STUDY ON CLIMBER VEGETABLES AND THEIR AGRO- ECONOMIC PRODUCTIVITY IN HOMESTEAD AREA OF BARIND TRACT

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CERTIFICATE

This is to certify that thesis entitled, ***"STUDY ON CLIMBER VEGETABLES AND THEIR AGRO-ECONOMIC PRODUCTIVITY IN HOMESTEAD AREA OF BARIND TRACT"*** *submitted to the Department of Agroforestry and Environmental Science, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE IN AGROFORESTRY AND ENVIRONMENTAL SCIENCE,*** *embodies the result of a piece of bona fide research work carried out by* ***Mahmuda Binte Qader Shammi,*** *Registration NO.: 14- 06076 under my supervision and guidance. No part of the thesis has been submitted for any other degree ordiploma.*

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Dated: June, 2021

Place: Dhaka, Bangladesh

Dr. Ferzana Islam
Supervisor

ABBREVIATIONS

Full word	Abbreviation	Full word	Abbreviation
Applied	App.	Negative logarithm of hydrogen ion concentration (-log[H+])	pH
Agriculture	Agric		
Bangladesh Agricultural Research Institute	BARI		
Bangladesh Bureau of Statistics	BBS	Science	Sci.
		Society	Soc.
Biology	Biol.	Technology	Technol.
Biotechnology	Biotechnol.	Thailand	Thai.
Botany	Bot.	University	Univ.
Horticulture	Hort.	United States of America	USA
International	Intl.		
Journal	J.	Serial	Sl.
Kilogram	Kg	Number	No.
Liter	L	Sum of squares	SS
Department	Dept.	Environmment	Environ.
Development	Dev.	Food and Agriculture Organization	FAO
East	E		
Editors	Eds.	And others	*et al.,*

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The Author

Place: Dhaka, Bangladesh

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ABSTRACT

Barind tract of Bangladesh considered as an important area for vegetable production especially climber vegetables. However, there is still significant knowledge gap of regarding climber vegetable productivity status and their economic performance in Rajshahi division. To explore this importance a field survey was conducted and evaluate (i) the existing types of homestead vegetable production systems in Bangladesh (ii) the most prominent support system for climbing vegetable production and (iii) the influence of the climber types vegetable production on the agro-economic productivity of the homestead farmers. The majority of farmers in the research area grew climbing vegetables on trellis support systems (53.4%), followed by roof top support systems (35%) and tree support systems (11.7%) accross the barind tract. Most of the respondent farmers (60%) in Level Barind used the trellis support system for vegetable production. However, in the Terrace Barind, most of the respondent farmers (46.7%) used trellis support systems for vegetable production. The majority of respondents (43.3% and 50% in Level Barind and Terrace Barind, respectively) used and sold their products for personal consumption. Summer white gourd, ridge gourd, and winter bottle gourd, country bean were the most common climbing vegetables. Lack of knowledge about technology, proper cultural operations and variety selection were the major problems for vegetable production in the study areas. Thus, farmers who practice homestead vegetable gardening can boost their per capita income and save for the future.

CHAPTER 1

INTRODUCTION

Homestead gardens, a relatively stable system, play a significant role in Bangladesh's economy, providing approximately half of the country's revenue flow (Ahmed *et al.*, 2005). Homestead garden production systems of Bangladesh produce over 70% fruit, 40% vegetable, 70% timber, and 90% fuel and bamboo (Miah and Ahmed, 2003). In addition, non-timber items such as medicinal plants, ornamentals, bamboos, cane, and grasses are known to be found in home gardens. From the village woodlands, Latif *et al.*, (2001) identified 148 native and alien species. Similarly, Basak (2002) found 105 tree species and 27 herbaceous species (vegetables and plants). The land areas for field crops have declined while average homestead area per farm has increased from 0.032 to 0.036 ha due to population increase especially in rural areas. This indicates that increasing the homestead area increased opportunities to some extent for home-based farm and non- farm production system (Mandal, 2003).

The land of Bangladesh has a unique opportunity where a large number of diversified vegetables can be grown. Vegetables, which are recognized as nutrition-givers of the highest order, are grown in Bangladesh mostly in homesteads from time immemorial. As in the case of fruits, vegetables belong to the group of ‘protective food’ which provides essential vitamins and minerals (Tsou, 1992). However, species or plant diversity varies from place to place largely influenced by ecological and socioeconomic factors. It varies among the homesteads even within similar ecosystems and socioeconomic groups depending upon individual needs and preferences.

Relatively higher numbers of species per homestead was recorded at south-western and eastern regions, while lower number of species was found at north-western region (Millat-e-Mustafa *et al*., 1996; Basak, 2002). In north-western region, Barind tract is considered as an ecologically fragile ecosystem with extremely low rainfall and low vegetation. Practically, this area has very limited tree cover except in the homesteads (IUCN, 2002).

The Barind Tract is a distinctive physiographic unit in the north-west of Bangladesh, which is characterized by extreme environmental conditions. Landless, marginal and

small households comprise >70% of the rural population, and among them, 34% have only homestead. Homesteads are the resources that provide major share of livelihood especially for poor farmers. Those resource poor farmers (RPFs) get about 50% of their food and cash from homestead (Banglapedia, 2015).

Homestead area can be utilized to grow different vegetables, which can significantly improve rural health as well as economic conditions. Integrated farming system approach provides to improve farming condition and livelihood of Barind farmers by integrating available resources. The households of this area are poor, and growing vegetables in the homestead is one of the major farming activities. Vegetables are produced either for commercial purpose or for domestic consumption. Commercial gardens are often relatively large in size but encompass a fewer number of species, sometimes just one vegetable in the entire season (Alam, 2011).

Creeper/climber type vegetables on different support systems such as trellis, roof top and tree species are common in the homesteads of those resource poor farmers. Because of resource constraints, usually, such farmers grow vegetables in association with trees and on the roof top of houses with the assumption that the association would not affect either of the components or would have little effect on them. But information on the compatibility of tree-crop association in terms of agronomic and economic performance is lacking which needs to be studied. Thus, we set following objectives:

i) To identify the existing types of homestead vegetable production especially climber type under different supports systems in the Barind tract.

ii) To find out the most prominent support system for climbing vegetable production.

iii) To determine the influence of the climber types vegetable production on the agro-economic productivity of the homestead farmers

CHAPTER 2

REVIEW OF LITERATURE

2.1 Barind Tract of Bangladesh

Barind Tract (Varendra Tract the largest Pleistocene era physiographic unit in Bangladesh) is located in the center and west of Rajshahi division covering an area of 7,728 km^2. It occupies one fourth of the entire Rajshahi Division. The Barind Tract represents a series of uplifted blocks of Madhupur Clay. Agro ecologically it is divided into two regions ie, (i) Level Barind Tract (AEZ 25) and (ii) High Barind Tract or terrace Barind Tract (AEZ 26).The Level Barind Tract occupies about 65 percent of the entire Barind Tract. It is located in Dinajpur, Gaibanda, Jaipurhat, Bogra, Nogaon, Natore and Sirajganj districts. This tract covers an area of 5,049 km^2 (BMDA, 2004).The soils of Bangladesh classified into seven soil tracts. (Islam and Islam 1956). In Barind Tract, soil pH varies between 6.0 to 7.5and soils are deficient in nitrogen and phosphorus. The High Barind Tract was previously termed as the Dissected Barind Tract. It occupies about 20 percent of the Barind Tract. The High Barind Tract is located in Rajshahi, Nawabganj and Nogaon districts covers an area of 1,600 km^2 (BARI, 2002). The Barind Tract is a distinctive physiographic unit in the north-west of Bangladesh which is characterized by extreme environmental conditions for agricultural production characterized by grey terrace soil, low organic matter, low rainfall and high temperature. The climate of the area is generally warm and humid. Barind region is classified as highland (about 47%), medium highland (about 41%) and lowland (about 12%). Agricultural land commonly occupies about 80% of the terrace slopes of Barind. The tenant farmers have less financial capability and they have no access to any institutional loan. They are also not much interested in diversity the cropping pattern. They experience insecure food, malnutrition, unemployment and poverty. They are not familiar with the homestead vegetable production system and do not know how to use their farm resources effectively for maximum output. Social problem like tenant farmer and lack of motivation hinder the vegetable production (BARI, 1999).

