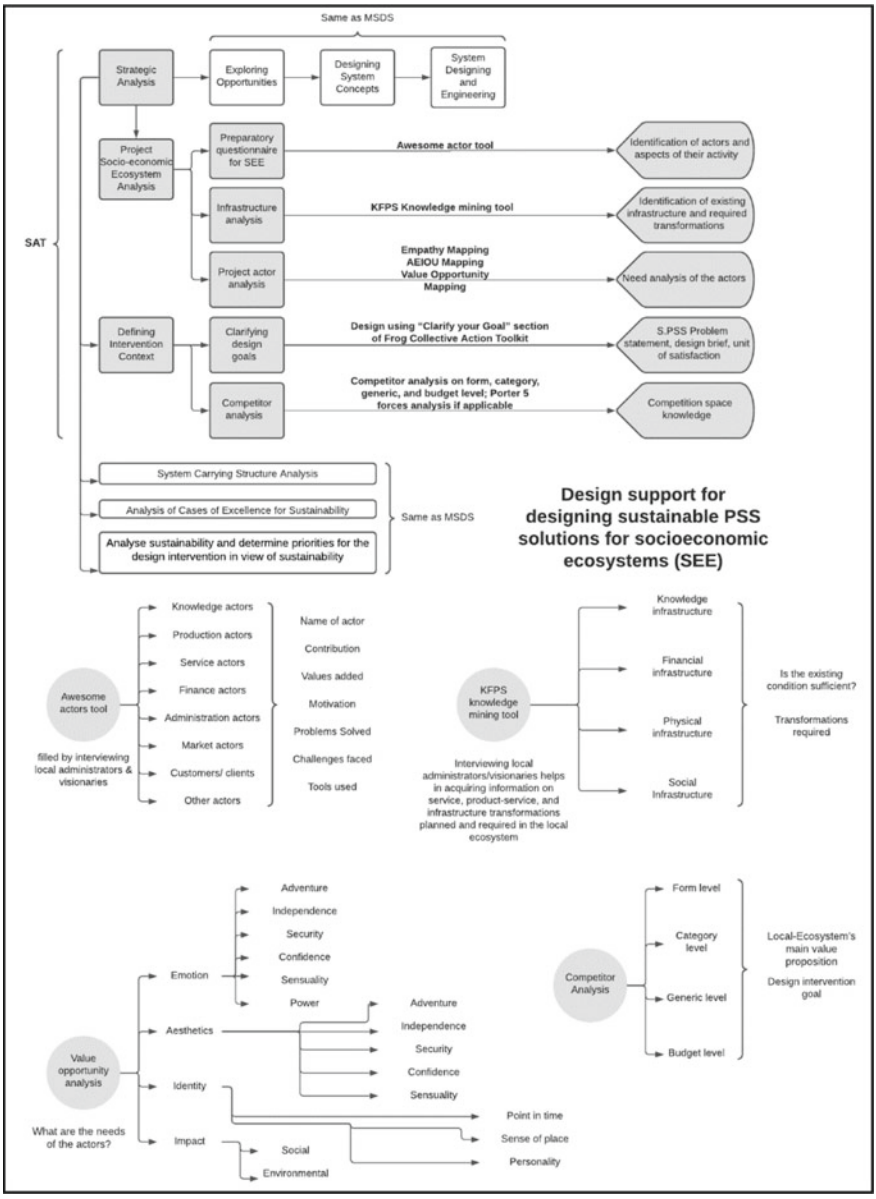


Fig. 2 SAT and modified MSDS for designing for SEE

of weaving on the job and come from different parts of the state. They are paid per unit of garment woven and the density or complexity of the design elements. Some post training go back to their homes and start their weaving set-up. The reelers and helpers are paid monthly. The other supporting actors are designers, loom makers, servicers, middlemen, distributors, shopkeepers (selling raw materials/finished products), government support units for low-cost raw materials for small owners, silk testing laboratory and Sualkuchi Tat Silpa Unnayan Samity.

This SEE has achieved SL over centuries due to its biggest strength, the inherently distributed nature of operations, which puts the different stakeholders at par. However, the number of large units (tending to a centralized economy) is increasing in the landscape. Moreover, the increasing cost of raw materials and lack of institutional financial support services are pushing the small owners to oblivion. The next pressing sustainability challenge that Sualkuchi is facing today is due to its unorganized production systems. That has led to a lack of adequate attention to technology, design, business model upgradation and stagnation.

Two batches of students (batch 1: Research scholars and batch 2: undergraduate and postgraduate students from multiple institutes and disciplines) used the SAT to study the SEE and conceptualize S.PSS solutions. After that, the students showcased their concepts to the SEE stakeholders for feedback. The experience shows that SAT helps analyse a SEE. It also aids novice designers in navigating through the nuances of a complex and wicked problem like design for SL for a SEE.

3.5 Key Challenges and Gaps

The faculty team initiated the development of the DS for sustainable SEE as part of their classroom project. The efficacy of the DS to date is tested only on students and as a pedagogy tool. Due to lack of financial support and the absence of institutional stakeholders to take the design outcome forward, the evaluation and validation of the SAT lack depth. Although SAT was helpful, further refinement of stage 2, exploration of opportunities, is needed to keep the students' explorations and solutions grounded in the context. Also, other tools are needed to capture traditional and grassroots knowledge and value systems and access their long-term impact at the personal, family, community and national levels.

4 DS 2—Design for Sustainable Agricultural Mechanization (D-SAM)

4.1 The Context and Its Challenge

Sustainable agricultural mechanization (SAM) is one of the key focuses of the Food and Agricultural Organization of the United Nations. It is critical to achieving the sustainable development goal of doubling the productivity and income of small-scale food producers by 2030 (FAO (2016a). SAM is described '*as mechanization that is economically feasible, environmentally sensitive and socially acceptable*' (Sims and Kienzle 2017; FAO 2016b). However, for mechanization to be sustainable, it needs to be designed considering the '*technical, economical and engineering aspects*' of machinery design while connecting it to the allied service ecosystem. The allied service ecosystem should contain '*linkages and inter-dependencies with other sectors*' that will offer a holistic view of conducting agriculture and integrate many stakeholders, both large- and small-scale, like manufacturers, service providers, farmers and governments. The stakeholders might have varied kinds of interests like research, profit-orientation, non-profit or governance. Although the overarching guiding principle for designing for SAM exists from FAO (FAO (2016b) and other researchers (Sims and Kienzle 2017, 2006, 2009, 2015, 2016; Sims et al. 2012, 2016; Baudron et al. 2015; Bezruk et al. 2014; Corti et al. 2015; Jongebreur and Speelman 1997; Gathorne-Hardy 2016; Vieri and Sarri 2010; Veisi 2012; Romanelli and Milan 2012; Brinks and Kool 2006; Hendrickson et al. 2008; Ziout and Azab 2015), there is no DS for designing for SAM (Banerjee and Punekar 2020).

The critical challenge in mechanizing small farms is their financial constraints, making machinery ownership beyond their reach (Sims and Kienzle 2016; Clarke 2000; Mottaleb et al. 2016). However, the custom hiring model is gaining momentum in this segment (Sims and Kienzle 2017; Diao et al. 2018; Mrema et al. 2014) (Banerjee and Punekar 2020). Thus, designing for SAM can be approached using an S.PSS model, wherein the machinery and its allied service ecosystem are designed in tandem. SL here implies sustaining the livelihood of the smallholders and also others in the system. These can be the machinery operators, owners, service personnel, spare parts sellers, manufacturers, employees, etc. Agricultural households often improve their income potential by engaging in other activities like becoming machine operators, owning shops, etc. Hence, designers have to view SAM design from four perspectives: 1. S.PSS design; 2. design for a sustainable agricultural outcome; 3. environmentally sustainable product design; and 4. SL. The S.PSS methodology, MSDS, lifecycle design toolkit, ICS toolkit and SLF form a good base for perspectives 1, 3 and 4. However, no DS exists for perspective 2. Hence, the central challenge here for a DS is: How to support designing for SAM considering amalgamation of the following four perspectives: 1. S.PSS design; 2. design for a sustainable agricultural outcome; 3. environmentally sustainable product design; and 4. SL?

4.2 The Case—Redesign of Power Tiller-Based Bed Planter and Its Ecosystem for South Bangladesh

Bed planting entails planting in raised beds to protect the plant from floodwater. A bed planter thus creates alternate beds and furrows and performs planting. A power tiller is an appropriate machinery for smallholders and widely popular in Bangladesh (Esdaile et al. 2009). Unfortunately, no machinery for bed planting was commercially available despite the popularity of the method. However, the introduction of a power tiller-based bed planter did not succeed in the market. (Banerjee and Punekar 2020) An analysis of the case revealed that the product was indeed designed keeping in mind the agronomic aspects well. However, it failed on ergonomics, build quality (due to lack of knowledge of the manufacturing team and availability of raw materials and manufacturing infrastructure), absence of supporting services like maintenance, servicing, training, etc. For example, the machine was very strenuous to manoeuvre, leading to extreme fatigue for operators. Thus, it was difficult to find operators who were willing to join the workforce.

4.3 The Design Support—D-SAM and G-SAM

We tested the four main stages of MSDS (*strategic analysis, exploring opportunities, designing system concepts and designing and engineering system details*) and the ICS toolkit on the case (Banerjee and Punekar 2020). They aided in the sustainability assessment of the current scenario (PSS and the machinery), sustainability priority setting for design intervention, sustainability-oriented ideation and assessment of the final solution. However, three gap areas emerged. MSDS lacked product design and design for a sustainable agricultural outcome focus. It also did not present methods to conduct participatory design in a scenario where the stakeholders varied widely in education and practical experience. On the one hand, they were highly educated stakeholders like engineers and scientists, and on the other, illiterate or semi-literate stakeholders like farmers and operators. To fill the sustainable agricultural outcome gap, a sustainable agricultural criteria (SAC) checklist was drawn. It also brought in aspects of the SLF in it. We integrated the SAC checklist in the various analysis, ideation and sustainability improvement evaluation processes of MSDS. The product design focus gap was filled by introducing a new process, product analysis in *Stage 1, Strategic Analysis* of MSDS (Fig. 3) and introducing a new stage, 'Product designing and engineering', as the fourth stage between *Stage 3: Designing system concepts* and *Stage 4: Designing and engineering system.* The case was successfully redesigned using this redesigned DS called D-SAM (version 1), standing for Design for Sustainable Agricultural Mechanization.

D-SAM (version 1) used three different toolkits (SDO, ICS and SAC) to achieve the four perspectives (S.PSS, sustainable agriculture, environment-friendly product and SL), making the task tedious. Hence, in D-SAM version 2, a comprehensive

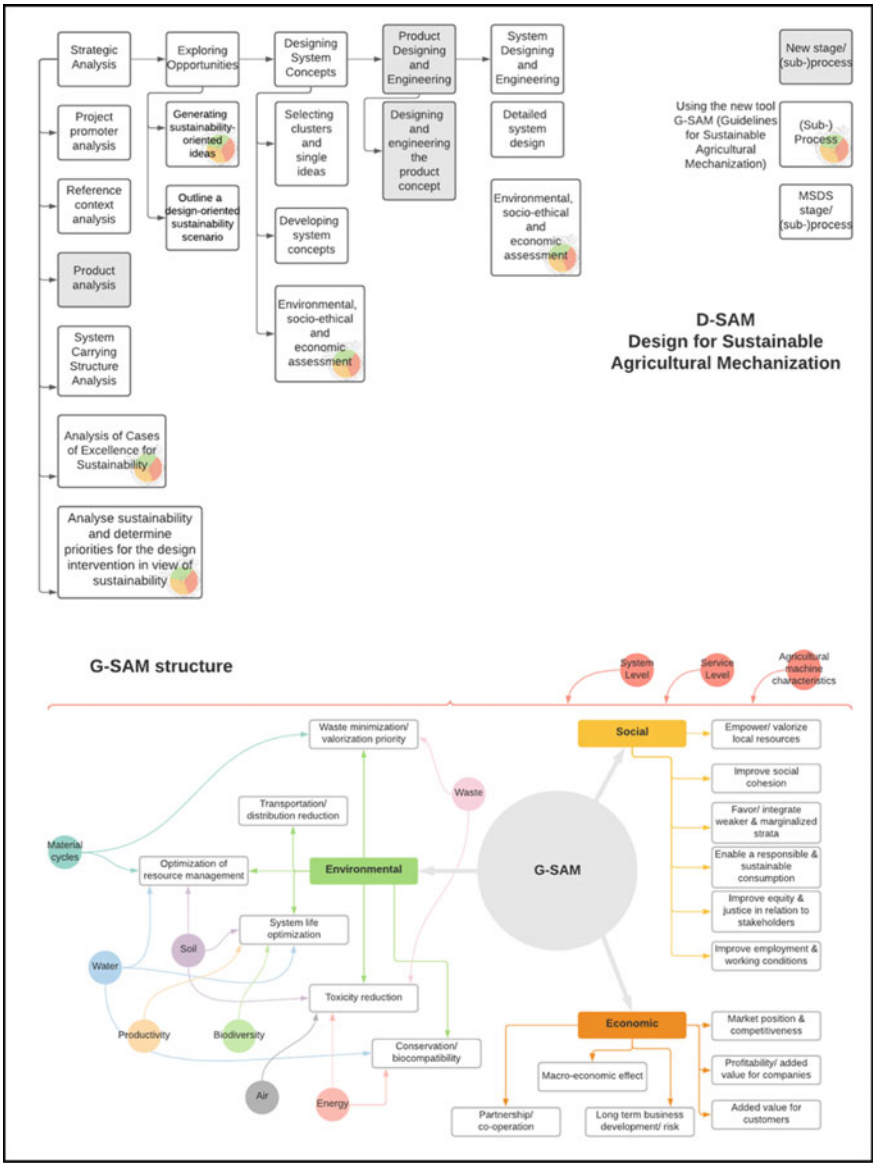
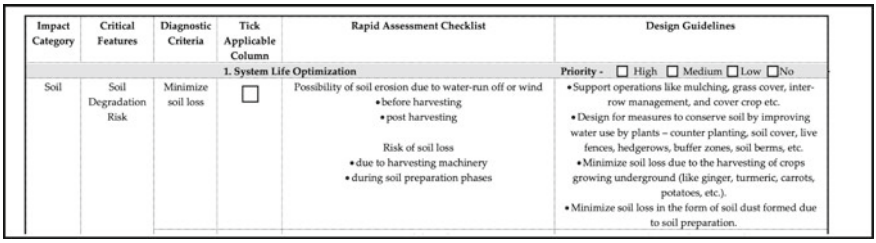


Fig. 3 DS for sustainable agricultural mechanization

toolkit called Guidelines for SAM (G-SAM) (Fig. 3) was designed. G-SAM is developed using the three toolkits and nineteen indicator-based sustainability assessment methods (Pottiez et al. 2012; Giovannucci et al. 2008; COSA 2013; Coteur et al. 2014; Dantsis et al. 2010; Elsaesser et al. 2015; Tzilivakis and Lewis 2004; Smyth 1993; Zahm et al. 2008; Rigby et al. 2001; Ehrmann and Kleinhanß 2008; Keulen



Impact Category	Critical Features	Diagnostic Criteria	Tick Applicable Column	Rapid Assessment Checklist	Design Guidelines
1. System Life Optimization					Priority - ☐ High ☐ Medium ☐ Low ☐ No
Soil	Soil Degradation Risk	Minimize soil loss	☐	Possibility of soil erosion due to water-run off or wind • before harvesting • post harvesting Risk of soil loss • due to harvesting machinery • during soil preparation phases	• Support operations like mulching, grass cover, inter-row management, and cover crop etc. • Design for measures to conserve soil by improving water use by plants – counter planting, soil cover, live fences, hedgerows, buffer zones, soil berms, etc. • Minimize soil loss due to the harvesting of crops growing underground (like ginger, turmeric, carrots, potatoes, etc.). • Minimize soil loss in the form of soil dust formed due to soil preparation.

Fig. 4 Sample of design guidelines with interdisciplinary pointers to aid ideation

et al. 2005; Meul et al. 2008; Gerrard et al. 2012; Grenz et al. 2009; Grenz 2011; Grenz and Sereke 2017; FAO 2013; Cauwenbergh et al. 2007; Wiek and Binder 2005; Binder and Wiek 2007; Binder et al. 2012; Calker et al. 2006) from other agricultural domains. It consists of three tables, one for each dimension (environmental, social and economic). Thus, the designer can select the applicable critical features for a given project, use the provided *rapid assessment indicators* for analysis and the *design guidelines* for ideation (Fig. 4). The ideation cues aid in creative thinking through cross-pollination of disciplinary knowledge.

We statistically evaluated the effectiveness of G-SAM using a before and after intervention study on a group of fifteen students (Banerjee et al. Unpublished results). The students' analysis and ideation depth improved by three to fourfolds, and the errors and misunderstandings reduced. Next, G-SAM was validated by seven professionals from India and China. They reported that G-SAM provided a structured and broad base for sustainability assessment and design ideation. That was irrespective of the disciplinary background of the participant. According to the participants, it *unhides* many (un)sustainability issues in their projects. They stressed the need for a more user-friendly toolkit presenting the set of guidelines.

4.4 Key Challenges and Gaps

D-SAM and SAC checklists were developed on a real-life sponsored case, designed by author 1, a professional. As a result, the depth of exploration and the institutional support was highly favourable. That led to a more grounded in reality DS development. The student projects on which the efficacy of the DS was tested were funded real-life projects but suffered from the students' lack of design expertise and experience. The seven projects on which the DS was validated catered to various agricultural practices like planting, harvesting, plant care and post-harvest processing from two different countries. However, the participants retrospectively compared their experience using the DS on these projects they had done in the past. The critical challenge in designing for SAM is the large volume of resources (time and workforce) required.

Hence, the DS has not been tested yet on another live SAM design case by professionals. G-SAM in its current form is information-heavy and needs further iterations to create a more user-friendly DS.

5 Design Support 3—Frugal Design

5.1 The Context and Its Challenge

Author 2, in his interactions with students working on projects for the base of the pyramid, observed that novice designers find it challenging to design for such context due to the various constraints which affect the design process (Upadhyay and Punekar 2019). Literature related to 'frugal innovation' provides a good starting point for designing for marginal contexts (Zeschky et al. 2015). Frugal innovations are solutions that cost significantly lower than existing solutions, are focused on a set of core functions and perform optimally to fulfil the need (Weyrauch and Herstatt 2016). The process of *'frugal* design' is a systematic approach to conceptualize frugal innovations.

Some critical differences exist between frugal design and the typical new product development approach despite the structural similarities. The frugal design process needs to consider deeper user understanding (Zeschky et al. 2015), take a holistic and broad scope (Khadilkar 2017) and identify constraints (Upadhyay and Punekar 2019). Some authors propose systemic solutions like PSS (Jagtap and Larsson 2013). Others argue that a *'frugal mindset'*, characterized by the designers' drive and pursuit to use resources during the design process judiciously, is an essential component of the frugal innovation (and design) process (Soni and Krishnan 2014). The outcome of a frugal design process should be a systemic and holistic solution (Khadilkar 2017). Thus, business and payment models, services and dissemination methods must be considered during the process (Upadhyay and Punekar 2019). The product architecture should be designed to reduce costs (Zeschky et al. 2015). The process should employ participatory and collaborative approaches to problem finding, idea generation and concept evaluation (Jagtap 2019). Multiple stakeholders should be sought and engaged in the design process and when the solution is deployed (Jagtap 2019). The final solutions should ideally create SL and income generation opportunities for the local populace (Jagtap 2019).

5.2 The Three Cases

Post literature review, author 2 analysed three project cases to understand the designers' difficulties in designing for marginal contexts. The first case is an undergraduate thesis project on developing a point-of-care medical device for performing

diagnostic tests for rural and marginal public healthcare centres in Northeast India. It was funded by a government agency and collaboratively designed by the Department of Design and Centre for Nanotechnology at IIT Guwahati. The Centre provided the sensors while the Design team focused on creating a user-friendly frugal design solution. The use of state-of-the-art technology shows that frugal solutions need not be based on rudimentary and archaic technology (Rao 2019). The second case is the design of semi-mechanized farm machinery for cleaning ginger and turmeric harvest for small-scale farmers. Rather than high technology, the focus here was on understanding social and environmental contexts in which the farmers worked and designing low-cost product architectures and novel means of dissemination through PSS. The third case centred around the design of solutions by understanding the washermen community of Guwahati, India. It concluded with a bicycle-mounted carrier design for transporting washed, wet clothes. It helped us understand the effect of social and geographical constraints on designing, developing and deploying design solutions in marginal contexts.

Thus, literature research and the three cases show the need for the design process to integrate aspects of the SLF (vulnerabilities, infrastructure, access, capitals and capabilities) and systems oriented design thinking. Although guidelines for frugal design are present (Jagtap 2019), DS development for the same has not been achieved yet. Hence, the central challenge here is operationalizing the guidelines, best practices, heuristics and approaches into a practically applicable DS.

5.3 *The Design Support—FDC Framework and FLOW*

The knowledge generated from the literature research and the case studies resulted in the frugal design conceptualization (FDC) framework (Fig. 5). Thus, frugal solutions are created in four phases: *understanding*, *ideation*, *conceptualization* and *finalization*. Participatory design is used to execute each phase. Each phase consists of

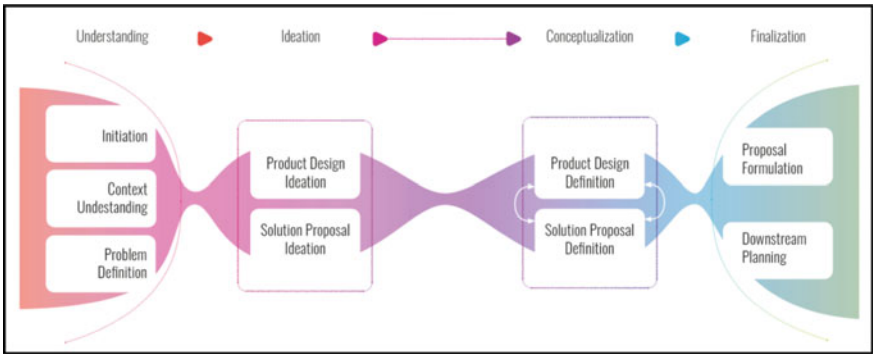


Fig. 5 Structure of the frugal design conceptualization (FDC) framework

interdependent and interlinked sub-phases which can be iterated. Each of these sub-phases consists of 'Design Activities' with specific objectives and outcomes. Finally, systematic execution of FDC results in a holistic frugal solution concept called a 'solution proposal'. A 'solution proposal' is a detailed plan with information on the product design, architecture, service design, business model and dissemination strategies. It is different from the concept of PSS as it is not dependent on servitization. In addition, it is different from a system design concept as it considers product engineering, architecture and manufacturing in greater detail than typically considered in a strategic and system design concept.

