RESEARCH REPORT

Strengthening Community Seed Banks for Gender Inclusive Development in India

CGIAR | INITIATIVE ON Seed Equal

R. Rengalakshmi | Ranjitha Puskur | C. M. Pratheepa
R. Gopinath | Suchaita Tenneti | Allan Bomuhangi

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The CGIAR Research Initiative Seed Equal aims to support the delivery of seed of improved, climate-resilient, market-preferred and nutritious varieties of priority crops, embodying a high rate of genetic gain to farmers, ensuring equitable access for women and other disadvantaged groups.

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R. Rengalakshmi, Director, Ecotechnology, M S Swaminathan Research Foundation, Chennai, India.
Email: rengalakshmi@mssrf.res.in

Ranjitha Puskur, Principal Scientist-Gender and Livelihoods, Module Leader-Evidence, CGIAR GENDER Impact Platform, Sustainable Impact Department, International Rice Research Institute (IRRI).
Email: r.puskur@irri.org

C. M. Pratheepa, Senior Scientist, Ecotechnology, M S Swaminathan Research Foundation, Chennai, India.
Email: pratheepa@mssrf.res.in

R. Gopinath, Principal Scientist, Ecotechnology, M S Swaminathan Research Foundation, Chennai, India.
Email: gopi@mssrf.res.in

Suchaita Tenneti, Associate Scientist: Gender Research, IRRI.
Email: s.tenneti@irri.org

Allan Bomuhangi, Scientist, Gender and Social Research at International Rice Research Institute. Uganda.
Email: allan.b@irri.org

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List of Figures and Boxes

ACRONYMS

CGIAR	Consultative Group on International Agricultural Research
CSB	Community Seed Bank
DUS	Distinctiveness, Uniformity and Stability
FPO	Farmer Producer Organization
HYV	High Yielding Varieties
IPR	Intellectual Property Rights
IRRI	International Rice Research Institute
MSSRF	M S Swaminathan Research Foundation
NBA	National Biodiversity Authority
NBPGR	National Bureau of Plant Genetic Resources
NGO	Non-Governmental Organizations
PPVFR	Protection of Plant Varieties and Farmer's Rights Act
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
SHG	Self Help Group
VSB	Village Seed Bank

Executive Summary

The formal seed system in India mainly includes seeds of notified varieties and important crops, predominantly produced for markets. However, it faces challenges in meeting the diverse crop and varietal needs of small and women farmers in marginal agroecosystems. Most importantly, formal seed systems have less space for women to access preferred varieties, knowledge, market potential, and institutional linkages due to existing gender norms. Women have also not been actively participating and making decisions on the use of improved varieties in food systems. They largely depend on informal seed systems to access seeds. However, with changing agrarian relations and structures, informal seed systems face challenges in ensuring equitable access to traditional and community-preferred landraces or varieties from informal social networks, connections, and exchanges. At the field level, these changes adversely impact women and marginal farmers' access to preferred crops and varieties/landraces, gender relations, food and nutrition security, dietary diversity, food systems resilience, and livelihoods. Against this backdrop, the Community Seed Banks (CSB) model has evolved as an important component in the informal seed system to ensure access to traditional varieties of different crops, specifically neglected and under-utilized crop species.

A detailed study was carried out to understand the significance of the CSBs, their operational processes, and challenges from the gender and social inclusion perspectives. It delved into the status and characteristics of CSBs in terms of their objectives, activities, functioning, governance structures, impacts, and challenges, aiming to understand their potential in the face of changing agrarian landscapes and climate-induced stresses. The research methodology combined a comprehensive literature review with primary data collection.

The study mapped 144 CSBs that have been functioning for at least five years until 2021. Of these, 54% were accessed primarily by women and 46% by both women and men. Predominantly, a higher proportion of the CSBs focus on traditional paddy and millets, combined with pulses, oilseeds, and vegetables to a small extent. The main promoters of the CSBs are Non-Governmental Organizations (NGOs). In the recent past, government and research organizations with an interest in conservation have also been engaged in facilitating CSBs.

The main goal of CSBs is to enable equitable access to seeds of locally adapted varieties/landraces which have less market value to the public and are not included in formal seed systems. Till recently, notified high-yielding varieties were also included in CSBs to improve the use of quality seeds and varietal replacement. The CSBs were established with the multiple objectives of on-farm conservation, ensuring the livelihoods and income of farmers, promoting sustainable/organic production systems with farm-level crop diversity, promoting cooperation among farmers in cultivating traditional crops and varieties in marginal agro-ecologies, and enhancing seed and varietal replacement rates.

The study revealed that CSBs follow multiple and context-specific strategies to achieve equitable seed access to marginalized farmers, such as strengthening farmers' networks to share knowledge and seed resources, raising awareness of farmers' rights, organizing community seed fairs/festivals, building skills of farmers in seed production and management, forging institutional partnerships, and bundling the service of seed access with other services. Also, the study highlighted the importance of mainstreaming the functions of CSBs with the group/collective approach in order to harness social capital for their effective functioning and ensure their sustainability in the long run.

Governance and operational processes

a. The predominant governance structures of the CSBs were either group-based (Self-Help

Group - SHG) or farmer collective (Farmer Producer Organization - FPO) models embedded with seed saver/user networks in 142 CSBs. Only two CSBs have adopted the nodal/individual farmer approach. The study also captured the transformation in governance structure of a few CSBs from group-based to individual-based approach, each with different strategies. This has implications on gender dimensions; women face challenges in operating independently while men quickly adopt this approach.

b. Almost 60% of the seed banks are governed by women's groups while 40% have both men and women members in the committees. The CSBs promoted by many NGOs have adopted pro-women and collective approaches as part of management guidelines; this is missing in CSBs promoted by government and research institutions.
c. Of the 144 CSBs mapped, 45% are village-centric, with operations confined to farmers within the village and 55% operate in a cluster of villages.
d. The CSBs largely operate on either seed exchange or price-based models. Seed exchange is a common practice for locally adapted varieties, wherein seeds borrowed are returned with double the quantity after harvest. It promotes agro-biodiversity. The model is predominantly followed by women farmers and covers varieties and crop species that are less economically important, largely used for household consumption, and have less marketable surplus. In the fixed-price models, seeds are transacted for a cost which is 5-10% less than that in the open market. This is common for high-yielding varieties or those with high market value. These models were largely adopted by male farmers, and mainly for varieties and crop species of commercial and economic importance focussing on the market. Of the two models, the seed exchange model mainly depends on social networks to borrow and return seed.

The CSBs adopted multiple capacity-building strategies to boost their knowledge and skills in seed production, handling, and bank operations. This provided an opportunity for women to gain new knowledge, skills, and to take a lead in seed management. The modules covered seed quality standards, testing protocols, storage methods, facilitation, and negotiation skills that were gained as members of the committee.

Women farmers consider the CSB as a social hub in the village that provides them a platform to meet and exchange knowledge, besides seeds. Otherwise, in the changing socio-economic context, the space for social networks for women is shrinking in rural areas. Such interactions have almost vanished, and due to their workload, women tend to come back early from such events. The CSBs were mostly promoted in marginalized areas with a greater focus on rural women and tribal communities. In specific cases, the unique knowledge of tribal communities was integrated into the operations of the CSBs.

The studies from the literature review have not explicitly mentioned the gender dimensions and social inclusion of the intervention process as well as its impacts and challenges. However, the operational geography comprises largely marginalized agroecosystems covering rainfed, coastal and remote hill landscapes, where women play a key role in food systems. The crops and varieties cultivated and conserved by them are mostly underutilized and neglected by mainstream seed systems; they function solely based on informal seed systems. Interaction with CSBs revealed that women farmers adhere to the terms and conditions of the CSBs more carefully than men farmers in the Kudumbam, Gram Vikas, CIRHEP and Koraput CSBs. Also, they prefer the exchange model to access seeds that come without a financial commitment as it helps them start sowing operations without depending on men. Given the social norm of restricted mobility, interactions with men outside the family, and access to finance to purchase seeds, women find CSB services useful.
The discussions and secondary sources revealed two different strategies being adopted by the CSBs. The first one is regularly organizing community seed fairs/festivals which help farmers to come together, discuss, and borrow/return seeds of preferred varieties. The second strategy is embedding or mainstreaming with the SHG federation/FPOs. In addition, horizontal social networks connected through individual visits, group meetings, and workspaces as a community

labor-sharing practice (common among women in tribal and geographically isolated landscapes) (CIRHEP, Gram Vikas, TEDE Trust, Kudumbam, Shrustidnyan, Kolli Hills and Koraput CSBs). Women prefer these informal networks and channels to receive information, knowledge, and seeds. Men avail of the initial support and then establish their own social networks through mobile phones, agro-input dealers, agriculture extension centres, group meetings, and meetings at NGOs.
Although there are several policies governing seeds, there are no specific guidelines and support for CSBs under the Seed Act of the Government of India. Only, it has made provisions under disaster management guidelines to establish seed banks with notified varieties to ensure quick access. From the Farmer's Rights perspective, the enactment of the Protection of Plant Varieties and Farmers Rights (PPVFR) Act 2001 enables CSBs to guide and link with farmers. The CSBs also act as a platform to facilitate farmers' rights by following either the ownership (intellectual property rights and claiming benefit sharing) or stewardship approach (recognizing the contribution of farmers in the innovation of crop genetic resources and documenting crop varieties in biodiversity registers). However, from the discussions with CSBs, it is evident that the promoting organizations do not have adequate knowledge and access to resources related to the PPVFR Act and the National

Biodiversity Act. Besides their core functions, CSBs support the firming up of agroecological principles (through mixed farming, intercropping, and sustainable/organic production practices) and livelihoods for better food and nutrition security. CSBs are a platform to build the value chain and link it with markets, revive social networks, promote leadership and the agency of women as guardians of seeds/ seed mothers, reduce inequalities, and promote innovative social enterprises for improved food security and livelihoods. The CSBs, established over the past three decades, serve as effective tools to strengthen local seed systems and empower women farmers by providing access to productive resources, knowledge, skills, and institutional linkages.

Some key challenges the CSBs face are as follows:

- Although they are institutionalized through SHG federations/FPOs, continuous nurturing of social capital among the members remains a challenge.
- Building and promoting the organization's capacity to characterize varieties according to Distinctiveness, Uniformity and Stability (DUS) standards and registering them under the PPVFR Act requires attention to recognize their due contribution. This empowers CSBs to claim ownership of unique landraces/varieties and necessitates adopting a gendered approach to document and recognize women's contributions.
- Seed policies of the Government of India have not recognized CSBs as a community-based institution; a formal recognition will motivate such sources.

In the context of the increasing push for organic or natural farming by several states, the demand for traditional varieties/landraces/locally adapted notified varieties is expected to increase. As local seed systems predominantly involve crops of women's preference, formalizing and scaling up CSBs in special mission-based projects, such as millet missions, natural farming and organic farming, is crucial to ensure access and control over seed resources by women and marginalized farming communities.

1. Introduction

Community Seed Banks (CSBs) are a village-level decentralized, informal collection of seeds of locally adapted landraces/cultivars/traditional varieties that are stored, preserved, and managed by local communities. Farm-saved seeds and sharing seeds at the community level have been traditional practices in India that ensure equitable access to seeds for all. Such systems are informally managed through a gendered network and institutions with self-evolved norms and practices. However, these community-level practices have been on the verge of disappearing due to the introduction of high-yielding varieties (HYVs) and the push for formal seed systems coupled with changes in agroecology and agrarian relations, especially social and gender relations in productive roles. These changes have led to deeper and adverse impacts on local crop/plant genetic resources, community-led practices and institutions, associated traditional knowledge, and most importantly, livelihoods, food and nutrition security, and gender relations.

In the past three decades, there have been efforts to systematically revive community seed-saving systems aimed at conserving, restoring, revitalizing, and strengthening local seed systems, resources, institutions, and practices. In general, community seed-saving and exchange networks prioritize traditional varieties/landraces that are not part of formal seed systems. Despite women's contribution to informal seed systems, prevailing gender norms reinforce inequalities and influence women's access to seeds and their effective participation in the production sphere (Puskur et al. 2021). The community-based seed saving system is also referred to as community seed system/bank, farmer seed bank/hut, community seed reserve, village seed bank, etc. In this project, we refer to it as Community Seed Bank (CSB). CSBs are established and managed by local farmer groups with the technical and managerial support of community-based organizations (CBOs), research institutions, and NGOs, depending on the context.

