Journal of Agroforestry and Environment

Volume 15, Issue (1), 2022

Journal DOI: https://doi.org/10.55706/jae

Journal homepage: www.jagroforenviron.com

Enhancing Livelihood and Biodiversity Through Caritas Intervened Project in the Northeastern Region of Bangladesh: A Case Study

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Received: 22/03/2022

Accepted: 21/04/2022

Available online: 15/05/2022

Abstract: In the last two decades, many development projects have been undertaken by different GOs and NGOs in diverse areas of the world with the expectation that they will simultaneously address the challenges of declining rural livelihoods and biodiversity. Caritas Bangladesh, a leading national and non-profit organization, has implemented several social welfare and community development projects since the 1970s. Accordingly, Caritas implemented a noble project in 2019, namely: Improving the livelihoods of extremely poor people by promoting green energy and biodiversity in the aspect of climate change in disaster-affected areas of Bangladesh (ILPGB). Therefore, the objective of the study was to evaluate the impacts of the ILPGB project on the livelihood and biodiversity improvements of the rural farmers in the Netrokona and Sunamgonj districts of Bangladesh. The assessment was done through random samplings of 60 stakeholders using a semi-structured questionnaire for livelihood analysis and quadrat (10 x 10 m^2) plotting techniques in the farmer's homestead for biodiversity analysis. The results showed that the ILPGB project had brought changes, most of which have had positive impacts on the human, social, physical, economic, and natural capital of the participants, and the process of livelihood development was slow but showed improving trends. Nevertheless, a platform for social relations and networks has been created among the participants in the project implementation areas. On the contrary, a total of 34 plant species were identified in the participants' homestead, of which 18 were trees, 6 shrubs, and 10 herb species. The species dominance showed that farmers tend to grow fruit tree species for their family's needs, and the general plant diversity in the northeastern region of Bangladesh was moderate to low. So, the study strongly recommends that the ILPGB project should continue for another two to three years. During this time, farmers could easily build their livelihood capital and improve their homestead biodiversity with the help of the project's planting materials and agricultural inputs.

Keywords: Livelihood capitals; Homestead plantation; Species richness; Species diversity.

INTRODUCTION

Globalization has led to an upsurge in demand for food, fuel, and natural resources. However, natural resources still account for 26% of the total wealth of low-income countries, whereas the figure is limited to only 3% for the developed countries around the globe (World Bank 2020). Those demands for natural resources, like wood and firewood, can cause environmental changes. Non-sustainable land-use practices and exploitation of natural resources, in particular forest resources and biodiversity, (Beenhouwer et al. 2013; Lax and Joachim 2013). Additionally, forests and trees also provide indirect benefits to the global environment. On the contrary, poverty and

environmental degradation are two distinct yet related global concerns in the current century. Over the last few decades, it is projected that the world has lost almost 25% of species, with an annual rate of 27,000 species (Nyaupane and Poudel 2011). To protect the loss of species and its diversity, many conservation approaches have been taken throughout the world under the direct patronization of different GOs and NGOs.

Inclusion of poor people and local communities in species protection and livelihood improvements has become increasingly common in recent times, and this approach is now a universal phenomenon (Agrawal and Gupta 2005; Islam et al. 2012; Larson 2001, Nilsson 2005). Many NGOs (Non-Government Organizations) have already come forward to work with communities so as to improve the livelihoods of rural people and also conserve biodiversity as well as species richness in the village areas of Bangladesh. Caritas Bangladesh is a local, national, non-profit and development organization that has executed many development projects since 1970. Accordingly, Caritas Bangladesh has implemented a noble project, namely- Improving the livelihoods of extremely poor people by promoting green energy and biodiversity in the context of climate change in disaster-affected locations in Bangladesh (ILPGB) from 2019 to 2022. The main goals of the project were to improve the livelihoods of poor households through climate resilient agriculture practices, protect biodiversity, enhance food and nutritional security, and enjoy sustainable livelihoods. In this connection, Caritas Bangladesh built the capacity of the rural farmers, provided timber and fruit tree saplings, trained farmers on climate-smart agriculture and conservation agriculture practices, and supplied different agricultural inputs (e.g., seeds, fertilizers, manures, organic manures, vegetable seedlings). The project would also provide information, technical support, and need based quality agricultural implements as suggested by the experts to over 50844 households in the four locations of Bangladesh.

Since the ILPGB started in July 2019, the project and the program have undergone several changes both in infrastructure and approaches and themes. This has to a large extent designed the process of learning in the program and would need to be evaluated for further improvements and modification in light of the livelihood enhancement and biodiversity conservation goals. So, the objective of the case study was to determine the impacts of the ILPGB project on the livelihood and biodiversity improvements of the rural farmers living in the Dharmapasha and Kalmakanda Upazillas of Netrokona and Sunamgonj districts in Bangladesh.