The Frugal Solutions Workflow (FLOW) Toolkit was designed to implement the FDC framework. The toolkit consists of a workbook, a set of cards, posters and 'Canvases'. The FLOW workbook describes the design activities comprehensively. FLOW posters provide information, inspiration and focus for executing the design activities and are designed to be placed in a designer's workplace and filled with information as the project progresses. Certain design activities have a 'Canvas' that works as prompts, probes and visual aids to properly execute the design activities. FLOW cards in the toolkit offer an abridged version of the design activities and serve as an aid. They can be used as a creative tool while planning the project or executing the design activities, or selecting the relevant stages (see Upadhyay 2021).

Version 1 of FLOW (step-by-step instructions based on the FDC framework) was tested with nineteen students from the Department of Design, IIT Guwahati, to check the efficacy of the FDC framework in frugal design for marginal contexts. The students were briefed on the research insights into the practices of the local washermen community and tasked to design solutions for four different tasks, two individually and two in groups. They used FLOW version 1 individually in the third session and groups in the fourth session. The first and second sessions used a workbook similar to FLOW but based on an established new product development process (design based on the text Ulrich 2003). The generated concepts were evaluated by five experts from industry and academia using a subjective multi-criteria decision-making method. We also interviewed the participants to understand their take on the efficacy. The evaluation revealed that FDC was an effective aid in the frugal design and was more effective when used in a group. Next, FLOW version 2 was designed using version 1's structure and iterating at the 'form' and modality level. Version 2 was prototyped and then evaluated by author 2, one expert and three students. Version 3, as presented at the beginning of the section, is currently under evaluation by professionals.

5.4 Key Challenges and Gaps

The FDC framework does not span the entire process of solution development. There are crucial aspects of pilot testing and execution that are not part of it. Although many aspects of pilot testing, evaluation are included within the FDC framework, the design team needs to append their work accordingly. Crucial inputs to the FDC framework

and FLOW toolkit were based on our experience in the Indian context. Some aspects of the toolkit may need to be adapted for other geographies and social scenarios. Both the FDC framework and FLOW toolkit were primarily evaluated in a laboratory setting with student subjects. Detailed evaluation in live projects is warranted to understand the efficacy of the toolkit fully. The toolkit was designed primarily for product design projects; its use in designing social innovation and software-based solutions is not yet fully understood.

6 Discussion

6.1 Designing Design Supports

We demonstrate how DS can be designed to aid designers in designing for projects where the focus is 'design for SL', 'design for marginal contexts' or 'frugal design'. The case study descriptions show that these projects have certain commonalities. They cater to the marginal contexts, and the cost of the final result and the design process is critical for success. There is a strong need for generating livelihoods and sustainability, the socio-ethical orientation of the design and development process and socio-technical innovations. However, they need different kinds of design approaches and, thus, the need to develop context-appropriate DS. These supports can be built on top of existing DfS methodologies by giving them appropriate adaptations (DS 1 and DS 2) or from scratch (as in DS 3). However, the DS building process should consider incorporating the core ideas behind SLA and 'designerly ways' for the given context.

In our attempt to find DS, we saw several DS for specific design contexts and goals. That suggests that generalizing DS is a challenging endeavour that may need rigorous validation to handle different design projects. Thus, a way to approach generalizing DS is through iterative design and multimodal validation.

6.2 Quasi-experimental Approach

The non-experimental nature of DS evaluation raises the question of its validity. Since rarely are these quantitatively verified, their validity must be scrutinized through qualitative research. In that sense, taking a constructivist view and validating through disconfirming evidence, field engagement and detailed accounts can be a way to establish the effectiveness of the outcome (Creswell and Miller 2000). Thus, DS validation must be conducted using real scenarios, improving them after each use and analysing the designers' experience in its implementation.

6.3 Creative Thinking

Designers are trained in creative thinking. A designer is also trained in effectively bringing together a plethora of stakeholders and helping them in performing participatory design for social innovation. Designing for social innovations is the key to creating SL. Thus, designers can bring together the two worlds of DfS and SL creatively and facilitate the system stakeholders to collaboratively design sustainable system-oriented solutions that can achieve SL.

Björklund (2013) reports significant differences between expert designers' mental models versus that of novice (student) designers' mental models in the context of *'defining and structuring wicked design problems'*. The differences lie in the amount of information needed, problem structuring, process selection and presentation of the problem. Experts demonstrated *'superior extent, depth, and level of detail, accommodating more interconnections and being more geared toward action'*. We observed similar trends in terms of creative thinking for wicked problems. The DS can come in handy in such cases. The DS 2 and 3, for which more extensive testing has been done, we saw that we could improve the students' creative exploration of wicked problems by incorporating creativity-enhancing processes and tools. A preliminary study with the DS 2 shows that experts' creative thinking also improved. DS 1 needs further development on this aspect, and DS 3 is under investigation with experts. DS 2 aids in creative thinking by making available many interdisciplinary pointers (e.g. Fig. 4), which can be used during ideation. A DS for the given context can be designed considering the need for supporting creative thinking as systems oriented problems are complex. Balancing the act in such cases can put creative thinking on the back seat. Novice designers face this problem more often than experienced ones (Banerjee et al. 2019a).

However, DS is just a tool. It is the skill of the designer if they can use it to its best capacity. Some authors caution against the excessive use of DS or considering them as a substitute for the designers' skill (Freach 2021). There is no substitute for a rigorously executed design process and a skilled designer who can interpret the findings into meaningful insights. However, DS can bridge the gap to provide a structured thinking process and make it easier for designers to approach complex and challenging socio-technical design problems.

6.4 What Can DfS Learn from SLA?

Whenever the context of DfS is 'design for SL', 'design for marginal contexts' or 'frugal design', the designer and the DS should investigate the vulnerability context, livelihoods assets, policies–institutions–processes, livelihoods strategies and livelihoods outcomes. The analysis and design process should also examine and balance the five capitals: human, natural, financial, physical and social. That is because designing for the (economic) top of the pyramid and the bottom is different. In

the latter case, designing products must be looked at in conjunction with poverty alleviation and business development (Jagtap et al. 2014). The livelihoods approach also brings an integrated outlook (rather than a sectoral approach) to the United Nations Sustainable Development Goals (Scoones 2019; Scoones et al. 2018).

6.5 What Can SLA Gain from DfS?

DfS can bring in 'designerly thinking' into SLA. Designers are trained in creative and systems oriented thinking. They can translate abstract requirements into innovative solutions by playing around with the interrelationships between the system parameters. DfS thinking is geared towards achieving socio-technical innovations and giving the design process a socio-ethical orientation. DfS focuses not only on the system design aspects but also on the granular-level design of each system component: products, services, interactions and systems. Thus, the possibility of creating social innovation and SL is well supported by DfS. A designer trained in the art of DfS might possess one or more of the following key competences: (1) systems thinking; (2) interdisciplinary work; (3) anticipatory thinking; (4) justice, responsibility and ethics; (5) critical thinking and analysis; (6) interpersonal relations and collaboration; (7) empathy and change of perspective; (8) communication and use of media; (9) strategic action; (10) personal involvement; (11) assessment and evaluation; (12) tolerance for ambiguity and uncertainty (Lozano et al. 2017). All these skills and the DS which embed these in them can come very handy in designing for SL.

6.6 Social Innovation and Its Challenges

Social innovations contributes positively to achieving sustainable livelihoods and lifestyles (Mehmood and Parra 2013). It presents a unique opportunity to achieve sustainable development through inclusive practices and coproduction. It advocates proactively designing with the stakeholders, following a bottom-up approach rather than a top-down approach. Thus, participatory designers gained its momentum over ego-centred design for DfS. Incorporation of this feature of DfS into the design process and building appropriate DS to aid the same further strengthens the process. However, this brings us to some unique challenges as well. As stated in the case example for DS 2, some of these contexts might demand participatory design between stakeholders who are highly educated and others who are illiterate but proficient in the art of the trade. Bridging the communication gap in such cases becomes the biggest challenge for a designer. Participatory design also demands high levels of institutional support. In general, any social innovation demands high degree of institutional support and depth of exploration for success.

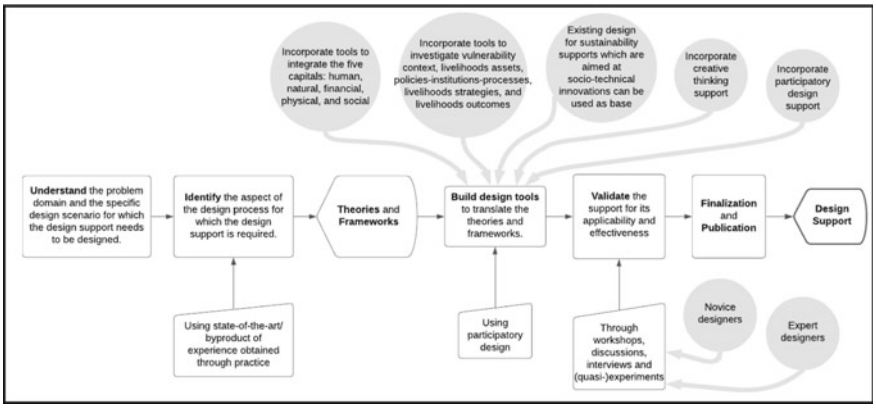


Fig. 6 Process for designing design supports for sustainable livelihoods

Thus, we conclude the above discussion with Fig. 6 that summarizes the process for designing DS for SL.

7 Future Work

The three DS mentioned in this paper are work under progress. They have been evaluated mainly by students or by professionals retrospectively. Our teams' primary goal in the future will be to test them with professionals on real-life cases and iterate the DS further. Our DS is still far from achieving any ground-breaking socio-technical innovations. Hence, we aim to apply them to real cases with long-term engagements to study their potential in instigating social innovations.

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Chapter 5
One Size Does Not Fit All: Heterogeneous Groups and Digital Training for Women in Tamil Nadu, India

Arun Kumar Gopalaswamy and M. Suresh Babu

1 Introduction

The sustainability and long-term success of small and tiny businesses becomes a crucial point to ensure livelihood opportunities for the poor (Cant et al. 2016). Adoption and absorption of recent technologies is considered to be one of the most important tools for these entrepreneurs in growing sustainable businesses (Adeniran and Johnston 2016). In recent times, there is an increased need for small businesses to employ information and communication technologies (ICT) to enhance their businesses. Cant et al. (2016) note that ICT is an essential success factor for many successful small and medium enterprises (SMEs). Mutula and Van Brakel (2007) state that one of the major challenges faced by developing countries is the elevation of education and literacy, in general, and digital literacy, in particular. This, in turn, leads to an increased need for digital literacy interventions for these entrepreneurs.

Social enterprises in India have been extensively focusing on bridging the digital divide through a host of initiatives ranging from helping create an ICT-based microenterprise to imparting basic skills in digital literacy to rural women. In this study, we provide the results of evaluation of such an initiative in the state of Tamil Nadu, India. This initiative set out an ambitious target of empowering 57,000 women and youth in three districts, viz. Kancheepuram, Tiruchirappalli and Salem in Tamil Nadu, India. Our evaluation assesses the performance of the digital literacy project with specific reference to, relevance, efficiency, effectiveness, sustainability and potential for impact.

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An inquiry through the sustainable livelihood framework, a particular form of livelihood analysis, which used by a number of organizations (Carney 1998), could provide useful pointers. 'It is primarily a conceptual framework for analyzing causes of poverty, peoples' access to resources and their diverse livelihoods activities, and relationship between relevant factors at micro, intermediate, and macro levels. One feature of this framework is that it looks at more aspects of people's lives than how many live on a purchasing power of $1.00 a day. A second key feature of the sustainable livelihoods framework is that it recognizes people themselves, whether poor or not, as actors with assets and capabilities who act in pursuit of their own livelihood goals' (Adato and Meinzen-Dick 2002, pp 6–7). The conceptual framework for sustainable livelihoods is discussed in DFID (2001). The framework is intended to be dynamic. It recognizes changes due to both external fluctuations and the results of people's own actions. Attention is given to the assets that people can draw upon for their livelihoods. Further, it is premised that assets interact with policies, institutions, and processes to shape the choice of livelihood strategies. These, in turn, shape the livelihood outcomes, which are often the types of impact we are interested in. The asset based upon which people build their livelihoods includes a wider range of assets than are usually considered.

2 Benefits of ICT in Women's Microenterprises

Participation of women is significant in influencing livelihood outcomes. Shoba et al. (2004) state that gender differences in distribution and access to assets—such as credit or technology—are crucial in ownership and management of sustainable enterprises. Further, it can also be noted that UNDP's Social Development and Poverty Eradication Division (SEPED) has integrated technology into its sustainable livelihood framework (UNDP 1997) as gendered access to and use of technologies is crucial for livelihood outcomes.

In the context of emerging economies, enhanced access for women regarding product information and increasing their participation in supply chain helps increase competitive power for the microenterprises they operate and improve earnings. This could lead to increased personal incomes and overall economic development as women empowerment and economic development are closely related. Empirical evidence suggests that money in the hands of mothers increases expenditures on children. Doepke and Tertilt (2019) indicate that women indeed spend more on children and invest more in human capital. The study also documented targeting transfers to women increases the growth rate of an economy. Women's economic opportunities are linked directly to women's access to land, labour, financial and product markets. In transforming economies where ICT-based services provide avenues for women's participation in economic activities, increasing women's opportunities to benefit from new electronic-based services could lead to enhanced productivity and incomes to support their families and communities. Though it is not easy to measure the impact of ICT in areas of health and education, there exists positive impact of

ICT-based enterprises in terms of saving of time and gaining flexibility for women (Melhem et al. 2009). According to Duncombe et al. (2005), a focused approach towards empowering women leads to improved financial assets, improved physical, human and social assets, recognition, respect and acceptance in the society. Further, the study also documented that it is not only women who are benefitted due to the ICT enterprise but the agency which aids the women also to stand to gain in the process. These gains could be in the form of achieving their goals on social welfare objectives to aid in garnering donor funds, recognition or improved performance appraisals, enhanced entrepreneurship development, employment and growth.

Empowerment is not a visible component in entrepreneurship research as they focus mainly on addressing barriers and opportunities for women's entrepreneurship, entrepreneurial character, intent or motivation (Al-Dajani and Marlow 2010). However, there is growing evidence on issues related to women's microenterprise (Kantor 2005; Mayoux 2002; Odero-Wanga et al. 2009) that a positive relationship exists between motivation, empowerment and entrepreneurship (Al-Dajani and Carter 2010). According to Dajani and Marlow (2013), women's entrepreneuring is intimately entwined with empowerment opportunities and, moreover, their business ventures provide a legitimate outlet for expressing, sharing and celebrating their heritage, identity and political power through traditional craft. Doepke and Tertilt (2019) conclude that women empowerment cannot be regarded as a generic concept that has uniform effects at all stages of development. Rather, the effects of women empowerment depend both on the specific form that an empowerment policy takes. In this study, we analyse an important dimension of empowerment which assumes relevance in a technology-driven era that is the role of ICT-based entrepreneurial activity by the women.

3 The Context

Financial inclusion for women leads to empowerment and has resulted in increased household welfare and more vibrant local economies. If achieving financial inclusion is key for women to be able to engage with their local economies and invest in their families and communities, investment in appropriate and transformative local infrastructure can be a critical accompaniment to accelerate progress for gender equality and women's economic empowerment. Providing access to financial resources and capital for women and gender-sensitive investments not only increases inclusive growth, but can also help to reduce income gaps between men and women. Access to and use of regulated financial services increases incomes of low-income population, helping them to move out of poverty and stay out. Individuals and microentrepreneurs secure opportunities to build equity, invest in businesses and in themselves (e.g. on health care, education and skills), better manage their small and/ or irregular incomes that would otherwise cause vulnerability, and more easily pay for merchants or send and receive money from relatives and friends. Similarly, small and medium businesses secure opportunities to invest and grow, which create jobs and help individual

employees to secure regular income flows, enabling them to better plan and manage their finances. One of the models adopted to achieve this is through formation of self-help groups (SHGs), wherein the members of the tightly knit group encourage savings and collectively aid in individual development. This also provides them the necessary group collateral to garner financial support from microfinance institutions. Studies indicate that SHGs mediated by microfinance have helped women gain control over assets and subsequently acquire self-esteem, knowledge and power (Zaman 1999; Pitt et al. 2006; Swain and Verghese 2009; Chowdhury 2009). Further, Swain and Floro (2012) document that vulnerability declines significantly for those that have been SHG members coupled with increase in food consumption. Recognizing that a blend of gender-sensitive public and private investment will be required to advance local development is imperative for inclusive growth. Hence, programmes designed for inclusive and equitable development have to test ways of unlocking private finance for potentially transformative infrastructure projects that benefit women. Further, a major causal link identified in terms of enhancing empowerment is the fact that microcredit delivered through SHGs helped women gain control over assets and acquire self-esteem (Pitt et al. 2006; Chowdhury 2009).

As portrayed in Fig. 1, membership in SHG and subsequent training programmes envisage a series of positive outcomes culminating in higher incomes and empowerment of women. Evidence from eastern India shows positive changes in the income of members after joining SHG-linked MF initiatives (Mula and Sarker 2013). Focus on a gender-sensitive infrastructure project that has the potential to be a significant driver of poverty reduction and women's economic empowerment is considered beneficial. Interventions have used a variety of investment in the form of training women engaged in micro, small and tiny enterprises leading to substantial benefits.

Though India has been appreciated globally for providing IT services, the persisting digital divide with lower penetration for access to Internet poses a serious challenge for its rural population. It has also been documented that the gap in accessibility arises out of the differences in factors such as income, location, gender and age. Further, it may also be noted that women use less digital technology compared

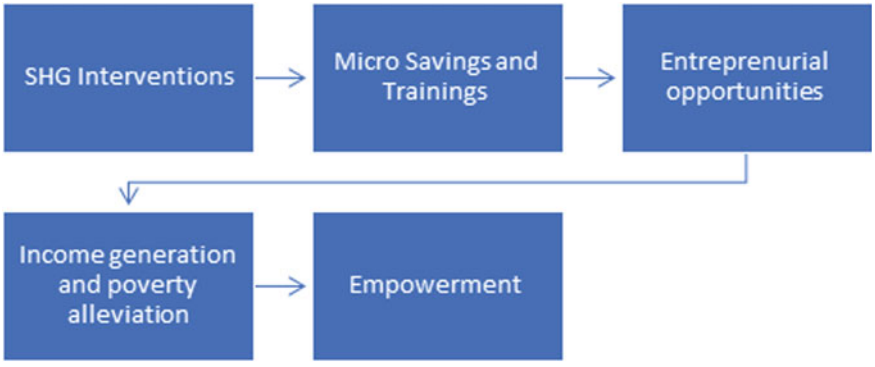


Fig. 1 Expected causal chain

to men, and gaps are even greater between youth and aged sections of the population. It is thus imperative that for enhanced social progress there exists a need to increase access to information and communication technology especially among women in rural areas as the spread of ICT can benefit the economy and society through increasing productivity gains only if people having access to technology also have the requisite skills for making optimal use of it.

Digital adoption among businesses has been uneven across all sectors. Digital leader firms are two to three times more likely to use software for customer relationship management, enterprise resource planning or search engine optimization. Firm size is not always a differentiator: while large firms are far ahead in digital areas requiring large investments like making sales through their own website, small businesses are leapfrogging ahead of large ones in other areas, including acceptance of digital payments and the use of social media and video conferencing to reach and support customers.

Digital applications could proliferate across most sectors of India's economy. By 2025, core digital sectors such as IT and business process management, digital communication services and electronics manufacturing could double their GDP level. Newly digitizing sectors include agriculture, education, energy, financial services, health care, logistics and retail, as well as government services and labour markets. Digital applications in these sectors help raise output, save costs and time, reduce fraud and improve matching of demand and supply. New digital ecosystems are already visible, reshaping consumer–producer interactions in agriculture, health care, retail, logistics and other sectors. Opportunities are growing in such areas as data-driven lending and insurance payouts in the farm sector.

With the continuing advancement in technology, the use of smartphone as an alternative way to connect with the online world is increasing especially for those who are economically deprived. Although smartphone helps in enhancing the access to Internet, it frequently encounters a number of constraints in terms of basic awareness and safety attributes for use. It is documented that despite disadvantages, the advantages of using a smartphone and its features have been enormous such as finding job opportunities or gaining new career skills, learning about or accessing government services, learning new things that may improve their lives and getting health information. Given this, there has been an increased emphasis through various initiatives in technology to bridge the digital divide through initiatives such as 'digital literacy learning'.

4 The Programme

In order to bridge the digital divide and fill the information gap in ensuring empowerment among women, a prominent development sector organization[1] launched a tailor-made digital literacy training programme for women in three districts of Tamil

[1] Name concealed for maintaining confidentiality.

Nadu, India. The purpose was to educate women on the use and applications of smartphones that would enable them access all information from their hand-held device, which is widely available among the rural population in Tamil Nadu. The primary objective of the project was to reduce the digital divide and to empower women and youth by imparting knowledge on Internet usage through effective use of smartphone. The project targeted to empower around 57,000 women and youth in the three districts, viz. Kancheepuram, Tiruchirappalli and Salem in Tamil Nadu, India. The training was expected to enable them to use digital technology to carry out their business/enterprises. Ensuring that the target group goes through a well-structured course helps them become digitally literate, specifically in the efficient use of smartphones. Further, the project is also expected to aid the users in accessing information on the key social and economic welfare schemes of the government specific to women and youth, for which promoting the use of smartphone would be extremely beneficial. The target group assumed significance as access to and use of mobile telephony, and Internet was expected to increase incomes of low-income population and help them to move out of poverty. The ultimate goal of this initiative was to reduce the digital divide and to empower women and youth by imparting knowledge on Internet usage through effective use of smartphones.

Access to smartphones and the ability to effectively use technology such as the Internet are becoming increasingly important for better participation of citizens in the economic, political and social development of society. Low mobile literacy and lack of support in acquiring digital skills are the significant barriers to women's mobile Internet usage.

Against this background, promoting digital literacy among women will be considered as a unique and relevant attempt in bridging the digital divide among semi-urban and rural women to enable them to access relevant and critical information for their socio-economic empowerment. Use of a mobile phone especially a smartphone and subsequent positive outcomes culminating in terms of self-development and higher spends on children's education is depicted in Fig. 2. Focus on various features of smartphone usage especially with Internet facility has the potential to be a significant driver in terms of empowering women. The intervention used a variety of methods firstly in training the women on the usage of phone and the potential benefits that could derive from it and secondly in the form of providing credit to them for acquiring a smartphone to encourage and empower them.