Although a lot of work has been done on CSBs at the field level, there are very few research studies that have been peer-reviewed. However, vast grey literature is available about them. The CSBs differ in terms of their scope, size, governance structure, management style, gender dimensions, infrastructure created/available, and technical aspects that they handle, such as seed selection, storage, conservation, and documentation. Despite changes in seed systems over the years due to the change in local cropping patterns and social relations and institutions that govern land ownership and production, there is no systematic study to understand the status of community-based farmer-led or farmer-managed seed banks in India with its potential to reach out to women farmers to ensure food and nutrition security and facilitate income-generating opportunities. Besides, CSBs have evolved as a major institutional form in the informal seed systems space. This study fills these gaps and aims to:

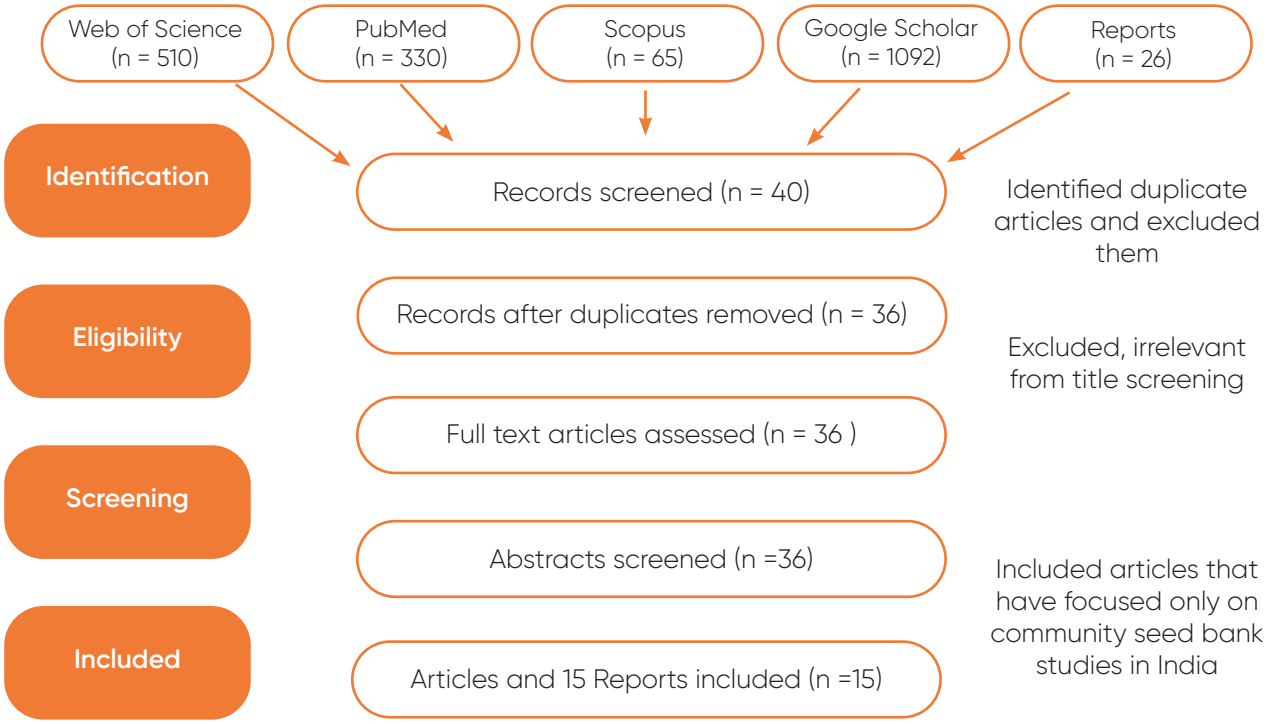
a. Map the CSBs in India through a literature review and secondary sources, taking previous mappings as points of departure; analyze their scope of work and functions with a focus on their engagement with women and other vulnerable groups of smallholder farmers and their ability to reach these groups with timely availability of affordable and quality seed.
b. Select a few CSBs for an in-depth study of their contribution to food and nutrition security and improved livelihoods in light of climate change-induced stresses and threats, with a particular focus on women and other vulnerable groups.
c. Identify factors that influence the ability of these CSBs' to contribute to improved access to good quality seed to women and other vulnerable groups, based on the case studies.

2. Methodology

2.1. Mapping CSBs and literature review

The systematic process of identifying and listing CSBs in India was done using databases such as Web of Science, Google Scholar, PubMed, Scopus and grey literature from various digital sources (Figure 1). These databases hold a wide range of peer-reviewed literature, research reports, policy notes, working papers, conference papers, and case studies.

Figure 1. Flow chart of the systematic screening process.



The study applied a combination of keywords relating to the search on CSBs (Box 1). Each set of terms was applied to specify the country name India. The study used both online resources (Annexure 2) as well as the MSSRF library which has a rich collection of publications on CSBs.

BOX 1 KEY TERMS USED FOR THE SEARCH

The key terms used for the search were: "Community Seed banks", "Seed Banks", "Seed conservation", "Traditional seed conservation", "Community seed conservation in hilly areas", "Indigenous seed conservation methods", "Village Seed conservation methods ", "Seed conservation of traditional varieties", "Conservation of seed varieties in millets", "Community-based indigenous seed conservation", "Informal seed system", "Local seed system", "Seed exchange" "Seed sharing", and "women and vulnerable farmers managing CSBs".

The keywords "seed bank" yielded other related keywords including "village seed bank" and "seed conservation" in combination with "seed banks". The process adopted the inclusion criteria (Table 1).

Table 1. Inclusion and exclusion criteria for the study.

Criterion	Inclusion	Exclusion
Geographic location	Indian articles	Non-Indian studies
Language	English	Any other language
Type of publication	Articles available online and MSSRF library source	Other unknown sources
Participants	Both men and women farmers, vulnerable groups – ST and SC communities	-
Time/period	Articles published till May 2023	Articles published after May 2023
Relevance	All relevant content as per keywords, peer-reviewed articles, and grey literature	Similar content under different titles and years of publications
		Tool kits and manuals on CSBs

All the 40 articles identified were imported into Endnote software and duplicate articles were excluded. Following the initial title screening, 36 articles and 15 Reports (reports, books, and scientific papers) were identified, including 15 peer-reviewed articles. Then the shortlisted titles, abstracts, and key contents were screened carefully (as per Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines). All the identified articles were used to map the CSBs and prepare a profile of CSBs in India. Also, the peer-reviewed articles were analyzed to understand the CSB profile and their characteristics.

2.2) Profiles of the CSBs identified in India

The mapping exercise recorded through secondary sources identified 144 CSBs that are functioning across 24 states. These are facilitated by 93 community-based organizations in India. The state-wise number of CSBs is listed in Table 2.

Table 2. The number of CSBs in 24 States in India (as of May 2023) and the crops they cover.

State	Number of CSBs	Crop
Andhra Pradesh	24	Millets, pulses, paddy, vegetables, oilseeds, and cash crops
Telangana	21	Paddy, wheat, millets, pulses, and cash crops
Madhya Pradesh	12	Paddy, wheat, millets, pulses, oilseeds, and cash crops
Gujarat	9	Paddy, wheat, millet, maize, pulses, and cash crops
Odisha	9	Paddy, millets, vegetables, and cash crops
Karnataka	8	Millets
Maharashtra	8	Paddy, wheat, millets, and pulses
Tamil Nadu	8	Paddy and millets
Uttar Pradesh	8	Pulses, wheat, oilseeds, and cash crops
Chhattisgarh	5	Paddy and pulses
Jharkhand	5	Paddy, pulses, and oilseeds
Rajasthan	5	Wheat, millets, and pulses

State	Number of CSBs	Crop
Kerala	3	Paddy
Uttarakhand	3	Paddy, millets, legumes, vegetables, and oilseeds
West Bengal	3	Traditional paddy, vegetables, and pulses
Arunachal Pradesh	2	Paddy
Assam	2	Paddy, pulses, vegetables, and cash crops
Bihar	2	Paddy
Tripura	2	Paddy, maize, vegetables, and cash crops
Goa	1	Paddy and vegetables
Himachal Pradesh	1	Barley and millets
Meghalaya	1	Traditional paddy, maize, millets, and pulses
Mizoram	1	Cash crops
Nagaland	1	Paddy and vegetables

Source: MSSRF 2023

A basic profile of the CSBs was compiled from the respective articles, websites, phone calls, and emails. The profiles cover the crops the CSB is associated with, the kind of seed exchange/sale practiced, and the main users of the bank (Annexure 1).

Andhra Pradesh, Telangana, and Madhya Pradesh have the highest number of CSBs. It was observed that the CSBs have been established not only for traditional varieties but also to promote high-yielding and improved varieties. However, the proportion of such CSBs is limited. The type of crops stored in CSBs covered cereals, particularly paddy, millets, pulses, oilseeds, and vegetables. Among cereals, paddy was the dominant one, with a focus on locally-adapted varieties/landraces. Only in a couple of cases were high-yielding varieties of wheat and paddy included. In the recent past, apart from CBOs, government agencies (in Goa, Arunachal Pradesh, and Nagaland) too have been promoting CSBs intending to promote on-farm conservation of traditional varieties of main crops.

2.3. In-depth case studies of select CSBs

The mapping exercise identified 144 CSBs across India. The mapping also revealed that a significant number of them were closed or stopped functioning within a few years of commencing operations. Hence, the following criteria were followed to select 10 CSBs (Table 3) for in-depth case studies:

a. Those that have been functioning for at least five years as of 2021;
b. Those from vulnerable agroecosystems such as coastal, hilly, and rainfed regions as well as those working in a range of crops and crop varieties within these regions; and
c. Those with diverse operations and governance structures.

Table 3. Profiles of the CSBs chosen for an in-depth analysis.

S. no.	Name of the CSB	Location	Agroe-co-system	Crop focus	Operational structure	Promoting organiza-tion	Focus com-muni-ty
1	Amman Women SHG – Community Seed Bank, CIRHEP	Pudur, Nilakottai, Dindigul district, Tamil Nadu	Semi-arid system - rainfed	Sorghum and green gram landraces	Women SHG promoted by CIRHEP	NGO	Rural
2	Community Seed Bank for Paddy in Goa Biodi-versity Board	Curtorim and Bando-ra villages, North Goa district, Goa	Coastal systems	Tradition-al paddy varieties	Bank manage-ment commit-tee (BMC), from farmer groups supported by Goa Biodiversity Board - men	Govern-ment insti-tution	Rural
3	CSB Gram Vikas	Kuubara-halli, Malla-nayakana-halli Gram Panchayat, Kolar dis-trict, Karna-taka	Semi-arid system - rainfed	Tradition-al paddy varieties and fin-ger millet	Seed bank man-agement com-mittee of women farmers group, supported by Gram Vikas		Tribal
4	CSB TEDE Trust	Thiruporur, Kancheep-uram district and Palai-yur, Nagap-patinam district, Tamil Nadu	Coastal system - irrigated	Tradition-al paddy varieties	Started with a CSB manage-ment committee – men farmers group and later changed to in-dividual farmers, supported by TEDE trust	NGO	Rural
5	CSB Kudumbam	Keeranur, Pudukot-tai district, Tamil Nadu	Semi-ar-id system - rainfed and irri-gated	Tradition-al paddy varieties and kodo millet	Started as a CSB and changed to men and women custodian farm-ers, supported by Kudumbam	NGO	Rural
6	CSB Cohe-sion Foun-dation	Vansda, Navsa-ri district, Gujarat	Hilly region	Tradition-al paddy varieties, pulses, and veg-etables	Bank manage-ment committee – women sup-ported by Ujas Mahila Khedut Sangthan of Cohesion Foun-dation Trust	NGO	Rural and tribal

7	Seed network, Thanal	Thiruvananthapuram and Wayanad districts, Kerala	Hilly region	Traditional varieties of paddy and vegetables	Men and women farmers - custodian farmers supported by regional-level community seed banks managed by Thanal	NGO	Tribal and rural
8	CSBs – Kolli Hills, MSSRF	Alathruanpatti, Kolli Hills, Namakkal, Tamil Nadu	Hilly region	Traditional landraces of small millets	Seed bank management committee – women SHGs	NGO	Tribal
9	CSB Koraput, MSSRF	Boipariguda block, Koraput, Odisha	Hilly region	Traditional paddy and finger millet landraces	Seed bank management committee – women FPO	NGO	Tribal
10	CSB Srushtidnyan	Ratnagiri, Maharashtra	Hilly region	Traditional paddy and finger millet landraces	Seed bank management committee – farmer interest group – women	NGO	Tribal and rural

3. Analysis of CSBs

3.1. Context of CSBs

Numerous stakeholders are involved in seed production and distribution, including individual farming households (men and women farmers), farmer networks, community-based producers, local traders, government institutions, research institutions, and private seed companies. Seed networks are classified as formal, informal, and integrated seed systems (Reddy et al. 2010). The formal seed system has a clear supply chain and seeds of notified varieties and crops are predominantly focused on the market. However, it has limitations in meeting the diverse needs of small farmers in remote rural areas and is highly centralized at the state level. Most importantly, women have less space to access knowledge on different varieties and their characteristics, market potential, and price and have limited institutional linkages.