Homestead vegetable gardening may improve farming condition and livelihood by integrating the available resources. Homestead area can be utilized to grow different

vegetables, which can significantly improve rural health as well as economic condition (Abdullah, 1986). Integrated farming can increase sustainable income and socioeconomic status of the resource poor farmers. For improvement or enhancement of living standard of resource poor farm households homestead vegetable production system may be an essential tool for raising total vegetable production in this area (Khan *et al*., 2009).

2.2 Homestead Production System

Homestead production system is one of the most elaborate systems of indigenous agroforestry, found most often in tropical and subtropical areas The term "homestead" could be anything for growing vegetables behind houses (Fernando and Nair 1990) They defined the term as land use practices involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual house, the whole tree-crop- animal unit being intensively managed by family labour/members.

The number of layers of vegetation varies from homestead to homestead, ranging from three to five (Yoshino, 1996; Ahmed, 1999; Bashar, 1999; Basak, 2002; Miah and Hussain, 2004) and even six (Millat-e-Mustafa *et al*., 1996). The first layer is within 1 m height from the ground and is composed of vegetables, tuber crops and other herbaceous plants. Shade tolerant plant species like pineapple, turmeric, ginger, taro, etc. belongs to this stratum. The second (above 1-5 m) and third (above 5-10 m) layers are nearly continuous and overlap. Banana, papaya, lemon, guava, pomegranate, drumstick, jujube, carambola, lotkan, olive, amloki and other medium sized trees form these layers. The fourth layer (10-16 m) is composed of medium-tall sized fruit and forest trees such as jackfruit, mango, litchi, betel nut, hog plum, ghoraneem, arjun, koroi, shimul, kadam, etc. The fifth and the top most layer (above 16 m) is composed of tall trees such as Palmyra palm, coconut (tall variety), eucalyptus, tetul, rajkori and other tall trees (Farukh *et al*., 2001).

About 105 tree species and 27 herbaceous species in a recent study covering 15 districts in different ecological areas of Bangladesh (vegetables and spices) founded by (Basak 2002). Among 105 tree species, 42 were perennial and annual fruits, 31 forest trees (timber and fuel wood), 7 medicinal and 22 ornamental/aesthetic species.

Across the regions, relatively higher number of species per homestead was recorded at south- western and eastern regions, while lower number of species was found at north-western region (Millat–e- Mustafa *et al*., 1996; Basak, 2002).

2.3 Factors Affecting Homestead Production Systems

2.3.1 Competition for light resources

Shading reduces the photosynthetic capacity of plant. It reduces the productivity of under–storey crops/vegetables. Among different limited resources, light availability is one of the most important factor. Performance of the under-storey crops/vegetables where an upper-storey perennial forms a continuous over-story light availability is limited. Unlike water and nutrients, light cannot be captured and stored for later use in the way that other natural resources are managed (Miah *et al.*, 1995).

The combination of tree and crop species in homestead offers much more scope for useful management of light interception and distribution than do mono-culture forests and agricultural crops (Miah *et al*., 1995). The potential benefits as a result of combining field crops with trees are so obvious from consideration of the limited of light resources experienced in orchard and tree crop orientations (Jackson, 1987).

The degree of rivalry between under-stored crops and trees in the homestead is determined by how resources are shared, particularly light and water. Essentially, the underlying processes of resource partitioning (e.g., light, water, and nutrients) remain unknown. To support the creation of enhanced systems of combination, planting arrangement, and management, a deeper mechanistic knowledge of resource collection and use in agroforestry systems is necessary (Howard *et al*., 1995).

2.3.2 Shade on crop morphology

Shade influences plant height, stem diameter (girth), internode length, and number of primary branches plant, leaf number plant, leaf size, thickness and leaf area. Plant height increased gradually with the decrease light levels in okra (Ali, 1999), eggplant (Miah, 2001), mung bean (Islam, 1996) and chickpea (Murshed, 1996). But in red amaranth, plant height and stem girth decreased with reduction of photo synthetically active radiation (Ali, 1999 and Wadud, 1999). Shading produced taller tomato plants with longer internodes (Thomas and Teoh, 1983) and thinner stems (Bscetinulik *et al*., 1994). Plants grown under low light levels was found to be apically dominant than

those grown in high light environment resulting in taller plant under shade (Hillman, 1984).

Leaf number usually decreases under shading condition in most of the crops such as red amaranth, Indian spinach and mung bean (Ali, 1999; Wadud, 1999; Islam, 1996). But in tomato and okra, highest number of leaves were produced at 75 percent photo-synthetically active radiation (PAR) (Miah, 2001).

Plants grown at high light intensity have different leaf morphology from those grown at low light intensities. Leaf size (length x breath) increased under shaded condition in different vegetables such as cabbage, carrot, radish and tomato (Miah, 2001). This may be attributed due to the stimulation of cellular expansion and cell division under shade condition (Schoch, 1972). But in red amaranth and Indian spinach, leaf size progressively decreased with decrease of PAR (Ali, 1999). Yoshida and Parao (1976) reported that vegetables grown under shaded condition had smaller leaves and shading did not have significant influence on leaf size (Wadud, 1999). Shading reduced leaves number, leaf thickness and leaf area of beans (Crookston *et al*., 1975).

Under shaded condition, leaf senescence is delayed (Sheldrake and Sayena, 1979), which might prolong the reproductive phase i.e. life ripen of shade grown plants and root growth reduced (Andersen *et al*., 1993). Weight of leaves remain unchanged and stomatal density decreased at both sides of leaves grown at low irradiance (Marler *et al*., 1994).

2.4 Importance of Homestead Vegetable Garden in Bangladesh

Homesteads are multipurpose entities with dwellings, vegetables, spices, fruits and fuel wood/timber species. Historically, homesteads have been providing multiple products to the households and meet their diversified need through the production of a wide variety of fruits, Vegetables, spices and different tree products (Miah and Ahmed, 2003). The prevailing climatic and edaphic conditions of Bangladesh are the key factors for providing such a unique opportunity of producing a wide range of products.

Alam and Sarker (2011) Bangladesh with a view to fulfill the nutrition demand of those farmers' family and to earn some cash income, vegetable production in homestead area is done. In this regard, six vegetable crops *viz*., brinjal, red amaranth,

spinach, radish (with leaf), batishak and bush bean grown in five beds of open sunny place and two creeper vegetable crops *viz*., bottle gourd and country bean were grown on the farmers' cottage roof top and trellis. Brinjal and red amaranth were grown in same bed simultaneously. They reported that the maximum amount of vegetables (95.97 kg homestead^{-1}) was produced in the month of December from each homestead and thereby sharply declined up to February. Among the crops, brinjal, red amaranth, spinach, radish (with leaf), China cabbage (*batishak*) and bush bean produced 23.35, 28.20, 30.94, 33.97, 39.75 and 15.45 kg fresh vegetables, respectively. On the other hand, creeper vegetables bottle gourd and country bean gave 22.40 and 15.50 kg fresh vegetables from each homestead. In *rabi* season, each family produced 209.56 kg fresh vegetables from the homestead. The products that were consumed, distributed to relatives and sold by a single family were 97.70, 33.46, and 78.38 kg fresh vegetables, respectively. Each family earned Taka 1518.57 and 1398.57 gross and net returns, respectively through market value of the total products during *rabi* season. On the other hand, Kabir and Edward (2008) reported that vegetable consumption increased due to vegetable production in the homestead and it could overcome the malnutrition problem of the rural poor farmers.