5 Methods

As a primary step, the details of training were analysed, the input provided and expected output for each of the modules was assessed for identifying the expected outcomes of the initiative. At the second level, a field survey and collection of both qualitative and quantitative data from a sample of women and youth who have undergone training were carried out. The scope involved administering questionnaire to a predecided sample of beneficiaries who have undergone training. The sample was

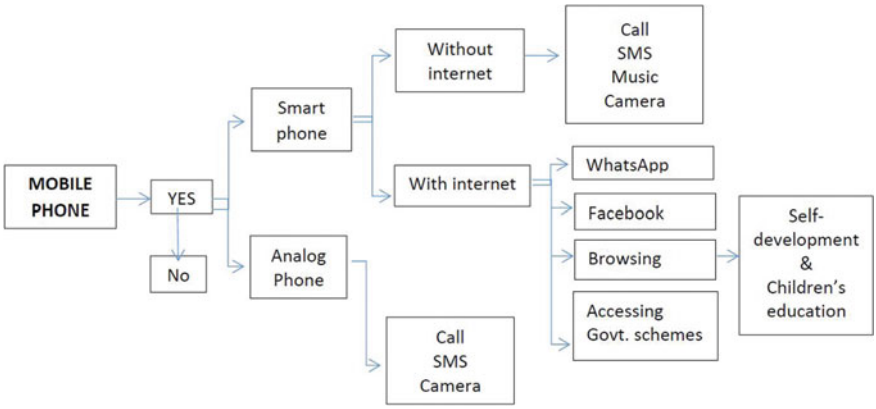


Fig. 2 An overview of the intervention

based on demographics, such as age, social status, location, educational qualification and family income. The sample covered all the project districts and across identified demographics where intervention was carried out. Based on the analysis of the responses to the questionnaire, we conducted focused group discussions (FGDs) to validate the findings.

Given the scope of training programme imparted on the use of smart mobile phones, the possible benefits could be both tangible and intangible. Secondly, these benefits could be short term or initially slow to accrue. Based on these parameters, we arrived at the following broad aspects of possible benefits:

- Financial transactions;
- Accessing government schemes and public welfare schemes;
- Entertainment;
- Occupation;
- Enhancement of family income;
- Skill enhancement and employment.

We chose mixed methods approach as the most appropriate methodology for this study by combining relevant qualitative and quantitative approaches in social science research (Creswell 2003). Regarding quantitative approach, our focus was on collecting numerical data from a sample which could be used to draw some generalized inferences across sections of the population. However, such generalizations could bear the risk of oversimplification, which is hedged with the use of qualitative data focusing on collecting information from the experiences/opinions of the participants. Mixed methods combine the elements of quantitative and qualitative research approaches in order to understand the entire phenomenon. Both open-ended and closed-ended data were collected and analysed.

We employed a sample survey following a cross-sectional design in the quantitative phase. Our survey instrument was developed with the help of literature and inputs received during discussions with the personnel who have been at the design

and implementation of the initiative. Based on discussions with the project implementing team, it was felt that it takes six months from the date of completion of training to realize the complete potential of the training. In addition, the maximum impact is also felt in the first one year controlling for other effects. Therefore, it was decided to focus on participants who were trained six months prior to conducting the survey but not earlier than one year from the date of start of the survey. We also eliminated participants who were trained in the first few rounds of the project as it takes at least three to four rounds of training for the training module to reach a steady state based on the feedback from the initial trainees. Further, the initial rounds of training were more than a year prior to the start of survey.

We chose staged cluster sampling as the most appropriate method for administering questionnaire for data collection. According to the guidelines in the literature when the population is large and widely dispersed, it may be more appropriate to initially select subgroups such as geographical areas rather than randomly selecting from the whole population. The sample selection was based on a predetermined set of process. Further details on the classification of the respondents based on gender and qualification in terms of exact number in each of the group are presented in the subsequent section. After eliminating invalid responses due to missing fields and other factors, we had 2754 valid responses for analysis.

Our data collection and analysis were carried out on two aspects: (i) individual level in terms of awareness and (ii) individual level use for socio-economic benefits. Further, we conducted FGDs after the initial analysis of the data at seven locations covering all the three districts. Target audience of the FGDs consisted of women/men who have undergone training on use of smartphone. Each focus group had a strength of about 10–14. As indicated earlier, the study was conducted in the districts of Kanchipuram, Tiruchirappalli and Salem where the digital literacy training was conducted for rural communities. The three districts cover seven blocks, namely Balchettychataram and Walajabad in Kanchipuram district; Tiruchirappalli Corporation, Manikandam and Thuraiyur, in Tiruchirappalli district; and Nangavalli and Edappadi in Salem district.

6 Survey Findings

a. Socio-economic Profile of the Participants

This section portrays the socio-economic characteristics of the respondents. Of the total valid 2754 beneficiaries, 2571 were female and 183 were male. It may also be noted that there are variations in the socio-economic profile of the respondents. The data provided in all the tables are in percentage.

From Table 1 which provides the age profile of the respondents, it can be observed that there is a wide variation in terms of age of the participants in the programme ranging from 18 to 70 years. Out of 2754 valid respondents, 50 per cent were in the age group of 31–40 followed by 27 per cent in the age group of 21–30 and 18 per

Table 1 Age profile

Age group	Male	Female	Total
Less than 20	14	2	3
21–30	45	26	27
31–40	31	51	50
41–50	9	19	18
51–60	1	1	1
61–70	0	1	1

*All figures are in percentages

cent in the age group of 41–50. About 38 respondents representing 1 per cent were in the age group of 61–70 years. Thus, it can be noted that 77 per cent of respondents were in the prime working age group of 21–40 years and can be classified as youth or as population who might derive the maximum benefit. The age distribution among male and female, participants indicate a higher number of female respondents in the age group of 31–40, while majority of male respondents were concentrated in the age group of 21–30.

Education is considered as an important indicator for the use of smart mobile phones. Out of 2754 respondents, about 32 per cent of them had completed middle school followed by 28 and 20 per cent of the respondents having completed high school and higher secondary, respectively. It can also be observed that about 8 per cent of the respondents had completed under-graduation. The educational status among male and female, participants indicate that majority of male (32 per cent) participants had completed higher secondary while majority of female (34 per cent) participants had completed middle school (Table 2).

Of the 2754 total respondents, 71 per cent were homemakers. It can also be observed that about 42 per cent of the male respondents were employed and 22 per cent were self-employed while majority of the female participants were homemakers. Table 3 provides the occupational distribution of the respondents.

Table 2 Education profile

Educational status	Male	Female	Total
Primary	2	10	9
Middle	7	34	32
High	20	28	28
Higher sec	32	20	21
UG	28	6	8
PG	2	1	1
Diploma ITI	8	1	1
Professional	1	0	0

*All figures are in percentages

Table 3 Occupational distribution

Occupation	Male	Female	Total
Housewife	0	76	71
Student	21	3	4
Self-employed	22	8	9
Employed	42	10	12
Unemployed	15	3	4

*All figures are in percentages

Table 4 Monthly family income (INR)

Income	Male	Female	Total
Less than 5000	7	11	10
5001–10,000	46	49	48
10,001–15,000	33	21	23
15,001–20,000	11	13	13
20,001–25,000	2	4	4
25,001–30,000	1	2	2
Above 30,000	0	0	0

*All figures are in percentages

Income is an important indicator for understanding socio-economic status of the population and is expected to have a positive relationship with mobile phone usage. Table 4 indicates that 48 per cent of the total respondents were in the category of family income level between INR 5001 and 10,000 per month followed by 23 per cent in the category of INR 10,001–15,000 and 13 per cent in the category of INR 15,000–20,000. The variation was not much among the male and female respondents for monthly family income. It should be noted that family income of the respondents and not individual income has been used to indicate the economic status.

It can be observed that most of the participants were in the age group of 31–40 years and have completed middle school. The educational background of the participants does not vary much across male and female. However with regard to occupation, it can be observed that majority of female participants were homemakers while male participants were either employed or self-employed. Given this socio-economic context of the respondents, it is important to analyse the ownership and usage of mobile phones which is discussed in the subsequent section.

b. Prevalence and use of Mobile phone

In this section, the details of the ownership and utilization of the phones are discussed. Out of 2754 total valid respondents, about 2285 (83%) owned a mobile phone. Of the 2285 phone owners, 55 per cent owned smartphone and the rest owned analog mobile phone. More number of men (80 per cent) owned smartphone compared to women (53 per cent). Women use relatively lower rung smartphone and analog phones compared to men. Even though the ownership of smartphone would be lower

among women, the number of users among women could be high as they tend to use the phones owned by the other members of the family.

Awareness about the possible uses of smartphone is a key factor to determine the level of usage of the phone. This training was expected to increase the level of awareness about smartphone which is expected to result in higher ownership and usage. With the help of survey, we were able to assess the level of usage of smartphone in terms of time spent in using the phone per day. Figure 3 presents the time spent by the respondents in using the smartphone per day. It can be observed that about 40 per cent of the respondents use the phone for about 1 to 3 h per day on an average while 20 per cent of them use it for less than an hour. At the other end of the spectrum, we also found that 12 per cent of the respondents use the phone for more than 9 h a day (including for all forms of usage).

Figure 4 presents the percentage of Internet users among smartphone owners. It can be observed that 96 per cent of the smartphone (both male and female) owners also use Internet.

c. **Outcomes of the training**

Having observed that 96 per cent of smartphone owners have Internet facility in their phone, the source of knowledge on the use of Internet assumes importance. The respondents were asked for the source through which they learnt to use Internet on their smartphone. Majority of the Internet users on the phone (89 per cent) indicated that they learnt to use Internet through the training imparted as part of digital literacy programme. It may also be noted further that 90 per cent of the women Internet users on smartphone learnt to use Internet through training. Thus, it can be inferred that more female participants benefitted through the digital literacy programme. Similar

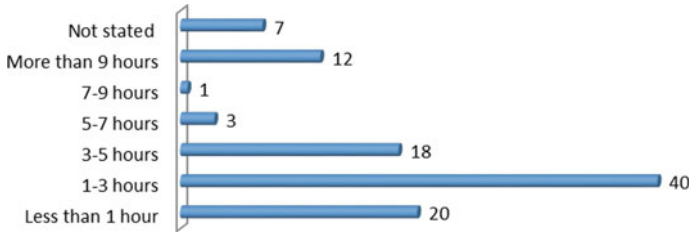


Fig. 3 Pattern of phone usage

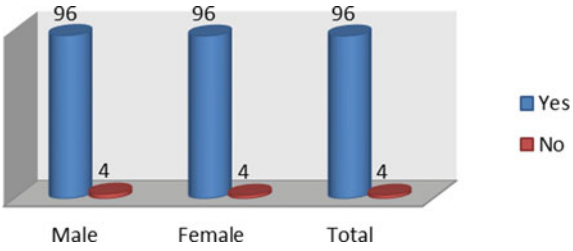


Fig. 4 Internet usage on smartphone

Table 5 Source of learning to use Internet

Sources	Male	Female	Overall
HiH training	83	90	89
Self-learning	26	21	22
From friends	11	4	5
From spouse	1	6	6
From children	70	2	2

*All figures are in percentages

to the earlier case, survey participants were allowed to choose more than one option if their source of learning was more than one which is depicted in Table 5.

Since a large section of the respondents learnt to use Internet through training, the logical next step is to assess the usage of applications (apps) on the phone among the phone-based Internet users. It can be observed from Table 6 that WhatsApp is the most commonly used application with 74 per cent of the mobile Internet users followed by YouTube (70 per cent) and Facebook (40 per cent). There was no significant difference in terms of the pattern of usage of apps between men and women. Use of phone for financial transactions especially for banking applications was the least preferred for both men and women possibly due to the fear of losing money while transacting over phone.

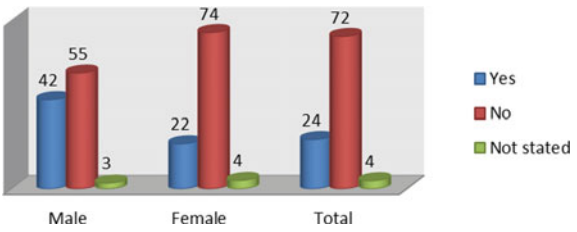
Though banking operations were used only by nine per cent of the Internet users on phone, about 24 per cent of the Internet users on phone had used it at least once in the past for financial transaction. The nine per cent users are the frequent users of smartphone for banking operations. From Fig. 5, it can be observed that among

Table 6 Applications commonly used

Apps	Male	Female	Overall
Google	63	44	46
WhatsApp	81	74	74
Facebook	59	38	40
Email	29	13	14
YouTube	66	70	70
Banking/financial	15	8	9

*All figures are in percentages

Fig. 5 Smartphone usage for banking operations



the phone users for banking operations higher number of men used smartphone at least once for banking operations even though it is not the most preferred app. In this context, banking operation refers to using net banking for banking transactions.

It was be observed 32 per cent of the phone users for banking operations (9%) used the feature for online purchase or sale, 52 per cent of them used for mobile recharge and less than 7 per cent were used for online bill payment and ticket booking. It was also observed that there was a significant difference with higher usage among men than women for financial transactions.

d. **Smartphone for accessing Government Schemes**

From Fig. 6, it was observed that only 16 per cent of the owners of smartphone used the phone for accessing government schemes such as Pradhan Mantri Awas Yojana (PMAY), Pradhan Mantri Jan Dhan Yojana (PMJDY) and Pradhan Mantri MUDRA Yojana (PMMY). The usage was predominantly for obtaining information on the prevailing schemes of the government. The percentage of men using the phone for accessing these schemes was slightly higher compared to women, and a possible reason for this skewed variation between men and women could be the relatively lower population of respondents among men.

Probing further, it can be observed that those using phone for accessing government schemes predominantly use it for contacting officials, lodging complaints, accessing services and accessing records. Thirty-three per cent of the phone users for accessing government schemes used it for contacting government officials followed by accessing government services and records. Even here, the usage by men was marginally higher than the usage by women.

Another important use of the phone was for accessing utility services. It can be observed from Fig. 7 that nearly 70 per cent of the phone owners use the phone for accessing utility services. However, it is important to note that a considerable number

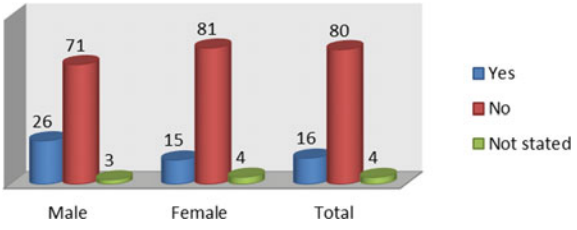


Fig. 6 Smartphone usage for accessing government schemes

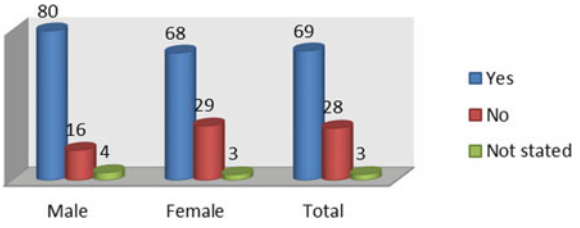


Fig. 7 Smartphone usage for utility services

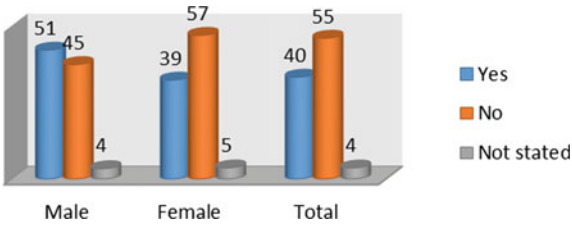


Fig. 8 Smartphone usage and occupational benefits

of women use their phone for accessing utility services. Regarding various types of utility services accessed by the owners of phone, 69 per cent use it for liquefied petroleum gas (LPG) refill for domestic consumption, followed by complaining to Tamil Nadu Electricity Board (TNEB). Accessing other utility services such as voter identity card or Aadhar card was extremely poor.

It emerges from the survey that on an average respondents spend 1–3 h per day using their smartphone. In terms of Internet penetration, we found that 96 per cent of the smartphone owners had Internet subscription. A notable finding from the survey is that 89 per cent of the Internet users on the phone learnt to use Internet through the training imparted. This has enabled them to use a range of apps on their phones. While communication and entertainment apps were the most popular, banking apps were relatively less used. This opens new vistas to broaden the content and character of future training programmes.

e. Impact of training on entrepreneurship and incomes

Given the importance of smartphone on economic empowerment, the role of smartphone in their occupation was assessed as it is expected to directly lead to economic outcomes. It can be observed from Fig. 8 that around 40 per cent of smartphone owners have indicated that use of smartphone has helped them in their occupation with men indicating marginally higher benefits.

The next logical assessment was in terms of the specific benefits derived for their occupation. Overall about 13 per cent of the smartphone owners indicated that using the phone led to earning higher income, 12 per cent benefited in terms of starting a new business where the use of smartphone played a key role. The benefits on occupation accrued more for men than women probably because more number of women respondents are homemakers. Only 18 per cent of men stated that smartphone helped in the form of starting a new business and earning more income while women felt it was 12 and 13 per cent, respectively. Thus, given the socio-economic conditions prevailing smartphone has helped men more than women in exploring new avenues for income generation. The details in the form of benefits that the respondents realized in certainty are indicated in Table 7. Even here, the respondents could choose more than one option.

Information and communication technology helps to contact more people locally and globally that could result in more employment opportunities, business, income and industrial development. Figure 8 indicates that 35 per cent of smartphone owners found potentially new opportunities, be it in terms of clients or other for developing

Table 7 Benefit to business

Form of benefit	Male	Female	Overall
Starting a new business	18	12	12
Earning more income	18	13	13
Finding more clients	22	10	11

*All figures are in percentages

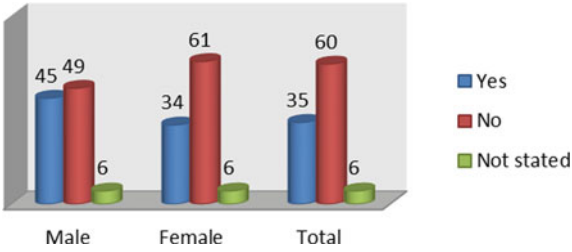


Fig. 9 Smartphone usage and opportunities for business

Table 8 Identification of potential client using smartphone

Method adopted	Male	Female	Overall
Posting product details	15	11	11
Posting features and pictures	6	4	4
Quoting price	13	5	6
Specifying discount/offers	14	8	8

*All figures are in percentages

their business/occupation through smartphone. The gender-based difference on this aspect can also be seen in Fig. 9. Forty-five per cent of male and 34 per cent of female admitted that they found potential clients through smartphone. Examining the figure in conjunction with Table 8 shows that though the number of smartphone owners finding potentially new opportunities is high the translation of these opportunities into tangible benefits such as earning more income is not very high.

We also examined the various approaches adopted by the smartphone owners for finding potential clients. Accordingly, 11 per cent found potential clients through posting product details on one of the apps of the smartphone followed by 8 per cent through specifying discount/offers again publicizing them through apps such as WhatsApp. Men benefited more than women in finding potential clients through smartphone. Only 6 per cent of men and 4 per cent of women found their potential clients through posting features and pictures of the product again with the help of apps. Table 8 provides details on the potential benefits which is different from the earlier table (respondents could choose more than one option).

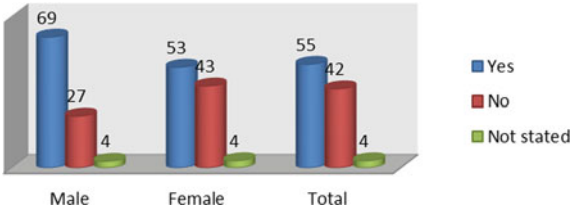


Fig. 10 Effect of smartphone usage and family income

f. Smartphone and Family Income skill enhancement and employment

Income is an important economic indicator to understand the individual's economic empowerment and welfare. Ownership and use of the smartphone is one such initiative to empower. It can be observed from Fig. 10 that about 55 per cent of the smartphone owners indicated an enhancement in their family income either directly or indirectly. Further, it can also be observed from the figure that men had relatively higher benefits compared to women.

The forms in which smartphone helped generating additional income reveal an interesting picture. Of the respondents who had enhanced family income due to usage of smartphone, 60 per cent stated that the increase was due to the time savings in following up with clients. There was not much difference on this factor among men and women. Thirty per cent of the respondents who had enhanced family income indicated that it was through identifying new clients for their produce.

Another possible important aspect that could benefit the smartphone users would be in the form of aiding them in identifying possible job/employment opportunities. Surprisingly, we found that about 57 per cent of the respondents were able to access information on jobs or employment through the use of smartphone. The benefits of identifying opportunities accrued more to men than women as can be seen in Fig. 11. This was also corroborated during the FGD where we found that a few women had found employment in the government sector by accessing information through their smartphone.

Further, Table 9 indicates the source that was used by the respondents who used smartphone for accessing information on job/employment. It can be observed that 50 per cent of the respondents who were benefitted in accessing information on employment indicated that it was through Google Search followed by messaging and mail services.

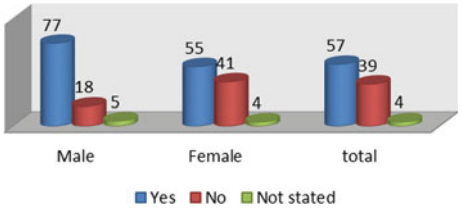


Fig. 11 Identifying new employment opportunities

Table 9 Sources used for identifying employment opportunities

Sources	Male	Female	Overall
Google Search	63	49	50
SMS	23	9	11
Email alert	16	6	7
Subscription	4	1	1
Others	0	0	0

*All figures are in percentages

7 Concluding Observations

The digital training imparted to rural communities has created number of tangible and intangible benefits. It has greatly influenced the way individuals socialize, create and exploit economic opportunities and knowledge resources, thereby impacting empowerment of rural communities. Smartphone has eased the access to information, which is considered as an important measure of development. Further, it has raised monthly family income, helped in expanding occupation/business, found potential clients, increased social status, created opportunities for learning and developed socialization. Young participants benefited more than older members as the training helped them to use smartphone for educational purposes. We found that smartphone was used more for social and entertainment purposes than for economic purposes.

An important question that emerges in the context of evaluating the training is: How can one make the claim that this intervention or programme actually leads to lasting changes? This question can be addressed in multiple ways as there are number of possible methods of evaluation adopted depending on the context. One of the popular methods of measurement is to conduct a 'before–after study', wherein the data on key variables of the intended participants are collected prior to the interventions and again the same data are collected after completion of the intervention to assess the change. The other possible method could be to conduct 'controlled trials', wherein the population who have been possibly benefitted by the intervention are compared with the controlled group to assess the benefits. The third possible method could be 'social audit' by an independent agency to measure effectiveness of the intervention and identifying the economic and social gaps. The process also ensures awareness is created among the beneficiaries and aids in policy formulation. Social audit could be in the form of 'process evaluation', wherein rather than measuring change in outcomes, it examines whether the programme was carried out as planned in terms of was the target group being reached, the frequency and content of the training, etc. This is usually followed by 'impact assessment' where the benefit accrued by the programme is measured by identifying the change that would not have occurred if the programme had not happened. Lastly, the process involves 'outcome evaluation', wherein the outcomes are identified and measured.

