Acta Scientific AGRICULTURE (ISSN: 2581-365X)

Volume 10 Issue 2 February 2026

Research Article

Participatory Rural Appraisal as a Tool for Documenting Indigenous Agricultural Practices and Environmental Stewardship in Bangladesh

M Nazirul Islam[1]*, Sajia Rahman[2], Quazi Maruf Ahmed[3], Sumaiya Falguni[4] and M Sayedur Rahman[5]

[1]Former Chief Scientific Officer, Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh

[2]Senior Scientific Officer, PGRC, BARI, Gazipur, Bangladesh

[3]Scientific Officer, PGRC, BARI, Gazipur, Bangladesh

[4]Research Fellow, Department of Fisheries Biology and Aquatic Environment, Gazipur Agricultural University, Salna, Gazipur, Bangladesh

[5]Principal Scientific Officer, Agricultural Economics Division, Seed Production Station (BSPS), BARI, Debiganj, Panchagarh, Bangladesh

***Corresponding Author:** M Nazirul Islam, Former Chief Scientific Officer, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh. Email: nazirhrc@yahoo.co.in

DOI: 10.31080/ASAG.2026.10.1542

Received: November 07, 2025

Published: January 31, 2026

Abstract

The study was conducted in the villages of Mashok and Moumari, focusing on climate-resilient farming practices in two agroecological zones of Bangladesh from February to August 2018. Various tools and techniques of Farmer Participatory Research Appraisal (PRA) were employed to collect community knowledge about social behavior and management practices. Findings reveal that climatic variability, including erratic rainfall and elevated temperatures, is disrupting traditional farming calendars, leading to lower agricultural income and increasing dependence on non-farm employment. Homestead gardening has played a key role in empowering women and diversifying food sources for households. Biodiversity assessment revealed Mashok to have higher species richness, while Moumari exhibited greater evenness. Farmers demonstrated a strong knowledge of crop rotation and genetic flow, but have limited awareness of composting and fallow systems. Crop diversity, wild relatives and traditional weather forecasting collectively sustain resilient agroecosystems, aligning with the SDGs 2, 13, and 15 by ending hunger, promoting climate action, and protecting ecosystems. Acknowledgement of gender-sensitive participation in national environmental sustainability strategies is crucial for diversified rural livelihoods and ecological resilience.

Keywords: Biodiversity; Participatory Research Appraisal (PRA); Bangladesh

Introduction

In Bangladesh, homestead farms function as active ecological units, integrating subsistence needs with biodiversity conservation. These systems are closely linked with indigenous knowledge and are sustained through generations of adaptive practices. The country is endowed with over 5,000 plant species. This incredible biodiversity in this country is associated with resilience and flourishing agroecosystems. However, this diversity is increasingly at risk due to rapid genetic erosion caused by land-use changes and the intensification of conventional agriculture. The erosion of plant genetic resources threatens both ecological integrity and the cultural heritage associated with traditional agriculture. To address this challenge, institutional efforts such as the establishment of the Plant Genetic Resources Centre (PGRC) at the Bangladesh Agricultural Research Institute (BARI) have promoted germplasm conservation and sustainable use [1-3]. Yet, beyond formal conservation frameworks, farmers themselves act as stewards of biodiversity in traditional farming . They achieve this through context-specific cultivation methods and seed-saving practices, which are sustained and shared through a local network [4,5]. These decentralized, community-led approaches underscore the importance of integrating farmer knowledge into national strategies for climate-resilient agriculture. Acknowledging and valuing such contributions are necessary for developing inclusive policies that promote both environmental sustainability and rural livelihoods.

Focusing on this context, this study aims to document indigenous agricultural practices and environmental stewardship. It utilizes gender-sensitive Farmers Participatory Research Appraisal (PRA) with biodiversity metrics across contrasting agroecological zones, documenting community-led forecasting indicators. species prevalence and rankings. The dual-site comparison, combined with Simpson's Index and livelihood mapping, provides a replicable framework for capturing ecological resilience and cultural specificity. This framework underscores the significance of data-driven documentation of agroecological heritage. Moreover, this study documents the pivotal roles of women as stewards of the environment alongside traditional weather indicators, elevating the discourse on climate adaptation [6,7].

Materials and Methods

Selection of communities and study sites

The study spanned from February to August 2018 in two villages, Mashok and Moumari, representing ecologically distinct regions of Bangladesh. Mashok is located under Kapasia Upazila of Gazipur district at coordinates 24°02'-24°16'N, 90°30'–90°42'E at an elevation of 8 m. Positioned in central Bangladesh, it lies approximately 20 km north of the Bangladesh Agricultural Research Institute (BARI) headquarters, ensuring close institutional access. In contrast, Moumari falls under Debiganj Upazila of Panchagarh district at coordinates 26°00'–26°19'N, 88°39'-88°49'E with an elevation of 64 m. Situated in northern Bangladesh, Moumari is about 370 km from BARI headquarters but only 8 km from the BARI Seed Production Station (BSPS) Debiganj, reflecting both remoteness and local institutional linkage. These contrasting sites provided a representative framework for examining ecological and geographic variability across central and northern agro-ecological zones of Bangladesh. Plate 1 shows the sites of the locations, focusing their ecological and geographical distinctness, which is crucial for understanding regional variations in the study outcomes.