Alimur *et al.*, (2006) reported that in high Barind area, creeper vegetable crops viz., bottle gourd, sweet gourd, sponge gourd and country bean were grown on the farmers' cottage roof top and trellis They reported that the maximum amount of vegetables (105 kg homestead^{-1}) was produced from the studied homestead. The products that were consumed, distributed to relatives and sold by a single family was 95.70, 30.46, and 88.38 kg fresh vegetables, respectively.

A vast majority of rural people in Bangladesh who cultivate land for crop production remains unemployed for a considerable period of the year because of seasonality of production activities and labor requirements. Homestead farming is the best answer to such unemployment situation through both vegetable growing, and culture of quick growing fruits enabling the people to remain employed round the year (Ahmad, 2005). It has been found that over the decades, small-scale homestead activities have become the most significant income generating activities of poor households. For example, over 5 million people in Bangladesh live in the revering sand and silt landmasses (known as char in Bengali). These areas are highly prone to sudden flooding and erosion of land, and makes living in the chars hazardous and insecure.

Technologies for gardening and livestock-raising, improving food security and dietary practices, providing employment for women and a source of income for the household (HKI, 2003). The jackfruit is consumed almost as the main food during the main harvesting periods (July-August) and the seeds are used in various cooked forms (Miah and Ahmed, 2003).

2.5 Status of homestead gardening in Bangladesh

Homestead is the center of socio-economic activities and traditional cultural heritage of villages in Bangladesh. The homesteads-in which the people live in are locally known as; Bari which occur in linear, cluster or individual pattern (Hossain *et al*., 2005)

Homestead perhaps the most important production unit in Bangladesh, which accounted about 25.36 million in the country with 21.90 million in the rural areas (BBS, 2011). These homesteads occupied about 0.54 million hectares of land (BBS, 2011). The average size of the rural homestead is very small (0.02 ha), which varies widely according to region and socioeconomic status of the households (Basak, 2002).

Depending on the locations, the homestead is raised above the f1ood level from the surrounding fields. Generally, a homestead possesses at least a living room, a kitchen room and few tree species. Besides, there are some vacant spaces for different production purposes. Khan (2005) reported that in Bangladesh about 75% of the households have a homestead garden; yet a majority of them depend on the market for selling their vegetables.

The size of the home gardens in Bangladesh is similar, ranging from 1.0 to 1.5 decimals and the varieties of vegetables grown in the gardens range from 1.4 to 3. The average monthly vegetable production household^{-1} ranges from 0.3 kg to 8.6 kg. Per capita vegetable consumption by household members ranges from 69 to 112 g per day. He also reported that a majority of the farmers use their own stock as a source of seeds and seedlings for homestead (Alam *et al*., 2010).

Hossain (2002) reported that more than 90 vegetables and 60 fruits are grown in Bangladesh, with great regional variation in the extent of cultivation. The cultivated

area given to fruits and vegetables is 0.52 million hectares, covering 3.7 percent of total cropped area. Vegetable production provides only about one-fifth of the recommended daily intake of 200 g per person. Likewise, present fruit production provides only 34 g toward the daily requirement of 75 g per person.

Robiul *et al*., (2005) studied the feasibility for growing vegetables round the year in the homestead area of Barind Tract. They found that year-round production of vegetables in the homestead proved excellent activities in respect of proper utilization of homestead area, improvement of nutritional status in daily diet, creating opportunity for women employment and income generation. Maximum vegetables produced in the homestead area were utilized as consumption by the family members that helped to improve nutritional status of Barind people.

2.6 Impact of homestead vegetable cultivation on food and nutrition security

Nutrition problem is key issue along with food security in Bangladesh today. A small percentage of the people have access to nutritious food, whilst the majority is forced to survive on subsistence diets that are unbalanced and devoid of essential food ingredients (MoA-FAO, 2000). Generally, landless and marginal farmers are at more risk nutritionally than larger households. These households have lower per capita grain availability and higher rates of child malnutrition (Talukder *et al*., 1995).

Of all the options available to tackle national malnutrition problem, the most practical and sustainable option would be to promote both cultivation and consumption of horticultural crops (fruits, vegetable and spices) that could provide basic requirement of the essential vitamins and minerals. Production of crops especially vegetable and fruits may well be the answer to the potential problems of hung and malnutrition in Bangladesh (Ahmad, 1999).

2.7 Production of climber type vegetables in homestead

Climber type vegetables are a type of vegetables, which cannot stand without supports. Climber type vegetables can be annual, bi-annual or perennial. Climbers are commonly grown on walls, rooftops, trellises, and tree supports. Diversified creeper or climber type vegetables are used to grow on the different support systems such as trellis, roof top and trees etc. and these are the common practices in the homestead production systems of Bangladesh especially in the homesteads of resource poor

farmers. In north-western region, Barind tract is considered as an ecologically fragile ecosystem with extremely low rainfall and low vegetation. Practically, it has very limited tree cover except in the homesteads (IUCN, 2002)

Rahim *et al.,* (2006) reported that indigenous vegetables such as yams, teasle gourd, sponge gourd, bitter gourd, pumpkin, pointed gourd, ash gourd, ribbed gourd, string beans, sword bean, stem amaranth, Indian spinach, plantain, aroids, moringa and brinjal are the rich sources of minerals, vitamins and essential amino acids. These vegetables can play an important role in alleviating the poor nutritional status of human beings in Bangladesh. Rai *et al*., (2008) studied in Indian cucurbitaceous vegetables to improve productivity on sustainable basis through developing biotic and abiotic resistant variety/hybrids coupled with quality attributes. They reported that the yield potential of cucurbits could be increased by adopting the standardized agro-techniques and plant protection measures. BARI (2002) reported that cooperative farmer could effectively utilize the rooftop of the homestead for creeper vegetable, which was previously remained either unutilized or underutilized. The annual production of the vegetables of all the cooperative farmers in the homestead increased tremendously after intervention. Increased production of vegetables leads to better consumption in the family and economic return.

2.8 Livelihood improvement through vegetable production in homestead

Homestead vegetable farming can play an important role in reducing poverty by providing food, cash income, and employment opportunities for the rural poor people. They can utilize their time, energy, and efforts for productive work and earn additional income, which makes them independent. It is appropriate for improving livelihoods for the rural poor people. Shafique and Hossain (2002) conducted a study in High Barind area on farmers participatory integrated rice based farming for improved livelihood for resource-poor farm household. They reported that after interventions of modern technologies, resource mobilization, and participation, family labour utilization were increased and that is why net income as well as food habit was improved remarkably.

Islam *et al*. (2003) reported that homestead vegetable gardening may be a first investment for a livelihood weapon to increase their income and minimizing poverty. Therefore, the poor could be helped if they undertake some income earning activities

like homestead vegetable garden. He also found that the poor will gradually move away from dependent to self-sustained livelihood activities. In this way, vegetable farming can bring the social well-being for the rural people.

CHAPTER 3

MATERIALS AND METHODS

3.1 Experimental Site

3.1.1 Location

The experiment was conducted in Barind tract of Naogoan Sadar upazila under Naogoan district and Paba upazila under Rajshahi district. The experimental site belongs to the Agro-Ecological Zone 25 and 26 (UNDP and FAO, 1988). Map of study area shown in Figure. 1 and 2

3.1.2 Soil

The soil belongs to the Amnura and Sonatola soil series of dark grey soil of the Barind tract. The soil of the experimental field was more acidic than normal in reaction with low in organic matter content (1.1-1.7) and its general fertility level was also low (SRDI, 2020).

3.1.3 Climate

The experimental area is located in the northern part of Bangladesh with low rainfall and high temperature compared to the other regions of the country. The monthly average rainfall (108 mm), temperature (21.17^0C as minimum and 32.23^0C as maximum) and relative humidity (73.2 %) were recorded at Barind Tract of Rajshahi. The mean annual rainfall of the experimental area is about 1200 ± 300 and five months from May through September receives maximum rainfall (BMD, 2020).