In addition to these methods of measurement change, one of the popular methods used for measuring the benefits is through 'theory of change' (ToC). In this study, we

have adopted the ToC approach to identify the benefits that have accrued to the target population. As the name suggests, a ToC is the thinking behind how a particular intervention will bring about results. The process for developing a ToC usually starts with asking the question: 'What is the long-term goal or outcome?' Once this goal has been identified, the next consideration is: 'What conditions must be in place to reach the goal?' These necessary conditions would then be shown as outcomes on the theory of change pathway, underneath the long-term outcome. In a ToC, the preconditions (otherwise known as 'outcomes') lead to the achievement of the long-term outcome. Early outcomes must be in place for intermediate outcomes to be achieved; intermediate outcomes must be in place for the next set of outcomes to be achieved; and so on. Not only does the ToC show the outcomes/preconditions, it also outlines the causal linkages in an intervention between the shorter-term, intermediate and longer-term outcomes. The identified changes are mapped—as the 'outcome pathway'— showing each outcome in a logical relationship to all the others, as well as chronological flow. Ideally, every outcome/precondition should be accompanied by at least one indicator to measure success.

In Fig. 12, we present the ToC that emerged from our evaluation of the training programme. We observe that the final or long-term goal of the training is to enable the use of smartphone for personal and social emancipation. Three outcomes can be identified towards achieving this. Firstly as a short-term outcome, we observe that training leads to the use of features and apps on the phone. This is the starting point of the causal linkage chain. The second outcome, the intermediate one, is the enhanced self-confidence and awareness that has resulted from the use of the features on the phone. Further, we find that the training has resulted in the use of various apps for three aspects: (a) educational purpose, (b) social aspects and (c) generating economic benefits. Apps such as YouTube, WhatsApp, Google and Facebook are the ones used frequently for these purposes. In terms of the long-term outcomes at the microlevel, we find that the use of apps has led to beneficial impacts on children's education,

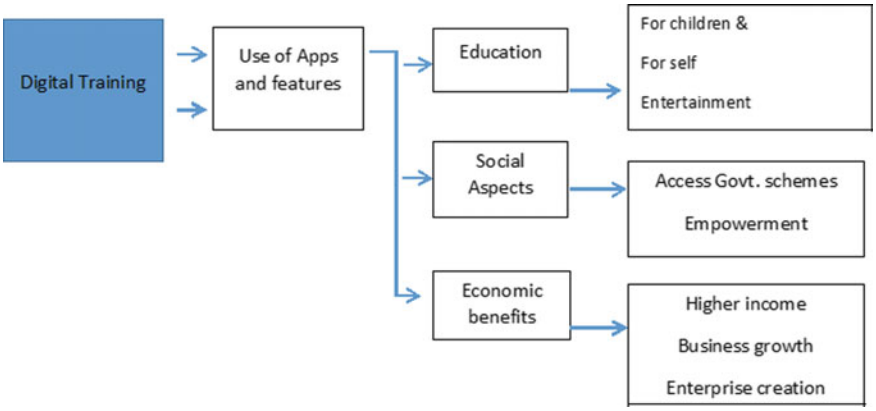


Fig. 12 Theory of change

self-learning through videos and higher income from business and jobs, all of which could be termed as private/personal individual benefits. At the meso-level, we find evidence to support that the use of apps has led to better family networks and bonding. This has been facilitated largely through video call facility. At the macro-level, we find that there are larger social benefits such as access to various government schemes and e-governance initiatives. We also found that the demand and the use of public goods have increased due to the awareness created by the use of smartphone. This in our view that led to increased empowerment on the citizens, especially of women.

While we observe that this ToC could be generalized, there exist subtle variations of the benefits accrued across age groups, location of residence and income class. On the whole, we find that young educated women in urban locations have been able to derive more benefits from training. Older women attached more importance to family cohesion and bonding, while younger women ranked education and entertainment as important benefit. Urban women accessed government services more frequently than rural. Women who had a small enterprise prior derived higher income from the use of smartphone after the training than those who ventured after. These variations underscore the need to identify target groups more clearly and design tailor-made programmes for them.

It emerged from our analysis that, even though there are many benefits of ICT adoption and interventions on the market to improve the success of entrepreneurs, there does not seem to be such a great shift in technology uptake per se. More so, the specific business type seems to be a determining factor of technology uptake. Thus, there is a need to ascertain what specific barriers rural entrepreneurs experience before engaging in any ICT development interventions for small businesses to be sustainable. In designing such interventions, institutions need to be careful about using the phrase 'digital literacy' in the broader sense of the term and to rather focus on the specific businesses and build interventions around each specific business.

Even though the training imparted large number of positive benefits to the participants, we find that there is still scope for enhancing the benefits. One of the issues that we found was the inability of the training modules to take into account the wide heterogeneity among the participants; e.g. the participants were of vastly different age groups (18–71) and educational background (illiterate–graduate). In this context, a common content might not maximize benefits across all the sections of participants and results only in providing very basic introduction to smartphone and Internet. Alternatively, we could have differentiated programmes for participants of different age groups and educational background. There exists a need to re-examine the inclusion of older participants (23%) in the training programme as the impact on them has been minimal. While the training has been successful in imparting knowledge about Internet, its use has not always been beneficial across all sections of the participants. We find little evidence on the use of Internet for banking and financial transactions. This is largely due to the fear of the use of smartphone in transacting money. Similarly accessing large number of government services and utilities, other than LPG refilling and TNEB complaints have been minimal. The training has also not unlocked the potential of the use of smartphone in demanding and utilizing local public goods.

Finally, even though we find longer hours of utilization of the phone in the post-training period compared to the pretraining, bulk of the utilization was for listening to music, which calls for focused upgradation of the content of the training.

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Chapter 6
Indo-German Cross-Cultural Collaboration: Sharing Experience and Co-creating Knowledge for Sustainable Urban Livelihoods Design

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1 Introduction

In recent years, sociocultural dimensions have stepped more into the limelight as a necessary factor for a global transition to sustainability. Equally, cities and towns have assumed an important role in action addressing global climate change at the local level. The twenty-first century will be dominated by the phenomenon of urbanization,

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as approximately two-thirds of the population across the globe is expected to live in cities by 2050 (UN 2018).

UN Habitat[1] also recognizes the 'transformative power of urbanization', with the emergence of cities as loci not only of productive activity and resource consumption, but of social and technological innovation. A report by the German Advisory Council on Global Change strongly supports this view (WBGU 2016). Recent debates on climate change mitigation and adaptation strategies as well as on efforts to achieve the Sustainable Development Goals (SDGs) have reached a significant turning point, with the acknowledgement that technical solutions alone will be insufficient. It is essential that social practices of consumption and usage, routines and lifestyles are taken into account (Liedtke et al. 2015). Changes in lifestyle and consumption will also be needed to effect just or equitable transitions to sustainability. Across the globe, we witness innumerable grassroots initiatives and individuals pioneering novel lifestyles, consumption patterns and ways of living. They acknowledge humanity's global interconnectedness and intend to be more economically fair, socially responsible, ethical and ecologically sustainable. Yet, another report of the Advisory Council on Global Change stresses the significance and need of such a global citizens' movement to combat climate change (WBGU 2014).[2]

We place these challenges in relation to the co-creation of knowledge within the design for sustainable livelihoods. Originally, the sustainable livelihoods framework (SLF) has been associated with leveraging capabilities through existing assets (natural, human, financial, social, cultural, etc.) that individuals, households and communities are endowed within their specific locations. Over the years, the SLF has been adapted to specific areas of intervention (e.g. not only rural but also urban) and enriched with a widening array of these assets, e.g. in India notably by including 'spiritual capital' (see IFAD no date; Höegger 2004; Woiwode 2013). The core focus of SLF is on reducing vulnerabilities and understanding institutional structures as enabling or hindering change and development (Scoones 1998; Shackleton et al 2021). Therefore, SLF has primarily been a tool that provides a rationale for development interventions employed to analyse existing conditions and diagnose 'development issues' in order to advance appropriate livelihood strategies. While knowledge and skills fall within the ambit of human capital for the successful pursuit of different livelihood strategies, another kind of asset has been less in focus so far: the role and types of modes of knowledge that may inform or aid in processes of institutional, systemic innovation that leads to transformative change with respect to innovative new institutional designs of social, cultural, economic and other systems. Likewise, processes of knowledge co-creation for sustainable livelihoods are a relatively underexplored area especially in urban(izing) contexts such as in India.

Consequently, this paper's focus is on transnational and intercultural knowledge exchange and sharing of socially innovative approaches to enable sustainability transitions. It deals with the challenges and design of a process of knowledge exchange

[1] http://unhabitat.org/habitat-iii/.

[2] See also the World Action Programme to support Education for Sustainable Development https://en.unesco.org/themes/education-sustainable-development.

and possible transfer, or adaptation. It also describes the experience of an open-ended, intentionally inclusive and co-creative process of interaction, exploration of various types of knowledge and values, modes of knowing and knowledge cultures in the two participating countries. This thinking inevitably puts participation on the agenda. Yet while it includes participation, co-creation transcends and goes beyond it, for we understand by co-creation a transdisciplinary approach of stakeholder involvement across knowledge domains in society including the corporate, community, grassroots, civil society, government and academic sectors, to name a few. Such approaches of collaboration and learning that activate collective *power with* (Partzsch 2017) have become increasingly popular in recent years as a promising response to wicked, globally intertwined challenges of climate change and sustainability. We consider such activities as contributions to SDG 17 that generate worldwide collaboration based on the intent of creating mutual understanding which results in co-created outcomes to achieve the other SDGs.

2 Background: The Indo-German Dialogue on Green Urban Practices in a Nutshell

Transnational, cross-cultural sharing of local experiences gathered in processes of social innovation is an important factor in global learning for sustainability transformations. The Indo-German Dialogue (short IGD) on Green Urban Practices was initiated in 2017 by one of the authors (C. Woiwode) at the Indo-German Centre for Sustainability in Chennai. It is conceived as a series of annual events to establish a platform of exchange, sharing of experiences and knowledge transfer on urban, socially innovative change between academic and non-academic actors in Germany and India. Besides mutual learning, another key objective of the platform is to leverage action towards transdisciplinary projects. Moreover, we view this interaction as a trans-cultural project of change to address the challenges of urbanization and sustainability from a broad perspective that also includes rural–urban linkages and relationships.

The overall objectives of the dialogue series are as follows:

- To facilitate cross-cultural experience, knowledge transfer about mutual perspectives and offer fieldtrips/exposure visits;
- To complement this series of dialogues with ongoing research by participants and the organizers; and
- To conduct research that emerges from the dialogue networking process, potentially resulting in collaborative research proposals.

Hitherto, four such IGDs have taken place in alternating locations in India and Germany. Additionally, every year a new focus theme is identified by the delegates, with the Indo-German Centre for Sustainability (IGCS) collaborating with

a local host and supported by various funding partners.[3] The first IGD held in Chennai in 2017 emerged from a pilot project[4] on urban sustainability initiatives studied in Bangalore and Chennai (Hackenbroch and Woiwode 2016; Woiwode and Selvakumar 2018) entitled 'Social Innovation and Change Agents towards Sustainable Lifestyles and Consumption' (Woiwode and Bienge 2017). At the 2nd IGD in Freiburg in 2018, the focus theme was 'Education, Learning, Training and Awareness for Sustainable Development' (Woiwode and Lay-Kumar 2018), which led to the 3rd meeting in Pune in 2019 on 'Co-creation of the Living Environment' (Woiwode and Schneider 2020), and finally the 4th one co-hosted with the University of Applied Sciences Bochum but as an online event in 2020 about 'Wellbeing and The Good Life: The human being in sustainability transformations' (Woiwode et al. 2021). The series' design principles highlight its character of a learning journey with an open-ended, evolutionary process that facilitates co-design of the event and allows for an emergence of topics relevant to the delegates and their work (see below section Design and Learning).

3 Framing and Conceptual Foundations of the IGD Approach

We place the activities of the IGD within several interrelated theoretical approaches grounded in transformative sustainability transition research (Geels 2002; Grin et al. 2010; Loorbach et al 2017; Wittmayer and Hölscher 2017). Within this research, a rapidly growing body of the literature on social change and transformation focuses on grassroots agents of social change (Haxeltine et al. 2017; Seyfang and Smith 2007), as 'grassroots innovations constitute 'innovation spaces for bottom-up forms of socially just and environmentally sustainable technological futures" (Ramos-Mejía et al. 2018: 222). As the WBGU (2011: 391) states, they are those 'actors who play a central role in the initiation and shaping of change processes. Initially, these are usually single individuals and small groups fulfilling various tasks or functions in transformation processes, including the identification of alternatives, development, communication and mediation, synthesis, investing, optimisation, diffusion, etc.'. Actors not only benefit from the windows of opportunity that open but are frequently actively involved in the opening. Transition research thus assumes that, for the most part, transformation processes commence in niches, where they are initially confined and almost invisible.

While transition research has greatly gained in popularity across many Western countries, its application in and potentially added value for countries of the Global South are relatively recent (Berkhout et al. 2010; Hansen et al. 2018; Wieczorek

[3] Heinrich Boell Foundation India, German Consulates General Chennai and Mumbai, German House for Research and Innovation (DWIH) New Delhi, German Academic Exchange Service (DAAD) through IGCS at RWTH Aachen University.

[4] With seed funding from The Indian Institute of Human Settlements (IIHS), Bangalore.

2018). High levels of inequality, poverty and a large informal sector call for a more pronounced balancing with environmental issues (Ramos-Mejia et al. 2018). Interestingly, Hansen et al (2018) suggest with regard to countries in the Global South that 'innovation may often include less formalised 'shop-floor' based activities as has been expressed in concepts such as 'frugal innovation', 'grassroots innovation' and 'inclusive innovation', which utilize local assets and involve indigenous knowledge systems located outside R&D [Research & Development] laboratories' (ibid. 2018: 199). Clearly, a main challenge for sustainability transition studies lies in connecting the environmental sustainability agenda with the agendas of poverty reduction, local community development and capacity building (Romijn et al. 2010). Some authors suggest socio-institutional sustainability should be at the centre of transition studies in the Global South because the role of socio-technological innovation is not only about becoming more resource-efficient, but about reconfiguring the existing power balance within production–consumption systems (Ramos-Mejía et al. 2018). It is here that we identify the potential of SLF as a 'bridging' concept which offers added conceptual value to transition research.

Our second conceptual field, related to the previous one, revolves around cross-cultural global learning, knowledge co-creation and transdisciplinarity (Clemens et al. 2019; Mauser et al. 2013). All of these are 'heavy' terms in ongoing research debates and practice. Scholz and Steiner (2015) conceive of transdisciplinarity 'as a facilitated process of mutual learning between science and society that relates a targeted multidisciplinary or interdisciplinary research process to a multi-stakeholder discourse for developing socially robust orientations about a specific real-world issue (either a problem or a case)' (ibid. 2015: no page). Experimentation in so-called living laboratories or real-world laboratories has become a prominent methodology to facilitate such processes of learning and co-creation of knowledge for transformative sustainability transitions (Parodi et al. 2018; Puerari et al. 2018; von Wirth et al. 2018). In the socio-ecological systems literature, and especially in the context of collaborative resources management, learning has emerged as an important element (Armitage et al. 2008; Krasny et al. 2013).

In the context of the IGD, three learning theories are of particular relevance, i.e. social learning (Argyris and Schön 1978), experiential learning (Kolb 1984) and transformative learning (Mezirow 2000), emphasizing collaboration and group learning but also the fact that individuals learn within a social context in a changing environment (Armitage et al. 2008). In addition, the report of the 2nd IGD states that learning academically is not enough; instead, nature- and place-based learning opportunities like urban gardening are necessary to demonstrate interdependencies. This also involves emotional and social learning as well as thinking about how we connect with and depend on nature (Woiwode and Lay-Kumar 2018). Mezirow's theory helps to understand the learning processes of intercultural competency (Taylor 1994). One approach that brings transformative education and intercultural learning together is Global Citizenship Education (GCE). With its focus on global interconnectedness, GCE provides a normative background as to why cross-cultural communication can be essential. GCE strongly relates to the need for global sustainable transformation (UNESCO 2015) and describes conceptions of how exchange could happen at that

scale. Consequently, participatory decision-making processes, mutual knowledge sharing and collective self-awareness are crucial for GCE (Carvalho da Silva et al. 2012). Presumably, such learning processes result in knowledge about transformation and transformative knowledge being co-produced in a transdisciplinary process of interaction known as Mode 3 science and learning (Schneidewind and Singer Brodowski 2015; WBGU 2011) or, even going beyond this, deeper into awareness-based action research (Scharmer and Kaufer 2013) also known as Mode 4 science (Iser et al. accepted). The IGD process aims to offer such an inclusive approach of co-creation to integrate processes of knowledge production, policy and action towards sustainable futures.

Returning to the role of designing sustainable livelihoods (SLs) in the light of the above, we highlight the importance of social innovation as a key element of transformative intervention. Mulgan (2006: 146) proposes: 'Social innovation refers to innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly diffused through organizations whose primary purposes are social'. However, our concept of social innovation extends explicitly to the ecological, ethical and economic realms, too. Hence, we take into account the overarching goal of sustainable societies that are generating livelihoods based on fair, just, economically viable and normative principles through ethically guided behaviour. In our context, we may understand SLF as relating to the redesign of specific economic domains through social innovation. Some of the examples in both India and Germany highlight the intrinsic interdependencies of ecological, economic and social factors, and the attempt to find an integrated solution to existing challenges (see the case of Nallakeerai and the increase of organic food shops in Chennai; or The Good Food shop in Cologne and examples of community-supported agriculture in Freiburg). While these often address livelihood vulnerabilities, their main characteristic change impulse lies in institutional innovation by creating novel systems of socio-economic interaction with the goal of achieving higher levels of ecological sustainability. By doing so, these 'new ways of doing' seem to offer more integrated, holistic responses to local challenges (such as employment and livelihoods) as well the more profound ones (such as climate change and sustainability). The above discussion may be summarized in a triangular relationship linking (a) SLF, (b) knowledge co-creation and (c) social innovation for sustainability transformation (Fig. 1).

4 A Two-Pronged Methodology

IGD delegates originate primarily from higher education, research, civil society organizations, socio-ecological enterprises and not-for-profit organizations with a clear focus on grassroots initiatives (Table 1). However, while the intention is to be inclusive, there has not been any delegate so far from government or local authorities as such. Therefore, the connection to the policy level is limited. Furthermore, given the intention of the dialogue to bridge disciplines and sectors, the distinction of academic

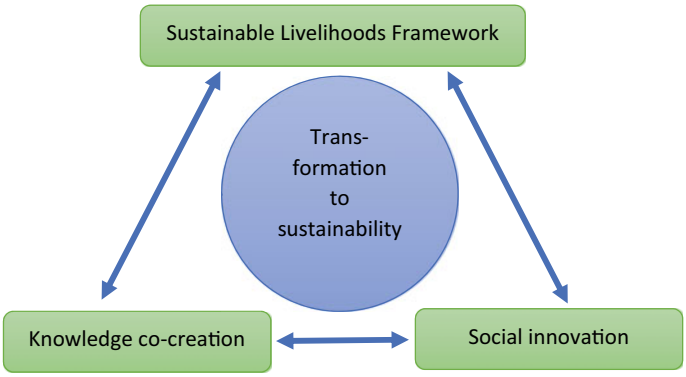

Fig. 1 Interplay of SLF with knowledge co-creation and social innovation for transformation to sustainability (*source* authors' own)

Table 1 Composition of participants at IGDs—place and type of organization

IGD	Indian	German	Non-academic organization	Academic organization	Total
1st	25	15	18	7	40
2nd	20	19	27	12	39
3rd	20	12	15	17	32
4th	22	31	26	26	53[a]

[a]The number of participants is higher because of the online format

and non-academic organizations in Table 1 is somewhat artificial, especially when keeping in mind that many organizations and/or delegates are transgressing these boundaries through action and transdisciplinary research activities. From its inception and by design, participation is by invitation only with a maximum of 40 people. The rationale for this is to protect the specific approach and to enable the highly interactive workshop character.

A two-pronged methodology is geared to support the primary goal of knowledge sharing and exchange on the one hand, as well as co-creating knowledge about the focus themes of the IGD series on the other hand.[5] The first methodology concerns the facilitation and moderation of the IGD series itself and centres on core principles which may be described as experimental, open ended, emerging and evolving, transnational and intercultural. The varying methods of the research accompanying the IGD series constitute the second methodological strand. These methods are wide ranging, qualitative in focus and experimental (interviews, questionnaires, videos, embodiment practice).

[5] We presume that both these processes influence the work of the delegates in their own organizations, at least partly. However, we have not yet done a survey specifically of those participants who attended more than one or all the IGDs.

In addition, we conducted supplementary research involving participants of the IGD during the second and third events (Schneider 2019 and 2020). The first study, resulting from the 2nd IGD, is based on seven qualitative interviews that were conducted during the event. The interview schedule comprises ten open-ended questions out of which three questions are on gardening, and one each on food production, daily life issues, global justice, mutual understanding and personal exchange. Interviews were conducted with participants from India (5; 4 males, 1 female) and Germany (2; 1 male, 1 female). They were analysed with the help of an adapted model of ecosystem services (ES; Potschin and Haines-Young 2011) and in relation to the approach of Global Citizenship Education (GCE, e.g. UNESCO 2015).

The study on the 3rd IGD was built on findings from the previous research about the 2nd IGD (Schneider 2019) by applying an action research approach with emphasis on observation and reflection. The familiarity of the researcher with most participants of the dialogue series was an important prerequisite for conducting action research during the 3rd IGD. Empirical data were derived from participant observation and a voluntary and anonymous survey that was filled in by 17 out of 32 participants. Conducting the survey had the character of an intervention (cf. intervention research in Real World Labs: Parodi et al. 2017). From the beginning of the dialogue, the participants were confronted with the questions, and the idea of the research was explained to them before the first interactive session. It is assumed that this influenced participant behaviour and individual reflection during the course of the dialogue. Key strategies used for analysis were informed by reflexive grounded theory (cf. Breuer et al. 2019), encompassing assumptions of self-disclosure and the use of detailed reflection, whereby survey answers are seen as self-disclosures by the participants that are meaningful to their own actions. Additionally, detailed field notes from participant observation were mindfully combined with the survey answers to create field memos.

5 Design and Learnings from the Process of Co-created Transnational Dialogue

The overall IGD process has evolved and was developed further ‘on-the-go’, with each event building on previous experience and feedback. Consequently, from the 2nd IGD onwards it became established practice that the topics for the subsequent IGD were identified in an emergent manner by the participants during the meeting. This condition may be considered the foundational framing which allows maximum involvement of delegates in steering this process in a co-created, open-ended fashion. Table 2 summarizes the IGD process so far.