The informal seed system is farmer-centric, location-specific, and has evolved based on the community's specific seed requirements. It includes the way farmers produce, store, and access seeds from their harvest and exchange them among community members either through informal networks or in the local markets. It serves as the main source of seed for small and marginal farmers, especially women, that can be accessed directly from their harvest or through local networks or community-based sources. The system is characterized by its flexibility to access preferred and locally-adapted traditional varieties or landraces. The seed quality is governed by trust-based certification and locally evolved information channels are used to access and exchange seed. In the recent past, the system has changed. The main issue is the difficulty in accessing traditional and community-preferred landraces or varieties from informal social networks, connections, and exchanges. These informal seed networks have broken and operated with a shorter node, adversely impacting gender relations, food and nutrition security, and livelihoods of marginalized farming communities. The case in Box 2 clearly explains the importance of the horizontal seed network in ensuring access to seeds and its operational norms, women's leadership in the network, and the context in which CSBs evolved.

BOX 2 TRADITIONAL SEED MANAGEMENT PRACTICES IN KOLLI HILLS, TAMIL NADU

Kolli Hills is inhabited by Malayali tribal communities that predominantly cultivate three species of small millets in both mid- and upper slopes under rainfed conditions. The farmers rely on their own source of seed. At the household level, it is the primary responsibility of the women to ensure seed availability for the next sowing. They usually store five times the quantity of their seed requirement. After sowing in the current season, women keep a part of the excess seed as buffer stock for the next season, foreseeing the risk of crop failure in this vulnerable rainfed system. In addition, they share seeds with needy farmers; the terms and conditions for these transactions have evolved and been institutionalized at the societal level. Malayali farmers have informally recognized certain farmers as 'seed savers', and evolved a trust-based horizontal seed network among them, mainly based on kinship and neighborhood networking, and self-evolved to facilitate and ensure seed availability to all the farmers. Sometimes, they exchange seeds based on their agronomic and genetic purity. The network function is governed by local norms and ethics and exchange takes place without cash transactions. The current governance structure is a CSB management committee with a president and treasurer selected by the farmer groups themselves. Women play a dominant role in exchange networks by sharing information, which is the

base for the network operation and its sustenance. Women ensure seed quality while lending and take the responsibility of returning 1 ½ to 2 times the borrowed quantity after harvest. Fellow farmers trust the neighborhood certification of seed quality in terms of its vigor and germination percentage. If the harvest is affected in a particular season, the borrowed amount can be returned after the subsequent harvest, in which case the borrower has to return three to four times the seed borrowed.

Women set the norms in the exchange process and normally exchange takes place for products having equal value. For example, samai (little millet) or thinai (foxtail millet) are not exchanged for paddy because after threshing paddy has nearly 60% of edible portion while in the case of samai and thinai, after dehusking they have around 75% of edible portion. Similarly, they never exchange products which require energy and labor for processing before being converted into useful products. For instance, even among Italian millet landraces, killanthinai is not transacted for koranthinai because the former needs less energy for pounding than the latter. This shows the intrinsic knowledge women have of the different landraces of small millet species. Usually, farmers exchange seeds due to seed scarcity that occurs due to a poor harvest or lack of rainfall. Also, they exchange germplasm with other farmers if the seeds are not true to type or mixed with other landraces of the same crop. Thus, in addition to farmers' sources, the local seed exchange network ensures seed availability within the community.

However in the late 1990s, small millets were on the verge of disappearing and the cropping pattern shifted towards cash crops, with a steep decline in the area under small millets. At this point, due to the ineffective horizontal social seed network, the farmers interested in growing millets are facing challenges in accessing preferred seeds of landraces. Focus group discussions and participant observations during 1999-98 as part of reviving small millet cultivation came out with a strategy of forming a community-based infrastructure to ensure equal access to seeds (seed is considered a common property resource by tribal farmers), leading to the formation of the CSB.
(Source: Rengalakshmi and Vedavalli 2022)

Over the last three decades, CSBs have evolved into local institutions that are mostly informal, governed and managed by the local community, and functioning based on banking principles. Their main goal is to enable equitable access to seeds of locally adapted varieties/landraces to men and women farmers where existing social networks and cropping systems are undergoing changes. In the recent past, a few CSBs evolved to promote the use of notified varieties to improve seed and varietal replacement rates. Besides, CSBs have been upgraded with additional functions that are context-specific and in the interest of the promoting organizations. Table 4 clearly demonstrates the multiple objectives of the CSBs.

Table 4. Profiles of the CSBs chosen for an in-depth analysis.

Main goal	Reference
Maintain seeds of locally-adapted varieties/landraces, manage crop genetic resources, ensure timely access and availability of seeds, and empower farmers to advocate for themselves.	Vernooy et al. 2014; 2021; 2022
Enable the continued use of indigenous knowledge in crop genetic resources management for seed selection, treatment, storage, multiplication, and distribution.	Vernooy et al. 2015
Some activities have been upscaled to provide additional services to farmers and a few CSBs have graduated to Farmer Producer Organizations.	Vernooy et al. 2020

Main goal	Reference
Enable a strong social network and foster trust between fellow farmers in the community, as well as establish social hubs to serve as a platform for women farmers to meet and exchange knowledge, besides seeds.	Reddy et al. 2010; Vernooy et al. 2020
Restore the cultivation of traditional landraces and crop genetic resources, facilitate easy access to seeds, revive traditional agricultural practices, and ensure food and nutritional security, besides facilitating the awareness of farmers' rights (Kolli Hills CSB, Tamil Nadu and CSB, Koraput, Odisha).	Case study
Encourage sustainable agriculture/organic agricultural practices to ensure food and nutritional security along with the conservation of natural resources/ecosystem, on-farm cultivation of traditional landraces, and promote local consumption (CIRHEP, CBS Kudumbam and TEDE Trust CSB, Tamil Nadu and Shrustidnyan CSB, Maharashtra).	Case study
Promote on-farm conservation of traditional landraces/varieties (Goa-based CSB)	Case study
Facilitate the cultivation of paddy landraces to sustain paddy cultivation and ensure the conservation of paddy wetlands (Thanal CSB)	Case study
Revive and safeguard local agro-biodiversity by encouraging traditional agricultural practices (Gram Vikas CSB, Karnataka)	Case study

The core activities of the CSBs include mapping traditional crops and varieties, collecting seeds, raising awareness among farmers, organizing community seed fairs, facilitating quality seed production, aggregating seeds for the bank, and exchanging seed with needy farmers. In the process, it operates with utmost transparency and social responsibility and fosters trust among farmers in the communities.

3.2. Strategies adopted to fulfil CBS goals

Though the objectives of CSBs vary depending on the location, the common objectives are to improve local seed systems for major, minor, and neglected crops for better crop production, and food and nutrition security; conserve valuable plant genetic resources; and strengthen cooperation among farmers and others involved in agro-biodiversity conservation and improve their livelihoods. The strategies largely focus on strengthening the network among farmers to share knowledge and seed resources, raising awareness of farmers' rights, building skills of farmers in seed production and management, forging institutional partnerships, and bundling the service of seed access with other services. The in-depth case studies showed that at the grassroots level, multiple strategies were followed to promote CSBs among men and women farmers that are highly context-specific. Most importantly, almost all the CSBs studied adopted mainstreaming with the group approach to harness social capital for effective functioning and ensuring sustainability in the long run (Table 5).

Table 5. Key strategies adopted by promoting organizations to fulfil the objectives of the CSBs.

Sl. no.	Name of the CSB	Core objectives	Specific strategies
1	Kolli Hills (Tamil Nadu) and Koraput, Odisha (King et al. 2015).	On-farm conservation of indigenous crop diversity and building resilience among tribal farmers.	• Adopted the 4C approach (Conservation, Cultivation, Consumption and Commerce)

Sl. no.	Name of the CSB	Core objectives	Specific strategies
2	Navdanya[1]	Promote a large network of CSBs across several states and advocate the on-farm conservation of agrobiodiversity through seeds of locally-adapted landraces/varieties	• Building farmer skills in sustainable cultivation practices • Strengthening networks among farmers through CSBs • Promoting self-reliance among farmers for seed access • Raising awareness on farmers' rights
3	Telangana (Reddy et al. 2006; 2010)	Establish alternative informal systems that are reliable for the timely supply of seed of notified varieties at affordable prices and quality	• Integrating informal seed production as enterprise in the regular cropping systems
4	Madhya Pradesh (Vernooy et al. 2020)	Provide timely access to seeds of locally suitable varieties and the sustainable management of crop genetic resources	• Building farmers' resilience in seed production • Expanding institutional linkages to improve their participation in the value chain
5	Tamil Nadu (Dwivedi 2022)[2]	Restore the in-situ conservation of traditional paddy landraces/varieties and promote their cultivation	• Mapping diverse traditional paddy varieties as heritage seeds • Promoting the knowledge of their therapeutic properties • Facilitating on-farm cultivation across 24 districts of Tamil Nadu by identifying champion farmers in partnership with local NGOs in the respective districts
6	Madhya Pradesh (Vernooy et al. 2020)	Promotes improved varieties with the objective of increasing seed replacement rate	• Integrating formal seed production among lead farmers with value addition and input supply (facilitating access to fertilizers and pesticides) and marketing of harvested products

[1] https://www.navdanya.org/living-seed/navdanya-seed-banks
[2] Dwivedi S. 2022. Community Seed Bank Initiative Traces & Revives Heritage Rice Varieties in Tamil Nadu, https://krishijagran.com/agriculture-world/community-seed-bank-initiative-traces-revives-heritage-rice-varieties-in-tamil-nadu/, Sep 2022.

CASE STUDIES			
Sl.No.	**Name of the CSB and location**	**Core objectives**	**Specific strategies**
7	Amman Women SHG – CSB, CIRHEP, Tamil Nadu	Promote diverse mixed cropping systems to ensure household food security and enable access to seeds of traditional varieties of sorghum, pearl millet, and cowpea	• Strengthening networks among farmers through existing grassroots institutions (SHG federation and Watershed management committees) and embed CSB as one of the services • Promoting organic farming and agro-ecologically diverse mixed cropping systems which create demand for seeds that are not available in the formal systems • Raising awareness among women farmers and school children on the importance of millets in diets and its health benefits
8	CSB for Paddy in Goa Biodiversity Board	Facilitate the cultivation of traditional paddy varieties that are adapted to the region	• Conducting seed fairs at the village level • Preparing People's Biodiversity Registers and including the crop genetic resources • Embedding the CSB in the village-level committees
9	CSB Gram Vikas	Promote the cultivation of traditional paddy and finger millet	• Raising awareness about traditional crops and varieties • Promoting organic farming which needs these traditional varieties • Mainstreaming the seed bank with women SHGs in the village
10	CSB TEDE Trust	On-farm conservation and cultivation of traditional paddy varieties suitable to the region	• Facilitating a cadre of custodian farmers who continuously cultivate two to three traditional paddy varieties • Promoting organic farming • Supporting the processing of those paddy varieties, linking them with potential markets, and preparing diverse value-added products • Providing market services by organizing organic shops • Networking among farmers through regular meetings and bringing them together as farmer collectives • Post-project, the approach shifted from a centralized CSB to a decentralized custodian farmer approach among men, with the promoting agency continuing to mentor and provide institutional support

Sl.No.	Name of the CSB and location	Core objectives	Specific strategies
11	CSB – Kudumbam	Encourage the cultivation of traditional millet species, kodo millet, finger millet sorghum, and traditional paddy varieties	• Building the capacity of women and men farmers in organic farming practices • Promoting value addition facilities at the local level to process millets • Regularly conduct health camps to build awareness among local communities, and. school and college students • Organize networking platforms to link farmers through seed festivals and annual farmers' meetings • Post-project, the approach shifted from a centralized CSB to a decentralized custodian farmer approach mainly among men, with the promoting agency continuing to extend mentoring and institutional support
12	CSB, Cohesion Foundation	Promote the cultivation of traditional varieties and improve the livelihoods of farmers	• Raising awareness among farmers on the importance of traditional crops and their nutritional qualities • Building a network among farmers for seed exchange • Supporting them in linking with markets and other institutions
13	Seed network, Thanal	Revive the cultivation of traditional paddy varieties and improve the livelihoods of farmers	• Promoting networks among farmers to share and exchange seeds • Conducting on-farm demonstrations and organizing seed fairs to bring farmers on to one platform • Organizing awareness programs on the importance of organic farming and traditional varieties of paddy
14	CSBs – Kolli Hills, MSSRF	Revive the cultivation of small millets and promote on-farm conservation of genetic diversity for household food security and better livelihoods	• Adopted the 4C approach (Conservation, Cultivation, Consumption and Commerce) • Introducing agronomic and post-harvest processing and value-addition technologies to improve productivity and reduce drudgery • Raising awareness on the consumption of small millets • Building the skills and capacities of women in preparing value-added products by building community assets

