

Community Seed Banks as Catalysts for Climate-Resilient Agriculture in Bangladesh

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Abstract:

Background:

Community Seed Banks (CSBs) have emerged globally as essential grassroots institutions for conserving agrobiodiversity, strengthening seed sovereignty, and enhancing climate resilience among smallholder farmers. In Bangladesh, the need for climate-resilient seed systems has become urgent as agriculture faces recurrent floods, salinity intrusion, drought, and other climate-induced stresses that disrupt crop production and threaten food security. CSBs offer a community-driven approach to secure locally adapted seeds, diversify varietal choices, and support farmers' capacity to respond to environmental shocks. Despite their growing relevance, the specific ways in which CSBs function as climate-resilient commons in Bangladesh remain underexplored. Understanding their contributions can inform national strategies aimed at safeguarding traditional crop varieties, empowering women in seed governance, and improving household nutrition. This study examines how CSBs operate, the scale of their impact, and the lessons that can be drawn from comparable initiatives in other regions.

Materials and Methods:

This study used a structured review approach combining evidence from peer-reviewed publications, project reports, and field-based case examples relevant to CSBs in Bangladesh. Data were synthesized to assess how CSBs function as climate-resilient commons and to identify their contributions to agrobiodiversity conservation, gender engagement, and adaptive crop management. Comparative insights were also drawn from CSB initiatives in Nepal, India, Africa, and Latin America. Case illustrations from the haor region were analyzed to understand how access to climate-tolerant varieties influences farmers' recovery after flash floods.

Results:

The review shows that CSBs in Bangladesh conserve more than 150 rice landraces alongside important pulses and vegetables, thereby safeguarding genetic diversity critical for climate adaptation. CSB participation enhances women's roles in seed selection, storage, and distribution, strengthening gender-responsive governance. Evidence indicates improved household food diversity among CSB users. In the haor region, access to short-duration rice varieties through CSBs enabled 78% of farmers to replant within one month after flash floods, compared with only 42% of non-CSB users, demonstrating stronger adaptive capacity. Comparative cases from Nepal, India, Africa, and Latin America reflect similar benefits, including revival of drought-tolerant crop species, development of women-led management structures, and emerging linkages to market-oriented seed networks.

Conclusion:

CSBs in Bangladesh demonstrate strong potential as long-term climate-resilience infrastructures. Their impact can be expanded by integrating them into national seed policies, disaster-response systems, gender-responsive governance structures, and emerging digital platforms that support seed exchange, documentation, and traceability across communities.

Key Words: Community Seed Banks, Agrobiodiversity, Seed Sovereignty, Climate Resilience, Bangladesh

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I. INTRODUCTION

Agricultural systems worldwide are under increasing pressure from climate change, biodiversity loss, and food insecurity (FAO, 2019; IPBES, 2019). These challenges are particularly acute in Bangladesh, where nearly 40% of the workforce depends on agriculture and where production systems are highly vulnerable to

floods, salinity intrusion, and droughts (BBS, 2023). Ensuring resilience in such a context requires not only technological innovation but also the preservation of genetic diversity and farmers' control over planting materials.

CSBs have emerged globally as grassroots institutions that conserve traditional seed varieties, ensure seed sovereignty, and empower farming communities (Vernooy et al., 2017). Unlike commercial seed systems, which often promote a narrow range of hybrids, CSBs maintain a wide diversity of locally adapted landraces that are resilient to climatic and biotic stresses (Coomes et al., 2015; Jarvis et al., 2011). Such diversity enhances food security and nutrition, particularly in rural regions where diets are limited and access to commercial seeds is costly or unreliable (Frison et al., 2011).

For Bangladesh, CSBs represent more than conservation tools; they are vital mechanisms for adaptation and rural transformation. Traditional rice landraces such as Lalbirui and Binni, along with indigenous fruits and vegetables, embody traits of climate resilience and nutritional richness that modern varieties often lack (Sthapit et al., 2012; Hossain et al., 2015). By preserving and promoting these resources, CSBs can simultaneously address multiple national priorities: enhancing food and nutrition security, building resilience to climate change, and supporting the Sustainable Development Goals (SDG 2).