Theoretical Framework: The case study would look at the livelihood improvement pathway and biodiversity status of the project implemented areas, and thus, the study used the Sustainable Livelihood Framework developed by the DFID (2001) and a common diversity index (e.g., Shannon-Wiener Index) to analyze the livelihood and biodiversity. A person's livelihood is comprised of their capabilities and assets (material and social) and the activities essential for their way of living. So, a livelihood is sustainable when it adapts and improves in the face of vulnerability and sock, maintains or increases its capabilities and capital while not undermining the natural resource base (Scoones 1998).The DFID's sustainable livelihood framework refers to the core dynamics of livelihoods and how people are characterized by a number of capitals as a foundation for their livelihoods (Carney 1998; Islam et al. 2012; Hussein and Nelson 1998). In addition, the livelihood framework is convenient for illuminating the interrelationship among diverse livelihood assets and their application in spreading livelihood approaches to achieve required results (e.g., enhanced income) in the accessible and favorable environment. In the DFID's livelihood framework, these capitals/assets are characterized by human capital (e.g., skill, knowledge, capacity, good health), social capital (e.g., trust and interchange, platforms, networks, group membership), physical capital (e.g., infrastructure, roads, transport, shelter), natural capital (e.g., land, forest, watershed, wildlife, biodiversity) and financial capital (money, savings, credit, remittances) (Figure 1).

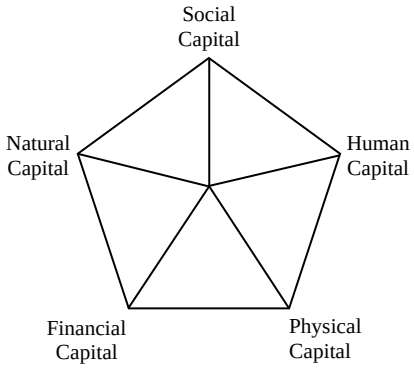

Figure 1. Dimension of the livelihood capitals/assets of the rural households.

MATERIALS AND METHODS

Study Area

The study was conducted in the Lengura and Rongchati Unions of Kalmakanda Upazilla under Netrokona district and also Uttar and Dhakin Bongshikunda Unions of Dharmapasha Upazilla under Sunamgonj district of Bangladesh where the ILPGB project was implemented (Figure 2). The villages are situated in the Northern and Eastern Piedmont Plains Agroecological Zones. Soils of this area are loams to clays in texture inclines to slightly acidic to strongly acidic. However, the average soil fertility level is low to medium, and the average annual rainfall is 2940 mm.

Description of the ILPGB project

The ILPGB (in Bengali called "Sabuj Jibikayon") project has been executed in the four locations of three disaster-prone districts of Bangladesh, viz., Sunamganj (Dharmapasha and Jamalgonj), Netrokona (Kolmakanda),

DOI: https://doi.org/10.55706/jae1501

Kurigram (Chilmari) and a total of 5844 extremely poor farmers are involved. The aim of the project was to ensure the sustainable development of rural communities through uplifting the livelihoods of the poor farmers, biodiversity of the resource poor areas while also making the local farming systems climate resilient to face the climate change impact (Figure 3). The ILPGB was initiated from July 1st, 2019 to December 31st, 2022 and provided a number of livelihood opportunities for supplying improved crop varieties and tree saplings to impoverished farmers. The project also developed farmers' capacity and skills through various training and workshops in order to build farmers' capacity in climate resilient farming systems from the local to the global level. The research focused on what aspects of the ILPGB project improved the species diversity, dominance, and richness in the rural communities and also assessed the farmers' livelihoods, particularly the human, social, physical, economic, and natural capital of the livelihood development.