Sl.No.	Name of the CSB and location	Core objectives	Specific strategies
			• Linking them with markets by enabling the production of diverse products • Expanding their institutional linkages and exposure • Mainstreaming CSB services as part of the FPO service • Raising awareness on farmer's rights
15	CSB - Koraput, MSSRF	Revive the cultivation of traditional paddy varieties suitable to the region and promote on-farm conservation of genetic diversity and household food security of the farmers	• Adopted the 4C approach (Conservation, Cultivation, Consumption and Commerce) • Followed participatory varietal selection and quality trials with farmers to raise awareness • Promoted post-harvest processing technologies and reduced the drudgery in processing • Embedded the CSBs with women SHGs and FPOs
16	CSB, Srushtidnyan	Promote the cultivation of traditional paddy varieties	• On-farm demonstrations of traditional paddy varieties • Raising awareness and building the capacities of farmers in cultivation • Promoting organic farming and networking among farmers

3.3. Governance structure and operations of the CSBs

The CSBs differ in their governance structure, operational boundaries, and gender profiles. In terms of governance, a majority of them (142 out of 144) followed both group-based (predominantly SHG) and farmer-collective (FPO) models embedded with seed-saver/user networks. Such models largely depend on social capital for effective functioning. However, two of the 144 CSBs (in Kerala and Rajasthan) adopted the nodal/individual farmer approach (Malik et al. 2013).

The in-depth case studies revealed that all CSBs had initially adopted an SHG/FPO-based group approach that helped them map diversity, access quality seeds, and regularly transact with farmers (both giving and receiving). Although in the initial years, such an approach facilitated the building of farmers' networks, as they matured 3 of the 10 CSBs changed their operational structure to nodal farmer-based models. Discussions revealed that cultivating traditional varieties of millet/paddy/other crops by the farmers was mainstreamed into their farming systems. There has been a notable behavior change towards such traditional crop cultivation, and individual farmers were committed to maintaining seed sources by themselves. Farmers who did so were recognized as lead farmers and seed savers in the farming community in that region. One of the promoting the organization of the CSBs stated that the on-farm conservation of such valuable traditional varieties/landraces had been taken over by the farmers themselves. However, it is important to note that such farmers are mostly men, as was observed in the case studies of Kudumbam, TEDE Trust, and Goa Biodiversity Board.

In terms of operational boundaries, of the 144 CSBs, 45% are village-centric with operations confined to farmers within the village and 55% have been serving a cluster of villages in the region. The participation of women was greater in village-centric CSBs than in those with a wider geographic ambit. Based on the geographical location and focus crops/varieties of the CSBs, it was inferred that those agroecosystems are unique (covering rainfed/drylands and marginalized hilly agroecosystems) and focus on small and marginal farmers. The case studies showed that CSB operations are confined to marginalized agroecosystems - 5 out of 10 focus on hilly ecosystems, 3 on semi-arid regions (2 on rainfed and 1 in irrigated), and 2 on coastal agroecosystems. Three CSBs work with tribal farmers, 4 with rural farmers, and three cover both. Eight out of 10 CSBs focus on traditional paddy varieties/landraces, of which 3 additionally cover millets, and 2 exclusively focus on sorghum and small millets.

As part of their governance and operations, CSBs have a management committee that defines operational terms and conditions. There may be a few exceptions where the promoting organizations take a lead in facilitation, as was observed in Kerala and Rajasthan. Almost 60% of the seed banks are governed by women's groups while 40% have both men and women members in the committees. The number of women in the committees and their participation is higher, since this is linked to their group meetings. Women's deeper knowledge of different landraces/varieties, seed selection skills, and meticulous management practices at both postharvest and storage stages are making them better managers of CSBs (as demonstrated by CSBs from Odisha, Kolli Hills, and Wayanad). In CSBs, seeds are normally stored in a common facility for a short duration (ranging from one season to three years) depending on the quality and crop. In the meantime, seed stocks or core collections are replenished collectively through seed exchanges. Hence, returning borrowed seed with that which meets quality (physical and genetic) standards is crucial for the success of CSBs.

Eight of the ten CSBs mentioned that they receive back only 60% of the seeds borrowed by farmers (Odisha, Gujarat, Karnataka, Tamil Nadu, and Kerala). They emphasized that engaging with such farmers is crucial to sustain networks. This requires a platform to meet (once or twice a year) and networking among them, where social capital serves as an important trigger. The case studies revealed that this works fairly well with women's groups since they are part of the women's SHGS/interest groups, but is not common among men farmers. In addition, women's participation in community seed fairs and festivals enables the sharing of experiences and knowledge in crop management, the returning of borrowed seed with pride, and to build ties among them (Wayanad, Odisha, Tamil Nadu, and Gujarat).

In terms of seed production and seed exchange, the management committee is responsible for ensuring their quality, procurement, fixing the seed rate, and record management. Some seed banks appointed a seed bank manager to oversee the functions. The case studies showed that the majority of CSBs (6 out of 10) are managed by women farmers, two have mixed membership, and two are managed by men farmers.

The seed exchange protocol varies among CSBs. Seed fairs and community seed festivals are the main pathways for seed transactions. In the majority of farmer's collectives, these events are organized twice a year; before the sowing season and after harvesting. It is done to facilitate the borrowing and returning processes (Ramanjaneyulu et al. 2015; King et al. 2015; Puskur et al. 2021; NESFAS 2021[3] ; Vernooy et al. 2022).

There are two models of transactions adopted by CSBs:

1. Seed loan - return double the quantity of seed borrowed and here there is no cost transaction involved. If there is any crop loss, farmers compensate with the equivalent value of seed of other varieties they have; and
2. Fixed price – Cash sale (normally less than the market price).

The first model is common among CSBs, where locally adapted varieties/landraces are priority. The initial seed stock is locally mobilized from farmers who have special skills and interest in maintaining seed stocks and replenishing them from the harvest during the exchange process.

Table 6. CSBs adopting seed exchange as a practice to provide access to seeds.

CSBs	Reference study	Main crops covered
MSSRF-promoted Koraput Odisha	Shrestha et al. 2013	Finger millet and traditional paddy landraces
SDMC-promoted CSBs in Odisha	Shadangi and Misra 2023[4]	Finger millet and traditional paddy landraces
Navdanya-promoted CSBs across several states	Navdanya[5]	Traditional paddy landraces, millets, pseudo cereals, and pulses
CSB-Sanjeevini in Andhra Pradesh	Duthie-Kannikkatt 2019	Millets and pulses
WASSAN- promoted CSBs in Andhra Pradesh, Telangana, and Odisha	Nagubandi et al. 2021	Millets, oilseeds, and pulses
Seva mandir CSBs in Udaipur, Rajasthan	Vernooy et al. 2020	Maize, wheat, black gram, sesame, rice, mustard, wheat, Bengal gram, green gram, and vegetable seeds

Table 6 shows examples of CSBs adopting seed exchange as a primary mode of enabling access to seeds, mostly those of food crops. Interactions with a few CSBs as well as the case studies revealed that women are the main stakeholders/ borrowers accessing seed from CSBs.

[3] https://nesfas.in/community-seed-banks-and-community-seed-fairs-reaffirming-seed-sovereignty/
[4] Shadangi, S.K., and Misra, S.S. 2023. Community Seed Bank: Beyond Preservation And Conservation, https://www.oxfamindia.org/featuredstories/community-seed-bank-beyond-preservation-and-conservation, Aug 2023
[5] https://www.navdanya.org/climate-change/seed-of-resilience

Table 7. CSBs adopting a price-based model.

CSBs	Reference study	Main crops covered
BAIF-supported CSBs in Palghar, Maharashtra	Vernooy et al. 2020	Notified varieties of paddy, vegetables, and small millets
ASA-promoted CSBs in Madhya Pradesh	Vernooy et al. 2020	Notified varieties of wheat
Kurnool district, Andhra Pradesh	Reddy et al. 2006	Notified varieties of groundnut
Raichur district, Karnataka	Lokesha et al. 2016	Notified varieties of groundnut
A CSB in Madhya Pradesh	Vernooy et al. 2022	High-yielding seeds of wheat to migrant workers who returned to their hometowns due to the COVID-19 pandemic
A village seed bank in Karnataka	Reddy et al. 2007	Notified varieties of groundnut multiplied and marketed – truthfully labelled seeds among farmers

From Table 7, it is evident that the second model is followed in CSBs that promote high-yielding varieties of both food and commercial crops and the main borrowers are men. The CSBs sourced foundation seed from reliable institutions, trained a cadre of farmers in seed production, and sold them to local farmers as truthfully labelled seed. The main objective here is to improve the varietal/seed replacement ratio for higher productivity. Such models need an initial investment to procure seed from the market. Such a model was effective and sustainable in providing more secure and timely access and availability of seeds of improved varieties of groundnut (Reddy et al. 2006; Lokesha et al. 2016). The study by Vernooy et al. (2022) pointed out the challenges of this model. Its main advantages to farmers are the low seed price compared to the market, timely access, availability throughout the season, and quality seed without admixtures. In the event of post-sowing problems in germination or emergence, they could quickly report and get alternate solutions. However, the short shelf life of improved varieties, high susceptibility to storage pests, and significant decline in seed germination percentage after two years were also reported. The case studies showed that all the CSBs adopted the seed exchange model in the initial period of establishment and focused exclusively on traditional landraces/varieties of crops, largely food crops. However, recently three CSBs (TEDE Trust, Kudumbam and Thanal) shifted to the custodian farmer model and adopted the price model for seed transactions. These CSBs deal with traditional paddy landraces/varieties which have gained market demand among consumers and have become a commercial crop with a niche market focus.

The gender analyses in these two models of transactions indicate that the 'seed exchange' model is pro-women. Mainly women and socially marginalized sections of farmers adopt it as there is no initial investment required for seed and location-specific adaptable varieties/landraces can be accessed. The 'price-based' model calls for an initial investment by farmers on seed and varietal types that are generic to the region. In the seed exchange model, the primary stakeholders, both as users and enablers at the grassroots level, are women farmers. The initial support to set up infrastructure, nurturing women's group activities to continuously build and strengthen social capital, need-based capacity building to improve their knowledge and skills on the management of CSBs, regular meetings and interactions among management committee members, organizing seed festivals and fairs to receive and exchange fresh seed evolved as practical strategies. This is illustrated in the case study of CIRHEP CSB (Box 3).

BOX 3 IMPACT OF CSBS ON WOMEN

Women play a key role in making decisions related to mixed crops, planting, harvesting, and utilization. Their voices and decision-making are further strengthened through capacity building programs on quality seed management and other production technologies ranging from pre-production to value addition. As women are key players in ensuring household food and nutrition security, during one of the FGDs, an elderly woman stated, "We are telling young women in our villages that in agriculture women should not depend on men, and that women should have the necessary knowledge and skills to raise food crops, including ensured access to quality seeds". Women should be self-reliant both in terms of knowledge and resources, including seeds. An internal survey conducted has shown that 47% of the women farmers in the region are now practising millet-based mixed farming systems and 80% of the production is for household use. Regarding the consumption pattern, the survey showed that about 30% of them consume millet-based food once a day and 26% eat food made of millet twice or thrice a week. Millet availability at the household level results in regular consumption. Women play a key role in deciding crop combinations and regularly monitor the fields and harvest the crop at maturity. Some of the farmers have intercropped flowers with millets. The women farmer groups noted that CSBs are key to facilitating the revival of mixed cropping systems and millet consumption. Besides, such innovations provided complete independence for women farmers from the formal seed system, where such crops and varieties were not given importance and were often neglected.
(Source: Primary data, CIRHEP)

As stated above, the preference for the crop and variety accessed from CSBs is gendered. Women prefer seeds of landraces/varieties based on their knowledge about their suitability to their land conditions and other functional requirements (fodder, shorter duration, nutritional quality, etc.). Although there are concerns about the quality of seed, women trust seed obtained from fellow farmers, as they have observed their performance in their fields and received informal certification from other farmers (cases from Tamil Nadu, Karnataka, Maharashtra, Odisha, and Kerala).

