Case Study

From climate vulnerability to local leadership: Community-driven climate adaptation and resilient livelihoods in flood-prone northern Bangladesh

Abstract

Climate change intensifies livelihood insecurity for households exposed to recurrent flooding, riverbank erosion and waterlogging in northern Bangladesh. This practice-based case study examines community uptake of locally appropriate climate-smart agriculture and livelihood measures promoted through the Socio-Economic Empowerment with Dignity and Sustainability (SEEDS) Project of the Eco-Social Development Organization (ESDO) in Ulipur, Chilmari and Rajarhat upazilas of Kurigram District. The analysis draws on project monitoring records and case documentation and interprets the experience through the emerging framework of locally led adaptation (LLA). The SEEDS portfolio includes sack-bag cultivation, keyhole gardens, floating vegetable gardens and seedbeds, vermicomposting, and raised-platform goat rearing. Project records report that approximately 3,000 households practiced sack-bag cultivation; in 2025, around 50,000 sacks produced approximately 22 tonnes of ginger valued at about BDT 3 million. By 2026, community practice had expanded to about 80,000 ginger sacks and 20,000 chilli sacks. The project also supported 205 vermicompost entrepreneurs. These findings suggest that low-cost, movable, resource-efficient and income-generating practices can facilitate a transition from project-supported experimentation toward wider community replication. However, the evidence base does not yet demonstrate all dimensions of LLA, particularly devolved finance and formal community authority over adaptation decisions. The paper therefore positions the SEEDS experience as a pathway toward locally led climate action and identifies priorities for stronger local governance, community climate finance, longitudinal monitoring and rigorous evaluation.

Keywords: locally led adaptation, community-driven climate action, climate-smart agriculture, flood resilience, resilient livelihoods

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Practice and policy highlights

A. The most promising ESDO practices combine hazard adaptation with immediate livelihood value, increasing incentives for continued use.

B. Reported replication of sack-bag cultivation beyond initial project-supported practice is a meaningful indicator of local ownership and diffusion.

C. The current evidence supports describing SEEDS as community-driven and locally grounded; full LLA requires stronger documentation of devolved decision-making and climate finance.

D. Future monitoring should measure avoided loss, household income, nutrition, soil outcomes, women and youth agency, own-resource investment, and continuation after project support.

Introduction

Climate change is increasingly reshaping the conditions under which rural households pursue agriculture, food security and livelihood security. In South Asia, climate-related changes and extremes are affecting agriculture, water resources, ecosystems, health and livelihoods, while future risks are projected to intensify with warming.[1,2] For poor households with limited land, savings and access to formal risk-transfer mechanisms, relatively modest shocks can translate into crop loss, asset depletion and repeated livelihood disruption.

Bangladesh has responded to these risks through long-term adaptation planning. The National Adaptation Plan (NAP) of Bangladesh frames adaptation as a medium- and long-term national development priority and seeks to reduce vulnerability by strengthening adaptive capacity and resilience.[3] Yet national planning ultimately depends on workable solutions at household, community and subnational levels, where climate impacts are experienced and day-to-day livelihood decisions are made.

This has contributed to growing interest in locally led adaptation (LLA). LLA goes beyond consultation or participation by emphasizing the agency of local actors over adaptation priorities, design, implementation, finance, monitoring and learning.[4,5] The eight widely referenced Principles for Locally Led Adaptation include devolving decision-making, addressing structural inequalities, providing predictable and accessible finance, investing in local capabilities, combining local and scientific knowledge, enabling flexible learning, strengthening accountability, and promoting collaborative action.[5]

The distinction between community-based activity and genuinely locally led adaptation is analytically important. Recent scholarship cautions that projects can be locally implemented without transferring meaningful authority or resources to local actors; labeling such activity as LLA can obscure persistent power imbalances.[6] For this reason, the present paper uses the more evidence-consistent term community-driven adaptation while assessing the extent to which ESDO's SEEDS experience indicates a pathway toward stronger local leadership.

The paper examines the Socio-Economic Empowerment with Dignity and Sustainability (SEEDS) Project implemented by the Eco-Social Development Organization (ESDO) in Ulipur, Chilmari and Rajarhat upazilas of Kurigram District. Project documentation describes a portfolio of climate-smart and flood-adaptive practices, including sack-bag cultivation, keyhole gardening, floating gardens and seedbeds, vermicomposting and raised-platform goat rearing.[7] The central research question is: what does the SEEDS experience suggest about the conditions under which locally appropriate livelihood practices can evolve from project-supported interventions into community-owned climate action?