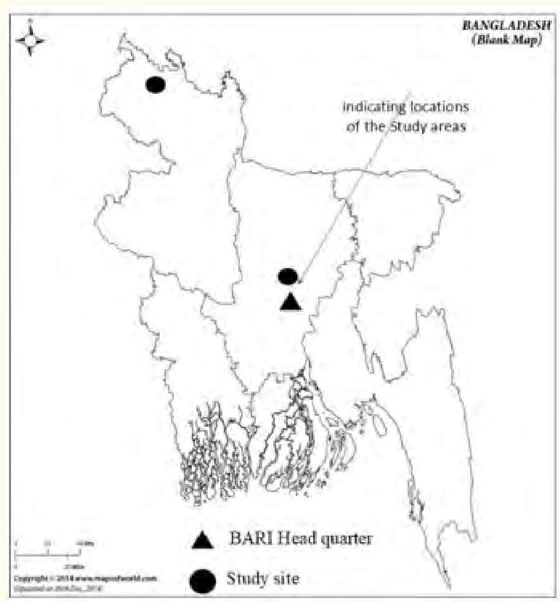

Plate 1: Geographical location of Mashok (Gazipur) and Moumari (Debiganj) study sites, highlighting ecological and agro-edaphic contrasts.

Arrangement of participatory meeting

Participatory Rural Appraisal (PRA) was applied to document traditional practices and indigenous knowledge (IK) related to homestead farming, aiming to support conservation and sustainable agricultural development. PRA offers an interactive approach that draws on local insights to assess rural conditions [8]. A multidisciplinary team comprising horticulturists, entomologists, plant pathologists, extension experts and agricultural economists was trained to facilitate engagement and collect data effectively [9]. Farmers were informed three days in advance to ensure preparedness. Participants ranged from 15 to 70 years of age, allowing for broad representation. On the day of the session, facilitators outlined the objectives and procedures, encouraging active involvement. To promote inclusivity, men and women participated in separate discussion groups. Male participants were divided into two teams, each guided by at least two scientists, while female scientists and extension workers conducted sessions with women in their homes. Separate group discussions facilitated by multidisciplinary teams, enabled inclusive dialogue on traditional farming practices, ecological knowledge, and community priorities for sustainable agriculture. The PRA sessions unlocked community knowledge by shifting individuals to move from passive informants to active analysts of their own circumstances, challenges, and opportunities. Visual and interactive tools of PRA allowed villagers to map, rank, and analyze their own resources, thereby enabling community members to share knowledge with researchers [10].

Data recording

Using PRA matrices, we meticulously recorded data that organized demographic details, agro-edaphic features, climate conditions, and socioeconomic attributes. Community narratives were recorded and analyzed in structured way to highlight the environmental indicators that people frequently use to make weather predictions. This process also created a detailed inventory of plant species associated with crops, including both wild and weedy relatives, effectively capturing the dynamics of local resources. The collected information was cross-validated among the gender groups to ensure it was reliable, inclusive, and relevant to the ecosystem.

Plate 2: Participatory Rural Appraisal (PRA) sessions in Mashok and Moumari, showing inclusive engagement of male and female participants facilitated by multidisciplinary teams.

Data analysis

Biodiversity assessment

Species diversity was quantified using the Simpson Diversity Index and Shannon Diversity Index. The Simpson Index was calculated as:

$$D = 1 - \sum_{i=1}^{s} \left(\frac{ni}{N}\right)^2$$

Where *ni* is the number of individuals of species *i*, *N* is the total number of individuals, and S is the total number of species (Simpson, 1949) [11]. The Shannon Index was calculated as:

$$H' = -\sum_{i=1}^{s} pi\ln(pi)$$

Where *pi* is the proportional abundance of i species. These indices provide complementary measures of diversity, with Simpson emphasizing dominance and Shannon emphasizing richness and evenness [12]. We used the ranking-based formula for Relative Prevalence (PR) following the method outlined in [13]:

PR = Species population per homestead × percentage of homesteads containing the species.

Weather data were analyzed using thematic coding. In this process, community narratives were recorded to highlight the environmental indicators. Recurring environmental cues are systematically sorted into themes like seasonal plant signals, insect activity, and observations of the sky and wind. This coding process made it possible to identify local weather predictors and understand their significance for agricultural decision-making [14]. The matrix-based tools align with established PRA methodologies, emphasizing structured, participatory analysis of community dynamics [15].