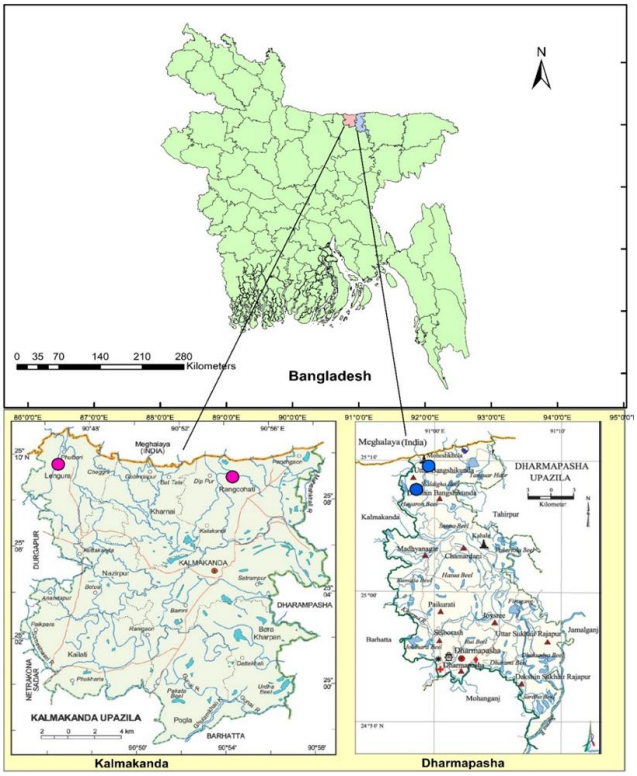

Figure 2. Study area showing Bangladesh, Kalmakanda and Dharmapasha maps.

Therefore, the ILPGB project would provide information, technical support, and need-based quality agricultural inputs (e.g., tree saplings) along with alternative livelihood support so that the stakeholders themselves would be able to ensure food and nutritional security, increase income, generate productive assets, and ultimately get rid of the vicious cycle of poverty.

Sampling and Data Collection

Before proceeding to data collection, the case study was collected ILPGB farmers' homestead information with an informal discussion with local people of the communities and from the concern agricultural offices. A test survey of 5 farmers was carried out in the region and then the interview questionnaire was adjusted and finalized for data collection.

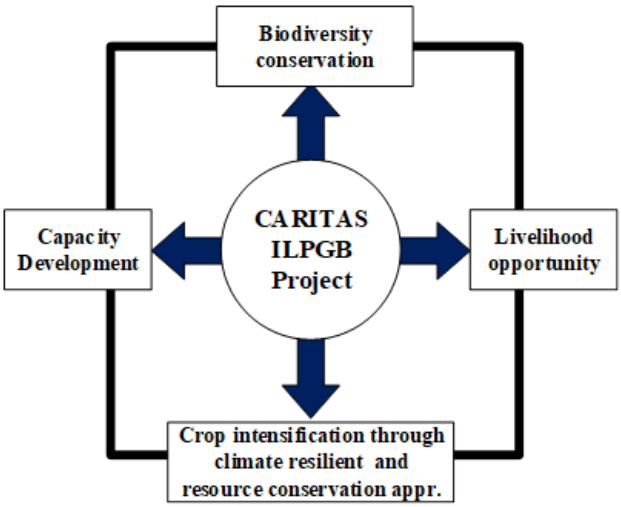

Figure 3. Portfolio of the Caritas Bangladesh intervened ILPGB Project.

The primary data of this study was obtained through household interviews and focus group discussions. For the farmers' (hereafter called Participants') household survey, the study selected 60 participants randomly, where 15 farmers represent each village. Also, the study collected plant biodiversity data through 20 Quadrat plot (size of 10m × 10m) techniques of the 20 participants' households. The face-to-face interview was carried out with the help of a semi-structured questionnaire, the questionnaire consists of participant demographic information, their agroforestry and farm income, improvement of five livelihood capitals through agroforestry systems and the biodiversity in their homestead. Interviews were held in the daytime with the assistance of two enumerators in Bengali. In addition to the household interview, the case study also conducted focus group discussions and in each of the villages, two focus group discussions were taken. The participants were informed about the focus group discussion and their perceptions were recorded accordingly. Repeated conservation with farmers was made in each common and decision-making question to ensure the validity of the information. Finally, the collected data were verified, cross-checked and authenticated in the study, the data collection period was conducted between 2021 and 2022.

Data Analysis

The entire area of the selected range was considered as a number of smaller units. In total 20 plots were measured of respective participants' homestead. The size of each quadrate plot was 10×10m2 (area=100m2) was considered for the data collection of mature trees ≥10 cm dbh. Shrubs and climbers were counted and identified in 5×5 m2 sub-quadrate and seedling and sapling 2×2 m2 sub-quadrate plot for seedling and sapling.

Species-area curve: Species area curves were designed from the total number of plant species found at different

DOI: https://doi.org/10.55706/jae1501

sample sizes to capture the maximum number of plant species from the study area.

Species richness: It is the number of different species in a specified area. The species richness was calculated to determine the sensitivity of these ecosystems and their resident species.