Conceptual framing: From community-based adaptation to local leadership

Climate-smart agriculture (CSA) offers a useful operational lens because it seeks context-specific agricultural strategies that can support productivity and food security, adaptation and resilience, and, where feasible, mitigation benefits.[8] The FAO framework emphasizes that CSA is not a single technology; the suitability of practices depends on location-specific evidence, institutions, capabilities and policy conditions. This is particularly relevant in flood-prone settings where the principal objective may be to protect production, shorten recovery time or maintain access to food under disrupted conditions.

LLA adds a governance dimension to this technical framing. It asks not only whether an adaptation practice works, but who defines the problem, who selects the response, who controls resources, whose knowledge counts, who monitors results and who can sustain the action when project support ends. Coger et al.,[5] argue that local actors should be at the center of adaptation decision-making and have more equitable access to finance and resources. Rahman et al.,[6] further emphasize that power, justice and definitions of 'local' require explicit attention if LLA is to be more than a relabeling of participatory programming.

For this paper, local leadership is interpreted as a continuum. At one end, households participate in externally selected activities; in the middle, they adapt, invest in, replicate and share practices; at the more locally led end, communities exercise formal authority over priorities, resources, monitoring and institutional arrangements. This continuum enables a more precise interpretation of SEEDS: substantial local uptake can be recognized without assuming that all LLA governance conditions have already been achieved.

Study context and methodology

Study area and climate-livelihood context

The SEEDS Project operates in Ulipur, Chilmari and Rajarhat upazilas of Kurigram District in northern Bangladesh. ESDO project records characterize the working area as highly exposed to recurrent flooding, flash floods, riverbank erosion and waterlogging. These hazards can inundate homestead gardens, damage seedlings and crops, constrain access to vegetables, and expose livestock to wet and contaminated conditions.[7] The local challenge is therefore not simply to increase agricultural output under normal conditions, but to make household production systems more mobile, elevated, water-compatible, resource-efficient and recoverable.

Study design and evidence base

The paper uses a descriptive, practice-based case-study design. The primary evidence is ESDO's 2026 SEEDS field documentation, including descriptions of technologies, reported implementation scale, project monitoring figures and two illustrative case narratives. The analysis organizes these materials around five intervention categories and then assesses the experience against selected dimensions of CSA and LLA.

No experimental or quasi-experimental evaluation data were provided. Accordingly, the reported figures are treated as project monitoring evidence rather than causal impact estimates. Where the project documentation does not quantify reach or outcomes, this paper explicitly records the evidence gap instead of imputing values.

Analytical approach

The analysis proceeded in three steps. First, each practice was examined for the climate risk it addresses, its operational mechanism and its livelihood pathway. Second, reported evidence of adoption, production, market value and entrepreneurship was synthesized. Third, the portfolio was interpreted using the LLA principles, with particular attention to local capabilities, decision-making power, finance, learning and institutional collaboration. The purpose is analytical learning rather than independent attribution of project impact (Table 1).

Table 1 SEEDS climate-adaptive practices and reported evidence

Practice	Primary risk addressed	Adaptation / livelihood mechanism	Evidence in supplied project records
Sack-bag cultivation	Flooding, waterlogging, loss of low-lying crops	Movable or elevatable crop containers; ginger, chilli, vegetables and seedlings can be protected or shifted	Approx. 3,000 households; ~50,000 ginger sacks in 2025; ~22 tonnes ginger; market value ~BDT 3 million; 2026 practice reported at ~80,000 ginger sacks plus ~20,000 chilli sacks.
Keyhole gardens	Flooding, waterlogging, household nutrition constraints	Raised compact homestead garden using household organic material; can be designed above locally relevant flood level	Qualitative evidence of introduction and practice; no project-wide reach or outcome figure provided.
Floating gardens / seedbeds	Seasonal flooding and persistent standing water	Vegetables or seedlings grown on floating beds in ponds, canals or waterlogged areas	Qualitative evidence of use by project farmers; no quantified reach provided.
Vermicompost entrepreneurship	Soil degradation, chemical fertilizer dependence, input costs	Organic waste converted to fertilizer for own use and sale	205 entrepreneurs targeted/developed; case record reports BDT 12,000 in compost sales by Momtaj Begum at the time of documentation.
Raised-platform goat rearing	Flood exposure, wet/ contaminated ground, livestock health and asset loss	Goats housed on elevated bamboo or wooden platforms	Beneficiaries reported as learning and practicing the method; no participant count or comparative loss data provided.