Results and Discussion

Agro-edaphic and socio-economic characteristics of the study sites

During the participatory discussions, the participants were able to perceive that crops, livestock, fresh water, timber, and medicinal plants, pollination, nutrient cycling, soil formation, habitats are tangible products of the ecosystem. As the discussion progressed, community interactions revealed that environmental services are not isolated functions but closely interlinked with biodiversity. They clearly identified and recorded where resources are located and how the changes in supply are impacting their livelihoods and the management of each resource in question. Table 1 illustrates the unique agro-edaphic and socio-economic characteristics of the study sites. Mashok, may have a smaller land area; nevertheless, it is home to a rich ecological diversity that encompasses uplands, valleys, forests, and loamy soils, as visualized in Plate 3 (a). Within this landscape, the rice-based cropping system is complemented by abundant winter and summer vegetables with fruit trees dominating homestead plantations. However, climatic variability, marked by erratic rainfall and elevated temperatures, has begun to disrupt these traditional farming calendars [16]. Villagers are more involved in service industries and less in agriculture. Further, the village is distinguished by the presence of governmental and non-governmental educational institutions, religious organizations, and orphanages, all of which contribute to strengthening the resilience of the communities. In contrast, Moumari, is comparatively less fertile, a condition depicted in Plate 3 (b). Despite this limitation, it agricultural landscape is sustained through rice based cultivation complemented by maize, wheat, oilseeds, pulses and seasonal vegetables. In addition, households in Moumari cultivate annual fruits in their croplands and fruit trees in their homesteads, representing adaptive strategies aimed at sustaining agricultural productivity under less favorable conditions.

Although the study sites exhibit diverse livelihood practices, the community in Moumari experiences heightened vulnerability due to a higher number of marginal households and a shortage of educational institutions.

Character	Mashok	Moumari
Land area (ha)	: 200	: 309
Number of households	: 300	:400
Land type (%)		
a) High	: 20	: nil
b) Medium-high (Floodplain	: 30	: 75
c) Medium low	: 20	: 20
d) Low	: 10	: 5
e) Very low	: 20	: 0
Soil type	: Loamy, high organic matter content	: Sandy loam, low organic matter content
Climate	: Mild to hot summer, heavy rainfall in the rainy season.	: Hot summer temperatures, cold winter, low rainfall
Landscape and topography	: Level upland, deep, or shallow broad valleys, forest on uplands with many useful herbs and shrubs, and plenty of seasonal water bodies including rivers	: Plain land with huge cropland, scattered village groves with wild edible species, and plenty of seasonal water bodies, including rivers
Major crops	: Rice, fruits/vegetables,	: Rice, maize, wheat, seasonal fruits, vegetables

Homestead farm size (%)		
a) Large (land operating >2.0 ha)	: 05	: 02
b) Medium (land operating 1.0-2.0 ha)	: 10	:05
c) Small (land 0.5-1.0 ha)	: 60	: 60
d) Marginal (land 0.21-0.5 ha)	: 20	: 30
e) Landless (homestead only)	: 03	:03
a) Public and local institute/ NGO		
a) Primary school	: 01	: 01
b) High school	: 01	: 01
c) Madrasa (private)	: 02 (1 non-govt.)	: Nil
d) Private school	: 02 (1 non-govt.)	: Nil
e) Temple	: Nil	: 01
f) Church	:1	: Nil
g) Orphanage	: 01	: 01

Table 1: Agro-edaphic and socio-economic characteristics of Mashok (Gazipur) and Moumari (Debiganj) villages based on PRA survey and Upazila Krishi Office data.

a) Ecological diversity of Mashok uplands and valleys | b) Cropland dominated plain landscape of Moumari

Plate 3: Topographic and land use characteristics of Mashok and Moumari landscapes, illustrating ecological diversity and distribution of agricultural resources.

Demographic and Socio-Economic Characteristics of the Study Sites

As detailed in Table 2, the communities of Mashok and Moumari exhibit diverse demographic and socio-economic profiles. Although agriculture remains the primary livelihood, households are increasingly finding new income sources. They are relying on remittances, small businesses, wage labor, and informal work, reflecting the limited sustainability of the farming system. This trend toward non-farm activities is more evident among landless and marginalized groups. Many depend on rivers and seasonal water bodies for fishing while others turn to fallow or uncultivated lands for supplemental food production. Plate 4 effectively visualizes how agroecological practices contribute to wellbeing in rural environments, including income diversification, gender empowerment, and nutritional well-being. Notably, home gardens empower women by allowing them to retain earnings from produce sales while income from natural water bodies augments family income and resilience.

a) Home gardens fostering women's empowerment through produce sales and diversified income streams | b) Reliance on seasonal water bodies as a source of household nutrition from natural food diversity

Plate 4: Agroecological practices in study sites, demonstrating contributions to rural wellbeing through income diversification, gender empowerment, and nutritional security.