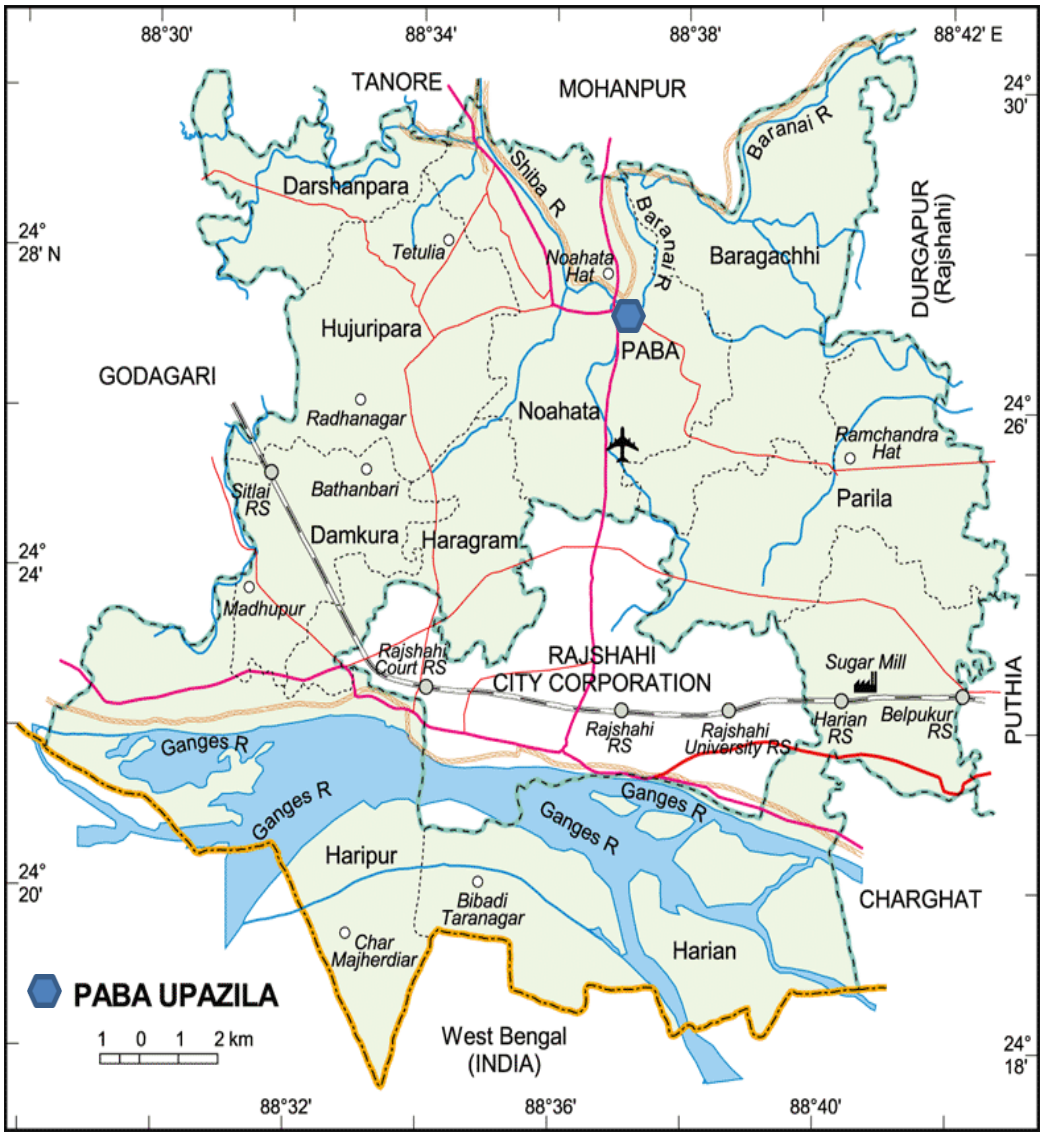

Figure.1 Map of Paba upazila of Rajsahi district

Source : Wikipedia

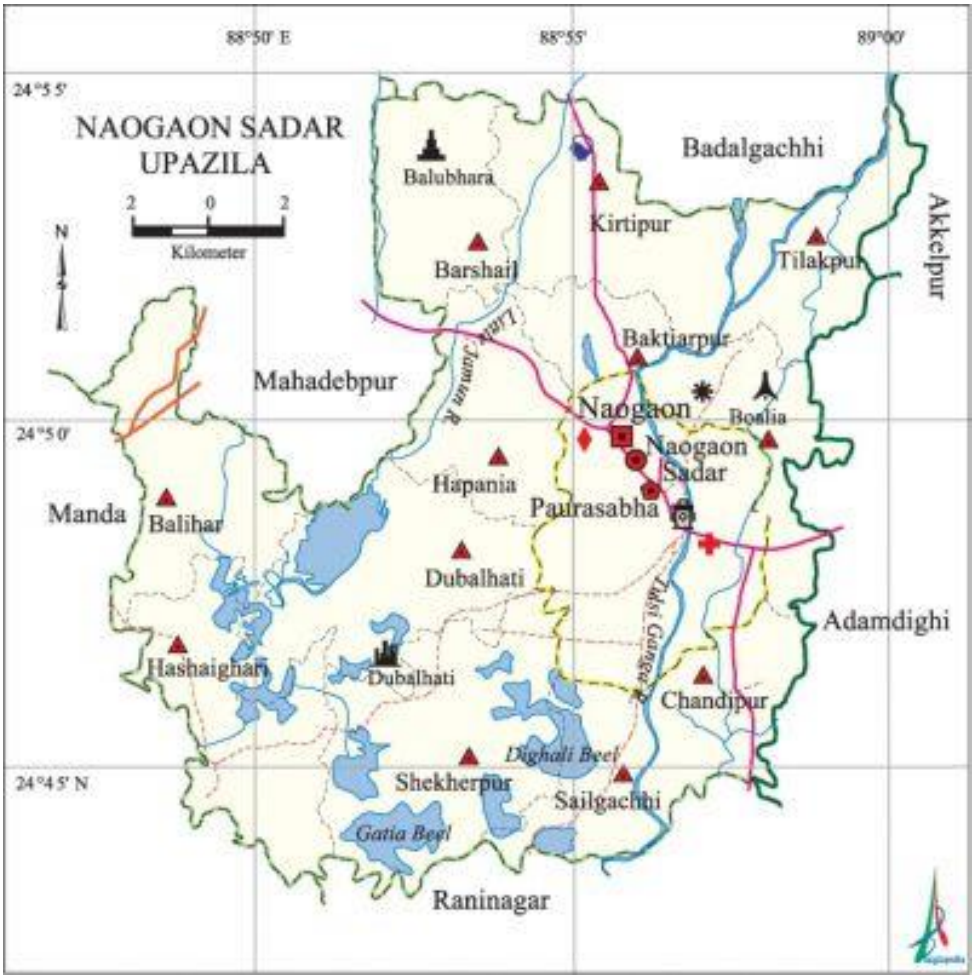

Figure.2 Map of Naogoan sadar upazila of Naogaon district

Source : Wikipedia

3.2 Study procedure

3.2.1 Selection of the study area

The study was conducted in Naogaon Sadar upazila under Naogaon district and Paba upazila under Rajshahi district. These upazilas were selected purposively for data collection on climbing vegetables production. These two upazilas were under two distinct tracts namely Terrace Barind (plate 1) and Level Barind (plate 2).

Level Barind (8 sq km): This region is developed over MADHUPUR CLAY. The landscape is almost level. The predominant soils have a grey, silty, puddled topsoil with ploughpan. Shallow grey terrace soil and deep grey terrace soils are the major components of general soil types of the area. The soils are low in available moisture holding capacity and slightly acidic to acidic in reaction. Organic matter status is very low and most of the available nutrients are limiting.