Source: Authors' synthesis from ESDO SEEDS project documentation.[6]

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Findings: The SEEDS portfolio of community-driven adaptation

Sack-bag cultivation: making crop production movable

Sack-bag cultivation is the most strongly quantified practice in the available SEEDS records. The method relocates crop production from permanently fixed, flood-exposed ground into containers that can be moved, elevated or protected as water levels change. ESDO reports that sacks can be prepared before flooding, shifted or hung above floodwater, and repositioned after water recedes, allowing households to protect seedlings or continue vegetable and spice production.[7]

The project records report approximately 3,000 beneficiary households practicing the method. In 2025, participating households cultivated ginger in approximately 50,000 sacks and produced about 22 tonnes, with an estimated market value of BDT 3 million. In 2026, practice was reported at approximately 80,000 ginger sacks, alongside about 20,000 sacks used for year-round chilli cultivation.[7] Although the records do not provide a counterfactual or household-level panel data, the increase in sack numbers is important as an adoption signal: the practice appears to have moved beyond a one-time demonstration into repeated and wider use.

From an adaptation perspective, the technology has four notable characteristics. First, mobility reduces exposure to floodwater. Second, households with little land can use small homestead spaces. Third, production can support household consumption and market sale. Fourth, the method is relatively simple to observe and imitate, making farmer-to-farmer diffusion feasible. These characteristics help explain why low-cost technologies can sometimes spread more effectively than capital-intensive adaptation measures.

Keyhole gardens: elevated nutrition and circular resource use

Keyhole gardening combines a compact raised garden with the use of household organic waste. In the SEEDS context, the practice is promoted around the homestead and can be established with attention to the highest locally experienced flood level. The project documentation emphasizes the possibility of multi-crop vegetable production, use of kitchen residues and year-round access to vegetables, including periods of flood, waterlogging or drought.[7]

The adaptation value of keyhole gardening is therefore broader than crop survival alone. It links resilience to nutrition, household waste reuse and reduced dependence on conventional horizontal plots. However, the supplied records do not quantify how many households established keyhole gardens, their production volumes, dietary effects or continuation rates. These variables should be incorporated into future monitoring.

Floating gardens and seedbeds: working with seasonal water

Floating vegetable gardens and seedbeds respond to a different adaptation problem: persistent standing water. Rather than waiting for land to dry, farmers can use floating beds in ponds, canals, riverside areas or waterlogged spaces to maintain vegetable cultivation and support seedling growth. SEEDS documentation specifically notes relevance for Aman rice seedlings and vegetables during the rainy season.[7]

Conceptually, this represents a shift from resisting water to designing production systems that can function in its presence. This is an important adaptation principle in environments where complete hazard prevention is unrealistic. Yet, as with keyhole gardens, the current documentation is descriptive rather than evaluative; future evidence should quantify adoption, costs, yields, survival rates and avoided delays in planting.

Vermicompost: adaptation as green entrepreneurship

Vermicomposting converts cow dung, crop residues and vegetable waste into organic fertilizer through earthworm-based decomposition. The SEEDS project promotes the practice to improve soil health, reduce dependency on chemical fertilizers, reuse organic waste and create local income opportunities. Project records indicate an initiative to develop 205 vermicompost entrepreneurs.[7]

The case of Momtaj Begum illustrates the intended livelihood pathway. After training and technical support, she reportedly used vermicompost on her own crops and sold surplus fertilizer to surrounding farmers; project records state that she had sold BDT 12,000 worth of compost at the time of documentation.[7] The significance of the example is not the absolute sales value, which is modest and time-bound, but the movement from training to own-use production and then to local market exchange.

This enterprise pathway can strengthen adaptation sustainability because a practice that reduces input costs or generates income has a reason to persist beyond project incentives. However, future evaluation should assess profitability after labor and input costs, repeat sales, customer retention, soil-quality changes and reductions in chemical fertilizer use.

Raised-platform goat rearing: protecting productive assets

Livestock can be a critical store of household wealth, yet floodwater and wet ground increase exposure to disease, contamination and asset loss. SEEDS promotes an elevated bamboo or wooden platform system that keeps goats off the ground and is intended to improve cleanliness and provide greater protection during flooding. The project documentation states that beneficiaries are learning and practicing the method and links it to reduced losses and improved income.[7]

The available records do not provide participant numbers, mortality rates, veterinary outcomes or comparative income data. Therefore, the claim of reduced loss should be treated as a reported project observation rather than a measured impact. This is an important area for future evidence generation because livestock protection could provide a strong economic case for household-level climate adaptation.

Interpreting the experience through the locally led adaptation lens

The SEEDS portfolio demonstrates several features associated with movement toward locally led adaptation, but it does not yet document all eight LLA principles. The strongest evidence relates to local capability, context-specific climate risk and community replication. The weakest documented areas relate to formal devolution of decision-making, accessible climate finance, downward accountability and institutional collaboration (Table 2).