Table 2 Evolution of a process—features and outcomes of each event

Event and place	Topic	Salient features (highlighting new elements in *italics*)	Action points/outcomes/results
1st IGD, Chennai, 2017	Social Innovation and Change Agents towards Sustainable Lifestyles and Consumption	– Collaboratory as method of facilitation – 2 external facilitators – Exposure visits	Experimenting with specific co-creation method in a cross-cultural setting Laying foundation for the IGD series
2nd IGD, Freiburg, 2018	Education, Learning, Training and Awareness for Sustainable Development	– *Self-facilitated* (by hosts and select participants who naturally stepped in) – Exposure visits – *Identification of next focus theme*	Consolidation of an emerging core theme: urban gardening/farming/food Beginning process to develop a collaborative action research project including IGD participants
3rd IGD, Pune, 2019	Co-creation of the Living Environment	– Self-facilitated – Exposure visits – *Event website* – *Public event* – *Framework for collaborative research*	Consolidation of a sort of IGD community Outreach beyond closed IGD delegates Indian–German links begin to function: IGD delegates begin to meet/collaborate outside the event
4th IGD, online, 2020	Wellbeing and The Good Life: The human being in sustainability transformations	– *Combination of self and external facilitation* – *Full online event* – *Facilitation method: art of hosting* – *Videos replace exposure visits* – *Experimenting with methods of inner personal and collective transformation during the event*	Create a proper IGD homepage (in process) A research proposal was submitted that builds on the IGD network and core theme

The 1st IGD followed a specific facilitation process designed and conducted by two external moderators.[6] The dialogical gathering was set up as a Collaboratory (collaboration laboratory)—a temporary space of co-creation in which diverse

[6] The first moderator, Markus Molz, was responsible for running the Collaboratory format and process overall. The second moderator and one of the co-authors, U. Zeshan, has been working in India for many years and brought to this exercise the necessary familiarity with the Indian context. She has also developed several serious games which she contributed to the process.

Table 3 Salient features of the collaboratory

Background	Collaboratory phases	Methods used during 1st IGD
• *Temporary co-creation space* • *Issue-based stakeholder involvement methodology* • *Created for a side event of the Rio + 20 conference in 2012* • *Implemented >200 times in many countries on many issues ever since* • *Flexible, adaptable and scalable vision-to-action choreography* • *Works with 30 to 300 participants, for 2 h to several days to series of events* • *Combines key practices of time-tested holistic approaches*	**1. Invitation** (attracting diverse stakeholders)	Wall of expectations
	2. Sharing (exploring the issue from multiple perspectives)	Fishbowl Meet and greet marketplace
	3. Visioning (whole person sensing of desirable futures)	Co-creating a mural
	4. Backcasting (identifying feasible next steps)	Turntable game, wall of feasibility (Zeshan 2020: 127)
	5. Teaming (gathering around concrete endeavours)	Open space
	6. Prototyping (developing actionable solutions)	Living diagram game (Zeshan 2020: 135)
	7. Planning (committing to tasks and timelines)	Breakout groups and plenary
	8. Follow-up (executing next steps and reporting back)	*Not applicable*

stakeholders engage with each other around a complex, burning issue. The Collaboratory is a collaborative multi-perspective, multi-stakeholder dialogue forum aiming at engaging relevant actors in a collective visioning process around 'big' social challenges (Muff 2014; Fein 2018). A Collaboratory process leverages collective intelligence based on the genuine concerns and dreams of the participants. The facilitators support their emergent process of mutual learning and shared inquiry into desirable futures. The Collaboratory methodology merges several time-tested holistic approaches, such as Appreciative Inquiry, Bohmian Dialogue, Design Thinking, Open Space, Theory U and Whole Person Learning, into a stimulating vision-to-action choreography (Bohm 1996; Curedale 2019; Scharmer 2009; Woolf and Corrigan 2020; Table 3; Fig. 2).[7] We added the element of serious games to the set of methods in the Collaboratory process, which was to become a more regular feature in subsequent IGD meetings with the continued participation of one of the facilitators (co-author U. Zeshan).[8]

The use of serious games was motivated, first and foremost, by the diversity of participants (see Zeshan 2020 for a detailed account of the event). Such a diverse

[7] For more information, see https://collaboratorybook.wordpress.com and www.leadership-for-transition.eu.

[8] A serious game is a game that is played for purposes other than mere entertainment, for example, for awareness raising, education, or group facilitation. The activity is framed as a game, so that people may feel relaxed and motivated, but the purpose is serious.

Fig. 2 Fishbowl session during the sharing phase of the collaboratory, 1st IGD in Chennai 2017 (credit: C. Woiwode)

setting can take people out of their comfort zone, and introducing a game framework acts as a counterbalance. People are often prepared to interact more openly when the situation can be framed as 'just a game' because this constitutes a non-threatening environment. Moreover, unlike the other approaches mentioned above, playing games is universal across all cultures at least in some form. Serious games have a strong impact on communication and interaction in a group. In IGD, a particular challenge is the diversity of communication styles—different accents when speaking English, academic jargon and country-specific norms need to be navigated. In the Living Diagram game, where groups created three-dimensional diagrams from props, communication was supported by the shared visual context. Communication was also slowed down because people followed the turn-taking rules of the game, for example, taking turns to get up from the table and place index cards onto the Wall of Feasibility. This gave everyone more time to catch up with the dialogue.

Games also support equitable group interactions. The feedback from later IGD events shows how important it has been for participants throughout the IGD series that all voices can be heard equally (see the analysis of feedback in the next section). In many serious games, this equity is built into the game rules. For instance, the Turntable game, used for brainstorming during the 1st IGD, requires everyone to comment on an idea written by another player, after which the originator of the idea comments back. This procedure ensured that everyone had an equal opportunity for their contribution to be heard. The game also included a fun element of chance because each idea was discussed by a new randomly constituted pair of players. In

fact, laughing together in a group is an excellent way of bonding, and games license emotional responses like laughter.

Finally, the series of games in the 1st IGD created both a visual record of sessions and improved the coherence of the event because each new game relied on output from the previous game (see Fig. 3). One of the aims of a Collaboratory is to generate concrete proposals that are actionable (at least in principle, if not in practice), and the outputs from the successive game sessions could be interpreted as visual milestones of a project planning process, although this was not necessary in order to participate fully.

With the participation of co-author Zeshan in further events, the use of serious games continued, and the 3rd IGD featured an 'Ecosystems' game as part of the exhibition that was organized for the general public (Fig. 4). This was a board game

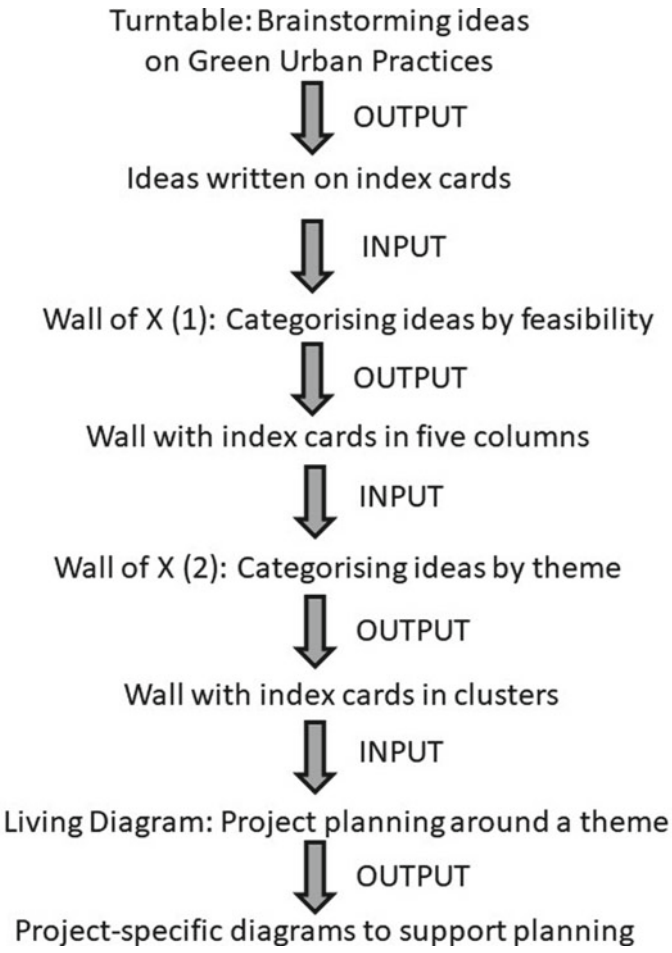

Fig. 3 Successive stages of serious games used at the 1st IGD (Zeshan 2020: 110)

Fig. 4 Students enjoying the 'Ecosystems' game during the public event at the 3rd IGD in Pune 2019 (credit: C. Woiwode)

with dice, pawns and cards to prompt discussion of risks and remedies in relation to different ecosystems. In the 4th IGD, one online breakout group explored alternative ways of work outputs (e.g. designing a risk assessment as a theatre play or an annual report as an artwork) in the 'Work-Play Conversion' game. This fit in with participants' motivation to 'get out of their heads' from time to time, which was a recurring topic in the 4th IGD.

This series of bi-country dialogues on sustainable practices is conceived as a learning journey. Applying the Collaboratory method as a workshop moderation technique during the first dialogue generated a highly interactive environment, which spurred on many discussions and critical reflection. Beyond this, importantly, it actively facilitated the production of concrete project ideas to continue further collaboration between groups and participants beyond the meeting. However, feedback from participants of the 1st IGD suggests that additional time for sharing and understanding each other's perspectives and situations in greater depth is a required prerequisite for durable and continuous interaction between diverse participants. Subsequently, the 3rd IGD placed co-creation centre stage attempting to capture two aspects: (a) focus on cross-cultural dialogue and participation to retain continuity of the process between the participants of the two countries, and (b) exposure to methodologies of co-creation towards sustainable futures (Pel et al. 2015). A wide array of approaches towards co-creation are relevant here such as action research and learning in different contexts (Osuteye et al. 2019), transdisciplinarity (Popa et al.

2015; Tobias et al. 2019), real-world/living laboratory projects for sustainability transitions (Puerari et al. 2018; Schäpke et al. 2018; von Wirth et al. 2018) and citizen science (GEWISS 2016).

Importantly, these methodological fields open up a debate about different knowledge domains, whether and how they are being considered or included in the development and/or research activity. By knowledge domain, we refer to modes of knowledge such as scientific, scholarly academic, local phenomenological, indigenous, experiential or even spiritual-intuitive. The themes of co-creation of the living environment address crucial challenges of global sustainability transformations by asking how change is being implemented in specific local–regional contexts, for example, in view of local livelihoods.

6 Supplementary Research 1: Theme-Based Learning for Cross-Cultural Knowledge Co-creation

During the 2nd IGD, four interrelated topics emerged through discussion in a plenary session: (i) agro-food systems and food sovereignty (relating to livelihoods, production and consumption); (ii) cross-cultural issues in Indian and German contexts (including the relevance of various knowledge domains); (iii) tools and techniques for participation and governance (facing sustainability transitions); and (iv) Indo-German relationships (referring to person-to-person contact) (Woiwode and Lay-Kumar 2018).

As mentioned in the methodology section, a supplementary study on natural resources management with a focus on urban gardening was conducted to identify the role of cross-cultural learning and education by applying the concept of Global Citizenship Education (GCE, e.g. UNESCO 2015). The study used a structured model of Ecosystem Services (ES) to identify possibilities for cross-cultural knowledge exchange in urban gardening. For this purpose, the Ecosystem Cascade Model (ECM) by Potschin and Haines-Young (2011) was adapted to the ecosystems services communication model (ESCM, Schneider 2019). The ESCM includes ecosystems, their components, non-human and human interactions happening within this ecosystem, outputs of the ecosystem and the values that people ascribe to all of them (Fig. 5).

This study aimed to answer two questions: 1. Who can be included in cross-cultural knowledge exchange on gardening and sustainability?, and 2. which are the media and topics of exchange in an urban farming/gardening context? From the statements of the interview partners, a range of stakeholders were identified. An overview of the mentioned subgroups can be found in Table 4. All age groups, starting from kindergarten, were named by participants.

GCE issues related to the participating learners can be found in daily life issues, issues on mutual understanding and exchange, and issues on global justice. Daily life issues raised by respondents refer to who has access to gardens, '*for example the*

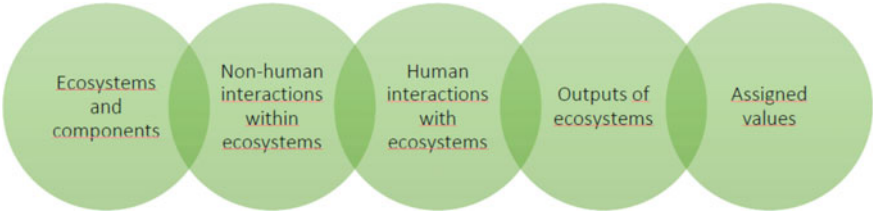

Fig. 5 Ecosystem services communication model, adapted from the Ecosystem Cascade Model (Schneider 2019: 12)

Table 4 Identified stakeholder groups and subgroups mentioned by interview respondents (adapted from Schneider 2019: 31–32)

Group name	Mentioned persons, groups and institutions
Geographic groups	Migrants, the West, Global South, people from different countries, tourists
Societal level	Society, citizens, residents, public, each person, volunteers, activists, NGOs
Education-related groups	Education organization, kindergarten, rural/urban/corporation school, university, botany department, eco clubs, biologists, social scientist, research associations
Governmental bodies	UN, FAO, state, local/central government, municipality, city manager, horticulture department, agriculture department, ministry of forestry, political parties
Economy-related groups	Private sector, CEOs, vendors, farmers, supermarkets, corporations, factories, employing organization, media workers, community-supported agriculture, farmers, gardeners, food consumers
Health institutions	Institutes, health funds
Cultural groups	Muslims, Hinduism, vegans, tribal people
Persons with personal relations	Family members, colleagues, neighbours

university botany garden is not open for citizens' and to the topic of '*who produced [the food]?'*. Issues regarding mutual understanding and exchange also involved food. Especially, cultural aspects are of interest to the respondents like the '*strong philosophical or religious background to […] production of food [in India]'*, the '*huge bottom of the pyramid who can only survive by eating non-vegetarian [in Africa or India]'* and '*different food choices [in different cultures within the same country in India]'*. According to the respondents, understanding other cultures is possible in the same country *by 'integrating, in this case [Germany] for example, refugees'* and also when '*people come from different countries […] because people can see from a different perspective'*.

Garden products were suggested to be used in addressing the issue of gender in '*a values clarification and value education lecture […][where] you can actually have a discussion and debate around […] whose labour should be respected, […] 'Is it only*

the physically strong boys that do the work, girls who do the work?'. Additionally, power relations related to financial ability play a role with respect to global justice, for example, when there is the interest *'to copy the west and become multi-industrial, farmers [are pushed] out'*.

Interviewees also mentioned a range of spatial and social agricultural ecosystem types (Table 5) that can be suitable for engaging with educational activities. Different media and resources can be used for learning (Siebert 2010), and in nature-based pedagogy natural materials are incorporated (Bolay and Reichle 2007). Garden components as well as outputs of gardening ecosystems are such natural materials. Components of garden ecosystems about which exchange may take place that were mentioned are 'weather', 'water', 'soil and seeds'. Material outputs from gardens are 'food', 'produce' and 'waste'. By talking about the '*[local] production and consumption cycles'*, daily life issues come up, and issues on climate change can be elaborated on: '*Gardens can provide you a great laboratory, lab to actually potentially observe what is happening as an impact of climate change in your city. Is the produce coming earlier, is the produce coming later? Usually, this information is available with farmers. But that could be still available within citizens and yourself, as your experiential learning'*.

The immaterial outputs from gardening ecosystems comprise mainly cultural achievements like 'peace of mind', 'sense of attachment', 'stress reliever', 'knowledge', 'awareness' and 'social skills' (Fig. 6). For example, mutual understanding can be based on agreeing on debates about specific garden types: *'There were a lot of case studies […] about what is happening in Kigali, Rwanda, or what is happening in Colombia, what is happening in Cuba… That kind of mutual understanding really helped us also to build a stronger case about rooftop vegetable gardening for our city'*. However, it is of concern whose knowledge is considered for education. When talking about global justice, one of the interviewees brought up: '*I realize how rapidly [tribal] cultures are being destroyed by homogenization and the way we teach things in formal schools. It is a very big concern. Much of this cultural traditional knowledge is linked to people who live out in forests or wetlands or rivers and are highly dependent on natural resources around them. That knowledge and that culture is actually being wiped out by formal education'*.

Table 5 Agricultural ecosystem types mentioned by interviewees (Schneider 2019: 34)

	Rather small	Rather big
Rather private	Pots of plants, small plot with gardening, small garden, terrace garden, rooftop garden, balcony garden, backyard garden, front yard garden, kitchen garden	Urban agriculture, crop land, farm, farming project
Rather public	Public garden, school garden, community garden, urban garden	Community-supported agriculture, community farm
Unspecific	Garden, land, green around, space that you can grow in, where it grew, where the food comes from, seed project, tree walk	

Fig. 6 Experiential learning through exposure visits—'Der Wandelgarten', an intercultural urban garden, during the 3rd IGD in Freiburg 2018 (credit: C. Woiwode)

7 Supplementary Research 2: IGD Experience of Creating Collaborative Learning Settings

The IGD series opens possibilities for collaborative and collective learning on sustainability issues. To instantiate this aim, it was decided to get a participatory, transdisciplinary research project underway. The starting point for this project was a facilitated World Café session during the 3rd IGD. It resulted in diverse themes of interest, with topics related to the role of citizens in the city and their impact on land use. The topics included neighbourhood engagement, the circular economy and sustainability education, with examples such as urban gardening and food as well as waste management and repair culture, and the establishment of information systems (Woiwode and Schneider 2020).

The 3rd IGD was accompanied by action research, with the aim to shed light on how citizens can be included in this planned research project. Interviews which were taken during the 2nd IGD identified the need to take power relations and structural inequalities into account with regard to involvement of individual knowledge and competencies in gardening projects (Schneider 2019). A fundamental principle of participatory research in order to avoid power imbalances is the concept of 'safe space'. Here, this is defined as a space where participants can disclose their personal

views of the situation, opinions and experiences in an atmosphere ensuring that nobody would suffer any disadvantages if they express critical or dissenting content (Bergold and Thomas 2012). To avoid structural inequalities, a social justice perspective emphasizes treating participants equally for legitimate representation in collaborative settings (Emami et al. 2015). Therefore, the action research concentrated on two questions with the aim to identify characteristics of collaborative learning settings: (a) What constitutes a 'safe space' for exchange? and (b) how can all voices be heard equally?

The answers to question (a) and (b) turned out to be very similar. *'Hearing all voices equally'* turned out to be an essential precondition for *'constituting a safe space for exchange'*. This is also illustrated by one response: *'a safe space would give an opportunity to all to contribute equally'*. For this reason, the answers to both questions were analysed together, with the findings of this action research presented below.

7.1 Collaborative Learning Participants: Roles and Personal Attributes

According to Herrmann and Jahnke (2012), position refers to formal roles (e.g. student or moderator) and informal roles (e.g. opinion leader) that an individual holds within a group. Roles are dynamic and can be actively shaped. Because of this reason, each individual can fill the same role in a different way. While individual participants who took part in the IGD held various formal roles, their informal, specific roles were dynamic and changed from session to session. The formal role of the facilitator was the only one which was described in more detail by the survey participants. Some of the answers highlight the role of personal characteristics: '*people who are more silent'*, '*people who are more introvert'*, '*people who are more extrovert* and *people from many different backgrounds'*. According to the survey, IGD participants acknowledge that in a '*diverse group'*, members carry '*expertise and capacities'* and have their own '*points of view*, *opinions* and *approaches'*. In reference to '*individual*, *diverse'* and '*different backgrounds*, *experiences* and *reference'*, they suggest to be '*aware*, *open-minded' and 'respect each other*, *especially when you have different opinions'*, be '*compassionate'*. Being *'non-judgemental' was* mentioned, and the wish to '*not let male/female differences matter'*. Space should be made for '*non-academics'*, '*age differences'* and persons with '*social differences'*. Everybody should be able to express themselves in '*their own way and language'*, while '*accepting a collective goal or a shared vision'*. This requires a commitment to '*deeply democratic values'* and the ideal of '*no hierarchies'*.

Other answers included '*living the "we"'*, '*worshipping diversity'*, *'complement each other's expertise and capacities' and to 'learn as a learning network'*. These answers reflect the appreciation of the group process during the 3rd IGD. Moreover, '*mixing groups'* was suggested by a survey member to create a safe space for

exchange. The IGD participants formed new groups throughout the course of the dialogue resulting in varying compositions of participants in each of the sessions that were conducted in smaller groups. The wish to grow together as a team seemed to be supportive of a planning session about the action research project:

> First, we had a feedback round, where one of the participants suggested that we should plan for team-building activities in the next dialogue. I suppose she felt that we were growing together as a group and wished to strengthen the bonds between each other. Her suggestion was welcomed by other members. Shortly after the feedback round we had a world café session with the aim to plan a common research project. Everybody seemed very concentrated and during coding I labelled all of the members to be in the 'project planning group' together.—(field memo L. Schneider)

7.2 Collaborative Learning Interactions: Communication and Process Attributes

The survey answers express what participants expect a role holder to do or not to do (cf. Herrmann and Jahnke 2012). They include specifications on what should happen at the beginning of group interaction. These comprise '*introduction'*, '*talking about equally heard voices' and* using '*icebreakers*, *were all can laugh a bit together and bond'*.

The activities of individuals within a group can be seen as tasks of a specific role (Herrmann and Jahnke 2012). According to the participant observation, IGD participants were involved in diverse communicative activities, which involved listening, talking, introducing, presenting, asking, giving feedback, sharing opinions and ideas, engaging in dialogue and conversations, clarifying and discussing. The survey answers focused on talking and speaking on the one hand and listening on the other hand: all participants, including the *'more introverted' ones*, should have an '*opportunity to talk',* but everyone should '*wait for their turn'*. In case of disagreement*, 'finding compromises'* is recommended. '*Deep listening'* should be practised, which could include a readiness to '*listen patiently and try to understand the things from other points of view'*. The '*listening skill'* should be improved by '*consciously learning to listen'* and having '*inputs on deep listening'*. Listening should go together with '*learning and integrating'*. Altogether, communication should be '*non-violent'*, there should be '*no adverse comments on anyone's ideas/inputs'* and there is the wish to '*take care of each other'*. One remarkable example of taking care of each other while communicating was happening during one of the field visits:

> We were visiting an informal settlement, where the walls of houses had been painted as a place-making activity in order to raise awareness on waste. We were invited to the local community learning center. There, local community members answered the questions of IGD participants. To overcome language barriers and provide transparency, one IGD participant asked to not only translate the community members' responses to IGD participants, but also translate the discussions of IGD members to the locals. I felt that involving all voices was something not only on my agenda but that at least some participants must share the same approach.—(field memo, L. Schneider)

Survey answers go into detail on the tasks of facilitators. They should '*consciously facilitate'* the communication process and '*concentrate on the actual task'*. *Facilitators* should be *'fully oriented towards dealing with complexity and conflicting views'*, and '*monitor and (de)prioritize speakers in a group'*. '*Freedom of the mode-style'* is recommended and the possibility to '*make all group members coaches and moderators over time, who take turns equally'*.