Character	Mashok (Gazipur)	Moumari (Debiganj)
Household size:		
• Member/family (Nos.)	: 4 (3.18)	: 5 (4.3)
• Babies and children up to 15 years	: 1	: 2
Workable members (16-50 years)	: 2	: 3
• 50 years and above	: 1	:1
• Male-female ratio	: 1:1	: 1:1
• Earning person	: Husband	: Husband
• Family head	: Husband	: Husband
• Family decision taken	: Men, occasionally discuss with their wives	: Men and women jointly
Role of workable member	: Share crop production activities; off-farm income activities, and tending livestock and poultry	: Share crop production activities, help in off-farm income; livestock/poultry rearing
Role of women in family	: Prepare food for family : Manage home garden, post-harvest processing of crops, seed storing, picking vegetables, collecting fire-wood, tending livestock/poultry	: Prepare food for family : Help with post-harvest processing, seed storing, managing home gar-dens/natural harvest, collecting fire-wood, tending livestock/poultry
Religious (%)		
• Muslim	: 88	: 90
• Christian	: 8	: 1
• Hindu	: 4	: 9
1) Education status (%)		
• Basic literacy (reading and writing)	: 20	: 32
• Primary level (up to class V)	: 45	: 35
• Secondary level (SSC)	: 20	: 20
• Higher secondary level (HSC)	:12	: 12
• Bachelor's and above	:3	: 1
2) Major income source	: Agriculture (crops, fishing, and live-stock)	: Agriculture (crops, fishing, and live-stock)
3) Others (non-farm)	a) Remittance b) Petty business c) Self-employment) d) Rickshaw pulling e) Tailoring f) Grocery store g) ICT h) Band party i) Priest j) Working at local factory	(i) Remittance on farm products (ii) Petty business (iii) Daily labor (iv) rickshaw pulling (v) Priest

4) Sharing of household income (%)		
• Agriculture	: 35	: 45
• Government service	: 15	: 5
• Private or company Job	: 20	: 15
• Other (non-farm)	: 30	: 35

Table 2: Demographic and socio-economic profiles of Mashok and Moumari communities derived from PRA matrices.

Analysis of household income

The data from Table 3 highlight a significant shift in rural household income sources between 2000 and 2018, with agriculture experiencing a marked decline. While agricultural income fell from 80% to 60%, the service sector doubled its share from 5% to 10%, and other sectors such as commerce, transport, and non-agricultural labor increased from 15% to 30%. A pronounced increase in non-farm income in rural Bangladesh between 2010 and 2016 has been reported [17]. As labor and capital shift away from farming, biodiversity-rich practices may be overlooked, leading to reduced crop diversity, soil degradation, and weakened ecosystem services.

Issue	Year of incidence (%)		Trends	Participants' reaction to the change
	2000	2018		
Income source				
Agriculture	80	60	Decreasing (20%)	• Symbiosis between industries and agriculture Socially looked down upon agriculture Farming as a laborious job • Soil health degradation • Inadequate marketing facilities • Outbreaks of pests and diseases • Male-dominated gender inequality
Service	5	10	Increasing (05%)	• Social status improved • Income opportunity for unemployed family members • Education status improved • Gender equity improved • The natural environment changed
Others (commerce, transport and communication, non-agriculture labor)	15	30	Increasing (15%)	• Farming is risky • Income opportunities in the agricultural supply chain • Low agro-biodiversity • Indigenous knowledge is extinct • Loss of arable land • Degradation of environmental health
Total	100	100		

Table 3: Trends in household income sources (2000 to 2018) and community perceptions of agricultural transitions compiled from pooled PRA matrices and community discussions.

Farming practices and community awareness of ecological impacts

Table 4 presents farming practices and ecological awareness in Mashok and Moumari. High awareness of practicing crop rotation and green manuring indicates strong community recognition of their role in enhancing soil fertility, resource use efficiency and crop resiliency. This is evidenced by the 80% awareness of weather forecasting methods and the cultivation of traditional crops in Mashok (50% in Moumari); similarly, traditional knowledge systems remain influential in ecological impacts. Conversely, notably lower awareness is recorded for ecologically beneficial practices like the use of organic inputs, fallow systems and home gardens despite their contributions to soil health, biodiversity, and erosion control. These findings resonate with the objectives of the Bangladesh Biological Diversity Act (2017), which emphasizes public awareness and community participation in biodiversity conservation. Farmers' strong knowledge of crop rotation and genetic resource flow aligns with policy goals of sustainable resource use, while limited awareness of composting and fallow systems reveals gaps that national extension programs must address. Thus, PRA documentation provides actionable insights for bridging policy frameworks with grassroots realities [18].

Participatory mapping of ecosystem services and farming practices

The participatory mapping effectively visualizes these interactions and guides land use decisions, underscoring the significance of local knowledge in promoting resilient, community-led agricultural transitions. A previous report highlighted participatory mapping as a rapid spatial assessment tool for ecosystem services in multi-use agricultural landscapes [10]. Consistent with this framework, Plate 5 demonstrates how community knowledge visualizes farming practices and ecological impacts, guiding resilient and sustainable landuse decisions.