Similarity index (Community Coefficient): The similarity index was determined to find out the species overlapping, similarity and contrarily difference among or between different forest sites or parks. Jaccard Index (Jaccard, 1912) and Sorensen Index (Sorensen, 1948) were calculated as,

Jaccard Index = j/(a+b+c-j)

Sorensen Index = 2S (A+B+C)

Where, j/S is the number of species common along the three zones and a/A number of species in zone A, b/B number of species in zone B and c/C number of species in zone C.

Shannon-Wiener Index (Diversity Index): The diversity index was determined to measure the species diversity and community composition in different forest sites and national parks as well. The Shannon-Wiener diversity index (Shannon and Wiener, 1963) using the following formula given by Magurran (1988):

$$H' = -\sum_{n=1}^{n}(pi * ln\ pi)$$

Where pi is the proportion of the ith species and the number of all individuals of all species (ni/N). Where pi is the proportion of characters belonging to the ith type of letter in the string of interest.

Simpson Index (The concentration of dominance): In ecology, the concentration of dominance is often used to quantify the biodiversity of a habitat. It takes into account the number of species present, as well as the abundance of each species. Simpson's index (Simpson 1949) measured the concentration of dominance (CD):

$$CD = -\sum_{i=1}^{S}(Pi * Pi)$$

Where pi is the same as for the Shannon-Wiener information function.

The Evenness: Evenness is a calculation of the relative abundance of the different species building up the richness of an area. Evenness was calculated by Pielou's index from the formula given my Magurran (1988):

$$E = \frac{H'}{\ln S}$$

Where, H' is the Shannon-Wiener diversity index and S is the number of species.

RESULTS AND DISCUSSIONS

Demographic Characteristics of the Respondents

The case study observed that the variation of participants' households' size among the four unions was very insignificant and their average size was more than 5 (Table 1). The mean ages of the participant farmers were 47 years (Table 1). The male and female ratio among the farmer households was almost the same in the two locations. In the case of the literacy rate, the farmers from Kalmakanda Upazilla and Dharmapasha Upazilla possess a higher (64% and 60%) rate (Table 1) than the literacy rate of the general districts (Netrokona and Sunamganj) 39.4% and 35% (BBS 2013). The majority of participants' religion was Islam followed by Christian. The mean landholding of respondent households was 0.58 ha (Table 1) and the households' main source of income is dominantly agriculture (Table 1). In case of table, table caption/title should be placed at the top of the table. (Figure 1. Land and forest cover of Bangladesh). All tables are to be numbered using Arabic numerals. Tables should always be cited in text in consecutive numerical order. For each table, please supply a table caption (title) explaining the components of the table. Identify any previously published material by giving the original source in the form of a reference at the end of the table caption. Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.

Table 1. Socioeconomic characteristics of the respondents

Characteristics	Dharmapasha	Kalmakanda
Age (Mean) year???	43.70	50.30
Household size (Mean) head or person???	5.7	6.7
Literacy rate	60%	64%
Per household landholding (ha) (Mean)	0.56	0.60
Distribution of households by religion		
- Muslim	44%	61%
- Christian	56%	34%
- Others	0%	4%
Households' main income sources		
- Agriculture	60%	78%
- Wage labor	17%	18%
- Business	3%	12%
- Unemployment	0%	0%
- Remittances	20%	0%
- Others	0%	0%

Livelihood Improvements

The ILPGB project area and target stakeholders are the poor farmer of the community who do not have different production and consumption option (Islam et al. 2021). After joining in the ILPGB project, the farmers were able to build their livelihood capitals which in turn develop their community as well, and this study determined some major parameters of their livelihood capitals development.

Through ILPGB project activity, a series of training programs, workshops and field day/visits were conducted by the Caritas staff together with the experts. The Upazilla Agricultural and Livestock Officers and also professors from Bangladesh Agricultural University acted as key resource personnel in the ILPGB project training programs. These training programs were conducted at the local level to raise awareness and capacity building of the mass participants. The data from the participants' and Caritas office showed that the training sessions played a vital role

and more than 70% of participants (Table 2) were able to build their capacity on climate-smart agriculture and conservation agriculture practices in their land. Moreover, the participants had able to gain knowledge on homestead agroforestry management, tree plantation, livestock rearing, vegetable cultivation on sack systems through different training programs arranged by the ILPGB project. The literacy rate of the participants and their children was slowly increased (Table 2). The participants have received financial support from the ILPGB project in order to cultivate crops and vegetables in their land, and the result showed that about 96% of farmers already received different types of financial support from the project. Participants' awareness of health care facilities has been improved and the Christian Missionary extended their hands to provide basic healthcare facilities to the rural people in the project implemented area.