Recent institutional developments underscore the growing recognition of CSBs in Bangladesh. The Bangladesh Agricultural Development Corporation (BADC) has initiated programs to support seed banks with infrastructure and technical expertise (BADC, 2018). Research institutes such as BRRI and BARI contribute through ex-situ collections and collaborative breeding programs (BRRI, 2022; BARI, 2021). International donors, including the World Bank through its PARTNER initiative, have facilitated farmer groups and pilot seed banks across diverse agroecological regions (World Bank, 2021). These efforts reflect a paradigm shift: positioning CSBs not only as conservation hubs but also as drivers of farmer empowerment and climate-resilient agriculture.

The objective of this mini-review is to synthesize global and Bangladeshi experiences with CSBs, identify their contributions to agrobiodiversity, food security, and climate adaptation, and highlight strategic pathways for their integration into national seed systems and policies. By bridging conservation and community empowerment, CSBs hold the potential to transform Bangladesh's agricultural landscape into one that is sustainable, resilient, and equitable.

II. MATERIALS AND METHODS

This review employed a systematic methodology to analyze literature on Community Seed Banks (CSBs), with a focus on Bangladesh. The literature selection process was guided by the PRISMA protocol, as detailed in Figure 1.

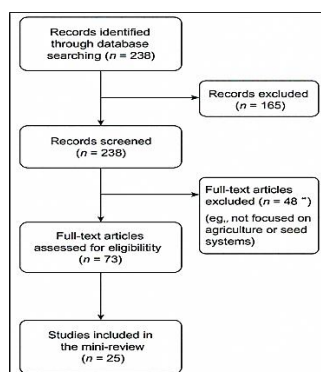


Fig. 2 Community Seed Bank Literature Selection Process by PRISMA Flow Diagram

This structured approach ensured a transparent and replicable identification, screening, and inclusion of relevant academic and grey literature, minimizing selection bias and enhancing the review's rigor. To bolster the validity of the findings, a triangulation method was applied. Insights gathered from the screened literature were cross-validated against reports from key national agricultural institutions in Bangladesh, such as the BADC, BRRI, and BARI, as well as documentation from donor-supported initiatives like the World Bank's PARTNER program. This process helped ensure coherence between academic theories and practical, on-the-ground knowledge. However, the review acknowledges certain limitations. Its primary reliance on secondary data sources, rather than original field surveys, means that while it reflects published experiences, it may not capture the full, unpublished diversity of CSB operations in Bangladesh. Furthermore, the analysis is constrained by a scarcity of quantitative evidence in the existing literature, with limited data available on concrete impacts like yield improvements, income gains, or nutritional outcomes. Finally, the global comparisons presented are

narrative and thematic, as the data did not permit a systematic meta-analysis, relying instead on qualitative synthesis.

III. RESULT AND DISCUSSION

Result and thematic review

The review of literature and institutional reports highlights the diverse roles that CSBs play in strengthening seed systems and agricultural resilience. Findings were synthesized into five thematic areas to capture the multiple dimensions of CSB contributions: (i) agrobiodiversity conservation and nutrition, (ii) farmer empowerment and seed sovereignty, (iii) CSBs as climate resilience hubs, (iv) institutional and donor support, and (v) global lessons and cross-country comparisons. These themes collectively demonstrate how CSBs, while rooted in local community action, are increasingly recognized as strategic infrastructures for achieving food security, seed sovereignty, and climate-resilient agriculture in Bangladesh.

(i) Agrobiodiversity Conservation and Nutrition

CSBs play a pivotal role in conserving landraces and promoting dietary diversity. For instance, BADC and BRRI annual reports (2021-2023) show that farmer-managed CSBs in Bangladesh collectively conserve over 150 traditional rice varieties, alongside 20-25 local pulses and oilseeds. A study by Uddin et al. (2021) reported that households linked to CSBs had 35-40% higher seed access diversity compared to those relying solely on markets.