SL No.	Management option	Ecological Benefits	Community awareness about the impact (%)	
			Mashok	Moumari
1	Green maturing, crop residues, crop rotation, crop association	• Improve soil organic matter, resource use efficiency, nitrogen use efficiency.	100	100
2	Use of manures, compost, and bio-pesticides	• Reduce production costs. • Improve soil health • Enhance environmental health and biodiversity.	30	20
3	Cultivating traditional crops, different varieties of the same crops	• As a part of heritage • Planting materials/seeds available • Low production costs • Meet family needs • Low insect pest attacks • Less or no irrigation • Source of fodder and fuel	80	50
4	The flow of genetic materials	• Replace poor-quality seeds • Grow better cultivars • Test new cultivars • Plant diseases and pests	100	100
5	Fallow system of cultivation; home garden	• Source of uncultivated harvest for household consumption • Promote wild crops, wildlife, and other species • Enhance homestead biodiversity • Stop soil erosion	30	30

6	Input use (Irrigation, fertilizers, chemicals)	• Water pollution, biodiversity loss	60	60
7.	Weather forecasting	• Rely on traditional methods	80	80

Table 4: Farming practices and community awareness of ecological impacts in study sites (PRA matrices).

Weather forecasting

Rural communities rely heavily on environmental cues such as cloud formations, animal behavior, plant phenology, and celestial patterns to predict seasonal changes, as summarized in Table 5. These traditional indicators, developed through generations of observation, remain vital for agricultural planning and climate adaptation, especially in low-resource settings where formal forecasting tools are limited. Prior studies highlight their socioeconomic relevance and cultural specificity [19,20]. Through thematic coding of PRA narratives, we documented five salient themes: cloud formations, celestial indicators, wind direction, animal behavior (bird chirping, frog and toad vocalization and behavioral shift), and agricultural signals. These themes illustrate how the communities read environmental signs to predict storms, rainfall, droughts, and floods. Comparative evidence from Zimbabwe and China demonstrates that indigenous seasonal calendars enhance resilience by improving local climate understanding [21-23]. Integrating such indicators into scientific forecasting frameworks can improve contextual relevance, strengthen adaptive capacity, and reinforce agricultural resilience across diverse agroecological zones.

Indicator	Phenomena	Anticipation
Cloud	• Cumulus clouds in the north/northwest in April-May	• A storm (northwestern) with hail
	• A long parallel band of feathery clouds appears	• A storm
	• Red sky at sunrise	• Upcoming rain
	• Night and day warm during monsoon	• Sign of approaching rain,
	• Clouds in the north, northwest in early summer with flying king stork	• Sing strong storm
	• Clouds form in the east and the south in July-August.	• Bad weather and rain
	• Spading-type clouds and blue sky in between during the month of July	• Chance of rain in early summer
	• A foggy winter morning near the new moon	• Chance of rain in mid-April
	• Winter morning of December with a foggy sky	• Chance of rain in mid-April
Moon	• Ring form around the moon	• Uncertain climate in near future
	• Upright moon.	• Chance of uniform rain
	• A crescent moon's "horns" point to the side (i.e., horizontally).	• Potential for rain or precipitation
	• Tilted position of the crescent moon (south-facing).	• Linked to drought in summer
Wind	• The Southwest monsoon wind	• Leading to heavy rainfall.
	• An east wind over Everest	• Can carry cold, dry air from over

Bird Chirping	• Jacobin cuckoo (*Clamator jacobinus*) chirping in April	
	• Chirping of greater coucal (*Centropus sinensis*).	• Sign of prolonged drought
	• Change in the voice of the kite bird (*Milvus migrans*) in March -April.	
Frog and toad	• Louder and more frequent calling	• Sign of the rainy season approaching
	• Alter the calls of toads and frogs	• Linked to drought
Bumper crops of certain plants	• Bumper production of mango	• Chances of a successful harvest of Aus rice
	• Abundant harvest of tamarind	• Indicator of potential floods
	• Bumper production of Jackfruit	• High possibility of floods that year

Table 5: Traditional weather forecasting indicators documented from PRA sessions in Mashok (Gazipur) and Moumari (Debiganj) villages compiled from pooled community matrices and thematic discussions.

Crop-associated bio-diversity, their wild and weedy relatives

Table 6 presents the depth and diversity of plant biodiversity highlighting species prevalence across the study sites. Mashok exhibits a rich diversity with 70 species across nine crop categories, especially in fruit trees and vegetables, with 27 and 19 species, respectively. Moumari has 55 species, notably 12 medicinal plants, reflecting traditional healthcare practices. The higher species richness of Mashok (70 species, Simpson's D = 0.22; Shannon H′ = 0.82) suggests a broader genetic pool that enhances adaptive capacity under climatic stress. In contrast, the greater evenness of Moumari (55 species, Simpson's D = 0.20; Shannon H′ = 0.78) reflects balanced resource distribution, which stabilizes yields but may limit adaptive flexibility. The wild edible species found in Mashok provide alternative food options and help families bounce back from unexpected challenges. On the other hand, the limited range of wild edibles in Moumari could hinder adaptive strategies, leaving households more reliant on cultivated crops and outside markets, though its richer medicinal plant diversity enhances health resilience. These complementary resilience pathways highlight the importance of tailoring interventions to site-specific ecological contexts [24,25].