From technology transfer to community replication

A central finding is that the most meaningful sign of local ownership may not be the number of people trained, but what households do after training. The sack-bag data suggest continued and expanded practice. This matters because replication requires households to judge a technology useful enough to allocate their own labor, space, materials and attention to it. In this sense, diffusion is a behavioral indicator of ownership even when formal governance devolution is incomplete.

Adaptation is more durable when it generates present-day value

Households face immediate livelihood needs, not only future climate scenarios. The SEEDS practices are potentially attractive because they can generate vegetables, spices, organic fertilizer, protected livestock or market income now while also reducing sensitivity to hazards. This co-benefit structure is consistent with CSA's emphasis on context-specific synergies among production, adaptation and sustainability.[8]

Table 2 Indicative alignment of the SEEDS experience with the Principles for Locally Led Adaptation

LLA principle	Evidence status	Interpretation from supplied SEEDS records
1. Devolve decision-making	Partial / not formally documented	Community adoption and adaptation are evident, but the records do not show formal community authority over project priorities, budgets or monitoring.
2. Address structural inequalities	Partial	The target group is described as marginalized communities; disaggregated evidence on women, youth, disability or intra-community power is not provided.
3. Patient, predictable and accessible funding	Not documented	The supplied material does not describe community access to climate finance or control over funding.
4. Invest in local capabilities	Strong	Training, practice, entrepreneurship and farmer adoption are central to the intervention model.
5. Understand climate risk and uncertainty	Strong	Technologies are explicitly selected for flood, waterlogging, riverine and livelihood conditions in Kurigram.
6. Flexible programming and learning	Emerging	Reported replication and technology adjustment suggest learning, but formal adaptive management and longitudinal MEL are not documented.
7. Transparency and accountability	Not documented	No evidence is supplied on downward accountability mechanisms or community-led monitoring.
8. Collaborative action and investment	Limited in supplied records	Project documentation lists local-government/partnership engagement as not available; stronger institutional linkage is a priority.

Note: The assessment is interpretive and based only on the supplied project documentation; absence of documentation is not evidence that a practice does not exist.

Low-cost does not mean low significance

None of the documented practices eliminates flooding or river erosion. Their function is more granular: protect seedlings, maintain vegetables, use inundated space, reduce fertilizer dependency or protect goats. Household resilience can therefore be understood as a portfolio effect in which multiple small risk-reduction measures together reduce disruption and accelerate recovery. This complements, rather than substitutes for, larger investments in embankments, water management, social protection and climate-resilient infrastructure.

Local leadership requires more than local delivery

The evidence also shows why terminology matters. Coger et al.,[5] and Rahman et al.,[6] distinguish locally led adaptation from projects in which communities mainly participate in implementation. The SEEDS experience clearly shows local practice and capability; however, the supplied documentation does not establish community control over finance or formal decision rights across the project cycle. Describing SEEDS as a pathway toward LLA is therefore both more accurate and more useful: it identifies what has been achieved and what institutional changes are still needed.

An ESDO pathway for community-driven climate action

Drawing from the case evidence, the SEEDS experience can be represented as a seven-stage pathway. The sequence is not strictly linear; households may enter at different points and move back and forth as climate conditions and livelihood priorities change (Figure 1).

Implications for policy, programming and scale

Measure ownership, not only participation

Future climate programmes should track indicators that capture local ownership: continuation after support, household investment from own resources, spontaneous replication, farmer-to-farmer learning, local adaptation enterprises and the proportion of activities selected or modified by communities. These measures can distinguish genuine diffusion from temporary project compliance.

1. Local climate risk	Flooding, erosion, waterlogging, crop loss, input stress and livestock exposure
2. Local knowledge + technical facilitation	Community experience combined with practical training, demonstration and climate-risk interpretation
3. Appropriate solutions	Movable, elevated, floating, organic and resource-efficient livelihood technologies
4. Household adoption	Practice, modification, repetition and investment of household labor/resources
5. Livelihood value	Food, nutrition, reduced loss, lower input costs, income and enterprise
6. Community replication	Peer learning, imitation, local markets and spread beyond initial participants
7. Local leadership	Communities and local institutions progressively shape priorities, finance, monitoring and scaling

Figure 1 Conceptual pathway from climate risk to local leadership derived from the SEEDS experience.

Build community climate innovation platforms

ESDO could institutionalize periodic community-level climate innovation forums in which farmers, women entrepreneurs, youth, persons from marginalized groups and relevant service providers identify emerging risks, compare technologies, assess failure as well as success, and agree on priorities for the next season. Such platforms would turn informal learning into a repeatable governance process.