Table 2. Major characteristics of the participants in the Kalmakanda and Dharmapasha areas of Bangladesh.

Parameters	Status and Trends
Farmers Literacy rate	52.5%, Improving slowly
Children literacy rate	79%, Sharply improving
Micro-credit and easy loan facilities	33%, Slightly improving
Financial support received from program	76%, Slightly progressing
Farmers received scientific training on agroforestry	70%, Satisfactory
Farmers social relationship with other ethnic of the community	Moderate, gradually improving
Household infrastructure and physical assets	Brick wall and tin roof, shift from raw/mud with sun-grass roof, Increasing physical assets
Road infrastructure to farm and markets	Average, Improving
Livestock small (e.g., chicken)	3.4, Increasing
Livestock big (e.g., cow, goat)	0.8, Slightly improving
Food sufficiency of the household members throughout the year	10 months, Increasing
Program creating health awareness	64.7%, Improving
Tree stock in household premises	27, Improving
Program improving soil	Partially, slightly improving
Alternative livelihood options	Exist, Increasing

On the other hand, rural road infrastructure was steadily improved and poor (made with mud) roads have been changed by the bitumen sealed roads (Table 2), the Caritas staff informed that ILPGB project central authority had always pushed the local government and roads and highway authority to improve the local roads infrastructure and often invited the government official to took part in the project activities as experts. Often, the local farmers took their initiatives to improve and reconstructed their village roads and, in that case, Caritas local office would extend their hands to support the local people. Islam and Sato (2012) mentioned in their report that the project activities had motivated local people to improve their road infrastructure by themselves. The ILPGB project participants were also bought small and big livestock with the income they earned from project activities and crop cultivation. Besides, a few participants stated that they bought small television with the profit from the cultivation of crops due to the support of the ILPGB project. The available labor of the participants' families had reduced and it was due to the awareness of the participants and migration to the capital city for garments jobs, mentioned by the respondents and staff of the ILPGB project.

Marketing channel and farmers product supply chain is a common problem faced by the participants and for this, the local farmers did not get the proper price of their agricultural product. A number of scientists had already stated that the market monopoly system and long intermediaries' channels have hindered the ultimate profit of the farmers all over the country (Islam et al. 2013; Islam and Sato 2013; Muhammed et al. 2008; Islam et al. 2015). With the income of the homestead tree and crop cultivation, the participants can also able to manage their family healthcare systems and visited the local hospital/clinic for the treatments. Initially, every participant received 40 tree seedlings for free of cost to plant in their household premises, and Caritas staff tries to create participants' awareness on increasing tree cover in their homestead premises through training and workshops. It would concurrently increase the tree coverage and decrease the participants' dependency on forest resources for firewood and timber.

One of the main goals of the ILPGB project was to provide alternative livelihood opportunities for the poor participants and thus, the project provided support to establish nursery, vegetable cultivation in sack systems, vermicompost culture and its marketing, small business, provided fishnets and boats, solar lighting technology and improve stove making technology to the participants. The results showed that the alternative livelihood opportunity had successfully been able to build participants' livelihood capitals and almost 89% of participants hold the ILPGB assisted profession to sustain their livelihood. That means the alternative livelihood option has increased for the local participants and the ILPGB project has been treated as one of the successful programs in improving the livelihood of the pro-poor in the Kalmakanda and Dharmapasha Upazilla of Bangladesh. Finally, most of the participants informed that the ILPGB project had increased their annual food sufficiency from half-year to 10 months (Table 2)

Participants' Social Relationship of the Community

Social relationships and networks are quite essential and critical assets for impoverished people, specifically during time of family crisis and sudden socks. The study showed

DOI: https://doi.org/10.55706/jae1501

that the ILPGB project had built a new social platform and the respondents were organized as an independent social group. In a measurement scale of a 5- point Likert scale, (such as +2 strongly positive, +1 positive, 0 neutral, -1 negative and -2 strongly negative) the study showed that the participants owned a positive relationship among themselves (Figure 4). The participants also showed a positive relationship with local agriculture offices. However, the participants' social relationships with local leaders were weak (Figure 4). Although social relationships and platforms are characteristics of an individual in a social setting (Sobel, 2002), the establishment of social capital relies on the institution, attitudes and worth that govern interactions among stakeholders and designate to economic and social development (World Bank 2002); and the overall social capital of the participants in the study area has been improved.