3.4. Building capacities to manage the seed banks

The seed exchange model focuses on seed mobilization from select farmers in the village who are locally known among communities for their seed management skills (Shrestha et al. 2013; King et al. 2015), whereas the price model adopts a participatory approach to produce quality seed from local farmers, as per the guidelines of the notified varieties (Reddy et al. 2010; Vernooy et al. 2020). In both models, building the capacity of seed bank committee members and operators is crucial for effective functioning (Table 8).

Table 8. Key capacity building strategies adopted by a few CSBs.

CSBs	Target members	Specific strategies	Source
Kolli Hills, Tamil Nadu	Managers of seed banks	• Promotes participatory quality seed production among selected farmers • Builds capacities of seed bank managers on quality control mechanisms to ensure optimum germination rate and physical purity of the seed material loaned and returned • Regularly monitors seed stock for pests	Case study

CSBs	Target members	Specific strategies	Source
		• Regularly monitors seed stock for pests • Maintains registers and ensures the availability of seed stock in the bank • Discusses relevant matters in group/FPO/committee meetings	
Mahbubnagar district, Andhra Pradesh	Village Seed Bank (VSB) management committee members	• Conducts participatory trials to identify suitable varieties for specific geographies • Trains a cadre of farmers as seed producers • Procures selected varieties and store in the village seed banks • Fixes seed procurement price based on the market price. • Selects the right seed producers, seed procurement, and fixes both procurement and selling price • Promotes VSB as seed enterprises through investments from seed bank members, committee office-bearers, and SHGs	Reddy et al. 2010
CIRHEP, Tamil Nadu	CSB management committee – women's group	• Training on identifying good quality seed, traditional drying, and storage technologies • Maintains registers • Reports in the SHG federation meeting • Identifies potential seed contributors	Case study
Gram Vikas, Karnataka	CSB management committee – women's group	• Maintains seed quality and tests germination percentage • Identifies varieties relevant to the region • Keeps records • Raises awareness among members	Case study
Koraput, Odisha	CSB management committee	• Recognizes different varieties of seeds, handles pest and disease infestations, and postharvest handling, including drying and secure storage	Case study

The Kolli Hills CSB has adopted a seed exchange model where the involvement of women in management positions enables them to improve their capacities to govern and coordinate the bank's activities, and build their leadership, negotiation, and organizing skills in addition to technical knowledge on seed quality profiles. Similarly, the CSBs of CIRHEP and Gram Vikas have imparted basic skills in scientific seed management and record keeping among women members.

It was observed that price model-based CSBs largely benefited men although both women and men participated in seed bank management committees. In the VSB promoted at Mahbubnagar district, Andhra Pradesh, a cadre of farmers was promoted as seed producers, their capacity on seed certification was built, and they received truthfully labelled seed certification of the crops/varieties of their interest. Discussions further revealed that men take the lead in coordination and delivery/sale of seeds to its members, as it happens in other technologies.

3.5. Inclusion of women and tribal communities

Documentation on the role of women in managing informal seed exchange networks, including CSBs, has been increasing. Such CSBs are largely promoted in rainfed/hilly and other marginalized agroecosystems targeting women and tribal communities (Table 9).

Table 9. Inclusion of women and tribal communities in CSBs.

CSBs	Inclusion status	Reference study
ASA, Madhya Pradesh	Has a fairly equal number of men and women, both active members and participants in seed production.	Vernooy et al. 2020
Seva Mandir, Rajasthan	Shareholders of the FPO are women who participate in capacity building events along with Village Resource Persons and other shareholders of the FPO in CSB management.	Vernooy et al. 2020
Village Seed Banks, Andhra Pradesh	VSB committees supported the empowerment of women farmers by transforming them into seed producers (especially those in SHGs) and turning them into small-scale seed entrepreneurs.	Reddy et al. 2010
70 villages in Andhra Pradesh and 20 villages in Maharashtra	CSBs graduated into the Seed Growers Association as demand for quality seeds increased. The promoting organization ensured that an equal number of women and men farmers participated and trained in seed production of paddy, red gram, soybean, and chickpea and expanded their market networks.	Ramanjaneyulu et al. 2015

Although many of the studies featured in this review highlight the importance of incorporating tribal knowledge into seed systems to promote agrobiodiversity, only a few studies have elaborated on their specific role in CSB management. The few specific cases recorded from the literature review are described in Table 10.

Table 10. CSBs among tribal communities.

CSBs	Inclusion status
Sanjeevini, Andhra Pradesh	Integrated tribal farmers' knowledge and practices into the day-to-day operations of CSBs to create self-sufficiency.
Kolli Hills, Tamil Nadu	A cadre of 35 traditional millet farmers from the *Malayali*[6] tribal community were encouraged to establish CSBs. Now they are part of the seed and knowledge exchange network. The group is composed of tribal groups with 70% women and it helps institutionalize CSBs as a community resource.

CSBs	Inclusion status
Koraput, Odisha	*Bhumia* and *Paroja* are tribal communities from Koraput, Odisha. Eighty tribal women millet farmers from eight CSBs were trained, of which 70% are women members and they are active seed champions in that region.
Koraput region of Odisha	Over 2000 economically poor and vulnerable tribal women farmers were organized into Women Farmer Producer Groups, building the capacity of a cadre of women as custodian farmers to produce quality seeds.
Western Ghats region of Kerala	Promoted tubers among the tribal community in the Western Ghats where women from nine SHGs (covering 50 households) were trained and facilitated to produce elephant foot yam[7], ginger, and greater yam and exchange the bulbs with other farmers in the villages.

3.6. Gender and CSBs

The studies do not explicitly mention gender dimensions and social inclusion or their impacts and challenges. However, the operational geography comprises largely of marginalized agroecosystems. Most of them rainfed and other vulnerable agroecosystems including coastal and remote hill landscapes, where women play a key role in food systems. Such systems are largely subsistence oriented. Also, the crops and varieties cultivated and conserved here are mostly underutilized and neglected by mainstream seed systems. Informal seed systems function in CSBs cover crops such as traditional landraces of small millets (little millet, kodo millet, foxtail millet, proso millet, barnyard millet); paddy varieties; grain legumes (lab lab, horse gram, moth bean, winged bean); vegetables and oilseeds (sesame, castor). In addition, women's role in maintaining such crops and varieties is unique and exclusive as they are directly linked to their household food and nutrition security.

Nevertheless, from the details of the studies and the institutional background, it is evident that in the process of building, many of the promoting organizations have adopted and mainstreamed a pro-women approach in designing strategies and harnessed the role of women in seed management. This has built women's leadership and agency in managing and accessing benefits from the CSBs. However, 30 per cent of the agencies have adopted the gender-sensitive and socially-inclusive approach in the process.

There is a gender dimension in CSBs based on the crops they deal with. Of these, traditional varieties of paddy and wheat are largely handled by men, while women are associated with millets, pulses, and oilseeds which are mainly grown under rainfed conditions and for subsistence food needs at the household level.

Gender was found to have significantly impacted access to seeds of crop species and farmers' dependence on seeds from CSBs. A preliminary analysis of the 144 CSBs shows that 54% of them were accessed frequently by women while 46% were by both women and men. Commercially important crops like groundnut, wheat, HYVs of paddy, and certain preferred landraces/traditional varieties of paddy were accessed by men, whereas women primarily accessed seeds of red gram, green gram, major and small millets, vegetables and traditional landraces of paddy. The FGDs revealed that women follow the terms and conditions of the CSBs more carefully than men farmers (Kudumbam, Gram Vikas, CIRHEP, and Koraput). The key indicators for this were the higher proportion of seed returned to the seed bank by women than men to replenish seed stocks and their participation in the community seed festival and seed fairs. From the discussions, it was clear that women prefer the exchange model to access seeds that does not involve financial resources, thereby helping them start sowing operations without depending on men. They stated that market-dependent seeds usually the costs are high, they don't have control over access, availability, affordability, varietal preference, and quality, and overall, there is no

[6] Malayali, meaning rules of hills, is the predominant traditional tribal community in Kolli Hills. They are an agrarian community spread across 16 Gram Panchayats in the Hills.
[7] https://keystone-foundation.org/community-seed-bank-tubers-at-godavary-tribal-settlement-thalappuzha/

seed sovereignty with them. They stated that CSBs enable easy access to preferred varieties/ landraces.

Given the social norms of restricted mobility, curbs on interaction with men outside the family, and access to finance to purchase seed, women prefer CSBs as they can make decisions independently. Women source seeds through seed exchange, seed loans, labor exchange, and grain exchange. In one of the CSBs in Odisha, women described how in the past they would depend on men to choose the variety and purchase seed from the market either by cash or on credit, and compared it to how CSBs allowed them to access seeds, decide the variety/landraces, and prepare for sowing. In addition, CSBs enabled the exchange of knowledge and promoted community-based labor-sharing practices among them.

The approach that promoting organizations adopt in ensuring gender dimensions in the CSBs was noted as an important area of concern. A gender-responsive approach has been adopted while promoting CSBs. The CSBs that have focussed on commercial crops (such as wheat and pulses in Madhya Pradesh, and paddy and pulses in Tamil Nadu) were also included women farmers. The women farmers were also given opportunity to gain new skills on seed production and promoted them as seed entrepreneurs adopting collective approach (Dixit et al. 2006; Reddy et al. 2010; Ramanjaneyulu et al. 2015; Puskur et al. 2021). However, divergent approach was also observed in a few CSBs, where men were given focus in seed production, reviving cultivation and developing a short value chain (such as traditional paddy and other crop varieties in TEDE Trust and SASTRA CSBs). Given the men's prevailing access to productive resources including land ownership, training, technology, institutional linkages, and other opportunities necessary for successful engagement in seed production and value chain, this enabling support promoted them as individual seed entrepreneurs. Although women play a crucial role in the selection and maintenance of seeds, they operate only at the subsistence scale, have limited access to productive resources and decision-making authority, and cannot harness commercial opportunities to move up in the seed value chain (King et al. 2015; Puskur et al. 2021). Most importantly, women farmers from such marginalized ecosystems were also culturally trained to focus on ensuring household food and nutritional security due to patriarchal values, gender roles, and social norms.

3.7. Effective communication and branding

Effective communication applies both within each CSB and between CSBs and other organizations to share knowledge on preferred seeds. Most importantly, promoting organizations in partnership with CSBs organize regular community-level meetings (seed festivals/fairs/food festivals, etc) to promote and raise awareness about seeds available in the CSBs and facilitate discussions on them among the participants through videos/ posters and exhibits.

The case studies have shown that the transactions of the CSBs are discussed at the regional level in their federation/FPO meetings. They also indicate the gendered sources of seed information. The informal, horizontal social network through individual visits, group meetings, and workspaces as community labor-sharing practice (common in the tribal and geographically isolated landscapes among women in CIRHEP, Gram Vikas, TEDE Trust, Kudumbam, Shrustidnyan, Kolli Hills and Koraput CSBs), community seed festivals, and seed fairs are the main sources for both women and men farmers (except the CSB promoted by Goa Biodiversity Board). Women are confident to reach out to these informal channels on their own but need the facilitating organization's input to link and connect with external stakeholders. On the contrary, men needed the initial support from facilitating organizations to build linkages, but moved forward as they established their own social networks through mobile phones, agro-input dealers, agriculture depots, group meetings, and meetings at NGOs (CSBs in Odisha, Gujarat, Madhya Pradesh, and Tamil Nadu) (Table 11).

https://keystone-foundation.org/community-seed-bank-tubers-at-godavary-tribal-settlement-thalappuzha/

Table 11. Communication/dissemination strategies of the CSBs.