Strengthen local government and extension-system linkage

The supplied project record does not document structured local-government engagement. A future phase should establish systematic links with Union Parishads, Upazila Parishads, agricultural extension, livestock services and local disaster-management structures. Institutional embedding is necessary if successful practices are to influence local plans and continue beyond a single project cycle.

Pilot devolved community climate finance

To move closer to LLA, selected communities could be provided with small, transparent adaptation funds governed through agreed local mechanisms. Communities would identify priorities, select eligible investments, disclose decisions and monitor results. This would test the transition from participation in ESDO-supported activities toward local agency over resources, one of the defining features of LLA.[4,5]

Develop local adaptation enterprises and service markets

The vermicompost experience suggests scope for adaptation-related enterprise. Potential models include local nurseries, resilient seedling supply, compost production, fabrication of raised livestock platforms, supply of sack-gardening materials, floating-bed services and youth-led agricultural advisory services. Enterprise development can reduce dependency on free distribution while creating local maintenance and supply chains.

Strengthen the evidence architecture

A publication-quality evidence system should link each technology to a small set of measurable resilience and livelihood outcomes. Priority indicators include:

A. adoption and continuation rates across multiple seasons;

B. own-resource investment and replication by non-beneficiary households;

C. yield, production value, net income and input-cost savings;

D. avoided crop or livestock loss during flood events;

E. household dietary diversity and months of vegetable availability;

F. soil organic matter, chemical fertilizer reduction and water-use indicators where relevant;

G. women and youth decision-making, control over income and leadership roles;

H. cost-effectiveness compared with conventional practice; and

I. local-government uptake and inclusion in plans, budgets or extension messages.

Limitations and research priorities

This paper is based on routine project documentation and is therefore subject to several limitations. First, the evidence is largely descriptive and not generated through a pre-specified research protocol. Second, most practices do not have quantified reach, baseline values or comparison groups. Third, the reported production and market figures for sack-bag cultivation are aggregated and do not provide household-level distributions, costs or profit margins. Fourth, the available documentation does not provide systematic sex-, age-, disability- or socioeconomic disaggregation. Fifth, institutional variables central to LLA—such as who decides, who controls funds and how accountability operates—are not documented in sufficient detail.

Future research should combine household surveys, production records, qualitative interviews, focus-group discussions and participatory resilience assessment. A longitudinal design following the same households before and after flood seasons would be particularly valuable. Where feasible, matched comparison households or phased implementation could improve causal inference. Research should also explicitly examine intra-community power and representation so that ‘local’ leadership does not become synonymous with leadership by already influential actors.

Ethical and publication considerations

The paper uses routine project documentation rather than data collected specifically for an independent human-subject research study. The identifiable case of Momtaj Begum is reproduced from ESDO project documentation. Before submission to an external journal or public repository, the authors should confirm that appropriate consent permits publication of identifiable personal information and should anonymize the case if such consent is not documented. No sensitive personal data are required for the analysis.[9,10]

Conclusion

The ESDO SEEDS experience in Kurigram demonstrates that climate adaptation can become meaningful at household level when it is designed around the actual constraints of everyday livelihoods. Sack-bag cultivation, keyhole gardens, floating beds, vermicompost and raised livestock platforms are modest technologies, but each responds to a specific risk in ways that households can potentially understand, modify and sustain.

The strongest documented result is the spread of sack-bag cultivation. Approximately 3,000 households are reported to have practiced the method; 2025 production involved about 50,000 ginger sacks, around 22 tons of ginger and an estimated BDT 3 million in market value, while 2026 records report approximately 80,000 ginger sacks and 20,000 chilli sacks. The establishment of 205 vermicompost entrepreneurs adds an enterprise dimension to the adaptation portfolio.[7]

These results do not by themselves prove long-term resilience or full locally led adaptation. They do, however, show a credible movement from training toward adoption, from adoption toward replication, and from adaptation practice toward livelihood value. The next institutional step is to transfer more decision-making, finance, monitoring and scaling authority to communities and local institutions while strengthening rigorous evidence of outcomes.

The broader lesson is that local climate action should not be judged only by the sophistication of the technology or the size of the investment. Its durability depends on whether people can use it, afford it, adapt it, benefit from it and ultimately make decisions about it. ESDO’s future contribution can therefore evolve from being principally a provider of adaptation technologies to being a facilitator of local capability, finance, evidence and leadership.

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Conflict of interest

The authors declare that there is no conflict of interest.

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