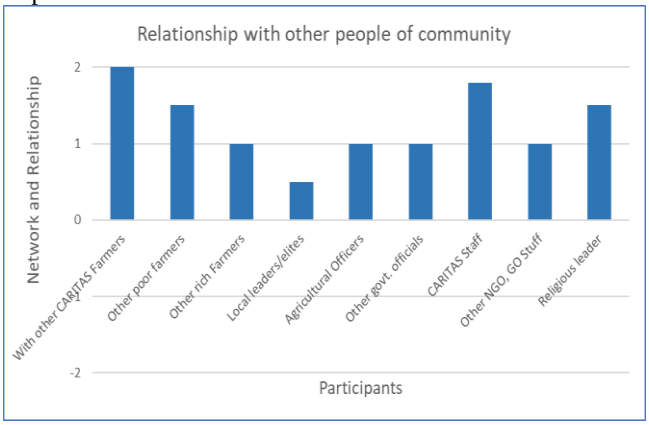

Figure 4. Participants social relationship in the community

Biodiversity Status

Biodiversity is one of the foundations for the development of an ecosystem and whole landscape of the country. It contains visible and invisible everything to sustain life on earth. Homestead plant in the northeastern part of Bangladesh having wider variation and the Caritas ILPGB project has tried to increase the species richness and tree coverage of northeastern region through supplying different types of tree saplings. The participants informed that the project had supplied more than 40 types of fruit, timber and medicinal tree species to the participants. Besides, the project also supplied different types of fruit and timber tree saplings in previous year to plant in their homestead areas, and all of those had impacts on biodiversity of the project implemented area. Thus, the study figured out the species richness, dominance and diversity of the homestead plants of the Kalmakanda and Dharmapasha region of Bangladesh.

Species Richness: In Kalmakanda and Dharmapasha Upazilla, 34 plant species were identified of which 18 trees, 6 shrubs, 10 herbs species (Table 3). Among these species, Mango (25.3%), Areca palm (19.0%), Jackfruit (17.8%), Coconut (7.8%), Taro (6.6%), Mahogany (6.4%), Litchi (6.0%), Neem (5.6%) and Marigold (5.6%) were the dominant plant species (Figure 5). It was obtained that Mango was the most dominant species in this forest area. These 34 plant species belong to 26 families and 32 genera. Among 26 families, Fabaceae having the highest species richness of 4 followed by Rutaceae with species richness of 3, Zingiberaceae, Meliaceae and Anacardiaceae with species richness of 2 and other 22 families with single species richness (Table 3). Among 32 genera, Citrus having highest 3 species followed by rest 32 genera with single species (Table 3).

Table 3. List of identified plant species in the study area with their scientific and family name.

Sl No.	Common name	Scientific name	Family name	Habit
1	Mango	*Mangifera indica*	Anacardiaceae	Tree
2	Litchi	*Litchi chinensis*	Sapindaceae	Tree
3	Taro	*Colocasia esculenta*	Araceae	Herb
4	Pomegranate	*Punica granatum*	Punicaceae	Tree
5	Ginger	*Zingiber officinale*	Zingiberaceae	Herb
6	Neem	*Azadirachta indica*	Meliaceae	Tree
7	Indian jujube	*Ziziphus mauritiana*	Rhamnaceae	Tree
8	Malta	*Citrus sinensis*	Rutaceae	Shrub
9	Turmeric	*Curcuma longa*	Zingiberaceae	Herb
10	Guava	*Psidium guajava*	Myrtaceae	Tree
11	Bamboo	*Bambusa vulgaris*	Poaceae	Herb
12	Jackfruit	*Artocarpus heterophyllus*	Moraceae	Tree
13	Coconut	*Cocos nucifera*	Arecaceae	Tree
14	Mehogony	*Swietenia macrophylla*	Meliaceae	Tree
15	Tulsi	*Ocimum sanctum*	Lamiaceae	Shrub
16	Blackberry	*Rubus fruticosus*	Rosaceae	Shrub
17	Marigold	*Tagetes erecta*	Asteraceae	Herb

DOI: https://doi.org/10.55706/jae1501

18	Olive	*Olea europaea*	Oleaceae	Tree
19	Acacia	*Acacia auriculiformis*	Fabaceae	Tree
20	Sugar apple	*Annona squamosa*	Annonaceae	Tree
21	Areca palm	*Areca catechu*	Arecaceae	Tree
22	Bean	*Phaseolus vulgaris*	Fabaceae	Herb
23	Papaya	*Carica papaya*	Caricaceae	Herb
24	Raintree	*Samanea saman*	Fabaceae	Tree
25	Brinjal	*Solanum melongena*	Solanaceae	Herb
26	Lemon	*Citrus limon*	Rutaceae	Shrub
27	Pomelo	*Citrus maxima*	Rutaceae	Shrub
28	Sapota	*Manilkara zapota*	Sapotaceae	Tree
29	Sajna	*Moringa oleifera*	Moringaceae	Tree
30	Bottle gourd	*Lagenaria siceraria*	Cucurbitaceae	Herb
31	Hog plum	*Spondias mombin*	Anacardiaceae	Tree
32	Tomato	*Solanum lycopersicum*	Solanaceae	Herb
33	China rose	*Hibiscus rosa-sinensis*	Malvaceae	Shrub
34	Tamarind	*Tamarindus indica*	Fabaceae	Tree