7.3 Collaborative Learning Environments: Spatial and Structural Attributes

Day one and three of the 3rd IGD took place in a university setting. Here, the spatial on-site conditions were characterized by an auditorium, seminar rooms with group tables, whiteboards and beamer-setting, and a patio. According to the participant observation, the degree of interaction which was allowed by these settings was very different. Later in the survey, participants stated that having '*smaller groups'* and '*face-to-face communication',* as well as '*bringing everybody to the table'* and then '*always sit in a circle'* can help to create a safe space. Besides spatial settings, the availability of catering and resource of food as a material requisite were observed to be of value for participant observation because this provided informal possibilities for personal exchange.

The survey answers supported this. For having a safe space, '*good food'* was named. More specifically, to '*have enough tea breaks, shared meals so that everyone can connect to various people'* contributed to hearing all voices.

8 Conclusion

This paper has presented an exploration of the conceptual triangle of SLF, social innovation and the co-creation of knowledge for sustainability transformations as one approach to designing meaningful interventions. We illustrated this with the example of a transnational, cross-cultural process of the Indo-German Dialogue on Green Urban Practices, highlighting the evolving processes and thematic focus areas. There is an expanding literature gradually building a body of such transdisciplinary, experimental methodologies particularly in urban studies. Fokdal et al. (2021), for instance, do not only present insightful case studies from across the world but also generated—in a co-creative process of several years of transdisciplinary interaction—a set of enabling factors which would support inter- and transdisciplinary knowledge co-creation. In their review of lessons learned from this collection of essays and experiences, Woiwode and Bina (2021) point out the pivotal capacity of building trusted relationships between participating stakeholders.

In our experience of the IGD process, the collective development of procedures contributed to the creation of a safe environment for trust to emerge, which develops when processes/procedures are perceived as legitimate, transparent and/or binding by all actors (Stern and Coleman 2015). Natural resources management that focuses on learning, as in our example in the contexts of urban gardening and farming, requires building of trust in order to be effective (Keen and Mahanty 2006). Therefore, the emergence of trust in the form of new social networks is an outcome (Van Mierlo and Beers 2020) that might be evaluated by research and for which a certain amount of time is required. The evolution of closeness, empathy and emotional involvement over time could be used as indicators here (Bergold and Thomas 2012). The role of trust emphasizes participants' emotions in collaborative learning. Feeling comfortable to share individual perspectives and confident of being respected are success factors of both social learning in natural resources management and action research (Wicks and Reason 2009). In the survey that was conducted during the 3rd IGD in 2019, perceptions of a welcoming or warm atmosphere, or of the appropriateness of a setting are related to such emotions. Research might increase collaboration by identifying attributes of an atmosphere that is conducive to holistic well-being and creation of a sense of belonging in collaborative learning settings.

Power is yet another dimension relevant in transdisciplinary processes of co-creation and knowledge production, even more so in often highly unequal settings of livelihood development interventions. Low-threshold and everyday-life-related formats might be suitable for enabling safe and more equal collaborative spaces. While our survey responses mention game activities, Real World Labs in Germany uses repair cafés as vehicle to support equal collaboration between academics and practitioners (Parodi et al. 2017). From a perspective that addresses societal sustainability challenges, urban experiments such as community gardens, climate-friendly makeovers of streets, green roofing of bus shelters (Dignum et al. 2020) or the urban art initiative in low-income settlements at the Pune Biennale that was visited during the 3rd IGD are emerging concepts that could serve as new types of urban commons. Similarly, formats such as festivals, local markets, urban gardens or pedestrian-friendly spaces that are related to management of natural resources (IGD participants 2019) could easily relate to the everyday lives of participants while having a low threshold for participation. However, they must fulfil the criteria of visibility, accessibility and addressability that are important for participatory formats (Parodi et al. 2017).

Interestingly, the process of the IGD led one of the hosting universities—Bharati Vidyapeeth Institute of Environment Education and Research—to explore their teaching–learning methods by delving deeper and more systematically into the process of co-creation of knowledge as an important tool in building student capacities for social innovation. Apart from the regular roles of a university, institutions of higher education have a mandate to usher in social change and innovation. The concept of co-creation furthered through their participation in the IGDs has led some institutions to the introduction of this concept as a research methodology tool to encourage students to design their master's thesis using a co-creation approach

where feasible. To date, there are hardly any guidelines or frameworks that demonstrate how universities can address social innovations in curricula that demonstrate the role of universities in contributing to social innovation. The restrictions and challenges in university structures and functions often create a barrier in attempting social innovation. The IGD through its approach of transdisciplinarity, learning theories and collaborative facilitation has demonstrated a pathway of integrating it within curricula, thus enabling the next generation of students to be exposed to these new approaches to facilitating social innovation that may impact on sustainable livelihood design as well.

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Chapter 7
Importance of Forest and Non-forest Environmental Resources to Sustainable Rural Livelihoods: Insights from a Case Study in Nepal

Bir Bahadur Khanal Chhetri, Santosh Rayamajhi, and Sony Baral

1 Introduction

Forests and environmental resources provide a wide range of direct benefits to rural communities in many parts of the developing world. More than 2.4 billion people worldwide rely on forests for their livelihoods, particularly for energy, food and other subsistence needs (FAO 2018). Forest products such as timber, firewood, fodder, grasses, game, fruits and herbs are harvested in significant quantities by a large number of rural households, which constitutes more than 30% of the total income of rural households (Giri et al. 2018). Scholarly works emphasize the importance of forest resources for the rural poor and their dependence on forest products for maintaining rural livelihoods (Neumann and Hirsch 2000; Singh et al. 2010). Rijal et al., (2011) and emphasize the role of forest products as a cornerstone in the livelihood strategies of rural poor households. In Nepal, the majority of rural households depend on forests for their livelihoods (Rayamajhi et al. 2012; Larsen et al. 2014; Chhetri 2015; Bhandari et al. 2019).

The engagement of a rural household in forest-related activities is an economic choice in its pursuit to make a living, given its human characteristics, resource endowments and exogenous factors (Babulo et al. 2008). The community-based institutions play a crucial role in supporting sustainable livelihoods and support the socio-ecological resiliency (Ashley and Carney 1999; Melles et al. 2020). The importance of forest income is analysed in a meta-study by Vedeld et al. (2004), showing

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that forest serves as a safety net against crises, prevents from falling into deeper poverty and provides a pathway out of poverty. Moreover, the community engagement on management of resources contributes towards building the socio-ecological resiliency (see Ashley and Carney 1999; Melles et al. 2020), especially by generating income to meet their household needs. Perhaps, most forest products are economically marginal, which is why poor people are forest-dependent and forest-dependent people are poor (Angelsen and Wunder 2003).

For many rural people living in, or close to, forests in Nepal and elsewhere in developing countries, forest products are one of the major sources of cash income (Shackleton and Shackleton 2003; Chhetri et al. 2012; Rayamajhi et al. 2012). Apart from direct cash income, forests are sources of subsistence forest products, such as firewood for cooking, fodder for livestock and litter for manure, and an important livelihood means for the agrarian society of Nepal, where more than two-thirds of people depend on agriculture economy (CBS 2011). Furthermore, forests represent rich natural pharmacies by virtue of being enormous sources of plant and microbial material with known or potential medicinal or nutritional value. In addition, forests offer a safety net for the most economically vulnerable population groups in developing countries like Nepal.

Forests provide local-level employment opportunities to the rural people and support their livelihoods (Chhetri et al. 2012; Harbi et al. 2018; Baral et al. 2019). However, livelihood contribution varies by socio-economic group and is affected by several factors, such as location, species composition and nature of the forest (Baral et al. 2019). Gauli and Hauser (2011) found that, in the *Dolakha* district of Nepal, people with low household cash income, low self-food sufficiency and living close to the forest are involved in forest product collection, particularly NTFPs. Likewise, Rayamajhi et al. (2012) empirically showed that forests contributed 22% in the total income account of an average household in the lower Mustang district in terms of both cash and subsistence. In addition, various forest services such as climate regulation, soil and water conservation, aesthetic and religious value have positive impacts on people's livelihoods (Kanel and Niraula 2004).

People, mostly rural poor, are dependent on forests mainly because of a lack of other sufficient income sources. Such people depend on forests for essential forest products, including NTFPs, to sustain their livelihoods (Larsen and Olsen 2006 and Melles et al. 2020). Lack of productive assets, particularly land for agriculture, makes poor households depend on forests for cash income. People with good agriculture land and livestock also depend on forests for fodder and manure. Furthermore, households with low food self-sufficiency are most dependent on forest product collection to run their livelihoods, whereas wealthy households depend less on it (Pyhala et al. 2006).

Despite the large national dependence on forest products and services, the potential of forests to support livelihood improvement and socio-ecological resiliency is not clear. Knowledge of seemingly persistent inequitable benefit distribution generated from the forest and environmental resources by the rural forest-dependent households is needed to understand the role of forest-based livelihoods in rural Nepal in contributing towards the sustainable livelihoods, including socio-ecological

resiliency. However, there are only a few studies that are related to forest environmental contribution to household's income. Hence, this study tried to explore to what extent the forest and environmental products from different sources contribute to household income concerning the total household account and thereby on socio-ecological resiliency.

1.1 Conceptual Framework

Understanding livelihoods begins with understanding how individuals and households manage their living. Forests provide a wide array of benefits to local communities (Rayamajhi et al. 2012; Chhetri et al. 2015; Larsen et al. 2014 and Baral et al. 2019). Community-level institutions and processes have been a most important approaches to natural resource management linking with social and ecological systems, which emphasized on the sustainable livelihood approaches (Ashley and Carney 1999; Melles et al. 2020). In a broader sense, household has managed the different income sources for their livelihoods (Ellis 2000). This research explored how socio-ecological system is being contributing to the livelihoods of rural communities of Nepal. For the analysis, sustainable livelihood approaches are taken into consideration.

Forest-dependent households are those households that rely on forest products to some degree for their livelihoods and whose condition would likely be worsened without access to forests. For poor households, forest-derived income can be particularly important in meeting their subsistence needs, bridging seasonal gaps, providing a more diversified livelihood base, and reducing and spreading the agricultural risk over space and time (Fisher and Shively 2005; Baumann 2006). Forest income considers all the resources which are available within the forests irrespective of the tenure rights on forests. Hence, the study considers all incomes that are collected from the forests as forest resources. Environmental resources are those resources that are available around the household, i.e. outside of the forest, which include firewood, timber and pole, bamboo, wild foods, medicine, grasses, forest litter, sand and stone, fish and aquatic, and others. Another source of income is the farm, which includes crops, livestock and wages. Non-farm income sources include remittances, services, gifts, pensions, business and others. Figure 1 presents a framework linking a different nature of household incomes and their contributions to people's livelihoods.

Guided by the above four sources of income of households, the study estimates the forest and environment resource dependence of the households by income quartile, especially to assess which categories of households are more dependent on forest and environmental resources. In this study, forest and environment dependence is defined in terms of income dependence, meaning that the households which derive a greater share of their income from forests and forest-related activities are more dependent on forests than others. A household income is a standard measure of welfare in rural household studies, i.e. the net value to a household of economic activity, inclusive of

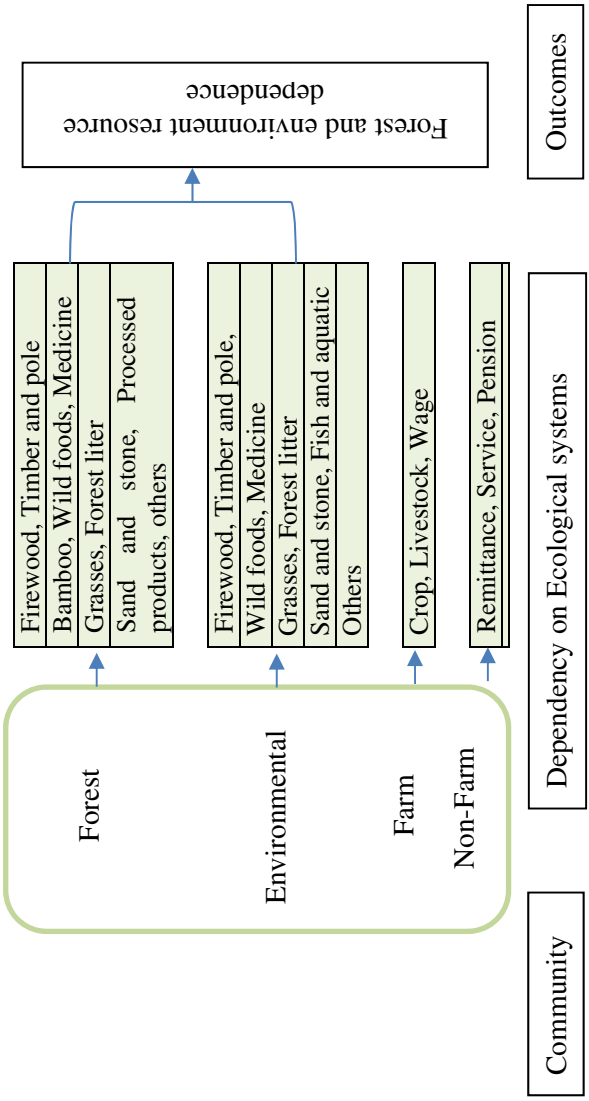

Fig. 1 Framework illustrating the linkages between different income sources to access the sustainable household's livelihoods

own use of labour income (Cavendish 2012) or gross income minus production costs. The study hypothesizes that poorer households have high forest and environment dependence compared to richer households and is conditioned by other household categories like the sex of the household head. In addition, diversity in forest activities with socio-ecological conservation and regrowth will play a more important role in supporting reducing poverty due to barriers on socio-ecological–socio-economic transformation (Ashley and Carney 1999; Melles et al. 2020).

2 Methodology

2.1 Study Site

The study was carried out in purposefully chosen Ajirkot Rural Municipality (earlier Simjung and Ghyachchok village development committees, an administrative unit). Simjung falls in ward number 4 and Ghyachchok under ward number 1 (Fig. 2). The municipality is located in the middle hills of Gorkha district (27° 15″–18° 45″N and 84° 27″–84° 58″ E), about 120 km west of Kathmandu. The basic criteria used in selecting these case study areas include: (i) relatively high forest dependence, (ii) remoteness, (iii) diverse ethnic composition and (iv) presence of a relatively large

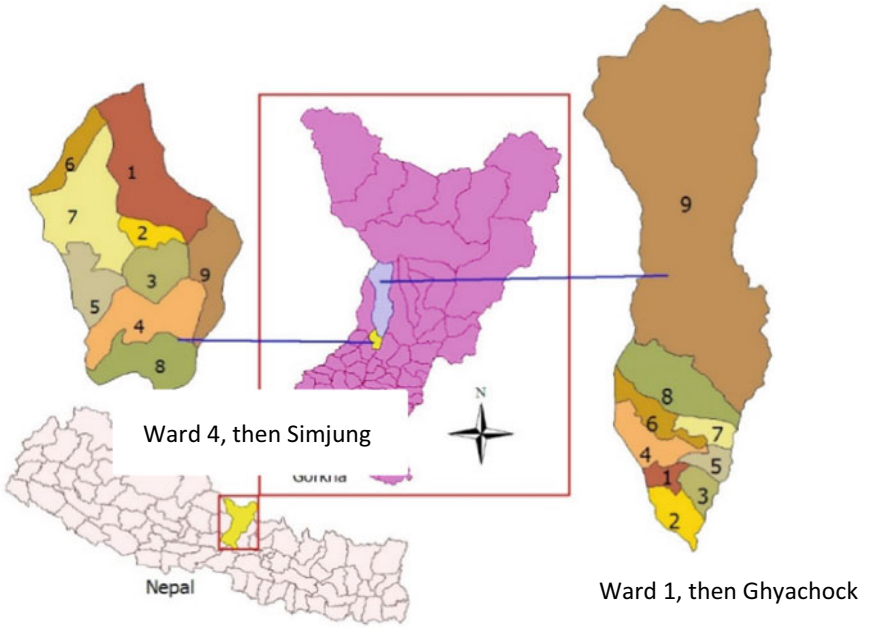

Fig. 2 Location of study site Ajirkot Rural Municipality, Gorkha district, Nepal

Table 1 General attributes of selected wards

Attributes	Ghyachchok (Ward no 1)	Simjung (Ward no 4)
Area	32.8 km^2	45.1 km^2
Ethnic compositions	Dominant by Gurung community and rest *Dalit* castes (kami, Damai and Sarki)	*Brahmin, Chhetri, Gurung, Tamangs, Newars, Magars,* etc., some other occupational castes; *Kami, Damai and Sarki*
Household compositions	Total HHs: 446, population: 2236 (1036 males and 1200 females) (CBS 2003)	Total HHs: 823; population: 3997 (1903 males and 2094 females) (CBS 2003)
Sample HHs	183	83
Economic activities	Farming, off-farm employment and business	Farming, off-farm employment and business
Source of forest products	Natural forests and farm trees	Community forests and national forests and trees in the farmland
Use of forests	Firewood, timber, wild vegetables, fodder, ground grass, etc.	Firewood, timber, wild vegetables, fodder, ground grass, etc.

Source Fieldwork 2012

number of households. The selected VDCs represent the socio-economic conditions that generally characterize rural mid-hill areas of Nepal (Table 1). An in-depth household survey was carried out to capture the socio-economic variations at the household level in terms of forest resource use and management. Out of a total of 404 community forest user groups (CFUGs) in Gorkha, 15 lie in Simjung and Ghyachchok, covering an area of 4.83 km^2 (482.8 ha) of national forest land (DFO 2008).

2.2 Data Collection and Compilation

The study focuses on primary data, with households as the unit of analysis. To collect the cash and subsistence income structure, a Poverty Environment Network (PEN) prototype questionnaire was employed. Data collection was carried out in 2012. By treating the list of households of both wards as one population, sample households were selected for an interview, using a random sampling technique employing a computer-generated random number table. In total, 276 households were randomly selected from 1,269 households. Surveys were administered by local enumerators supervised by the first author. Information on household incomes from agriculture, livestock, forest products, non-forest environmental products, business, wages, remittances, pensions and others was collected. Collected data were entered in Excel. After cleaning the data, data analysis was carried out through the STARTA software.

2.2.1 Household Survey

Total household income accounts were generated using an adapted Nepalese version PEN prototype questionnaire (PEN 2007) and the PEN standard data collection and handling procedures. Data were collected throughout 2012, using four quarterly recall household surveys, and involved 276 randomly selected households. Surveys were administered by local enumerators supervised by a research assistant and the first author. During survey rounds, follow-up was conducted daily to check the filled-in questionnaires and to clarify doubts by returning to the respondent households. The contextual knowledge of the local enumerators enabled relevant probing and facilitated trustful communication with the respondents. To establish good relations with respondent households, the researcher provided photographs taken during the initial interview and other small gifts were presented for extended periods and general interest in the respondents' well-being was shown. The household surveys focused on socio-economic household-level characteristics: assets and the data on households' incomes from agriculture, livestock, forest products, non-forest environmental products, business, wages, remittances, pensions and others. Data from previous quarterly survey rounds were brought for subsequent interviews to increase accuracy.

2.2.2 Recording and Valuing of the Available Products

Households used a large number of products, for both commercial and subsistence purposes, harvested across land use types in both wards. Marketable forest products such as timber and firewood, some animal products such as *ghee* (clarified butter) and milk, and most of the agricultural products were valued based on the village market prices. The barter system was used to value the forest products such as leaf litter, fodder and ground grasses, whereas some other products were valued based upon the exchange (substitution) pricing method, where the value of the marketed goods was used to value the value of non-marketed goods. The willingness-to-pay method also worked well in some cases. All products were measured in local units and were later converted into standard units. In addition, a price survey questionnaire was developed, where a list of all forests, livestock and agricultural products was first prepared and the price of each of those products—mostly non-marketed goods measured in local units, was filed out by organizing group meetings in various *toles* (settlements). Such price survey meetings were organized in each ward. The data of the price survey were used in triangulating the reported price (by the household) of various goods.

2.2.3 Data Categorization and Analysis

Total household income, including all cash and subsistence net incomes, is calculated by summing up all gross incomes minus the costs (intermediate inputs and capital costs) (Sjaastad et al. 2005) and is presented in per adult equivalent unit

(aeu). To avoid double-counting, the total household income was categorized into different income categories as prescribed in the PEN guideline (PEN 2007) and further grouped into three major income sources: environmental, farm and non-farm incomes. Environmental income is the sum of forest and non-forest environmental incomes. Forest income includes the net earnings from raw and processed products plus the wages from forest product activities and forest services. Non-forest environmental income includes the net value of non-cultivated wild products collected outside the forest, including fish and mineral products. The aggregate of the crop, livestock and farm wage constitutes the farm income. All other cash incomes generated from own business, national and international remittances, government and private sector employment and pensions, gift and rents, etc., comprise the non-farm income.

It was recorded from the household survey that communities were using 83 environmental and agricultural products for subsistence and commercial purposes. The costs of the products that were commonly traded in their door and local market were taken for determining the market price value of those products. The costs of products generally not traded such as grass, leaf litter and fodder were determined through the valuation techniques, e.g. willingness-to-pay method (Rayamajhi and Olsen 2008; Boxall and Beckley 2002 cited in Chhetri et al. 2015), and were analysed. The average household income per adult equivalent unit (aeu) is presented across quartiles by source and type (cash and subsistence). Second, the forest and non-forest environmental incomes are further decomposed by product categories. Last, data on income by the sex of the household head are presented and discussed.

3 Results and Discussion

First, average household income per aeu (NRs) is presented across quintiles by a source of income: environmental, farm and non-farm. Secondly, total annual mean household income from cash and subsistence, and environmental and non-environmental sources by income source across quartile are decomposed and presented. Unprocessed environmental (forest and non-forest environmental) income (NRs) per aeu by forest product type and sex of household head was examined.