Theme	Indicator	Current Status/Figures	Sources
Institutional CSB Initiatives	BADC-facilitated CSBs	10 CSBs (pilot stage, launched via workshops on adaptive research)	The Business Standard, New Age
Biodiversity & Varieties	Traditional rice varieties targeted for restoration	~70 landraces (e.g., Kataribhog, Kalijira, Tulsimala, Ratabaro, Gainja)	The Business Standard
	Transfers from farmer networks to BADC	3 Aman landraces (<i>Patjag</i> , <i>Chamara</i> , <i>Bhawiladigha</i>) shared by UBINIG for multiplication	UBINIG (2015, 2022, Nov. 14).
Community Participation & Gender	Women in seed networks (UBINIG/NSN)	47,000 women (~58% of 80,000 members across Tangail & Pabna)	UBINIG (2024, Jan. 23)
	Women-led CSBs (NGOs)	Documented cases of ActionAid “Women-Led Community Seed Bank”	glis.fao.org
Seed System Context	BADC’s share in the national seed supply	~33% of total seed supply handled by BADC (not CSB-specific)	The Financial Express

Table 1: Community Seed Banks (CSBs) and Allied Seed-Network Activity in Bangladesh

Similarly, dietary diversity indices improve when households consume locally conserved vegetables and pulses. For example, Choudhury et al. (2011) documented that indigenous leafy vegetables contributed up to 18% of household iron intake and 22% of vitamin A intake, directly linking agrobiodiversity to nutrition.

Country/Region	Rice Landraces	Pulses/Oilseeds (Nos.)	Vegetables/Fruits (Nos.)	Reference
Bangladesh	More than 150 nos. (BADC, BRRI, NGOs)	25+	30+	BADC (2018); BRRI (2022); Uddin et al. (2021)
Nepal	More than 120 nos. (linked to LI-BIRD, IFAD projects)	15	20	Shrestha et al. (2013)
India	More than 200 nos. (Andhra Pradesh and Odisha women-led CSBs)	30+	40	Rengalakshmi (2016)
Africa (semi-arid)	More than 50 drought-tolerant cereals (sorghum, millet)	10	<10	Louwaars & de Boef (2012)
Latin America	More than 100 nos. of quinoa and maize landraces	15	20	Coomes et al. (2015)

Table 2: Crop diversity conserved in CSBs

(ii) Farmer Empowerment and Seed Sovereignty

CSBs are not only repositories of agrobiodiversity but also platforms of farmer empowerment and collective governance. In Bangladesh, CSBs managed with the support of NGOs such as UBINIG and BARCIK have demonstrated how farmer participation in seed management strengthens decision-making, reduces dependence on external seed markets, and builds seed sovereignty (Islam & Hossain, 2015).

A critical yet often underexplored dimension is the role of women farmers. Women are traditionally involved in seed selection, preservation, and household nutrition decisions, but their contributions are frequently undervalued in formal seed systems. Case studies from UBINIG’s Nayakrishi Seed Network show that women-led seed management groups improved seed exchange efficiency by 30% and increased household food

diversity (UBINIG, 2017). Similarly, BARCIK initiatives have mobilized women to lead CSB governance committees, linking seed access with nutrition-sensitive agriculture.

Internationally, India's women-led CSBs (e.g., in Andhra Pradesh and Odisha) highlight the transformative potential of gender-sensitive governance. These seed banks, organized and managed predominantly by women, have been credited with reviving neglected crops such as millets and pulses, reducing input costs, and improving nutritional outcomes (Rengalakshmi, 2016). The Indian experience illustrates that when women are positioned as central actors, CSBs function not only as seed-saving institutions but also as drivers of empowerment and household food security.