Sl.No.	CSBs	Communication/dissemination strategy	Reference study
1	Seed saver group in Palghar district, Maharashtra	Organize seed exhibitions, wild food festivals, and visits to seed banks to expose local farmers to new crop options.	Vernooy et al. 2020
2	Sanjeevini in Andhra Pradesh, Kolli Hills in Tamil Nadu, and Koraput district in Odisha	Conduct community seed festivals, melas, and fairs with the support of promoting agencies.	Shresta et al. 2013; King et al. 2015; Duthie-Kannikkatt 2019
3.	Kudumbam CSB	Conduct a community seed fair before sowing and melas after harvesting to get back the seeds. Discuss and share seeds of varieties with like-minded CSBs promoted by NGOs in the region (TEDE Trust/Kudumbam). Women share the performance of the varieties and seed availability in the workspaces. In the recent past, men started sharing information about seeds through mobile phones/social media.	Case study
4	Shristidyan CSB	Conduct seed fairs before sowing and seed festival coinciding with the village festival. Organize a meeting at the demonstration plots where different traditional varieties are grown.	Case study
5	Kolli Hills CSB, Tamil Nadu	Conduct a millet fair with seeds and value-added products, aligning with a local festival. Discuss progress made and challenges in SHG/FPO meetings.	Case study
6	CSBs in Koraput, Odisha	Annual exhibition organized by the Department of Agriculture and regional-level seed fairs.	Case study

3.8. Conducive policy and legal environment

Among the several policies governing seed systems in India to ensure the use of quality seed are the Seed Act (1966), Seed Rules (1968), Seed (Control) Order (1983), New Policy on Seed Development (1988), Plants, Fruits and Seeds (Regulation of Import into India) Order (1989), National Seed Policy (2002), Seed Bill (2004) and draft Seed Bill 2019. Informal seed systems are not covered under the seed policies which only mention notified and registered varieties of seeds. The Seed Act of 1966 allows the free flow of unbranded seeds among farmers through commercial and non-commercial transactions. This allows seed exchange among farmers and the free flow that is facilitated through CSBs as informal systems. However, there is no provision to recognize such seeds legally. The seed policy promotes seed banks to enable access to improved varieties of crops suitable to the context in disaster prone regions. The primary objective of such seed banks is to support farmers in the event of a major disaster as a response action strategy (backup facility). So far, 22 such banks have been set up by the Government of India[8] under a formal seed system with notified varieties.

Subsequently, the PPVFR Act 2001 ensured farmers' rights over the seeds conserved by them, as stated in its objectives to "recognize and protect the rights of farmers in respect of their contributions made at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties". The PPVFR Act enables CSBs to follow multiple ways to manage crop genetic resources; they can operationalize the clauses governed in the PPVFR Act 2001, namely, the "right to save, use, exchange, and sell farm-saved seed and propagating material; the right to protect traditional knowledge relevant to plant genetic resources for food and agriculture; the right to an equitable share of benefits arising from the use of these resources; and the right to participate in decisions, at the national level, on matters related to the conservation and sustainable use of such resources". While not much progress has been made on the latter two aspects, CSBs have facilitated the other processes. This has revealed two common approaches practised -- ownership and stewardship – to protect genetic resources.

The ownership approach uses tools such as intellectual property rights (IPR) and benefit sharing to protect farmers' varieties, though there hasn't been much evidence of this approach. There is more evidence of the stewardship approach which pursues the protection of farmers' customary rights to save, use, exchange, and sell seeds through documentation and recognition, opting for tools such as recognizing the contribution of farmers in the innovation of crop genetic resources and documenting crop varieties in biodiversity registers (Ramanna and Andersen 2022).

A couple of CSBs together with their respective facilitating organizations have enabled their members to gain recognition for the conservation of traditional seeds under the PPVFR Act under both community and individual farmer categories (Vernooy et al. 2020). So far nine community awards, of which two are in the name of CSBs and 62 individual awards/recognition were provided by the PPVFR Act. Of the 62 farmers, only 4 were women who were recognized for conserving varieties/landraces. MSSRF has used both approaches to help protect farmers' rights with CSBs. For ownership, it has claimed IPRs by registering farmers' varieties. For stewardship, it has attempted to collect, characterize, and evaluate seed material from various seed communities (King et al. 2015), established a Community Gene Bank, and facilitated linkages with the National Bureau of Plant Genetic Resources (NBPGR) to safeguard ex-situ collections of those genetic resources. While developing such databases, it ensured gender dimensions by recording both men's and women's contributions. Such processes create evidence of the community's stake (both men and women) in the management of crop genetic resources as well as access to the provisions of the policy frameworks. The PPVFR Act allows recognition for the contribution of both men and women farmers' roles and leadership in conservation. In the absence of a gendered approach in such a process, women lose out on due recognition for their contributions.

Among the case studies, only the Odisha CSB has focused on linking with the National Biodiversity Act. It has been recognized for its contri-

[8]https://sansad.in/getFile/loksabhaquestions/annex/174/AU281.pdf?source=pqals

bution to the on-farm conservation of traditional paddy landraces under the PPVFR Act in mid-2000. While only two promoting organizations in the case studies knew about linking efforts with recognition of farmers' rights, the other eight had no knowledge of either ownership or stewardship approaches.

3.9. Impact of the CSBs

The CSBs increase farmers' self-sufficiency and choice of seed varieties, leading to improved production and food security. In addition, they generate significant socio-economic impacts (Table 12).

Table 12. Specific impacts of the different CSBs.

CSBs	Impacts	Source
CSB in Madhya Pradesh, promoted by ASA	The integration of seed systems as one of the services in FPOs has increased farmers' confidence and empowerment. FPO leaders were trained in developing a business strategy for seed and women make up a majority of the FPO's shareholders and are mainly involved in seed production. Farmers are chosen for the seed production program during village meetings. Standards to produce quality seed were followed in the trainings on field management practices in partnership with the Department of Agriculture. The new knowledge, skills, and institutional partnerships enabled women farmers to be recognized as seed producers. Although traditionally they possessed skills in seed management, the new knowledge and skills created an opportunity to be recognized as seed producers, providing them an identity and agency to function in this space.	Vernooy et al. 2022
CSBs in Odisha, Andhra Pradesh, and Rajasthan	Facilitated social networks and sharing of seed among farmers, improving their rights and ability to save, use, and exchange farm-saved seeds. CSBs serve as a base to realize farmers' rights – the records help to protect seeds that are adapted to local growing conditions and associated gendered traditional knowledge.	Ramanjaneyulu et al. 2015; King et al. 2015; Puskur et al. 2021; Ramanna and Andersen 2022; Vernooy et al. 2021; 2022
CSBs in Andhra Pradesh, Telangana, Odisha, Jharkhand, Maharashtra, and Rajasthan	Serves as a backup for valuable germplasm of traditional landraces and varieties of crops suitable to rainfed regions	Nagubandi et al. 2021
VSB in Andhra Pradesh	VSBs helped to increase the use of quality seeds of the improved varieties promoted in the region from 1.2 ha in 2002 to 142 ha in 2005; this led the Government of Andhra Pradesh to announce a scaling-up in 322 villages in partnership with ICRISAT.	Reddy et al. 2006

CSBs	Impacts	Source
CSB in Gram Vikas	The CSB supported lead farmers in gaining recognition from the local government for on-farm conservation efforts and expanded institutional linkages for seed access (Green Foundation). This led to the expansion of their portfolio.	Case study
Kolli Hills, Tamil Nadu	The management committee members stated that the new knowledge and skills in seed management imparted confidence in facilitating seed bank activities, promoting on-farm conservation, and the cultivation of small millets. Additionally, the local women are trained to produce value-added goods, including ready-made millet mixtures, rava, and malt, enabling them to effectively contribute to the seed sector by increasing the demand for millets. This has encouraged women to continue delivering quality millet products. At the same time, a cadre of custodian farmers was trained on quality seed production to ensure the regular supply of millet seeds in the region.	Case study
CIRHEP and Kudumbam in Tamil Nadu, PDMC Trust in Odisha, and Janajeevana MACS in Andhra Pradesh	Besides serving as a storehouse of seeds, the CSBs serve as a horizontal network among men and women farmers and play a vital role in reviving traditional practices, strengthening agro-ecological principles, and improving livelihoods for better food and nutrition security. They are facilitating mixed cropping systems with millets, pulses, and oilseeds in rainfed regions to ensure household food and nutrition security and dietary diversity.	Case study

3.10. Important challenges faced by CSBs

a. **Sustainability:** The performance of CSBs is often impacted by technical and operational challenges stemming from economic, institutional, social, and political factors. Many CSBs admitted to being quite effective during their initial years but had to face challenges once the promoting organization's support and monitoring were withdrawn (Ramanjaneyulu et al. 2015; King et al. 2015; Puskur et al. 2021; Vernooy et al. 2022). However, there are instances of CSBs having become sustainable as farmers became 'seed savers'/'seed keepers'/'seed mothers.' In Tamil Nadu, Karnataka, and Kerala, when the external support for CSBs diminished, a cadre of farmers took the lead in managing and conserving varieties by building their agency and leadership. This happens when seeds (of specific varieties and crops) have gained commercial value, as in traditional paddy varieties. Men are more likely to take the lead in the seed systems of these commercial crops.

b. **Deepening gender inequalities:** An emerging trend of seed savers: When CSBs are not functional following the end of project support or withdrawal of support by promoting organizations, a cadre of community leadership is evolving as seed producers/ seed savers/ seed mothers/ seed saviours/ seed custodian farmers. Again, there are fewer women than men in this sphere recognized for their contribution. This is evident from the data on the recognition of the PPVFR Act (refer sub-section 3.8). However, there is a set of farmers who constantly manage crop genetic resources in the marginalized agro-ecosystems across the country. Recognizing such farmers is crucial in sustainably managing crop genetic resources (Figure 2).

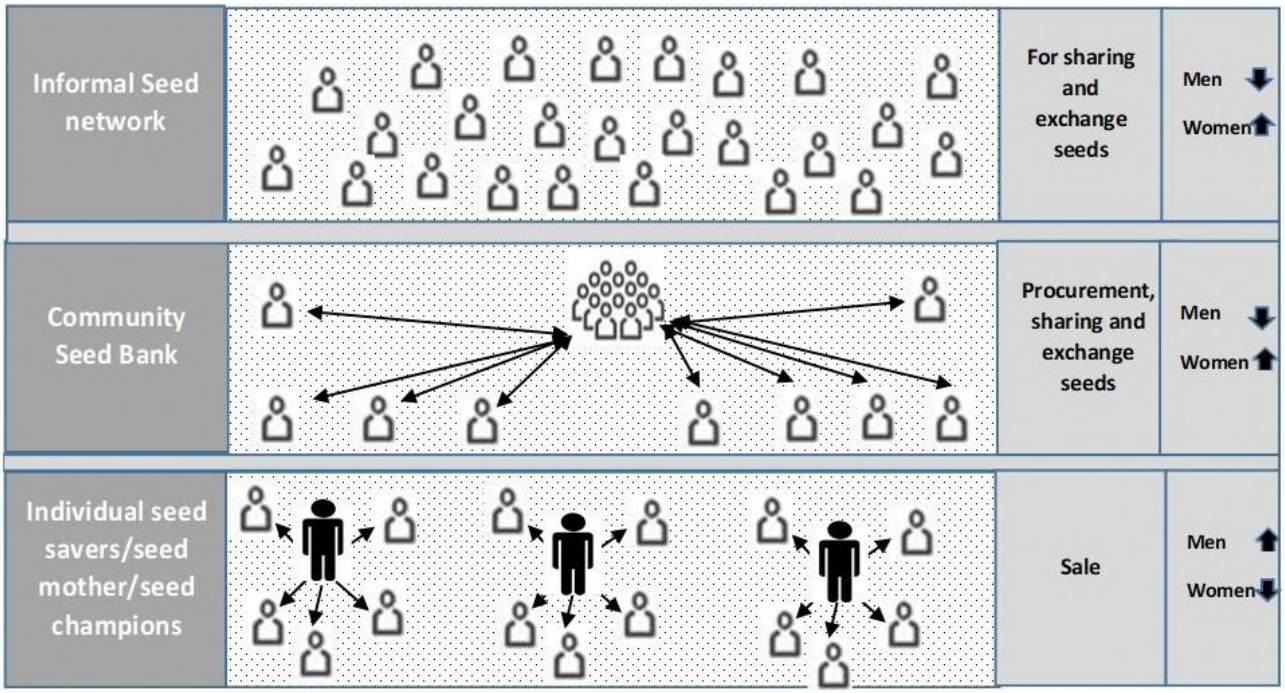
c. **Nurturing the social capital** of the borrower group is crucial and is another challenge faced by CSBs. The seed exchange and banking concept in CSBs depends on the close horizontal network among farmers. Also, the management of the CSB by the community member-based committees depends on social relations and networks for its sustainability. These types of CSBs are built on the base of social capital, which plays a critical role in shaping the behaviour of farmers in terms of returning borrowed seeds. Annual community seed festivals and seed fairs provide a platform for them to return seeds to the bank.

d. **Programmatic/longer-term support:** Although many farmers were satisfied with CSB initiatives, they cited the lack of long-term funding and linkages to markets as constraints (Vernooy et al. 2020). Many smallholder farmers do not have the technical, financial, and organizational capacities to scale up seed production on their own. Though many farmers are excited by the market opportunities that CSBs offer, some initiatives are forced to shut down or tone down the level of operations because they do not have appropriate connections to external stakeholders.

e. **Promoting organizations and the capacity to mainstream the gender dimension:** Most CSBs have been promoted by NGOs/CBOs with grant assistance from development projects. In the recent past, there have been few government institutions and research organizations promoting CSBs. Of the ten CSBs studied closely, nine were promoted by NGOs and only one was facilitated by the Goa Biodiversity Board. In this emerging trend, there is a need to ensure gender integration in CSB initiatives through appropriate policy guidelines.

f. **Recognition of CSBs in national seed policies and national-level crop genetic resources management systems:** The current seed policies of the Government of India have not recognized CSBs as a community-based institution promoting seed access in informal seed systems. Similarly, the strength of CSBs in maintaining in-situ on-farm conservation of crop genetic resources is not fully mainstreamed as a strategy in the plant genetic resources management framework. The recognition of such efforts at the policy level knowing its contributions will motivate and recognize such innovative actions.