3.1 Household Income

The results show there is some variation in household per aeu absolute and relative income shares by sources (Table 2). The mean annual income per aeu is NRs 53,208 and ranges from NRs 14,132 to NRs 122,669 from the lowest income quartile to the highest income quartile, respectively (Table 2). Share of household's environmental income is as much as the farm income if the farm wage income is deducted from the latter or environmental product collection is accounted for in the former. Non-farm income is the largest income, contributing an average of 51.4%, whereas the forest

Table 2 Total annual mean household (n = 276) absolute and relative income (NRs)[1] per aeu by income source and quartile

Income source	Income quartiles				Sample mean
	Lowest 25%	Second	Third	Highest 25%	
Environmental					
Forest	2411 (17.1)	5021 (17.0)	4877 (10.5)	6453 (5.3)	4691 (8.8)
Non-forest	2915 (20.6)	4851 (16.4)	7626 (16.4)	13,631 (11.1)	7256 (13.6)
Subtotal	**5326 (37.7)**	**9873 (33.4)**	**12,503 (26.9)**	**20,084 (16.4)**	**11,946 (22.5)**
Farm					
Crop	1477 (10.5)	2379 (8.1)	3244 (7.0)	4190 (3.4)	2823 (5.3)
Livestock	3613 (25.6)	6608 (22.4)	8607 (18.5)	16,491 (13.4)	8830 (16.6)
Wage	2148 (15.2)	3420 (11.6)	2580 (5.5)	794 (0.6)	2235 (4.2)
Subtotal	**7237 (51.2)**	**12,407 (42.0)**	**14,430 (31.0)**	**21,475 (17.5)**	**13,887 (26.1)**
Non-farm					
Remittance	2226 (15.8)	5442 (18.4)	7231 (15.5)	27,550 (22.5)	10,612 (19.9)
Service	73 (0.5)	40 (0.1)	12 (0.0)	121 (0.1)	62 (0.1)
Gifts	115 (0.8)	85 (0.3)	252 (0.5)	754 (0.6)	301 (0.6)
Pension	850 (6.0)	1346 (4.6)	4962 (10.7)	13,557 (11.1)	5179 (9.7)
Business	-2380 (-16.8)	-823 (-2.8)	979 (2.1)	32,418 (26.4)	7549 (14.2)
Other	685 (4.8)	1158 (3.9)	6132 (13.2)	6710 (5.5)	3671 (6.9)
Subtotal	**1570 (11.1)**	**7251 (24.6)**	**19,572 (42.1)**	**81,114 (66.1)**	**27,374 (51.4)**
Total	**14,132 (100.0)**	**29,528 (100.0)**	**46,502 (100.0)**	**122,669 (100.0)**	**53,208 (100.0)**

and environmental incomes together contribute an average of 22.5% of total household income. The contributions of the forest and environmental incomes decrease as the income of the household increases, indicating that poorer households are more dependent than richer households. Relative means of environmental and farm income sources decrease with increasing income, while the non-farm share increases with increasing income (Table 2). While in absolute terms richer household monotonically captures substantial share of income in all three categories, the wage income makes a significant contribution to the lower-income quartiles as farm income and in the real sense, the environmental income in real sense is realized by the household's net labour contribution. This echoes with the findings of other studies, which conclude that forest and environmental products are major sources of income in particular for the poorer and largely depend on forests and environmental resources for their livelihoods (Rayamajhi et al. 2012; Chhetri et al. 2015; Baral et al. 2019). Moreover, the environmental income played a major role in building the socio-ecological resiliency of the rural households especially by promoting sustainable management of the resources, reducing the vulnerability from the climatic shocks and increasing

[1] One US$ equivalent to approximately 80 NRs in 2012.

the income and employment opportunities. The increase in contribution of forestry income of the poor households often contributes towards the resiliency (see Gautam 2009; Melles et al. 2020).

3.2 Total Household Income by Income Quartile and Source

There are large variations in household per aeu absolute cash and subsistence incomes across quintiles and income sources (Table 3). The mean total annual household per aeu income in the study area is NRs 34,836 (ranging from NRs 5,588 in the lowest

Table 3 Total annual mean household (n = 276) absolute cash and subsistence income (NRs.) per aeu by income source and quartile

Income source	Income type	Income quartiles				Sample mean
		Lowest 25%	Second	Third	Highest 25%	
Environmental						
Forest	Subsistence	2344	4908	4832	6008	4523
	Cash	68	112	44	448	167
Non-forest	Subsistence	2880	4804	7516	13,116	7078
	Cash	36	48	108	516	177
Subtotal	**Subsistence**	**5224**	**9716**	**12,348**	**19,120**	**11,602**
	Cash	**104**	**160**	**152**	**964**	**345**
Farm		0	0	0	0	
Crop	Subsistence	1384	2024	2972	3764	2536
	Cash	96	352	272	424	287
Livestock	Subsistence	1940	3436	4268	7292	4235
	Cash	1672	3172	4336	9200	4595
Wage	Subsistence	–	–	–	–	–
	Cash	2148	3420	2580	792	2235
Subtotal	**Subsistence**	**3324**	**5464**	**7240**	**11,056**	**6771**
	Cash	**3916**	**6944**	**7192**	**10,416**	**7117**
Non-farm						
	Subsistence	–	–	–	–	–
	Cash	**1568**	**7248**	**19,568**	**81,112**	**27,374**
Total	**Subsistence**	**8544 (60.5%)**	**15,176 (51.4%)**	**19,588 (42.1%)**	**30,180 (24.6%)**	**18,372 (34.5%)**
	Cash	**5588 (39.5%)**	**14,352 (48.6%)**	**26,912 (57.9%)**	**92,492 (75.4%)**	**34,836 (65.5%)**

income quintile to NRs 92,492 in the highest). On average, subsistence income source contributes (60.5%) to the lowest income quartiles, followed by the second income quartile (51.4%), third income quartile (42.1%) and the highest income quartile (24.6%), whereas cash income increases from 39.5% in the lowest income quartile to 75% in the highest income quartile. It clearly shows that relative means of subsistence income sources decrease with increasing income while cash income increases with increasing income (Table 3). Thus, the reliance of poorer households on environmental products is primarily for subsistence, indicating their high dependency in this sector, implying very limited remunerative off-farm income opportunity for the poor in the village which seems to be the key factor for out-migration of the youths in search of employment in Nepal. The finding resembles the works of other scholars (Larsen et al. 2014; Chhetri et al. 2015; Bhandari et al. 2019), where poor households have less cash income compared to rich households. The present study found that environment income increases by income quartile. For example, cash income increases from NRs 104 to NRs 964 per annum and NRs 5,224 in the lowest quartile to NRs 19,120 in the highest income quartile. Both cash and subsistence incomes increase with the increasing income quartile, which coincides with the works of other scholars (Babulo et al. 2009; Kamanga et al. 2009; Rayamajhi et al. 2012 and Chhetri et al. 2015). However, an opposite pattern of higher environmental income dependency among highest income households has also been reported in this study (see Adhikari 2005; Chhetri et al. 2015). A possible explanation to the scenario depicted here is that abundance of the forest in the vicinity is a key factor that seems to lead to higher dependence on the forest be it for the poor or the well off alike. It may be explained that if forest depletes time for collection increases because thereby gradually dependency and income both decrease. Overall, the income survey noted that remittances and pensions are important or dominant sources of income except for the poorest income quintile. There may be significant barriers that hinder poorer households from pursuing these livelihood options, including costs (transport, visa, rent-seeking), lack of human capital (languages, illiteracy, skills) and negative modification of access due to social relations (difficulty in navigating official procedures and low caste). Rigg (2006) and Chhetri et al. (2015) have a similar finding that increasing human capital may constitute the most promising way to increase access of poorer households to higher return activities.

3.3 Total Household Forest Income by Income Quartile and Source

Table 4 shows different types of forest sources by different income quartiles. A large number of forest products are derived from all the income groups. The result shows that the households in the highest income quartile benefit more from firewood, wild foods, forest litter, processed products, and sand and stone. Grasses in the study villages and most other rural areas are by far the most important forest products next

Table 4 Total annual mean household (n = 276) forest income (NRs) per aeu by income source and quartile

Income source	Quartiles				Sample mean
	Lowest 25%	Second	Third	Highest 25%	
Firewood	1148	1798	1655	2326	1732
Timber and pole	177	253	218	196	211
Bamboo	5	4	15	0	6
Wild foods	103	218	137	237	174
Medicine	0	11	41	36	22
Grasses	1081	1907	1901	1608	1624
Forest litre	6	80	99	177	90
Sand and stone	89	150	194	294	182
Processed products	−285	440	374	1060	397
Others	87	160	244	519	253
Total	**2411**	**5021**	**4877**	**6453**	**4691**

to firewood; actually, the collection and consumption of it are more frequent than that of firewood and if carefully accounted its value may be higher (Rayamajhi and Olsen 2008; Chhetri et al. 2015). The grasses have multiple uses in the rural villages from cut and feed of livestock, grazing, cut and carry for bedding material on livestock sheds as well as thatching roof and making ropes which generate different earning possibilities for the poor also by selling grass to the well-off households with a larger number of livestock (Rayamajhi et al. 2012). The previous studies carried out by Chhetri et al. (2015), a study carried out in Gorkha, concluded that richer people benefit more compared to other classes. The study by Rayamajhi et al. 2012, from Mustang showed that the poor are relatively more dependent on firewood and bamboo, and the less poor on browse and graze. Likewise, Baral et al. (2019) and Bhandari et al. (2019) studies carried out in central Terai and mid-hills concluded that rich households get major benefits from public and direct goods. The households in the third income quartile benefit from bamboo and medicine. The majority of scholars (Oli and Treue (2015); Baral et al. (2019); Bhandari et al. (2019) and Baral et al. (2019)) conclude that forest and environmental services contribute to diversifying livelihood opportunities.

In a similar study from Mustang district in Nepal, poorer households are relatively most dependent on forest income (31%) while richer households' forest income is higher in absolute terms and consists of more valuable forest products. More explicitly, households derive as much as 22% of their total income from the forest and 4% from non-forest environmental common property goods combined higher than that from either crop or livestock income (Rayamajhi et al. 2012).

3.4 Total Household Non-forest Environmental Income by Income Quartile and Source

Table 5 shows non-forest environmental income from different sources. Poor households are less dependent on non-forest environmental sources for firewood and timber. A possible explanation is that if common property forest in the vicinity is abundant why bother to plant and protect trees in private farmlands (Rayamajhi et al. 2012); in particular, the poor in general cannot afford to allocate a separate parcel of land for it other than crop production; they travel larger distances to collect bamboo, wild food, medicine and grasses for self-consumption and cash income by selling in the local market. The households in the highest income quartile benefit more from all the sources except medicine. A lower-income household member indicated: '*Most of the time we go around the forests and even the surroundings to collect medicinal plants as they can be easily sold in the market to supplement our cash need. It is small in size and not attractive for the richer people'*. In the case of medicinal plants, households in the lowest income quartile benefit more. For example, Gauli and Hauser (2011) found that people with low household cash income, low food self-sufficiency and living close to the forest are involved in forest product collection, particularly medicinal plants. Among the income sources, grasses are the highest revenue-generating source, followed by firewood and sand and stone. The lower-income household member said: '*We don't have cattle; so, we are not interested to collect grasses. Some low-income households have few cattle; they collect in the surroundings of the house.* Most rich households have cattle; so, they collect grasses and sometimes we also support them in collecting grasses'. As expected, households in the highest quartile benefit from the high-income-yielding sector. This coincides with the finding of Larsen et al. (2014) and Chhetri et al. (2015), who studied in

Table 5 Total annual mean household (n = 276) non-forest environmental income (NRs) per aeu by income source and quartile

Income source	Quartiles				Sample mean
	Lowest 25%	Second	Third	Highest 25%	
Firewood	345	459	728	1531	766
Timber and pole	94	58	88	120	90
Bamboo	14	35	47	98	48
Wild foods	111	175	184	304	194
Medicine	11	1	3	0	4
Grasses	2122	3435	5514	9496	5142
Forest litre	8	29	42	208	72
Sand and stone	41	229	172	541	246
Fish and aquatic	113	165	269	328	219
Others	55	265	580	1006	476
Total	**2915**	**4851**	**7626**	**13,631**	**7256**

the same district. Households in the lowest quartile also benefit the least from all the sources except timber, pole and bamboo. This contradicts with the findings of Adhikari et al. (2004), Baral et al. (2009) and Baral et al. (2019), who conclude that the poorest section of people only has a stake in the leaf litter and grasses and subsistence goods like firewood rather than timber and poles. A lower-income household member said: '*We are less dependent on the forest and environmental goods. We mostly work for wages or migrate to work in cities rather than relying on the forest'*.

3.5 Unprocessed Environmental (Forest and Non-forest) Income by Product Type and Sex of Household Head

Table 6 shows the income earned by male-headed and female-headed households from different sources. The result shows that female-headed households are earning more from firewood, timber and pole, and is significant at 1% compared to the male-headed households. Likewise, female-headed households are also earning from wild food and grass is significant at 5%. Although male-headed households are earning more from medicinal plants, sand and stones, their earning is statistically not significant. This is because, in the study site, female-headed households tend to heavily rely on remittance generating direct cash income, which in general increase their purchasing capacity for pole and timber for constructing new buildings. However, the study findings contradict the findings of other scholarly works, which conclude that female-headed households of low income and social stratum are less likely to participate in the collection of forest products (Adhikari et al. 2004; Thoms 2008). The study found that female-headed households receive more benefits than male-headed households. This echoes with the findings of Asfaw et al. (2013) and Giri et al. (2018), who also observed that female-headed households benefit more than their male counterparts.

On the other hand, all the four income groups pursued a diversity of livelihood strategies; therefore, study dividing the households into comparing household income groups and livelihood strategy groups comparing the results may give better insights for targeting policy interventions in the area. While the share of the environment income is the highest among low-income quartile households, the value of income received is the highest among the high-income quartile households. This is mainly because the high-income quartile households have high landholding sizes and they cultivate trees on the farmland and leave land fallow for firewood and grass collection. An abundance of the forest in the vicinity is a key factor that seems to lead to higher dependence on the forest be it rich or poor household alike simply because when forest products deplete time for collection increases thereby community restrictions get more stringent; hence, dependency and income both decrease, following Gilmour's hypothesis—scarcity is the mother of invention.

Table 6 Unprocessed environmental (forest and non-forest environmental) income (NRs.) per aeu by forest product type and sex of household head

	Firewood	Timber and pole	Bamboo	Wild food	Medicinal plants	Grass	Forest litre	Sand and stone	Other
Male headed	2302	247	51	327	29	6301	146	470	611
Female headed	3401	548	72	554	9	8919	236	228	845
Total	**2497**	**301**	**55**	**367**	**26**	**6766**	**162**	**427**	**729**
ANOVA	***	***	NS	**	NS	**	NS	NS	NS

*** ANOVA statistic significant at 1%, ** at 5% and *** at 10%

4 Conclusion

This study assessed the role of the forest and non-forest environment income in supporting the rural livelihoods, focusing on their contribution to the household income sources by income quartile and sex of the household head and its contribution on building the socio-ecological resiliency. Our findings amplified that households adopt a diverse set of income sources and their dependency varies across the quartile. Forest and non-forest environment income remains one of the dominant sources of income among lower-income households. Moreover, low-income quartile households were more dependent on subsistence income (60.5%), followed by the second income quartile (51.4%), third income quartile (42.1%) and the highest income quartile households with low dependence (24.6%), whereas in the case of cash income, high-income quartile people are generating 75.4% of their total income as cash income and the share of it is only 39.5% for the lowest income quartile group. Remittances and pensions are important or dominant sources of income except for the poorest income quintile. It shows that the households in the highest income quartile benefit more from firewood, wild food, forest litter, process products, and sand and stones, whereas the lower-income quartile benefits more from bamboo, timber and poles. The study concludes that forest and non-forest environment income remains one of the dominant sources of income for poor and marginalized households and their customary rights need to be protected.

Though role of the forest income for the poorer households has increased, the study argued that there is a need of the resilience thinking approach achieving sustainable livelihood outcomes for communities. For this, institutional changes are needed. While the community forestry institutions are involved in managing the forests, there is need for collaboration with the different actors, especially private sector and government agencies in promoting the use of the forest resources, such that local communities are capacitated to manage the resources sustainably along with cope or recover from the shocks and stresses including maintaining of the forest assets. Currently, the forest resource condition of the country has not only degraded but a single agency (forest user group) is given responsibility for the management, which might pose a risk towards attaining the socio-ecological resiliency. There is a need to reform the policy and practices at the national level such that polycentric approach is promoted in management of the forest resources, such that socio-ecological resilience could be ensured.

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Chapter 8
Grassroots Innovation-Based Sustainable Livelihoods: Role of Intermediaries

Anamika Dey and Anil Gupta

1 Introduction

Intermediary organizations have crucial role to play in bringing partners from different sectors and segments together to support grassroots innovations and functional traditional knowledge which address the unmet social and technological needs of the people. Through the different functions, they help to convert the innovations and functional traditional knowledge into commercial or social enterprises. Intermediary organizations have been variously referred as brokers, third parties, bridges, intermediary firms in the past, while catering to their role as marketing agencies, technology partners, design or legal consultancy firms, service organizations, etc. (Howells 2006; Dalziel 2010; Dias et al. 2015). With the innovation systems becoming more distributed and complex, their existence as independent organizations is inevitable. The grassroots innovations often address the gaps that the formal systems of market or public institutions might have neglected or failed to address. Gupta (2012) notes users of commercial products have lesser freedom or ability to modify the factory-made standard products but GRIs are generally amenable to change and modifications by their users, fabricators, mechanics and end users.

Many grassroots innovations are frugal and sustainable. They ensure optimal use of both material and mental resource. Hence, frugality and environmental sustainability by: (1) Using economical materials (2) using materials economically (3) simpler process of manufacturing (4) reducing the number of steps in a process (5) sharing resources (6) optimal usage of resources, i.e. using it in efficient and frugal way (7) recycling or reducing waste. Grassroots innovations are characterized by their appropriateness to the local conditions. They use alternative low-cost materials performing similar functions as their expensive counterparts. They are affordable,

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accessible and adaptable to some extent. Cost can to some extent improve accessibility of people to resources. So, does adaptability. Rozadin's coffee-making machine works in all kinds of environment, and people from all segments can adopt it to have an espresso coffee without buying costly machine. And it does not need an electric source to run. Frugal innovations should be able to give users an advantage of running it in different power sources. Energy transmutability is an important aspect, often neglected by the formal R and D teams.

GRIs are simplistic in design. Two approaches have been taken to define frugal products with minimalistic design: (1) removing inessentials and (2) having only essentials. Both would reduce waste, but the former is a reductionist approach where an existing product is ripped off the additional not so important features to make it affordable for more. This can be possible only when firms do not consider any product or feature to be sacrosanct making them open to change. Keeping only essentials might not be feasible always. For example, at times, sugar is mixed with medicines for infants and kids or else they would be too bitter in taste. Though it does not add to its efficacy, it adds to its acceptability among the target users. Hence, other factors like acceptability adaptability, availability, etc., become important. GRIs are largely environmental-friendly with lesser ecological footprint and use material locally sourced. For example, the bamboo windmill was developed by Mehtar Hussan and Mushtaq Ahmed from Assam. The raw material was bamboo which is abundantly available in the region.

Grassroots innovations are often but not always frugal. But they are characterized by their appropriateness to the local conditions.

Most of the GRIs use second-hand parts and hence contribute to circular economy. Mansukhbhai Jagani's Bullet Santi is one such example, wherein the first model was made by modifying old Enfield bikes (which were available at a very low cost. Over the years, several derivative models have been made, customizing it to suit different customers according to the crop and the soil conditions (Gupta 2006). Grassroots innovators recognize community preferences. As they act within community resource and norms, they do not disrupt the social structure. The innovators are often bound by cultural norms and institutions which ensure sustainable use and supply of resources (many such examples can be read at Honeybee.org). There are times when local non-sustainable solutions also get social legitimacy (such as fishing by using dynamite) but generally not. Grassroots innovations may sometimes be suboptimal owing to resource and material constraints but have proven to be effective in solving the unmet needs which were probably not even sensed by institutions or companies. These can be optimized to meet the market standard or to suit the needs of other region if they are supported in terms of validation, value addition, design orientation and business development support by linking them to financial and market institutions apart from formal R and D laboratories.

The golden triangle linking innovation, investment and enterprise was conceptualized in 1997 when GIAN was set up with the help of the Honey Bee Network, SRISTI, IIMA and Gujarat government. The central premise behind setting up an intermediary organization like GIAN was to reduce the ex-ante and ex-post transaction cost of innovators, investors and entrepreneurs. The problem becomes particularly acute

for grassroots innovators who try to solve the problems often with limited material resources. For GRI, the cost of finding possible sources of finance, design, testing, technology upgradation, new materials and new tools is very high. A majority of the innovations, particularly mechanical, electrical and energy are often stay either at crude prototype level or finished product level (Dey et al. 2019). Most of them are less educated, and even their children who may be educated may not have the contact necessary for mobilizing resources, skill, technology and sometime the policy adaptation. The developmental intermediary can be of several kinds. There are organizations which charge for their services and may exclude those without the capacity to pay upfront. The other category of intermediary are those who mobilize resources from third party and pay up their fees from the mobilized resources. The third kind of intermediary may either not collect any upfront payment or collect a very small overhead between 5 and 10 per cent for meeting part of the transaction cost to cover the expenses in servicing these innovators. Many incubators have emerged in the past, but their ability to contribute free services is limited and in most of the cases they deal with professional start-up involving educated young people.

For grassroots innovators, GIAN was the first incubator which explored connection with the entrepreneurs, investors particularly public institutions and the innovators. Initially, when grassroots innovators were much less experienced or resourceful, GIAN was committed to all the services at the doorstep of the innovators. So much so, that Micro Venture Innovation Fund was set up for collaboration with SIDBI-funded innovators during pandemic entirely on the basis of trust without any physical visit or supervision. In majority of the cases, even today, the innovators are not asked to come to the office for dealing with any formalities. The staff would go to the innovators' doorstep and provide support. The National Innovation Foundation [NIF] was set up by the Honey Bee Network with the help of Ministry of Finance and Department of Science and Technology, Government of India. NIF tried to scale up the model of GIAN at national level.

2 The Role of Intermediaries in Supporting Grassroots Innovations for Sustainable Development

It involves the following functions of the value chain: [a] scouting and documentation, [b] validation and value addition, [c] market research and financing of innovations beside business development, [d] IPR protection wherever feasible and desirable, [e] dissemination through either commercial or non-commercial channel, [f] database development and digital integration through multimedia, multi-language communication.

2.1 Scouting and Documentation

Most grassroots innovators would not have heard about various institutional mechanisms sensibly set up to support them (Gupta 2016). That is the reason why most incubators never received query from grassroots level. The function of S&D becomes most difficult to identify and document creative ideas, innovations and outstanding traditional knowledge from the grassroots. Multiple channels are used to locate the innovators including Shodhyatra [learning walk], field visits, search for innovators in various fairs and community gatherings, news about innovators in the paper or on Internet and through volunteers to help in locating innovators without any compensation. In addition, innovators also search other innovators. Once the social capital is created, one may get links from strangers also. People believe that they have stumbled upon an idea that we need to know. In the early years, much of it was scouted through students during summer vacations who went from village to village looking for odd balls. It is their hard work which created the foundation for subsequent institutional development and the growth of the network.