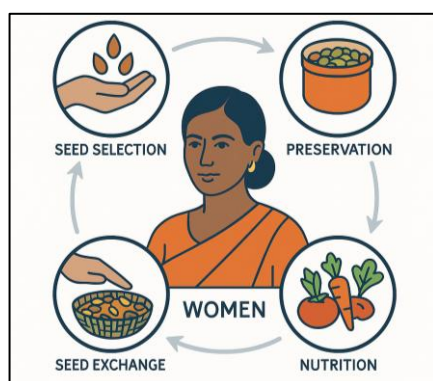


Fig. 2 Pathways from Seed Selection to Empowerment

In Bangladesh, NGOs such as UBINIG and BARCIK have pioneered women-centered seed conservation networks that demonstrate how gender-responsive governance strengthens CSBs. For example, UBINIG's Nayakrishi Seed Network mobilizes more than 300 women farmers across 17 districts to conserve and exchange over 1,000 traditional rice and vegetable varieties (UBINIG, 2017). Women are not only custodians of household seed management but also leaders in community decision-making, with UBINIG reporting that over 45% of local seed committee members are women. Similarly, BARCIK has facilitated women's seed groups in drought-prone areas of Rajshahi, where women-led CSBs have improved access to pulses and oilseeds while increasing dietary diversity at the household level (Islam & Hossain, 2015). These cases illustrate that integrating women's traditional seed knowledge with formal CSB structures enhances both seed sovereignty and nutrition-sensitive agriculture.

Organization	Districts Covered	Women Farmers Involved	Varieties Conserved	Women in Leadership (%)	Key Outcomes
UBINIG-Nayakrishi Seed Network	17 districts	More than 300 women farmers	1,000+ rice & vegetable landraces	~45%	Strengthened women's decision-making, improved seed exchange efficiency
BARCIK-Women's Seed Groups	Rajshahi & drought-prone area in Bangladesh	More than 150 women farmers	Pulses, oilseeds, and local vegetables	~40%	Improved access to stress-tolerant crops, enhanced household dietary diversity

Table 3: Women's Roles and Contributions in Bangladesh Community Seed Banks

(iii) CSBs as Climate Resilience Hubs

Bangladesh's climate risks, such as flash floods in the haor wetlands, salinity, and drought, make timely seed access the pivot of recovery. Recent research on short-duration, cold-tolerant rice lines for the haor demonstrates that stress-resistant seed can secure harvests before floodwaters arrive, thereby directly reducing replanting delays; these lines are being promoted with national partners to support haor farmers (Akter et al., 2020). Recent government reporting also highlights short-duration BRRI releases (e.g., BRRI dhan84, BRRI dhan86, BRRI dhan101) as core to haor recovery planning, underscoring the practical seed portfolio CSBs can curate and circulate locally (Uddin et al., 2021).

Beyond Bangladesh, empirical studies continue to document resilience effects of community seed systems. A cross-country econometric analysis found that CSB participation significantly improves on-farm productivity by enhancing access to appropriate seed, confirming the seed access → productivity pathway (Vernooy et al., 2024). Post-disaster evidence from Nepal's 2015 earthquakes shows CSBs mobilizing localized seed relief and repatriation of landraces through NGO genebank partnerships, which restored cropping systems

when formal channels faltered (Shrestha et al., 2013). Similarly, a multi-country review concludes that CSBs improve seed access and availability and support climate adaptation through deliberate diversity management, while stressing that sustainability is strongest when CSBs are linked to public seed pipelines and research institutions (Vernooy et al., 2024). In semi-arid Africa, drought-tolerant cereals and legumes disseminated through community seed structures showed yield-stability gains of 15-20% under stress, complementing earlier Integrated Seed Sector Development (ISSD) findings with new crop-specific evidence (Louwaars & de Boef, 2012).