Figure 2. Evolution of informal seed systems



4. Conclusion

The successful interactions across the states proved that CSBs are a powerful platform/approach to reach small and marginal farmers including women as well as to focus on traditional varieties/landraces, with the potential to revive diversified agro-ecological principles among small farmers. Observations from literature and studies on the institutional dimensions of gender relations in informal seed systems show that women's involvement in the whole seed value chain, from seed selection to storage and exchange, has been well established in the CSBs. Despite their contributions and roles, prevailing gender norms (ensuring household food security and low value of labor) drive women more towards a subsistence to semi-commercial scale of farming. However, women are gaining new knowledge and skills in seed management which enables them to take the lead in growing traditional native seeds/neglected and underutilized crop species, referred to as future crops. Such constant support and enabling environment are needed for women for their active participation in the seed systems. There is evidence that the adoption of a gender-responsive approach is helping women gain new skills and opportunities as seed producers/entrepreneurs. Currently, women farmers have limited recognition for their role in on-farm management of unique and valuable crop genetic resources. This trend needs to be reversed. Similarly, informal seed systems are not fully recognized in the country's seed policies; gender responsive action in this area can provide equitable and inclusive support for women farmers.

Community Seed Bank activities are shaped by the social capital and collective action among women farmers. Existing women's groups/collectives are potential platforms for their active participation in the functioning and management of seed banks. Equally important are self-reliance and agency in ensuring household food and nutrition security through improved access to seeds of preferred crops/landraces. The NGOs working in this area have been adopting women-led initiatives and gender-sensitive approaches as per their institutional mandate. However, for the government agencies/institutions that promote CSBs, there is a need to develop detailed gender and social inclusion guidelines and integrate them as part of the schemes.

Evidence and experiences from Andhra Pradesh and Sikkim, pioneers in natural farming and organic farming, respectively, have demonstrated that women and women's groups were the key forces behind transformative changes in the production systems. In such contexts, CSBs can be mainstreamed with the active leadership of women's groups and institutionalized with local agencies for sustained actions. In the last three decades, CSBs have proven to be effective tools/structures to strengthen local seed systems. This momentum can be harnessed to empower women farmers and enhance their access to productive resources (knowledge, skills, institutional linkages) and recognition under the Farmer's Rights Act. It is worth exploring how far these developments can be formalized in special mission-based projects like millet mission, natural farming, and organic farming. Recognizing women's contribution to informal seed systems is crucial as a considerable proportion of farmers depend on them. As gender inequality in seed systems is embedded in the overall food systems, an integrated approach is needed to address it structurally.

5. Recommendations and Way Forward

1. **Gender-sensitive support services to strengthen the CSBs and Seed network:** Women farmers need the technical guidance of the facilitating organization to link and connect horizontally and with external stakeholders vertically due to their limited access to information channels and institutional linkages. Men need technical support to strengthen their network using digital social media and institutional linkages to improve farmer varieties and mainstream potential varieties in formal systems for wider access.

2. **Improving the capability of the promoting organizations to ensure longer-term support to CSBs to link seed systems with livelihoods:** Promoting organizations, including NGOs, FPOs and the network of CSBs longer-term handholding and technical support is necessary to strengthen women's role in informal seed systems as well as to enhance the uptake of suitable notified varieties in formal seed systems. Besides, technical guidance and mentoring support are required to accelerate women's participation in the local value chain by getting into post-production and marketing initiatives.

3. **Strengthening the capacity of the CSBs in facilitating Farmers' Rights:** Capacity building of CSBs in the characterization of varieties as per DUS (Distinctness, Uniformity and Stability) standards and registration of varieties under the PPVFR Act is an area that needs attention and investment. This will give them ownership of the unique landraces/varieties they have maintained over decades. Apart from that, enabling support is required to get a geographical indication tag based on their uniqueness and innovativeness. While doing so, technical guidance is needed to adopt a gendered approach, so that women's contributions and unique traditional knowledge are documented and they receive due recognition under the stewardship process.

4. **Developing guidelines to mainstream gender in CSB's operation:** Evolving a set of guidelines to promote gender-responsive actions in both CSB management and operations. There is a need to build the capacities of the promoting organizations to mainstream gender during the design and implementation phases of the CSBs. Here building the capacities of the government agencies assumes importance as they are increasingly engaged in promoting either organic farming or natural farming processes and practices. CSBs have been promoted by government agencies like the Department of Agriculture under millet missions, organic farming and state Biodiversity Boards to boost agro-biodiversity and natural farming at the village level. In such initiatives, the strength of women in seed management can be acknowledged by formally recognizing them in leadership positions in CSB management and operations. As most state governments (Odisha, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Gujarat, and Jharkhand) are promoting organic or natural farming, reviving the cultivation of traditional varieties and landraces is gaining importance.

5. **Integrating and mainstreaming CSBs in Seed policy:** As community-based seed systems are largely working with crops of women's preference, the appropriate institutional mechanisms and operating frameworks in the seed policies to enable their agency and leadership are needed. Exposure visits, interaction with technical agencies, experienced peer group models, capacity building to the various activities of seed quality management and participatory crop improvement processes will drive women to make strategic

decisions to borrow seeds, cultivate and return the seeds without much external dependence.

6. **Developing a database/portal for CSBs at the state/national level:** Currently, the information about CSBs is scattered and there are no proper records about its functions and crop genetic resource management strategies. Many of them deal with unique, locally adapted, climate-risk-tolerant crop genetic resources. Such information is not linked to the centralised national gene bank. The strength of the CSBs can be harnessed by NBPGR to manage its continuous cultivation in in-situ conditions in partnership with CSBs. Digital tools can be effectively used along with geographical information systems to dynamically manage the information with farmers' participation.

7. **Engaging youth in CSB management practices:** Promoting youth's engagement in CSB management by building their knowledge and skill on seed management and nudging entrepreneurship by bringing new opportunities in local value chains linking with farmers' rights and geographical identity are necessary to sustain such innovations.

Promoting and boosting farm-level crop diversity is a proven strategy to improve food system resilience as well as household food and nutrition security and dietary diversity among vulnerable farming households. This study underlines the importance of CSBs in supporting women and marginalized farmers in accessing locally suitable seeds of crops and the associated knowledge in strengthening food systems' resilience.

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Annexure 1. Community Seed Banks across India as of May 2023.

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
Andhra Pradesh					
1	Association For Active Service in Rural Areas (AASRA)	Sorghum, pearl millet, and small millets	Seed savers/users' network	Exchange	Women
2	Agriculture People Poverty Line Coaching Education Society (APPLES)	Sorghum, pearl millet, small millets, pulses, and vegetables	Seed savers/users' network	Exchange	Women
3	Awakening Peoples Action for Rural Development (APARD), Kurnool	High Yielding Variety (HYV): Groundnut	Farmers collective	Sale	Women and men
4	Forum for Rural Development (FORD)	Sorghum, pearl millet, and small millets	Seed savers/users' network	Exchange	Women
5	Grama Vikas	Sorghum, pearl millet, and small millets	Seed savers/users' network	Exchange	Women
6	Jana Jagruti	Sorghum, pearl millet, finger millet, and groundnut	Farmers collective	Sale	Women and men
7	Janajeevana MACS (through Mana Vithana Kendras)	Groundnut and mixed crops such as sorghum, pearl millet, pigeonpea, green gram, cowpea, horse gram, and vegetables	Farmers collective	Sale	Women and men
8	Kovel Foundation	Pulses, paddy, and small millets	Farmers collective	Sale	Women and men
9	Kranthi Society	Paddy	Farmers collective	Sale	Women and men

10	Integrated Development Through Environmental Awakening (IDEA)	Paddy, red gram, maize, millet, and vegetables	Seed savers/users' network	Exchange	Women
11	National Association for Rural Integration (NARI)	Sorghum, pearl millet and groundnut	Seed savers/users' network	Exchange	women
12	People's Awareness and Social Service (PASS)	Sorghum, pearl millet, small millets, black	Seed savers/users' network	Exchange	Women
13	Rural Integrated Development Organisation (RIDO)	sorghum, pearl millet, and small millets	Seed savers/users' network	Exchange	Women
14	Rural Integrated Development Society (RIDS)	Pulses and groundnut	Seed savers/users' network	Exchange	Women
15	Sanjeevini Rural Development Society (SRDS)	Small millets and traditional paddy	Seed savers/users' network	Exchange	Women
16	Social Activities for Rural Development Society (SARDS)	Pulses, paddy, small millets, sorghum, pearl millet, and vegetables	Seed savers/users' network	Exchange	Women
17	Sri Satya Sai Farmers MACF Limited	Pulses, maize, and groundnut	Farmers collective	Exchange	Women
18	Watershed Support Services and Activities Network (WASSAN)	Sorghum, pearl millet, finger millet, and groundnut	Seed savers/users' network	Exchange	Women
19	Women Development Society (WDS)	Pulses	Seed savers/users' network	Exchange	Women
20	Sree Ganga Rural Development Society (SGRD)	Sorghum, pearl millet, and small millets	Seed savers/users' network	Exchange	Women
21	ICRISAT and the Department of Rural Development (DRD), Government of Andhra Pradesh	Groundnut	Farmers collective	Exchange	Women and men

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
22	Centre for Rural Operations Programs Society (CROPS)	Small millets, red gram, castor, paddy, and groundnut	Seed savers/users' network	Exchange	Women and men
23	Deccan Development Society	Small millets, sorghum, and pearl millet	Seed savers/users' network	Exchange	Women
24	Begari Lakshmamma CSB	Pigeonpea, green gram, black gram, lablab, safflower, and millets	Seed savers/users' network	Sale	Women
Arunachal Pradesh					
25	State Biodiversity Board	Traditional paddy and vegetables	Seed savers/users' network	Exchange	Women
26	Navdanya	Traditional paddy and millets	Seed savers/users' network	Exchange	Women
	Assam				
27	Seven Sisters Development Assistance (SeSTA), Chirang district	Maize and millets	Seed savers/users' network	Exchange	Women
28	Bongaigaon Gana Seva Society (BGSS)	Traditional paddy	Seed savers/users' network	Exchange	Women
Bihar					
29	Action for Social Advancement (ASA)	Traditional paddy and wheat	Seed savers/users' network	Exchange	Women

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
30	Gene Campaign	Traditional paddy, and wheat	Seed savers/users' network	Exchange	Women
Chhattisgarh					
31	Professional Assistance for Development Action (PRADAN)	Paddy	Farmers collective	Sale	Women and men
32	Sahabhagi Samaj Sevi Sanstha	Paddy, wheat, small millets, and major millets	Seed savers/users' network	Exchange	Women
33	Sangata Sahabhagi Gramin Vikas Sansthan	Paddy	Seed savers/users' network	Exchange	Women
34	Action for Social Advancement (ASA)	Paddy and wheat	Seed savers/users' network	Exchange	Women
35	Gene Campaign	Paddy and wheat	Seed savers/users' network	Exchange	Women
Goa					
36	Goa State Biodiversity Board	Paddy	Seed savers/users' network	Exchange	Women
Gujarat					
37	Area Networking and Development Initiatives (ANANDI)	Pulses, paddy, maize, and pearl millet	Seed savers/users' network	Exchange	Women