Terrace Barind (1,079 sq km): This region occupies several discontinuous areas on the north-eastern margins of the Barind Tract. It has silty or loamy topsoil and clay loams to clay subsoil. The soils are strongly acidic in reaction. Organic matter in the soils is low. General fertility is poor.

After a short visit and discussion with local people, two unions namely Chandipur and Haragram under Naogaon and Rajshahi district, respectively, were selected as study areas. Among other things, the following considerations were kept in mind during selection of the study area:

i) Production intensity of climbing vegetables
ii) No systematic study on this aspect had yet been conducted and
iii) Good co-operation from the respondents in view of getting reliable information

Plate 1.Terace Barind tract

Plate 2. Level Barind

3.2.2 Sampling technique

For the sake of convenience and cost effectiveness of time and money, a simple random sampling technique was followed. Sixty (60) respondents were randomly selected for the study, of which 30 homesteads from Paba upazila and 30 homesteads from Naogoan sadar upazila. A structured questionnaire was used to collect information on climbing vegetables production from the selected respondents. People who permanently reside in the selected villages constituted the active population of this study. As all population of the study area cannot measure, head of the farm families of one village named Chandipur under Chandipur union in Naogaon district and one village named Haragram under Haragram union in Rajshahi district was the population of the present study. However, representative sample from the population were taken for collection of data following random sampling technique. Chandipur village from Chandipur union and Haragram village from Haragram union were selected randomly. One farmer (who mainly operated the farming activities of the family) from each of the farm families was considered as the respondent. An updated list of all farm family heads of the selected villages was prepared with the help of SAAO and local leader. The list comprised of a total 653 farm families in the study area (317 farm families from Chandipur village and 336 farm families from Haragram village). About 200 respondents from each village were selected primarily for data collection on the basis of their cultivation practices. These 400 rural families constituted the population of this study. Fifteen percent (15%) of the farm families of these villages were randomly selected as representative sample by using a Table of Random Numbers (Kerlinger, 1973). Thus, 60 farm family head constituted the sample of the study for questionnaire survey. Final selection of respondents in the study area has been done by using (Yamane, 1967) formula:

$$n = N / \{1 + N (e^2)\}$$

Where, n = Sampling size

N = Population

e = Error of precision

Further ten respondents were selected randomly from the population except the sample included in the reserved list, which were interviewed when the respondent in the original sample list were not available at the time of interview. Sample data collection in the study area are presented in Plate 3. A detailed structure of population

and sample has been presented in the Table 3.1.

Table 3.1. Distribution of population and sample size in two selected upazila under two district (Naogaon and Rajshahi)

Village	Union	Upazila	District	No. of total households	No. of households primary selected	No. of households finally selected for data collection	Reserve list
Chandipur	Chandipur	Naogaon Sadar	Naogaon	317	200	30	5
Haragram	Haragram	Paba	Rajshahi	336	200	30	5
Total				653	400	60	10

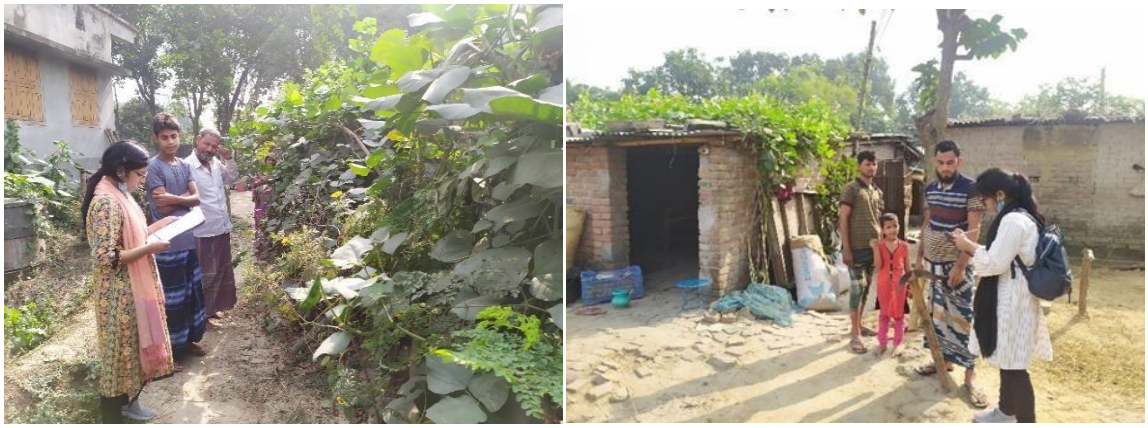

Plate 3. Information collection through questionnaire

3.2.3 Preparation of the questionnaire

As per the objectives of the study, a questionnaire was prepared for collecting the desired data. On the basis of the pretest of the schedule, necessary modifications, additions and alterations were made to improve the validity and applicability of the questionnaire. The questionnaire is presented in Appendix 1(English version).

3.2.4 Method of data collection

The information as collected during the period from October 2019 to February 2020.The data was gathered using the direct interview approach. Before beginning the actual interview, each farmer was given a brief overview of the study's goals and objectives. When they were satisfied that the investigation was strictly academic and had no ulterior motives, they offered the researcher their complete assistance. The

questionnaire was examined and confirmed after each interview to ensure that the responses were correct. To reduce inaccuracies, data was gathered in local units before transformed to standard ones.

3.2.5 Secondary data

Secondary data were collected from different sources. Data and information were collected from Bangladesh Bureau of Statistics (BBS), District and Upazila Agricultural Extension Office, Department of Forest and Environment, previous researches and survey reports.

3.2.6 Analytic technique

The collected data were summarized and scrutinized carefully and analyzed usingcomputer software packages MS Excel 2010.

Standard deviation of the population was calculated by using the following formula:

$$\text{Standard deviation} = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

Where, N= the size of the population

x_i = each value from the population

μ = the population mean

Plant density was calculated by using the following formula (Winkelmann, 1996):

$$\text{Plant density} = \frac{Mean\ of\ homestead\ size}{Mean\ of\ tree\ area}$$

Relative prevalence (RP) of species was calculated by using the following formula:
RP = Population of the species per homestead × % of homesteads with that species (Winkelmann, 1996).

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Demographic characteristics

4.1.1 Age

The climbing vegetable growers were classified into three age groups such as 18-35, 36- 50 and above 50 years. Distribution of the respondents according to age groups is shown in (Table 4.1). The result showed that the highest percentage of climbing vegetable growers were in middle age group (36-50 years) which was 60%. The second highest of the respondents 30% in the old age group followed by young age group 10% in Level Barind study area. The average age and standard deviation were 44.30±11.75. On the other hand, in Terrace Barind 40% of the respondents were in the middle age group followed by old and young age group 30%. The average age and standard deviation was 47.36±8.11. However, the mean of both the areas showed that most of the respondents (50%) were in the middle age group followed by old age (30%) and young age (20%) group. Age is one of the most vital factors concerning to one's livelihood. The result of the present study for both level Barind and Terrace Barind indicated that the middle age group farmers are the most important part of the study area regarding climbing vegetable production systems which might be the cause of experience with modern technical knowledge compared to other age group farmers. This seems logical because heads of the farm families were selected as respondent. With the increase in age they find few alternatives for livelihood except farming activities in parents' farm thus become committed in agricultural activities. This lead to understanding that household food safety would reflected more by the middle-aged group in the present study. Shabuj *et al*. (2010) also found similar scenario regarding the present study and found the highest proportion of the farmers (59%) in the middle age group compared to 12% in old age and 29% in young age category in terms of homestead agroforestry systems practiced by the farmers of Natore district.