Initially, when ideas and innovations are scouted, the format of the steps was very simple and brief. Only those ideas where some novelty is spotted, detailed documentation is done. A systematic literature, patent and market review reveal ideas that need to be taken forward. The prior art search is an important step that takes the ideas to the second stage.

2.2 Validation and Value Addition

Even if a priori, the ideas appear to be feasible, a systematic validation is called for. The difference is that when cost of failure is low, we can ask people for trials directly. The validation in those cases is done by the potential users. But, ideas/innovations requiring scientific validation go through in-laboratory or on-farm trials. The financial resources of such trials have to be organized by the intermediary organizations. Such funding can come from public, private or philanthropic organizations or CSR funds of the company. Once validated, ideas may not be ready for diffusion through commercial or non-commercial channels. They would need to be made robust. Here, the role of design, R&D and other means of value addition such as branding comes into picture. This is a very difficult step because commercial service providers are very costly, and the funds required for such purposes may also be much higher.

From prototype to product to utility is a long journey and can have many pitfalls. It is also very risky because even best of the market research companies do not have success rate of more than two–three per cent. In addition, when innovations are developed with second-hand parts, they are extremely affordable. But with new parts, the cost obviously increases and affordability may decrease. The design and value addition may, however, sometimes improve the efficiency so much that even with enhanced price the customers find it useful. This is where the scale should not be

allowed to become the enemy of scalability. If an innovative product or service fills a local niche which the market or state has not yet served, then we should welcome such products/service. According to the long tail of innovations, the niche is specific ideas will obviously have limited diffusion. However, these niches are left unserved and lead to alienation and at times to anomie. The ecosystem diversity requires such niches to be served along with encouraging scalable solutions.

Support system for distributed, diverse and location/niche-specific solution requires dedicated institutional platform. Almost none of the scientists pursuing validation experiments charged for their own time. Making the average cost of validation almost 1/5th of what it would have been, had they charged for their time. The goodwill of the network and intermediary organization made this possible (UN ESCAP and GIAN 2020).

2.3 Intellectual Property Rights Protection

Large number of grassroots innovations are easy to copy. In such cases, the intellectual property rights protection serves only the purpose of a defensive protection. A defensive patent is the one which is not meant for excluding anybody from copying but is aimed at preventing any third party from monopolizing the solution by filing patents. In a first–two file system, it does not matter who invented first. The one who files first gets the claim so long as the innovation is not in the public knowledge/prior art and is non-obvious and novel and has industrial application. The Honey Bee Network facilitated filing of thousands of patents in the name of grassroots innovators through National Innovation Foundation [NIF], Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) and Gujarat Grassroots Innovation Augmentation Network (GIAN) in India and abroad. In addition, dozens of plant variety developed by the farmer breeders were protected under protection of Plant Variety and Farmers' Rights Act. In several cases, trademarks were also protected. All the cases of intellectual property rights protection were filed only in the name of the innovators, although validation, technological elaboration and other documentation were done by the intermediary organizations. One important modification done by the Honey Bee Network while implementing the intellectual property rights protection was the concept of the *technology common.* Under this framework, people to people copying was allowed and encouraged. But people to firm were supposed to take place through licensing. 'People' here refer to self-employed community members. *Technology common* thus made the grassroots innovations open source for meeting livelihood needs of the common people. But it requires licensing deed for commercial applications. The Honey Bee Network facilitated more than 100 technological licensing deeds till 2018. Most of the licenses were made to small companies/enterprises. In each case, intermediary organization did not collect any share of the loyalty or licensing fee to cover its expenses. However, in future, such a small charge may be in order to make the process more vibrant and self-reliant.

The average of cost of filing patents was roughly $ 250 domestically and no cost for filing in USPTO. The normal cost could have been around $ 3000 for domestic filing and $ 10,000 for US filing. This could be achieved because of the *pro bono* help of the IPR community/patent attorneys made possible through social and ethical capital of the Honey Bee Network. Millions of dollars' worth of foregone cost of validation and IP filing was achieved by converting ethical and social capital into financial capital. It is interesting to note that even though traditional knowledge claims cannot be protected under the Indian Patent Act, a large number of patents are granted to the traditional knowledge holders and grassroots innovators through NIF by establishing the innovativeness of the peoples' knowledge claims. Other countries may consider whether such a provision in the Patent Act serves the interest of traditional knowledge holders whose documented knowledge is considered a prior art. Technically, even the undocumented knowledge would be considered prior art provided it is proved that the knowledge existed for a long time without any incremental innovation. In our view, various countries dealing with this challenge must allow IPR protection by any claim by individual or community which is not in the prior art already. *Inter alia,* this highlights a very rigorous academic practice. Majority of the ethno-botanical papers made the collector of the knowledge the author and knowledge providing people and communities anonymous. By doing so, the ethno-botanist and biologist have usurped the intellectual property rights of the real producers of the knowledge. To correct this unethical behaviour was one of the key purposes for which the Honey Bee Network was set up more than three decades ago.

2.4 Financing of Innovations

When it comes to financing, community-level ventures, microfinance seems to have been the major instrument worldwide. Microfinance is provided for goods and services for which market exists. When the rate of interest on bank loans for the farming sector having been reduced to four to five per cent, the rate of interest in microfinance is much higher ranging from 18 to 24 per cent per annum. Given the rigidity and other difficulties in accessing the bank loan, microfinance has made some impact in financing of small ventures. Micro Venture Innovation Fund [MVIF] was originally conceived in 1997 through establishment of GIAN providing risk capital through grassroots innovators under single signature and without any collateral. It was formalized in 2003 at NIF through partnership with Small Industries Development Bank of India [SIDBI]. Subsequent to winding up of this fund at NIF, it was restarted at GIAN in 2019–2020. Even during the pandemic, the risk capital was extended to innovators all over the country without any supervision or physical contact in most of the cases. Idea was to reduce the transaction cost to bare minimum, exchange of a simple letter or one page agreement written in non-legalistic language, essentially making it a completely trust-based transaction. Some of the investees have already started paying back. There is a need for a step ladder function in financing. In the cases where prototype does not exist and only a proof of concept or an idea

exists, one should be able to provide grant. In the second stage, where value addition is required, grants-cum-loan can be given for testing the idea in the market. The third step will involve soft loan with no collateral and no group guarantee for scale commercialization. The fourth stage will be incorporation of the company and equity investment. Depending upon country's specific condition, availability of resources and the credibility of the intermediary platform, the steps can be modified, shortened or expanded. The basic point is that if market-based innovation in technology or business models attracts venture capital and angel investment generally with expectation of high rate of return, should not there be risk funds with expectation of lower return, over longer period and on easy terms for grassroots innovators?

2.5 Dissemination

Dissemination of grassroots innovations is important for multiple purposes:

a. Creating role models for other community members to experiment and innovate to solve local problems;
b. Increase awareness about the solutions as Do-it-Yourself [DIY] for commercial products and services and thus expand social or economic market for GRI;
c. Build the confidence of distant communities who may feel provoked to do something better and thus trigger a healthy competition and a chain of incremental innovations;
d. To inspire young learners through incorporation of innovations in the curriculum at school and college levels;
e. To augment means of livelihood for disadvantaged communities who may not be able to afford costlier alternatives;
f. To reinforce circular economy movement because most GRI used second-hand parts;
g. To promote the culture of open sharing and open innovation by creating a community of innovators and experimenters who share their ideas openly;
h. Build linkages with the formal R&D system so that institutional experts feel motivated to join hands with the grassroots innovators;
i. To create benchmark of efficiency that can be achieved in the informal sector so that slowly and slowly the quality of grassroots innovations improves;
j. To influence regulators and policy-makers to smoothen the path of grassroots innovators, eliminate the obstacles, improve intersectoral linkages and provide public procurement support wherever possible.

There could be many other purposes which may be served by dissemination such as the self-respect and the pride of the people who may feel particularly good about helping so many others by sharing their knowledge in open.

Among various dissemination channels are the social and public media, print and internet channels, blogs and of course, the word of mouth. The network has also tried mobile exhibition, Shodhyatras, stall at cultural and agricultural fairs, column in the

newspaper, radio and television channels, etc. In some cases, the messages have also been beamed to thousands of cinema halls through the companies which broadcast these. Some of the film-makers have incorporated innovations in the mainstream film, thus popularizing the grassroots innovation stories. The use of radio has been made, but it is one of the most affordable and democratic means of communication. The potential of the same remains to be fully exploited.

It is important that while disseminating the knowledge we acknowledge both the intermediary channel individuals through whom the innovations were scouted and also through whom it has been disseminated or acknowledged appropriately.

3 Caselets: Four Examples from the Honey Bee Network and the Support Its Institutions Provided

Multi-purpose Food processing machine by Dharambir Kambhoj

Dharambir Kambhoj has innovated the multi-purpose food processing machine which got him Presidential Award. It can process different kinds of fruits and vegetables without crushing their seeds. So much so, that in some models, one can extract essential oil out of seeds or peels.

He was born and raised in Damla, Yamuna Nagar, Haryana. Apart from the machine, he also sells products he makes from the machine like aloe vera juice, gel, horticultural products like juices, candies, etc., as well as a variety of herbal goods including essential oils under his brand called 'Prince' (named after his son). Dharambir improved upon his machine and got successful after several attempts. He learnt from his visits, analogic learnings and zeal to experiment. For example, in the absence of any temperature control mechanism and direct heating of the vessel, the product processing had to be watched very vigilantly or else it used to get burnt. He got the idea of indirect heating during his visit to Rajasthan in 2005 as a member of a farmer's group arranged by the Haryana Agriculture Department. He chanced upon seeing somebody using a water bath to melt ghee. He felt that he can incorporate the same feature in his machine. But he needed to work upon a different set of temperature. He collected information regarding the media he should use, and as used in industries, he used oil bath.

HBN's role:

GIAN staff contacted Dharambir after his story was covered by a local newspaper. Initially, he did not believe that an institution was willing to help him without any charge or any other intention. But after a couple of visits, he relented. Financial help was given by GIAN and later NIF at different stages which helped him to improve the machine and also scale up his business, through grants and later in the form of Micro Venture Innovation Fund. The team from NIF helped him to incorporate an automatic temperature controller which improved the functioning a great deal. The service of a professional design company, January Design, was sought by NIF.

Although the innovator was reluctant to use this design, he later adopted it. The new design made the machine easier to clean and maintain and aesthetically pleasing.

SRISTI helped to demonstrate and encourage manufacturing in Kenya. In another meeting in India, the president of Zimbabwe was so impressed with the machine that he took the machine to his country. The role of innovation intermediaries in expanding the market of grassroots innovations is extremely important and may help them to explore geographies where the innovation may be useful, especially when the innovation helps communities to earn their livelihood by making products from local natural resources.

Dharambir was also supported to make a community workshop which helped him to augment his manufacturing capacity.

The innovator stayed in the president estate as a scholar in residence, which also helped him to build linkages. The Biennial Award from NIF was just a beginning to a series of recognition that the innovator got regionally as well as nationally and internationally through HBNCRIIA award through HBN and GIAN. It boosted his confidence in his craft and created many more innovative products which empower farmers to add value to their produce and earn a good profit margin.

Modified mawa making machine and boiler by Subhash Ola

Subhash Ola made a modified mawa (milk solids) maker in 2009. He had keen interest in steam-based technologies since his teens. He was a bright student but had to drop school to help his farmer father. However, he continued to do small experiments. He made modifications in the traditional mawa maker, making it energy efficient and saving water by nearly 70–80 per cent by recycling the steam in a closed circuit. He has found its applications in many other industries wherever boilers are used. NIF filed patent in his name and also helped him to access funds for scaling up. It also helped him in testing the technology.

These systems recover the steam after being supplied to the machine and return it to the boiler without much heat loss. Due to the recycling of steam which has some residual heat, fuel consumption is significantly reduced and being a closed loop, water is also not lost. By using a heat exchanger, he has also increased the efficiency of the machine. He has been able to find multiple domains where it can be used through the exposure and mentoring by NIF and other institutions.

Mitticool refrigerator and other clay products by Mansukh Prajapati

Mansukh Prajapati innovated the Mitticool clay fridge and other clay products like bottle, plates and other crockery. The double-walled clay structure has evaporative cooling to store vegetables and fruits, and also cool water. The materials are stored without electricity or any other artificial form of energy.

HBN's role

GIAN assisted in the testing of Mitticool at KVK, Chaswad, Bharuch. The National Institute of Design (NID) in Ahmedabad joined GIAN in improving the design of the refrigerator. It also aided Mansukh Bhai in determining the proper packaging needs for transportation. GIAN connected him to public spirited couriers to deliver

his fridge at a nominal cost all across the country and also provided insurance for breakage in transit. Later, Mansukh Bhai has developed multiple showrooms and channels in different cities for delivery of the clay goods.

GIAN had helped to innovate the non-stick tawa by making industry connections and helped to identify a coating which clay plate adsorbed on the surface and did not come off like Teflon which was used for coating in metal utensils. It also made design changes, including the ring support to make the tawas sturdier. GIAN supported the innovator initially when he was in debt and also helped to refine his technology. It played in important role in its development. The innovator's company now supplies in more than 63 cities in India through 200 + channel partners. The innovator employs many women at his facility in Morbi and also generated sustainable livelihood options for its channel partners. He was also supported by NIF through its different schemes. He is also recipient of its biennial presidential awards. He received support for Design & Trademark registration as well as venture support for enterprise development.

Cow dung Pot-making machine by Gopal Bhai Suratiya and Paresh Panchal

Shri Gopalbhai Suratiya came up with a brilliant concept of using cow dung pots to nurture saplings in nurseries. All over the world, the nursery plants are raised and sold in plastic pots. The innovation lies in achieving the best mixture of cow dung, straw and other natural binders to make it robust and pest-resistant. It is a simple to make product that is also environmentally beneficial.

HBN's role

Gopal Bhai was scouted by SRISTI during one of the Shodhyatras in the region. He had developed an innovation of a manually driven trolley pesticide sprayer. He later developed this dung pot. However, the prototype he made was very crude and hence GIAN connected him to Paresh Panchal, innovator of the Agarbatti-making machine. Pareshbhai refined his idea and turned it into product; the technology was licensed to Dip Technologies. However, the license was non-exclusive and the design was made open source. It was done for two reasons: (1) the idea was scalable as cow dung is easily available in rural parts of India, people can make the machine themselves to manufacture pots for nurseries, and hence it had the potential to generate thousands of jobs for people; (2) it could replace plastic bags which are indiscriminately used in the nurseries for raising the saplings, and hence, the HBN institutions wanted people to copy the design and make pots to be supplied all over the country.

With the help of GIAN, the innovator was supported under a scheme of Gujarat Energy Development Agency [GEDA] to popularize the machine in rural parts of Gujarat. NIF supported the innovation and helped in refining the solution.

In this paper, we have discussed how livelihood at the community level can be generated and augmented by converting innovations into social or economic enterprise. We have also described the way different functions of the inclusive innovation value chain have to align so as to provide handholding support to the innovators. Scouting through Shodhyatra is done by SRISTI, providing linkage to formal R and D system is pursue by NIF and operationalising grassroots to global pathway to a

systematic linkage with 92 innovator accelerator labs of UNDP in 113 countries is done by GIAN. Various challenges identified in the paper and illustrated through a few caselets show that intermediary organizations are essential to translate the aspiration of grassroots innovators in the language of formal institution and vice versa. One needs many nodes endowed with strong ethical value system to make the innovation ecosystem more inclusive and empowered. We have often argued that 'a change not monitored is not a change desired' (Gupta 1990). If policy and institutions are not designed to nurture grassroots innovations, then neither such intermediary organization would emerge nor will their roles be legitimized in nurturing the grassroots innovations as a major Gandhian approach of generating and sustaining resilient livelihood, capable of dealing with risk, uncertainty and climatic fluctuations (Dey et al. 2017).

4 The Challenges Ahead in Strengthening the Grassroots Innovation Ecosystem

1. **Gaining confidence and building partnership:**
   As an intermediary organization when one offers to help grassroots innovators without any condition, cost or even formalities, some of the innovators suspect the intention of the intermediary organization. Not having received such a support in the past, many of them wonder why would somebody extend support unconditionally. This requires persistence, persuasion and polite and patient engagement. It has to be understood that such reactions are not unreasonable. Access to public and private institutions for knowledge-rich, economically poor people has not been easy. The very fact that before the Honey Bee Network came on the scene, the terms 'grassroots innovations' and 'frugal innovations' were unknown. The deviant research by the common people was not acknowledged. Though historically, the early invention of automobile, aero plane and a few other commonly used facilities did involve efforts by semi-trained or untrained mechanical minds. The birth of modern milking machine in dairy sector was preceded by manual, pump-operated milking solutions. However, such inventions and innovations did not become a point of reference. As the technology evolved, market developed and the distance between informal R&D and the formal R&D started increasing to the extent that the link got almost disconnected. There is a need to understand and appreciate the role of intermediary organizations in bridging this gap around the world (Khan Sari 2010).

2. **Protecting knowledge rights of grassroots innovators:**
In a compilation, entitled, 'Fortune in formula for firm, farm and workshop[1]', authors had compiled practical solutions for solving problems and starting enterprise. Similarly, Gangaben Yagnik, Mansa Village, had compiled 2080 practices for self-employment, starting small business and solving day-to-day problems in 1898. Both the compilations like most done afterwards did not credit the source from which the knowledge was taken. The role of intermediary organizations in protecting the knowledge rights of the innovators is very critical. We not only have to acknowledge them but also ensure that what we learn from them will go back to them in local language and knowledge collected in that domain should also back to them. If any benefit is generated, a fair and just share accrues to the knowledge provider. Thus, knowledge and economic enrichment are essential for the reciprocity that Honey Bee Network reinforces for protecting the rights of the knowledge holder in GRI. In the absence of such a responsibility, the hesitation of GRI in sharing their knowledge is quite understandable.

3. **Building bridges between formal and informal sectors:**
The top-level agreements with the institutions are helpful. But, cooperation with specific scientists for testing or validation requires more than just the formal partnership. Every scientist/technologist has their own research programme, and unless there is a special motivation, they may not engage with the informal sector innovator. Intermediary organizations build mutual respect, make connections, facilitate collaboration and ensure fair reporting. For various institutional awards or investment, a report from formal sector R&D laboratory is very helpful and sometimes a prerequisite.

4. **Managing an enterprise:**
Most of the grassroots innovators have never learnt bookkeeping. They often mix personal account with the enterprise account. Since many of them do not draw a formal salary, they think it is alright to withdraw cash from business as and when needed. The result is that true cost of specific product or service becomes very difficult to calculate. Similarly, an unfortunate nexus between accountant and the entrepreneur prevents a proper costing to emerge. Institution building for ensuring proper payment of all taxes, maintenance of accounts and separation of personal and enterprise account is a very important need at the grassroots level.

5. **Absence of network entrepreneurship:**
As discussed elsewhere, it is very important for GRI entrepreneurs to collaborate with each other and grow collectively. It is unlikely that they will be able to grow very far individually. Promoting each other's products, developing common catalogue, becoming each other's franchisee, etc., are some of the

[1] Fortunes in formulas, for home, farm, and workshop; the modern authority for amateur and professional; containing up-to-date selected scientific formulas, trade secrets, processes, and money-saving ideas; edited by Gardner D. Hiscox and Prof. T. O'Connor [sic] Sloane (1939).

ways in which business of everybody can grow. Far too long, the academics have promoted competitive models of entrepreneurship. It is necessary that we promote collaborative model. It is obvious that not each grassroots innovator/entrepreneur can set up their own distribution chain, brand or promotional plan.

6. **Blending the unique strength of rural and industrial workers:**
Most of the industrial workers have emigrated from rural areas to join the ranks of informal sector workers and with or without skill upgradation have joined small or large industries. The industrial workers have the connect with their rural roots in most cases and have acquired new skills and perspectives by working in the industrial sector. During the first lockdown of the pandemic started, millions of workers walked or travelled back to their homes in villages. But rural workers and marginal farmers work on many farms to eke out their living and have a good understanding of the unmet technological and other needs of the poor. However, these workers, mechanics, artisans and others use tools, technique and materials which are quite old. Some of them have ideas to reduce their drudgery and improve their efficiency and augment their livelihood. The innovative ideas among these need to be converted into proof of concept, prototype and product. To pursue this process, a collaboration among rural and industrial workers could herald a new paradigm of collaborative problem solving. Such an initiative is being pursued by GIAN, but there is not much precedence of this kind of blend. The industrial workers will bring their skill and knowledge, while the rural innovators would bring their understanding of unmet needs and a possible solution. Collaborative platforms will need to be created where such kind of blending can take place and provide examples and eventually a tool box to other grassroots innovators struggling with similar problems.

7. **Community innovation and fabrication centre:**
The Honey Bee Network has tried with the help of National Innovation Foundation [NIF] to set up workshop for meeting community needs at the residence of grassroots innovators who have shown evidence of creative and empathetic problem solving. But for some reason, most of the innovators use the augmented facility for their own fabrication and only in a few cases encouraged others to join hands. Perhaps, by giving wider publicity and inviting local ideas that need workshop facilities for fabrication, these workshops can really become community innovation fabrication centre. One can try a few other models of similar workshops. They can be situated in government schools, industrial training institutes, polytechnics or even engineering colleges, provided they agree to provide 24 hours support to the innovative workers. The advantage of locating such workshops in polytechnic or ITI is the possibility of getting support from the faculty and experienced alumni. One can try multiple models and encourage grassroots innovators to mobilize new ideas by walking and talking to different

creative workers in their neighbourhood. Even in the governance of community design and fabrication centres located in polytechnic/ITI, grassroots can be involved to help screen the ideas and provide a frugal edge to the prototyping.

8. **Linking financial support for grassroots innovations, designers and other members of the value chain:**
As discussed earlier, a combination of grant, loan and equity investment/patient capital is required to convert innovations into enterprise, whether for social or economic purposes. One of the challenges in providing such support to distributed, scattered and segmented innovations is the transaction cost of reaching out and delivering the support at their doorstep. MVIF model has achieved it to a large extent, but a great deal remains to be done. The fact that most of the countries in the world have not moved beyond microfinance to microventure finance illustrates the conceptual and practical change in the mindset still waiting to happen.

9. **Policy articulation in support of GRI:**
There is a need for a think tank around the world to articulate and lobby for policy changes in support of decentralized and deconcentrated innovation-based enterprise development as an approach for employment, poverty alleviation and meeting SDG. Where it is the role of standards or providing regulatory support or extant public procurement to help scale these enterprises, a lot of policy and institutional changes are required to mainstream the economic and institutional contribution of grassroots innovators.

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