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
38	Bavla Mahila Vikas Sangathan	Paddy	Seed savers/users' network	Exchange	Women
39	Cohesion Foundation Trust	Pulses, paddy, wheat, maize, and pearl millet	Seed savers/users' network	Exchange	Women
40	Dakshin Gujarat Vikas Sanstha	Pulses and paddy	Seed savers/users' network	Exchange	Women
41	Development Alternatives (DA)	Pulses and wheat	Seed savers/users' network	Exchange	Women
42	Development Support Centre (DSC)	Pulses, wheat, and pearl millet	Seed savers/users' network	Exchange	Women
43	Human Development and Research Centre	Pulses and wheat	Seed savers/users' network	Exchange	Women
44	Satvik Promoting Ecological Farming	Pulses, wheat, and pearl millet	Seed savers/users' network	Exchange	Women
45	Vanita Sangthan	Pulses, wheat, and pearl millet	Seed savers/users' network	Exchange	Women
Himachal Pradesh					
46	Rural Technology and Development Centre	Barley, small and major millets	Seed savers/users' network	Exchange	Women
Jharkhand					

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
47	Navdanya	Pulses and paddy	Seed savers/users' network	Exchange	Women
48	Action for Social Advancement (ASA)	Paddy	Farmers collective	Sale	Women and men
49	Caritas India	Paddy and pulses	Farmers collective	Sale	Women and men
50	Gene Campaign	Paddy and small millets	Farmers collective	Sale	Women and men
51	Vikas Sahyog Kendra (VSK)	Paddy and pulses	Farmers collective	Sale	Women and men
Karnataka					
52	Navdanya (Vrihi seed banks)	Finger millet, paddy, small millets, vegetables, and pulses	Seed savers/users' network	Exchange	Women
53	Sahaja Samrudha	Finger millet, paddy, small millets, vegetables, and pulses	Seed savers/users' network	Exchange	Women
54	Green Foundation	Finger millet, paddy, small millets, vegetables, and pulses	Seed savers/users' network	Exchange	Women
55	Annadana Seed and soil savers	Small millets and pulses	Seed savers/users' network	Exchange	Women
56	Groundnut Growers' Self-Help Group Association	Groundnut	Farmers collective	Sale	Women and men

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
57	Krishi Prayog Parivar (KPP)	Traditional paddy and vegetables	Seed savers/users' network	Exchange	Women and men
58	Parisara Samrakshana Kendra (PSK)	Traditional paddy	Seed savers/users' network	Exchange	Women and men
59	Community Vanya Seed Bank, Vanastree, part of the Women's Earth Alliance	Vegetable seeds	Seed savers/users' network	Exchange	women
Kerala					
60	MSSRF, Wayanad	Traditional paddy	Seed savers/users' network	Exchange	Women and men
61	Thanal	Traditional paddy	Custodian farmers	Exchange	Women and men
62	Navdanya (Vrihi seed banks)	Traditional paddy	Seed savers/users' network	Exchange	Women and men
Madhya Pradesh					
63	Action for Social Advancement (ASA)	Wheat and pulses	Farmers collective	Sale	Women and men
64	MP Millet mission	Small millets	Seed savers/users' network	Exchange	Women and men
65	Abhar Mahila Samiti	Wheat	Seed savers/users' network	Exchange	Women and men

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
66	Aga Khan Rural Support Programme - India (AKRSP-I)	Small millets and sorghum	Seed savers/users' network	Exchange	Women and men
67	Centre for Advanced Research and Development (CARD)	Wheat	Seed savers/users' network	Exchange	Women and men
58	Development Alternatives (DA)	Pulses, wheat, and sorghum	Seed savers/users' network	Exchange	Women and men
69	Development Support Centre (DSC)	Pulses, wheat, and sorghum	Seed savers/users' network	Exchange	Women and men
70	Haritika	Wheat	Seed savers/users' network	Exchange	Women and men
71	PRADHAN	Paddy	Farmers collective	Sale	Women and men
72	Pragati Rath	Paddy	Seed savers/users' network	Exchange	Women and men
73	Samaj Pragati Sahyog (SPS)	Wheat and pulses	Seed savers/users' network	Exchange	Women and men
74	Self-Reliant Initiatives through Joint Action (SRIJAN)	Wheat	Seed savers/users' network	Exchange	Women and men
Maharashtra					
75	BAIF - Kalsubai Seed Saver Group	Rice, finger millet, little millet, maize, and sorghum	Seed savers/users' network	Exchange	Women and men

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
76	Navdanya (Vrihi seed banks)	Rice, finger millet, little millet, maize, and sorghum	Seed savers/users' network	Exchange	Women and men
77	American Spring & Pressing Works Pvt. Ltd. (ASPEE)	Maize and Sorghum	Seed savers/users' network	Exchange	Women and men
78	Development Alternatives (DA)	Pulses and paddy	Seed savers/users' network	Exchange	Women and men
79	Development Support Centre (DSC)	Pulses, paddy, sorghum, and pearl millet	Seed savers/users' network	Exchange	Women and men
80	Gramin Yuva Pragatik Mandal	Traditional paddy and sorghum	Seed savers/users' network	Exchange	Women and men
81	Pragati Abhiyan	Finger millet and wheat	Seed savers/users' network	Exchange	Women and men
82	Sourabh Gramvikas Bshud-deshiya Pratishthan	Wheat and small millets	Seed savers/users' network	Exchange	Women and men
	Odisha				
83	Social Awareness Institution (SAI)	Vegetables	Seed savers/users' network	Exchange	Women nd men
84	Pragathi	Traditional paddy and small millets	Seed savers/users' network	Exchange	Women and men
85	M S Swaminathan Research Foundation	Traditional paddy and small millets	Seed savers/users' network	Exchange	Women and men

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
86	Gene Campaign	Traditional paddy and small millets	Seed savers/users' network	Exchange	Women and men
87	Vrihi	Traditional paddy and small millets	Seed savers/users' network	Exchange	Women and men
88	Navdanya	Traditional paddy and small millets	Seed savers/users' network	Exchange	Women and men
89	Organisation for Rural Reconstruction & Integrated Social Service Activities (ORRISSA)	Traditional paddy and small millets	Seed savers/users' network	Exchange	Women and men
90	Oxfam India - SDMC Trust	Ginger, sweet potato, traditional paddy, tomato, brinjal, and oilseeds	Seed savers/users' network	Exchange	Women and men
91	Nirman	Traditional paddy and small millets	Seed savers/users' network	Exchange	Women and men
Rajasthan					
92	Navdanya	Sorghum and pearl millet	Seed savers/users' network	Exchange	Women and men
93	Apna Sansthan	Sorghum and pearl millet	Seed savers/users' network	Exchange	Women and men
94	Development Support Centre (DSC)	Pulses, paddy, sorghum, and pearl millet	Seed savers/users' network	Exchange	Women and men
95	Development Alternatives (DA)	Pulses and paddy	Seed savers/users' network	Exchange	Women and men

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
96	Seva Mandir, Udaipur	Maize, wheat, black gram, sesame, rice, mustard, wheat, Bengal gram, green gram, and vegetable	Nodal farmers	Exchange	Women and men
Tamil Nadu					
97	SASTRA, Thanjavur	Traditional paddy landraces	Seed savers/users' network	Sale	Men
98	Navdanya	Millets and traditional paddy	Seed savers/users' network	Exchange	women
99	M. S. Swaminathan Research Foundation, Kolli Hills	Small millets	Seed savers/users' network	Exchange	Women and men
100	Centre for Indigenous Knowledge System, Sirkazhi	Traditional paddy landraces	Seed savers/users' network	Exchange and sale	Women and men
101	Kudumbam, Keeranur	Traditional paddy landraces and small millets	Seed savers/users' network	Exchange and sale	Women and men
102	TEDE Trust, Nagapattinam	Traditional paddy landraces	Seed savers/users' network	Exchange and Sale	Women and men
103	Annadana	Organic vegetable seeds	Seed savers/users' network	Sale	Women and men
104	CIRHEP, Nilakottai	Sorghum and pearl millet	Seed savers/users' network	Exchange	Women
Telangana					

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
105	Action for Rural Development Society (ARDS)	Paddy, pulses, sorghum, and pearl millet	Seed savers/users' network	Exchange	Women
106	Balavikas	Pulses and paddy	Seed savers/users' network	Exchange	Women
107	Comprehensive Health and Education Society for Tribal Development (CHESTD)	Pulses and paddy	Seed savers/users' network	Exchange	Women
108	WASSAN	Pulses and paddy	Seed savers/users' network	Exchange	Women
109	Jaganadhapuram MACS	Pulses and paddy	Seed savers/users' network	Exchange	Women
110	Koutaguda Watershed MACS	Pulses, sorghum, and pearl millet	Seed savers/users' network	Exchange	Women
111	Meesala Vimala	Pulses	Seed savers/users' network	Exchange	Women
112	Ringanguda Watershed MACS	Pulses and paddy	Seed savers/users' network	Exchange	Women
113	Sahakara Mithra Samstha (Centre for Collective Development - CCD)	Pulses and paddy	Seed savers/users' network	Exchange	Women
114	Society for Integrated Development Services (SIDS)	Pulses and paddy	Seed savers/users' network	Exchange	Women
115	Society for Environment Protection and Education Development	Pulses and paddy	Seed savers/users' network	Exchange	Women

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
116	Society for Women Education and Environment Training	Pulses and paddy	Seed savers/users' network	Exchange	Women
117	Swathi Women & Rural Development Society	Paddy and maize	Seed savers/users' network	Exchange	Women
118	Deccan Development Society	Small millets	Seed savers/users' network	Exchange	Women
119	Integrated Tribal Development Agency (ITDA), Adilabad district	Small millets	Seed savers/users' network	Exchange	Women
120	Vikhasit Raythu Sankshema Samstha (VRSS)	Traditional paddy, red gram, and green gram	Seed savers/users' network	Exchange	Women
121	Youth For Empowerment of Society (YES)	Millets and pulses	Seed savers/users' network	Exchange	Women
122	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Groundnut	Farmers collective	Sale	Women and men
123	Chetna Organics	Pulses and cotton	Farmers collective	Sale	Women and men
124	Mulkanoor Cooperative Rural Bank & Marketing Society	Paddy - HYV	Farmers collective	Sale	Women and men
125	Agricultural Livelihoods Network (ALN)	Paddy - HYV	Farmers collective	Sale	Women and men
Tripura					

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
126	ICAR-ATARI	Maize and millets	Seed savers/users' network	Exchange	Women
127	Seven Sisters Development Assistance (SeSTA)	Maize and millets	Seed savers/users' network	Exchange	Women
Uttar Pradesh					
128	Parmarth Samaj Sevi Sansthan	Pulses	Seed savers/users' network	Exchange	Women
129	Akhil Bhartiya Samaj Sewa Sansthan (ABSSS)	Pulses, wheat, and oilseeds	Seed savers/users' network	Exchange	Women
130	Arunoday Sansthan	Wheat and pulses	Seed savers/users' network	Exchange	Women
131	Bundekhand Sewa Sansthan	Wheat and pulses	Seed savers/users' network	Exchange	Women
132	Yuva Kaushal Vikas Mandal	Wheat and pulses	Seed savers/users' network	Exchange	Women
133	Gene Campaign	Wheat and pulses	Seed savers/users' network	Exchange	Women
134	Navdanya (Vrihi seed banks)	Traditional paddy and millets	Seed savers/users' network	Exchange	Women
135	Gene Campaign	Traditional paddy, millets, legumes, vegetables, and oilseeds	Seed savers/users' network	Exchange	Women

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
	Uttarakhand				
136	Gene Campaign	Traditional paddy, millets, legumes, vegetables, and oilseeds	Seed savers/users' network	Exchange	Women
137	Beej Bachao Andolan	Small millets, pulses, oilseeds, and vegetables	Seed savers/users' network	Exchange	Women
138	Navdanya	Traditional paddy and millets	Seed savers/users' network	Exchange	Women
	West Bengal				
139	Centre for Interdisciplinary Studies, Vrihi	Traditional paddy	Seed savers/ users network	Exchange	Women and men
140	Navdanya	Traditional paddy and vegetables	Seed savers/ users network	Exchange	Women and men
141	Development Research Communication and Services Centre	Traditional paddy, vegetables, and pulses	Seed savers/ users network	Exchange	Women and men
	Meghalaya				

Sl No.	Organization	Crops covered	Seed savers/ users network/ farmers collective	Seed exchange/ sale	Primary stakeholders
142	NESFAS	Traditional paddy, maize, millets, and pulses	Seed savers/ users network	Exchange	Women and men
	Mizoram				
143	Mission Foundation Movement	Vegetables	Seed savers/users' network	Exchange	Women
	Nagaland				
144	North East Network	Paddy, foxtail millet, maize, king chilli, and peas	Seed savers/users' network	Exchange	Women

Annexure 2. Other sources referred to for the study.

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▲ Comunity Seed Bank at Ramaguda

Seeds of vegetables, Maize, Red gram etc stored at Seed Bank ▲

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