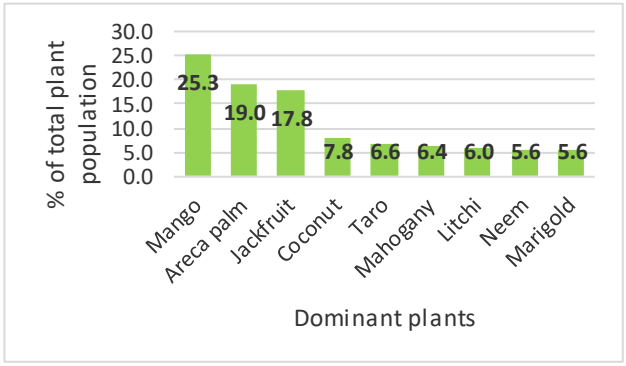

Figure 5. Relative percentage of population of the dominant plant species of the study area.

Diversity Index: It is the measure of dispersion of any species in the community.

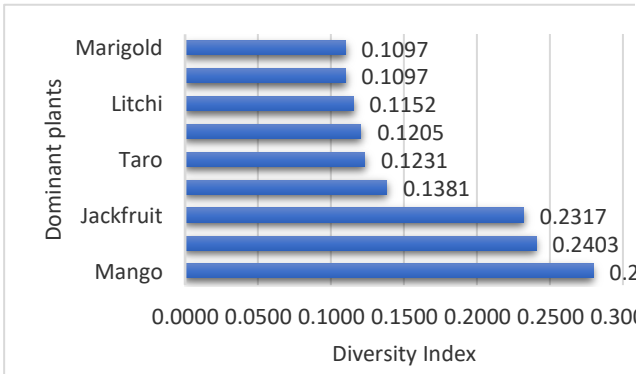

Figure 6. Diversity Index of the dominant plant species of Kalmakanda and Dharmapasha Upazilla.

Diversity index of Dharmapasha and Kalmakanda Upazilla were recorded from 0.0138 to 0.2794. The highest diversity index was found in the species Mango (0.2794) followed by Areca palm (0.2403), Jackfruit (0.2317), Coconut (0.1381), Taro (0.1231), Mahogany (0.1205) and the lowest (0.0138) one in Sapota (Figure 6). This result indicates that the species Mango widely dispersed or spread all over this region followed by Areca palm, Jackfruit, Coconut, Taro, and Mahogany species.

Concentration of Dominance: Concentration of Dominance of Dharmapasha and Kalmakanda Upazilla were recorded from 0.0000 to 0.0208. The highest concentration of dominance was obtained in the species Mango (0.0208) followed by Areca palm (0.0117), Jackfruit (0.0102), Coconut (0.0020), Taro (0.0014), Mahogany (0.0013) and the lowest (0.0000) in Sapota (Figure 7). The result showed that the species Mango is less stabilized and less active from a functional point of view.

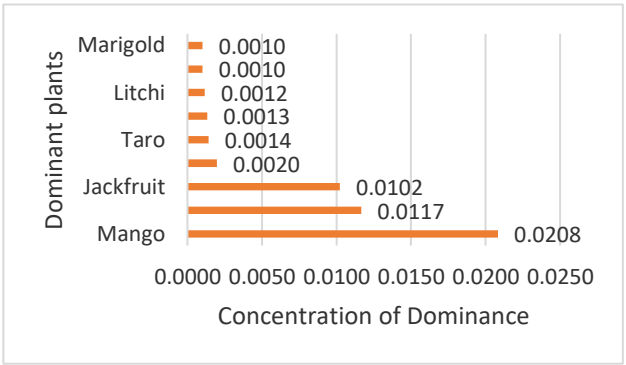

Figure 7. Concentration of Dominance of the dominant plant species of the study area.

Similarity Index: Similarity Index of Dharmapasha and Kalmakanda Upazilla were recorded from 2.143 to 2. Highest similarity index was found in the species Areca palm (2.143) and the rest species are 2. (Figure 8).