Crop/Plant group Mashok		**Number species**	
		Moumari	
1	Fruit tree	27	16
2	Annual fruit *	2	2
3	Timber	7	2
4	Vegetables	19	15
5	Spices	5	4
6	Cash crop	3	3
7	Medicinal	4	12
8	Edible wild	4	1
9	Wild or domestic shrub	3	-
	Total species=	70	55
	Simpson's index (D)	0.22	0.20
	Species diversity index (H ©)	0.82	0.78

Table 6: Plant biodiversity across crop groups in Mashok and Moumari villages with species richness and ecological roles compiled from PRA survey data and community resource inventories.

Table 7 further highlights the relative prevalence of key fruit species in Mashok, where jackfruit (*Artocarpus heterophyllus*), banana (*Musa spp.),* and monkey jack (*Artocarpus lacucha*) dominate homestead orchards, reinforcing their agroforestry and nutritional value. Primary fruits of Moumari include jackfruit, banana, monkey jack and litchi (*Litchi chinensis*) (Table 8). A diverge range of trees is a guarantee of year round food supply and support a richer mix of wildlife. By linking various trophic levels and enhancing physical conditions fruit trees reinforce overall ecosystem resilience.

Sl. Nos.	Fruit Species	Botanical name	Species size/ homestead	Households containing the species (%)	Relative prevalence	Ranking
1	Coconut	*Cocos nucifera*	2	30	60	10
2	Mango	*Mangifera indica*	5	100	500	5
3	Jackfruit	*Artocarpus heterophyllus*	16	100	1600	1
4	Litchi	*Litchi chinensis*	7	80	560	4
5	Banana	*Musa spp*	10	100	1000	2
6	Papaya	Carica papaya	5	100	500	5
7	Jujube	*Ziziphus mauritiana*	2	30	60	10
8	Monkey Jack	Artocarpus lacucha (*Buch)*	10	80	800	3
9	Amloki	*Phyllanthus emblica Lin*	5	20	100	9
10	Guava	*Psidium guajava*	3	50	150	7
11	Hog plum	*Spondias dulcis*	1	10	10	16
12	Pomelo	*Citrus grandis (L)*	2	25	50	11
13	Olive	*Elaeocarpus floribundus*	1	30	30	13
14	Blackberry	*Syzygium cumini (L)*	2	50	100	9
15	Chapalish	*Artocarpus chama*	1	2	2	19
16	Date palm	*Phoenix dactylifera*	3	45	135	8
17	Karambola	*Averrhoa carambola*	1	40	40	12
18	Pomegranate	*Punita granatum*	1	5	5	17
19	River ebony	*Diospyros peregrina*	1	3	5	17
20	Palmira palm	*Borassus flabellifera L.*	2	2	4	18
21	Wax Jambo	*Syzygium samarangense*	1	20	15	15
22	Rose apple	*Syzigium jambos*	1	2	2	19
23	Bullock heart	*Annona reticulate*	1	20	20	14
24	Lime/Lemon	*Citrus limon*	2	80	40	12
25	Stone apple	*Aegle marmelos*	1	30	30	13
26	Wood apple	Limonia acidissima	3	60	180	6
27	Phalsa	Grewia asiatica	1	10	10	16

Table 7: Relative prevalence of major fruit species in Mashok homestead orchards compiled from PRA survey data and community resource inventories.

Sl. Nos	Species	Botanical name	Species size/ homestead	Households containing the species (%)	Relative prevalence	Ranking
1	Coconut	*Cocos nucifera*	2	20	40	8
2	Mango	*Mangifera indica*	5	100	500	2
3	Jackfruit	*Artocarpus heterophyllus*	3	40	120	5
4	Litchi	*Litchi chinensis*	3	50	150	4
5	Jujube	*Ziziphus mauritiana(Lam)*	2	50	100	6
6	Banana	*Musa spp*	8	70	560	1
7	Guava	*Psidium guajava*	1	30	30	9
8	Pomelo	*Citrus gradis (L)*	1	10	10	11
9	Blackberry	*Syzygium cumini (L)*	1	10	10	11
10	Pomegranate	*Punica granatum*	1	5	5	12
11	Rose apple	*Syzigium jambos*	1	2	2	13
12	Bullock heart	*Annona reticulate*	1	20	20	10
13	Line/Lemon	*Citrus limon*	2	80	40	8
14	Stone apple	*Aegle marmelos*	1	30	30	9
15	Wood apple	Limonia acidissima	2	30	60	7
16	Papaya	Carica papaya	5	50	250	3

Table 8: Relative prevalence of major fruit species in Moumari homestead orchards, documented through PRA matrices and household orchard assessments.

Abundance = % of household containing the species.