Table 4.1 Age of the respondents of the study areas of Level Barind and Terrace Barind

Age group	Respondents (%)		
	Level Barind	**Terrace Barind**	**Mean**
Young age (18-35 years)	10.0	30.0	20.0
Middle age (36-50 years)	**60.0**	**40.0**	50.0
Old age (>50 years)	30.0	30.0	30.0
Age Range	20-63	28-65	20-65
Average age ± SD	44.30 ± 11.75	47.36 ± 8.11	45.83 ± 9.93

4.1.2 Education

Literacy makes a man more capable in managing scarce resources and improving management efficiency in crop production (Miah and Hussain, 2004). The educated farmers had better access to the relevant technical information, so the adoption of modern technology depends on education levels of the farmers. The levels of education of the respondents in this study are shown in table 4.2. Based on the collected information, education level of the sample farmers was categorized into four group's namely illiterate, primary level, secondary level and above secondary levels. It appears from table 4.2 that the highest proportion 40% of the respondents were primary education, while 36.7% and 20% of the respondents had illiterate and secondary levels of education, respectively in Level Barind. In case of Terrace Barind, the highest proportion 40% of the respondents had no formal education followed by primary level 30%, secondary level education 23.3% and above secondary level 6.7%. However, on an average, 38.35% of the respondents had no formal education, while 35% and 21.65% of the respondents had primary level and secondary level education, respectively in both the study areas. Moreover, a small proportion of the respondents (5.0%) had higher level education in of both Level Barind and Terrace Barinds location. People that have a higher education are more likely to express their positive attitudes towards healthy and environmental save product, and they also require more information about the production process and method through reading leaflets, booklets, books and other printed materials in this case. Education helps the farmers to expand their outlook and spread out mental horizon by helping them to develop favorable attitude, correct perception and knowledge about production technology and

postharvest practices. Comparatively educated person is relatively more responsive to the technology and new innovation. The findings of this study, however, indicate that above 70% of the farmers were illiterate to primary level of education which is supposed to face a great difficulty in producing vegetables regarding proper technical knowledge. Such consideration indicates the need for improving literacy level among the farmers for practicing desired vegetable production. Although near about 27% farmers had secondary to higher secondary education level but they are engaged in production of rice and wheat in order to maintain food security. So, motivational program should be arranged to make farmers' attention to produce vegetables in homestead garden. Similar findings was also observed by Shabuj *et al*. (2010) in Natore district Bangladesh and reported 32% of the farmers had secondary level education whereas 18% of them were illiterate, 8% of them were primary level and 42% was higher secondary level education.

Table 4.2 Education level of the respondents of the study areas of Level Barind and Terrace Barind

Education level	Respondents (%)		
	Level Barind	**Terrace Barind**	**Mean**
Illiterate (No schooling)	36.7	**40.0**	38.35
Primary (Class I - V)	**40.0**	30.0	35.0
Secondary (Class VI - S.S.C)	20.0	23.3	21.65
Above secondary (H.S.C and above)	3.3	6.7	5.0
Average	3.06±3.79	4.76±4.33	3.91±4.06

4.1.3 Occupation

The study revealed that agriculture was the main occupation of the studied farmers at both Level Barind (40%) and Terrace Barind (50%) (Table 4.3). Small amount of the respondents was engaged in service at Terrace Barind. However, on an average, most of the respondents (45%) depended on agriculture singly for their livelihood, which was followed by agriculture plus business (30%), agriculture plus service (11.65%)

and only 5% was in service. Occupation of a farmer is vital issue to survive their livelihood. It refers to the total income earned by all the members of the respondent's household from all activities in a calendar year. Bartol and Martin (1998) reported that occupation is a socio-demographic variable which could influence entrepreneurs' education, age, work history, relative experience, childhood family environment etc. Homesteads include vegetables gardening, livestock rearing, poultry raising, fish culture, homestead forestry, post-harvest processing and alike activities done by farmers as their occupations considered as sources of family income. The actual area of homestead devoted to vegetable cultivation is very small. Hussain *et al*. (1988) reported that about 13% of the total homestead area was under vegetable production and here agriculture was considered as their basic occupation.

Table 4.3 Occupation of the respondents of the study areas of Level Barind and Terrace Barind

Occupation	Respondents (%)		
	Level Barind	**Terrace Barind**	**Mean**
Agriculture	**40.0**	**50.0**	45.0
Business	6.7	10.0	8.35
Agriculture plus business	36.7	23.3	30.0
Agriculture plus service	10.0	13.3	11.65
Only service	6.7	3.3	5.0

4.1.4 Family size

On the basis of number of family members, respondent families were categorized into three groups i.e., small, medium and large. The study revealed that small family size was the common feature of the selected respondents in both the study areas. About one-half of the respondents (50 %) had medium families, which was followed by small (33.3 %) and large (16.70 %) sized families in Level Barind. Similarly, in Terrace Barind, mostof the respondents (46.7 %) had medium families followed by small (33.3 %) and large families (20 %) (Table4.4). There are about 18-20 million families in Bangladesh, most of them live in rural areas having a homestead for each. Their homesteads are the most effective and common production units for supplying

food, fuel, timber, and other family needs and employing family labours (Khan *et al*., 2009). Shabuj *et al*. (2010) conducted a study on homestead agroforestry systems practiced by the farmers of Natore district and reported that the family size scores of the farmers ranged from 2-12 with an average of 5.27 in the study area. Most of farmers (45%) had medium families compared to 33% small and 22% large families. Under the present study, the highest farmers constitute medium family in the study area.

Table 4.4 Family size of the respondents in the study areas of Level Barind and Terrace Barind

Family size	Respondents (%)		
	Level Barind	**Terrace Barind**	**Mean**
Small family (<5 members)	33.3	33.3	33.3
Medium family (5 - 6 members)	**50.0**	**46.7**	48.35
Large family (>6 members)	16.7	20.0	18.35
Mean ± SD	4.8 ± 1.49	5.2 ± 1.44	5.0 ± 1.46

4.1.5 Farm size categories

The findings of the study indicated that in Level Barind about one-half (50 %) of the respondents were in the landless farm category followed by small (33.3 %) and medium (16.7 %) farm categories, while none of respondents were in the large farm category. On the other hand, in Terrace Barind, about one-half of the respondents (56.7 %) were in the landless farm category followed by small (26.7 %), medium (13.3 %), and large (3.3 %) farm categories. The findings indicated that overwhelming majority (>80%) of the farmers were under landless to small farm size categories. Actually farm size is the main production unit to produce vegetables. Size of the farm is highly related with achieving crop production (Ali *et al*., 2009). It contributes to gross and net income. Most of the people of Bangladesh inhabit in the rural areas and majority of them have small income from small operational land. Many of them in rural area are without sufficient skill and knowledge on vegetable production. This is a great indulgence for achieving desired production (Khan *et al*., 2009). Therefore government extension agencies and NGO's should pay attention to take steps for landless and small farm holders on the priority basis. The extension

agencies will not able to give them land but can easily train them up for modern agricultural technology related to higher production.

Table 4.5. Farm category of the respondents of the study areas of Level Barind and Terrace Barind

Farm category	Respondents (%)		
	Level Barind	**Terrace Barind**	**Mean**
Landless (Homestead + <0.02 ha cultivated land)	**50.0**	**56.7**	53.35
Small (0.02 – 1.0 ha land)	33.3	26.7	30.0
Medium (>1.0 – 3.0 ha land)	16.7	13.3	15.0
Large (>3.0 ha land)	-	3.3	1.65
Mean ± SDs	0.94 ± 0.83	0.87 ± 0.71	0.91 ± 1.54

4.1.6 Homestead resources

Livestock, ponds, trees and houses are the valuable resources of the farmers. It was observed that none of the respondents had all assets like livestock (cows, goats), poultry (hen and ducks), trees, ponds and houses, in both the Level Barind and Terrace Barind (Table 4.6). All the respondents planted trees and the average number of trees per house hold was 47 and 49 in Level Barind and Terrace Barind, respectively. The price of the resources per respondent farmer is shown in (Table 4.6). The table also indicates that all respondents had house even landless farmers. Generally a homestead of a farmer comprise vegetables cultivation, poultry and livestock production, fish pond, homestead trees, post-harvest activities of crops etc. The actual area of homestead devoted to such activities is very small (Khan *et al*., 2009). Small farmers have some crop field. Usually they are to maintain their livelihood by utilizing the homestead resources. However, many small homestead areas of Bangladesh remain unutilized, which could be brought under round the year vegetable cultivation and other farming operation for reducing economic problems (Hussain *et al*., 1988; Khan *et al*., 2009).