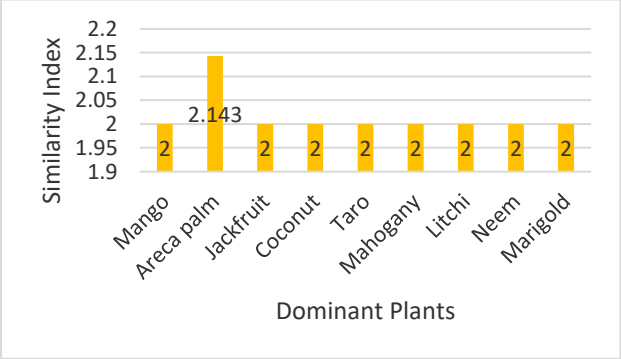

Figure 8. Similarity Index of the dominant plant species of the study area.

The Evenness: The evenness of Dharmapasha and Kalmakanda Upazilla were recorded from 0.0000 to 0.0208. The highest evenness was found in the species Sapota (4.5525). For dominant species the evenness was in the species Marigold (0.9470), Litchi (0.9278), Mahogany (0.9105), Taro (0.9025), Jackfruit (0.7030) and the lowest (0.6514) in Mango.

The reason for growing a variety of fruit species in the homestead garden was more or less complex and it depends on many factors. A number of factors determined the participants' decisions for growing particular species or group of species. The participants were keen to grow timber trees for cash income if they already had a successful strategy for deriving income from off-farm labor or agriculture crops. Participants having large family members tend to grow fruit trees and in general, the study found that homestead plant species are usually used for fruit and food, medicine, firewood, timber and beautification purposes. The results showed that more than 60% of the homestead plants species were fruit/food providing and farmers tend to buy more fruit trees in their homestead all over the country. Homestead agroforestry has long been the most effective and widespread measure for biodiversity conservation in Bangladesh (Islam and Sato 2013; Islam and Hyakumura 2019). Usually, rural people preferred to grow multipurpose tree species that can be served as fruit, timber, firewood, medicinal purpose and this kind of choice is most important for biodiversity conservation in Bangladesh. Participants also informed that home gardens attract several birds' species to collect their food and make the nest. Respondent also informed that some birds play a vital role as pollinators and also help to control insect pests.

On the contrary, the ILPGB project implementation area is affected by flashflood and monsoon floods, as a consequence, soil erosion is a vital problem in the northeastern region of Bangladesh. So, to keep participants' houses above the water level, it is obligatory to raise houses at the maximum elevations or fill the land with soil in summer season. As a consequence, the participants are well aware about the services function of tree to protect their home against water-induced soil erosion. Therefore, the participants' choice of homestead tree species also depends on the multipurpose function of the tree species.

CONCLUSION

The complexity that comes with the integration of agriculture, trees, alternative livelihood approaches, input support, capacity developments, small businesses, and other systems as done in the ILPGB project of Caritas poses significant challenges in evaluating the effectiveness of the project intervention. However, the improvement of the livelihood capital of local farmers and the species diversity of the farmers' homestead area through the intervention of the ILPGB project have been improved or greater than before. There is no question that the Caritas ILPGB project has set a good example, with a number of inspiring successes and future potential. First, it has improved the stakeholder's livelihood in an integrated way, which means building participants' capacity in climate-smart agriculture and conservation agriculture practices, providing alternative energy sources, enhancing their food and nutrition security, improving local road infrastructure, and improving livestock and micro-credit facilities. And secondly, the ILPGB project had supplied many fruit and timber tree species for planting in the participant's homestead area, which had significantly improved the species richness, diversity, and dominance in the northeastern region of Bangladesh. The results showed 34 types of different plant species were available in the Kalmakanda and Dharmapasha areas, in which 18 different tree species were recorded. Despite the fact that the study concluded that homestead plant richness and diversity were moderate in the Kalmakanda and Dharmapasha areas. The dominancy of the homestead plant species revealed that local farmers tend to grow fruit tree species in their homestead area and they also expect service functions from the woody species. Finally, the project is still in its implementing stage, and it is too early to make a list of recommendations and policy implications. The study, on the other hand, strongly recommends that the ILPGB project go on for another two to three years. During this time, the farmers could easily build their livelihood capital and improve their biodiversity thanks to the project's strong support, especially in the form of trees and vegetable planting materials.

ACKNOWLEDGEMENT

This research was undertaken with the financial support of the Caritas Banglasdesh Project, namely- Improving the livelihoods of extremely poor people by promoting green energy and biodiversity in the context of climate change in disaster-affected areas of Bangladesh (Sabuj Jibikayon), and was financially supported by Andheri-Hilfe and co-funded by BMZ, Germany.

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