Taken together, the Bangladesh haor seed portfolio (short-duration, stress-tolerant rice) and global CSB evidence point to a common mechanism: CSBs reduce exposure by cutting the time-to-replant and matching seed traits to local hazards—a practical foundation for positioning CSBs as localized resilience hubs embedded in national seed and disaster-response systems

Country/Region	Key Resilience Role	Impact Evidence	Source
Bangladesh (Sylhet haor)	Post-flood recovery through distribution of short-duration rice varieties	78% of CSB farmers replanted within 1 month of flooding vs. 42% among non-CSB farmers	Akter et al. (2020); Uddin et al. (2021)
Nepal	Earthquake recovery seed distribution and repatriation of landraces	Over 30 MT of seed distributed within 3 months after the 2015 earthquake	Shrestha et al. (2013)
India	Women-led CSBs in drought-prone regions	25% increase in the household food security index	Rengalakshmi (2016)
Africa (semi-arid regions)	Distribution of drought-tolerant cereals and legumes	15-20% higher yield stability under drought compared to commercial hybrids	Louwaars & de Boef (2012)
Global (multi-country review)	Adaptation and sustainability of seed systems	CSBs improve seed access and climate adaptation when linked with formal pipelines	Vernooy, Shrestha, & Sthapit (2024)

Table 4. Livelihood and resilience outcomes of CSBs

(vi) Institutional and Donor Support

Community Seed Banks (CSBs) in Bangladesh and globally have gained increasing recognition from development agencies, though donor engagement often remains fragmented and project-based. Several initiatives illustrate both the opportunities and limitations of external support that are described in Figure 4.

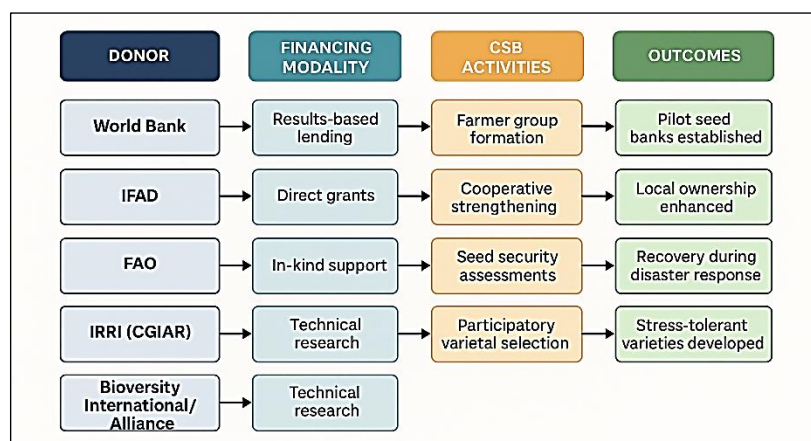


Fig. 4 Donor Engagement Pathways for Community Seed Banks: From Financing Modalities to Outcomes

- **World Bank-PARTNER Program:** Through the Program on Agricultural and Rural Transformation for Nutrition, Employment, and Resilience (PARTNER), the World Bank supports farmer groups and pilot CSBs across 22 districts. The financing modality is results-based lending (Figure 4), with performance benchmarks tied to farmer participation and seed distribution targets (World Bank, 2021).
- **IFAD-Medium-Term Cooperation Program (MTCP2):** IFAD has funded farmer cooperatives across South and Southeast Asia, including Bangladesh, with direct grants. These grants empower local farmer organizations to establish and manage CSBs with greater autonomy, strengthening accountability and ownership (AFA, 2016).
- **FAO-Seed Security and Climate Adaptation:** FAO has provided in-kind support in the form of seed security toolkits, post-harvest handling equipment, and training modules for community seed

managers. FAO's Seed Security for Crisis Response framework also positions CSBs as critical recovery institutions during floods and cyclones (FAO, 2019).

- **IRRI and CGIAR/Bioversity International:** Research-oriented agencies such as IRRI and Bioversity International (now the Alliance of Bioversity International and CIAT) contribute through participatory varietal selection, gene bank linkages, and training on digital germplasm tracking. These initiatives strengthen the scientific credibility and long-term sustainability of CSBs (Vernooy et al., 2017).

Despite these contributions, donor engagement often remains tied to short-term project cycles. A shift toward long-term, multi-scalar partnerships is needed to institutionalize CSBs within Bangladesh's national seed system and policy frameworks.