Farmers' experiences with crop and variety changes over time

The chronological account of farmers' experiences from 2000 to 2015 reveals a gradual transition in agricultural practices, marked by declining crop diversity, rising input dependency and erosion of traditional knowledge (Table 9). During 2000-2004, farmers faced yield and price uncertainty of the produce, alongside the expansion of poultry farming and pesticide use. These changes led to reduced agrobiodiversity and increased production costs, prompting labor migration and a gradual disengagement from farming. In 2005–2009, community reported a notable shift in agriculture with the introduction of high-yielding fruit and vegetable varieties like mango and litchi. Yet, the profit-oriented cropping diminish the farmers' control over production systems. The 2010–2015 period saw the disappearance of landraces and traditional crop varieties coinciding with food insecurity, hidden hunger and malnutrition. These transitions mirrored broader pressures on smallholder systems under market pressure, where external inputs replace local resilience [26,27]. The data underscore the need to revalue indigenous crop diversity and farmer-led innovation to support sustainable, inclusive agricultural development.

Limitations and scope

Participatory approaches to conserving and utilizing plant genetic resources in Bangladesh are still emerging with limited availability of skilled facilitators. As a result, some data, such as descriptions of women's roles in rice harvesting, may appear narrative in nature which could potentially reduce reader

Year of events	Relating events	Farmers' reaction to the event and social perspectives
2000-2004	• Reduction of the number of crops • Social inequality, change in land use practices • Expansion of poultry farming • Evolving new pesticides • Uncertainty of crop yield • High price of fertilizers • Uncertainty in price of products	• Agro-biodiversity reduced • Production cost increased • Unchecked growth of plague insect • Migration of farming labor to off-farm activities • Abandoning agriculture as profession • The production system was controlled by farmers
2005-2009	• Introduction and expansion of modern varieties of mango, litchi and vegetables • Expansion of poultry farming continuing • Incidence of new insect-pests and diseases • Lower price of paddy and higher price of rice	• The profit-oriented changes in cropping patterns • Crop agriculture not able to involve family members in workable ways. • Eliminating farmers' control over production system
2010-2015	• Disappearing local crops and traditional varieties • Ups and downs of agricultural production • Incidence of new pests and diseases • Increased use of external inputs in farming • Reduction in fertilizer price (subsidized rate) • Introduction of new crops and new varieties • Involvement of young and women in farming	• Disappearing of landraces • Food security threatened • Hidden hunger, malnutrition • Disappearing of traditional crops/varieties • High-value crops other than rice for higher productivity

Table 9: Chronology of crop and variety changes from 2000 to 2015.

engagement. This exercise enables participants to gain deeper insights through hands-on experience with PRA methodologies.

Conclusion

The study has built awareness among participating communities about the environmental benefits in which they live. The findings from the PRA reveal that protecting biodiversity, preserving crop variety and utilizing traditional weather forecasting techniques enhance our resilience to climate variability. The active involvement of women in homestead gardening, seed preservation and ecological management underscore their active role in food security and adaptation to these variations. By prioritizing community-driven approaches and policies on gender-sensitive participation can be effectively aligned with national strategies. This approach not only promotes environmental sustainability but also diversifies rural livelihoods and empowers marginalized groups. Aligning these initiatives with SDG 2 (Zero Hunger), SDG 13 (Climate Action), and SDG 15 (Life on Land) paves the way for a transformative pathway toward resilient, equitable, and sustainable rural development in Bangladesh.

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper

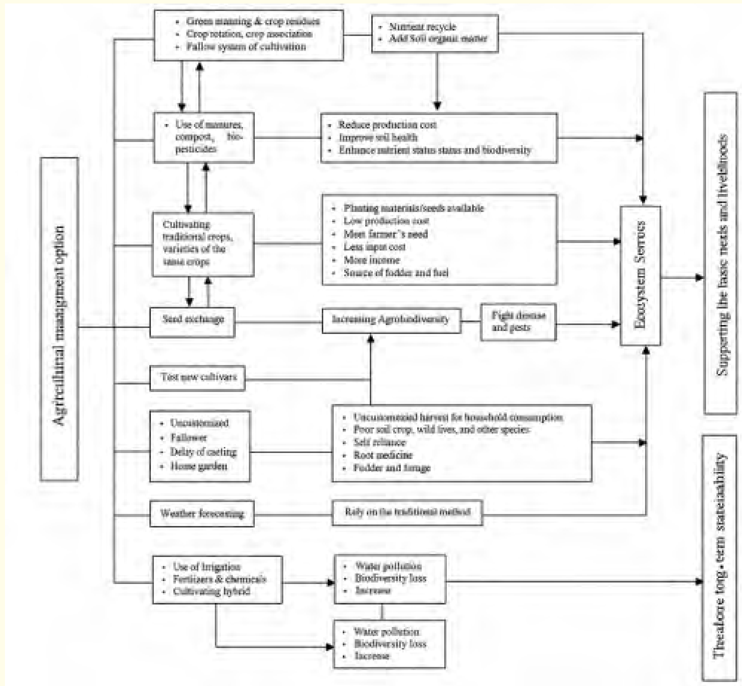

Plate 5: Participatory mapping of farming practices and ecological impacts, visualizing community knowledge for resilient, sustainable land use decisions.