Table 4.6 Homestead resources of the respondents of the study areas of Level Barind and Terrace Barind

Homestead Resources		Level Barind			Terrace Barind			Mean		
		% RF*	Average number of resource per RF	Total price of resource (Tk) per RF	% RF	Average number of resource per RF	Total price of resource (Tk) per RF	% RF	Average number of resource per RF	Total price of resource (Tk) per RF
Live stock	Cows	76.7	2.3	99758	76.7	2.4	109574	76.7	2.4	104666
	Goats	53.3	3.1	31956	53.3	3.4	39428	53.3	3.3	35692
Poultry (Hen and ducks)		93.3	21	9515	96.7	22	9411	95.0	21.5	9463
Trees		**100.0**	47	124582	**100.0**	49	102840	100.0	48.0	113711
Ponds		40.0	1	85778	46.7	1	94955	43.3	1.0	90367
House (Sleeping bed room, kitchen, cow-shed, etc)		**100.0**	3.2	160690	**100.0**	3.6	160350	100.0	3.4	160520
Total				512279			516558			514418.5

*RF= Respondents Farmers

In the study area, year-round vegetable production and proper utilization of other resources in the homesteads to improve the household food security and nutrition of poor farm family through increased intake of home-grown vegetables, meat, milk, fish, fruits etc. to generate additional income for farmers by selling surplus vegetables and other homestead products (cow, goat, hen, fish, fruits etc.) to create employment opportunity and to solve economic solvency for the family.

4.2 Structure and characteristics of tree species in the homestead area

4.2.1 Age of homestead settlement

Age of homestead settlement is an important factor in determining the different plant resources like trees and vegetables. The homesteads were categorized into up to 10, 11- 25 and above 25 years old. In Level Barind study area, 53.3% of the respondents established the homesteads 11-25 years ago followed by 36.7% of the respondents above 25 years old, while home land in Terrace Barind, 53.3% of the respondents established their homesteads 11-25 years ago followed by 26.7% for above 25 years old (Table 4.7). Homesteads within 10 years of age were 10% and 20% in Level Barind and Terrace Barind, respectively where average of the areas; we found 15% of the respondents established their homestead within 10 years followed by 31.7% for above 25 years and 53.35% for 11-25 years.

Table 4.7 Age of the sampled homestead of the study areas of Level Barind and Terrace Barind

Age of homestead settlement	Respondents (%)		
	Level Barind	**Terrace Barind**	**Mean**
Up to 10 years	10.0	20.0	15.0
11 - 25 years	**53.3**	**53.3**	53.3
>25 years	36.7	26.7	31.7
Mean ± SD	14.67 ± 7.38	18.86 ± 9.92	16.76 ± 8.65

4.2.2 Trees density

In the study area of Level Barind, the highest tree density was found in the small farmers (15.1) and the lowest in medium farmers (9.60). The highest tree density was found in landless farmer (8.7) and the lowest in small farmer (4.1) in Terrace Barind. Overall the number of plant species of homestead decreased gradually from landless farmer (9.6) to large farmer (3.00). On the other hand, the average number of trees per homestead decreased gradually from landless or small to large farmers in the study areas. It indicates that farmers with limited land, attempted to maximize output through planting of trees at closer spacing.

Table 4.8 Average homestead size and tree densities in different farm categories of the study areas of Level Barindand Terrace Barid

Farm category	Level Barind			Terrace Barind			Mean		
	Mean homestead size (dc.)*	Mean of tree area (dc.)	Tree density	Mean homestead size (dc.)	Mean of tree area (dc.)	Tree density	Mean homestead size (dc.)	Mean of tree area (dc.)	Tree density
Land less	10.0	1	10.0	11.3	1.3	**8.7**	10.6	1.14	9.3
Small	18.2	1.21	**15.1**	21.8	5.32	4.1	20.0	2.08	9.6
Medium	42.3	4.41	9.6	44.3	6.15	7.2	43.3	5.15	8.4
Large	0.0	0.0	0.0	47.3	7.88	6.0	47.3	15.77	3.0
Mean	17.6	1.65	8.7	31.2	5.16	6.5	30.3	6.035	7.6

*dc. = decimal

4.2.3 Relative prevalence (RP) of tree species

A total of 47 plant species was identified in the surveyed homesteads. The relative prevalence of the tree species has shown in (Table 4.9).

4.2.3.1 Fruit species

In Level Barind, mango (9.72) and jackfruit (5.80) were two most prevalent fruit species followed by betelnut (1.22), guava (0.69) and coconut (0.62). In the study area of Terrace Barind, the most prevalent fruit species was mango (7.73) followed by

guava (2.60), jackfruit and palmyra palm (0.60), while carambola (0.003), wood apple (0.011), hog plum (0.012) occurred scantily. Prevalence of mango (8.70) and jackfruit (2.74) species was found irrespective of study areas. The dominance of mango species in the study areas was probably due to the ecological and socio-economic advantages.

4.2.3.2 Timber species

In terms of timber species, eucalyptus (3.25) was the most common, followed by mahogany (1.0) and goraneem (0.59); teak (0.001), Kadam (0.022), and akashmoni were the least common (0.026). In Terrace Barind, on the other hand, the most common timber species were babla (1.51), sissoo (0.60), and mahogany (0.58), with eucalyptus (0.001) and pitali (0.001) being the least common (0.003). The main timber species in the average of two sites was eucalyptus (0.90), followed by mahogany (0.79).

4.2.3.3 Medicinal species

In the Level Barind site, drumstick (0.14) was the most common medicinal species followed by neem (0.12). In Terrace Barind site, neem (1.67) was the most common medicinal tree species followed by white murdah (0.05), khoir (0.05) and drum stick (0.03). In case of mean Relative Prevalence (RP) regarding medicinal species, neem (0.70) was the most common medicinal tree species followed by drum stick (0.074).

4.2.3.4 Fuel wood Species

In Level Barind, the most common fuel wood species was jiga (0.58) followed by red silk cotton (0.08), while in Terrace Barind, the most common fuel wood species was ipil ipil (1.10) followed by jiga (0.034). In case of mean Relative Prevalence (RP) regarding fuel wood species, ipil ipil (0.32) was the most common fuel wood tree species followed by jiga (0.22).

4.2.3.5 Aesthetic Species

In Level Barind, two plant species, banyan (0.022) and indian privet (0.014) was identified, while in Terrace Barind, only banyan (0.001) plant species was found.