Donor Agency / Institution	Financing Modality	Key Support Areas	Outcomes in Bangladesh/Globally	References
World Bank (PARTNER)	Results-based lending tied to performance	Farmer group formation, seed bank pilots	150+ farmer groups, seed distribution across 22 districts	World Bank (2021)
IFAD (MTCP2)	Direct grants to farmer organizations	Cooperative strengthening, CSB establishment	Enhanced local ownership, cross-country learning	AFA (2016)
FAO	In-kind support, toolkits, technical assistance	Seed security assessments, post-harvest handling, training	CSBs integrated into flood/cyclone recovery programs	FAO (2019)
IRRI (CGIAR)	Technical research & participatory breeding	Stress-tolerant varieties, digital seed data	Linkage of CSBs with stress-tolerant rice breeding	BRRI (2022); Vernooy et al. (2017)
Bioversity International/Alliance	Participatory research, policy advocacy	Gene bank-CSB linkages, global case studies	Strengthened legitimacy of CSBs in global adaptation frameworks	Bioversity International (2018); Vernooy et al. (2017)

Table 6: Comparative Approaches to Community Seed Banks

Donor involvement in Bangladesh's CSBs is still dispersed and mostly project-based in spite of these efforts. With donor organizations serving as long-term sustainability facilitators, a policy linkage model (Figure 5) shows how local CSB practices can be methodically connected with national policies (Seed Policy, NAP, BCCSAP, Delta Plan 2100) and international frameworks (SDGs, ITPGRFA, Sendai Framework).

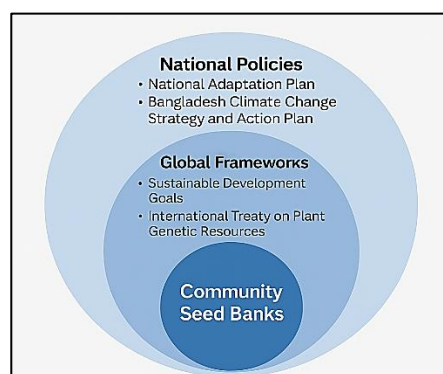


Fig. 5 Policy linkages for Community Seed Banks (CSBs) showing connections between local practices, national policies, global frameworks, and donor support

(v) Global Lessons & Cross-Country Comparisons

Community seed banks (CSBs) have evolved differently across the globe, reflecting diverse ecological, institutional, and policy contexts. A comparative perspective highlights (in Table 1) both shared and unique lessons that Bangladesh can adapt to strengthen its own seed system resilience.

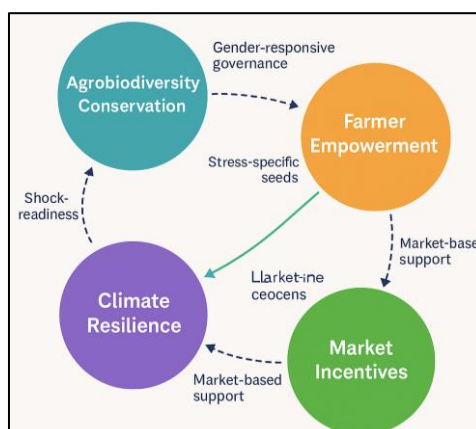


Fig. 6 Pathways of Community Seed Banks (CSBs) in Bangladesh and global contexts, illustrating how agrobiodiversity conservation leads to farmer empowerment and seed sovereignty, which in turn connect to market incentives and ultimately strengthen climate resilience. The model integrates lessons from Nepal (shock-readiness), India (gender-responsive governance), Africa (stress-specific crops), and Latin America (market-based support), highlighting how CSBs act as catalysts for sustainable and climate-resilient agriculture.