Acknowledgments

We extend our heartfelt gratitude to the participants of Mashok and Moumari villages for their enthusiastic involvement and dedicating their precious time to this study. We also wish to thank the local agencies of the Department of Agricultural Extension in Gazipur (Sadar) and Debiganj Upazilas in the Panchagarh districts for their essential support and collaboration during the PRA discussions. Special appreciation goes to the Chief Scientific Officers and Scientists at the Breed Seed Production Station (BSPS), BARI, Debiganj, for their logistical assistance and accommodation provided to the research team. Finally, we acknowledge the financial backing from NATP-II, BARC, which enabled the successful execution of the field research.

Bibliography

1. Chowdhury MKA. "Conservation and sustainable use of plant genetic resources in Bangladesh". Dhaka: Bangladesh Agricultural Research Council and FAO (2012).
2. Khan MS., *et al*. "Red Data Book of Vascular Plants of Bangladesh". Dhaka: Bangladesh National Herbarium (2001).
3. Khan MS. "Genetic Resources of Bangladesh". In: Conservation Strategy of Bangladesh. Dhaka: IUCN and BARC (1991).
4. Hasan M K., *et al*. "BARI Annual Report 2020-2021". (2021): 312-319. Bangladesh Agricultural Research Institute. Chapter: Plant Genetic Resource Centre.
5. Antrop M. "The concept of traditional landscapes as a base for landscape evaluation and planning: The example of the Flanders Region". *Landscape and Urban Planning* 38.1-2 (1997): 105-117.
6. Howard P L. "Women and Plants: Gender Relations in Biodiversity Management and Conservation". *Zed Books and Palgrave Macmillan* (2003): 1-65.
7. Gurung M B and Leduc B. "Guidelines for a Gender-Sensitive Participatory Approach". International Centre for Integrated Mountain Development (ICIMOD) (2009).

8. Eyzaguirre PB and Batugal P. "Farmers participatory research on coconut diversity: Workshop report on methods and field protocols". IPGRI-APO, Malaysia (1999).

9. Islam MN., *et al*. "Perceptions of the farming community in relation to problems in farming and prospects of coconut mite management in Bangladesh". *CORD* 34.1 (2018): 39-50.

10. Braslow J., *et al*. "Guide for participatory mapping of ecosystem services in multiuse agricultural landscapes - How to conduct a rapid spatial assessment of ecosystem services". *International Center for Tropical Agriculture (CIAT)* (2016).

11. Simpson E H. "Measurement of diversity". *Nature* 163 (1949): 688.

12. Shannon and Weaver W. "The Mathematical Theory of Communication". University of Illions Press, Urbana (1949): 117.

13. Millat-e-Mustafa M. "Tropical home gardens: An overview". In: Alam MK, Ahmed FU, and Amin SM (eds.). Agroforestry: Bangladesh Perspective. Dhaka: APAN/NAWG/BARC (1997): 18-33.

14. Baxter P and Jack S. "Qualitative case study methodology: Study design and implementation for novice researchers". *The Qualitative Report* 13.4 (2008): 544-559.

15. Mukasa G and Mugisha G. "Beyond the good discussion: The issues matrix for analyzing intracommunal difference in PRA". Participatory Learning and Action Notes, IIED (1997).

16. Rahman MM., *et al*. "Climate variability and its impact on agriculture in northern Bangladesh". *Annals of Bangladesh Agriculture* 20.1&2 (2016): 61-74.

17. Hill Ruth and Maria Eugenia Genoni. "Poverty in Bangladesh during 2010-2016: Trends, Profile and Drivers". *Bangladesh Development Studies* 42.2-3 (2016): 1-24.

18. Sajal IA. "Farming Practices and Community Awareness of Ecological Impacts". Bangladesh Biological Diversity Act 2017: An Appraisal. ResearchGate (2017).

19. Galacgac ES and Balisacan CM. "Traditional weather forecasting methods in Ilocos Norte". *Philippine Journal of Crop Science* 26 (2001): 5-14.

20. Burghardt AF. "The cultural geography of environmental perception: Spatial specificity and symbolic meaning". *Geographical Review* 90.3 (2000): 357-374.

21. Yang LE., *et al*. "Traditional ecological knowledge in China: Resource management and climate adaptation". *Ecology and Society* 14.2 (2009): 37.

22. Xu J., *et al*. "Landscape transformation through the use of ecological calendars in southwest China". *Mountain Research and Development* 34.4 (2014): 315-327.

23. Ranjitkar S., *et al*. "Ecological calendars and climate adaptation in rural China". *Environmental Development* 19 (2016): 60-71.

24. Heywood VH. "Wild food plants and their contribution to sustainable livelihoods and food security". Background paper for the FAO Expert Consultation on Nutrition Indicators for Biodiversity. Rome: Food and Agriculture Organization of the United Nations (2013).

25. Bharucha Z and Pretty J. "The roles and values of wild foods in agricultural systems". *Philosophical Transactions of the Royal Society B: Biological Sciences* 365.1554 (2010) 2913-2926.

26. Altieri MA. "The ecological role of biodiversity in agroecosystems". *Agriculture, Ecosystems and Environment* 74.1-3 (1999): 19-31.

27. FAO. "The state of the world's biodiversity for food and agriculture". Rome: FAO (2018).