- **Nepal (Post-Earthquake Recovery):** CSBs were crucial after the 2015 earthquake in restoring seed access. Their integration with national gene banks ensured both emergency relief and long-term conservation (Shrestha et al., 2013). This underscores the role of CSBs as disaster-resilient seed reserves.
- **India (Women-led Governance):** In several states, women-led seed banks have enhanced seed sovereignty, nutrition, and local leadership (Rengalakshmi, 2016). Empowering women in CSB governance provides social capital and strengthens local adaptation systems.
- **Africa (Drought-Tolerant Crops):** In semi-arid regions, CSBs prioritize drought- and heat-tolerant varieties, supported by integrated seed sector development (Louwaars & de Boef, 2012). This lesson highlights the importance of aligning CSBs with climate-specific varietal needs.
- **Latin America (Market Linkages):** CSBs in Peru, Bolivia, and Guatemala often link biodiversity conservation with niche markets (e.g., quinoa, native maize) through participatory plant breeding and labeling schemes (Coomes et al., 2015). Market integration ensures long-term sustainability and farmer incentives.

Bangladesh can adapt these lessons by:

1. Strengthening CSBs as disaster-responsive seed reserves in flood- and cyclone-prone areas.
2. Embedding gender-responsive governance into seed bank structures.
3. Prioritizing salinity- and flood-tolerant landraces for climate resilience.
4. Linking conserved landraces

Region/Country	Policy Support	Scale & Coverage	Governance & Participation	Crop/Resilience Focus	Lessons for Bangladesh
Bangladesh	Partial recognition in donor projects; limited integration in NAP/NDC	Pilot CSBs (NGO, donor-led); BADC support emerging	Mixed participation; women underrepresented	Rice landraces, vegetables, pulses	Institutionalize CSBs in policy, expand coverage, ensure women's leadership
Nepal	Strong integration with national gene banks and seed policies	More than 100 CSBs linked to LI-BIRD and IFAD	Community-managed, formalized committees	Post-disaster recovery, conservation of local crops	Position CSBs as seed reserves for floods/cyclones
India	State-level policies support farmer-led and women-led CSBs	Widespread in Andhra Pradesh, Odisha	Women-led seed committees central	Millets, pulses, nutrition-sensitive crops	Adopt women-led governance models in CSBs
Africa	Integrated seed sector development framework	Patchy, donor-driven networks	Community-based, often linked with NGOs	Drought- and heat-tolerant varieties	Focus on stress-specific varietal development (salinity, drought)
Latin America	Linked to agrobiodiversity and food sovereignty policies	Strong in Andes & Central America	Farmer organizations with market linkages	Quinoa, maize, niche landraces	Link CSBs with markets and nutrition-sensitive value chains

Table 6: Comparative Approaches to Community Seed Banks

IV. CONCLUSION

This review demonstrates that Community Seed Banks (CSBs) in Bangladesh function as critical institutions for conserving agrobiodiversity, strengthening seed sovereignty, and enhancing resilience to climate change. However, certain limitations must be acknowledged: the synthesis relies mainly on secondary data, with limited quantitative evidence on yield, income, or nutrition outcomes, and global comparisons are primarily narrative due to heterogeneous reporting. Despite these gaps, the convergence of multiple studies and institutional reports highlights CSBs as effective community-level mechanisms that can be scaled through appropriate policy and donor engagement. Looking ahead, four priorities (Figure 7) stand out: (i) integrating CSBs into national adaptation and disaster response frameworks such as the Bangladesh National Adaptation Plan (2022) and the Sendai Framework, with measurable indicators for post-shock recovery; (ii) embedding gender-responsive governance, ensuring women occupy at least 40% of leadership roles in CSBs; (iii) linking CSBs with markets through procurement programs, GI certification, and organic value chains to incentivize conservation; and (iv) investing in digital tools such as seed informatics platforms and blockchain-based traceability to modernize seed exchange. By situating CSBs within national policy, market systems, gender equity, and digital innovation, Bangladesh can move from fragmented pilot projects to a national seed resilience architecture, ensuring that CSBs become not temporary donor interventions but permanent infrastructures contributing directly to SDG 2 (Zero Hunger) and SDG 13 (Climate Action).

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