Table 4.9 Relative prevalence of tree species in the study areas of Level Barind and Terrace Barind

Common Name/ English Name	Local Name	Botanical Name	Relative Prevalence (RP)		
			Level Barind	Terrace Barind	Mean
Fruit Species					
Mango	Aam	*Mangifera indica*	9.72	7.73	8.70
Jackfruit	Kathal	*Artocarpus heterophyllus*	5.80	0.60	2.74
Guava	Peara	*Psidium guajava*	0.69	2.60	1.57
Coconut	Narikel	*Cocos nucifera*	0.62	0.24	0.41
Betelnut	Supari	*Areca catechu*	1.22	-	0.31
Palmyra palm	Tal	*Borassus flabellifer*	0.08	0.60	0.28
Papaya	Papay	*Carica papaya*	0.35	0.154	0.24
Jujube	Boroi/Kul	*Zizyphus jujuba*	0.26	0.16	0.21
Lemon	Lebu	*Citrus spp.*	0.04	0.30	0.15
Olive	Jalpai	*Elacocarpusfloribundus*	0.38	-	0.095
Banana	Kola	*Musa spp.*	-	0.33	0.083
Litchi	Litcho	*Litchi chinensis*	0.07	0.017	0.04
Pomegranate	Dalim/Bedana	*Punica granatum*	0.014	0.052	0.031
Date palm	Khejur	*Phoenix sylvestris*	0.006	0.048	0.03
Indian alamond	Badami (Kat)	*Terminalia catappa*	0.08	-	0.02
Wood apple	Bel	*Aegle marmelos*	0.03	0.011	0.02
Indian black berry	Jam (Kalo)	*Syzygium cumini*	0.02	0.014	0.017
Hog plum	Amra	*Spondias mangifera*	0.02	0.012	0.013
Carambola	Kamranga	*Averrhoa carambola*	0.01	0.003	0.006
Indian dillenia	Chalta	*Dillenia indica*	0.004	-	0.001
Bullock's heart	Ataphal	*Annona reticulata*	0.01	-	0.001
Tamarind	Tetul	*Tamarindus indica*	0.008	0.016	0.001
River ebony	Gab (Deshi)	*Diospyros peregrina*	0.004	-	0.001

Table 4.9 (Cont'd)					
Common Name/ English Name	**Local Name**	**Botanical Name**	**Relative Prevalence (RP)**		
			Level Barind	**Terrace Barind**	**Mean**
Timber Species					
Eucalyptus	Eucalyptus	*Eucalyptus camaldulensis*	3.25	0.001	0.90
Mahogony	Mahogony	*Swietenia mahogoni*	1.00	0.58	0.79
Sissoo	Sissoo	*Dalbergia sissoo*	0.31	0.60	0.45
Black babool	Babla	*Acacia nilotica*	-	1.51	0.38
Black siris	Kalo Koroi	*Albizzia lebbeck*	0.32	0.27	0.29
Goraneem	Bokain	*Melia azedarach*	0.59	-	0.15
Pithraj	Pithraj	*Aphanomixis polystachya*	0.12	-	0.03
Akashmoni	Akashmoni	*Acacia auriculiformis*	0.026	-	0.007
Kadam	Kadam	*Anthocephalus sinensis*	0.022	-	0.005
Pitali	Pitali	*Trewia nudiflora*	-	0.003	0.001
Teak	Segun	*Tectona grandis*	0.001	-	0.0002
Medicinal Species					
Neem	Neem	*Azadirechta indica*	0.12	1.67	0.70
Drum stick	Sajna	*Moringa oleifera*	0.14	0.03	0.074
White murdah	Arjun	*Terminalia arjuna*	-	0.05	0.012
Khoir	Khoir	*Acacia catechu*	-	0.05	0.011
Sandal	Chandan	*Santalum album*	0.012	-	0.003
Chebulic myrobalam	Hartaki	*Terminalia chebula*	-	0.01	0.002
Fuel wood Species					
Ipil ipil	Ipil ipil	*Leucaena leucocephala*	0.003	1.10	0.32
Jiga	Jiga	*Odina wodier*	0.58	0.034	0.22
Red silk cotton	Simul	*Bombax ceiba*	0.08	0.014	0.041
Khaiksha	Khaiksha	*Trewia sp.*	-	0.043	0.011
Fig	Dumur	*Ficus carica*	-	0.003	0.001
Aesthetic Species					
Banyan	Bat	*Ficus bengalensis*	0.022	0.001	0.007
Indian privet	Mehedi	*Lawsonia inermis*	0.014	-	0.004

4.3 Homestead vegetable production systems

4.3.1 Support for vegetable production

The investigation revealed that respondents used to grow different climbing vegetables on three types of support systems i.e., on trellises, roof tops and trees (Table 4.10). In Level Barind study area, most of the respondents cultivated climbing vegetables on trellises (60%) followed by roof tops (30.0 %) and trees (10 %). In Terrace Barind, the highest number of the farmers cultivated climbing vegetables on trellises (46.7%) and roof tops (40%), while 13.3 % of the farmers cultivated these vegetables on trees. Overall most of the farmers (53.4 %) cultivated vegetables on trellises followed by on roof tops (35 %) and on trees (11.7 %).

Table 4.10 Support systems for vegetable production in Level Barind and Terrace Barind

Vegetable production	% of respondent		
	Level Barind	Terrace Barind	Mean
Trellises	**60**	**46.7**	53.4
Roof tops	30	40	35.0
Trees	10	13.3	11.7

4.3.2 Profitability of vegetable production on different support systems

For climbing vegetables production, cost and return per unit area per homestead are shown in Table 4.11 and Table 4.12.

In summer season, white gourd with trellises support system gave highest yield 95 kg/dec and 142 kg/dec respectively at level barind and terrace barind. In case of winter season, bottle gourd with trellises support system gave highest yield 116 kg/dec and 168 kg/dec respectively at level barind and terrace barind (Table 4.11).

In the Level Barind area, sweet gourd (Tk. 1377 and 767) with trellises support systems yielded the highest gross and net returns, followed by county bean (Tk. 1006 and 760), bottle gourd (Tk. 812 and 580), and white gourd (Tk. 570 and 380). Respondents, on the other hand, benefited the most from country beans (Tk. 760 and 578) (Table 4.12).

On the basis of gross and net returns, respondents in the Terrace Barind study area benefited the most from county bean (Tk. 1813.5 and 1009.3, respectively) with the trellis support system, followed by sweet gourd (Tk. 1770.5 and 1008.3) (Table 4.12). Using the same support systems, few farmers got desired benefit from pointed gourd, teasel gourd and cucumber. In case of roof tops, the respondents got the highest benefit from seam followed by sweet gourd and white gourd but on the trees support system, farmers got the highest benefit from seam followed by sweet gourd and ribbed gourd.

Table 4.11 Vegetables production under climbing support system in the homestead

Season of production	Vegetable	Support system	Level Barind			Terrace Barind			Mean		
			% RFVP	Area for production (dec)	Amount (kg/dec)	% RFVP	Area for production (m^2)	Amount (kg/dec)	% RFVP	Area for production (m^2)	Amount (kg/dec)
Summer	White gourd	Trellises	40.0	41	**95**	50.0	47	**142**	45.0	44.2	**118.4**
		Roof tops	13.3	68	53	53.3	63	92	33.3	65.7	72.8
		Trees	10.0	12	64	36.7	34	74	23.3	22.9	69.0
	Ridge gourd	Trellises	13.3	44	31	26.7	58	45	20.0	51.1	37.7
		Roof tops	0.0	0	0	13.3	96	31	6.7	47.9	15.4
		Trees	13.3	21	33	13.3	24	37	13.3	22.7	35.0
	Sponge gourd	Trellises	6.7	32	45	26.7	47	49	16.7	39.6	47.1
		Roof tops	3.3	12	32	30.0	53	37	16.7	32.3	34.5
		Trees	6.7	60	14	16.7	58	39	11.7	59.0	26.3
	Teasel gourd	Trellises	6.7	27	14	6.7	101	54	6.7	64.1	34.0
		Roof tops	13.3	54	14	0.0	0	0	6.7	26.9	7.0
		Trees	0.0	0	0	0.0	0	0	0.0	0.0	0.0
	Pointed gourd	Trellises	0.0	0	0	30.0	8	83	15.0	4.1	41.6
	Bitter gourd	Trellises	10.0	21	55	13.3	22	59	11.7	21.3	56.8
	Cucumber	Trellises	10.0	12	41	16.7	27	43	13.3	19.5	42.1
	Snake gourd	Trees	0.0	0	0	16.7	11	45	8.3	5.4	22.3

* % RFVP= % Respondent farmers with vegetable production

Table 4.11 (Cont'd)

Season of production	Vegetable	Support system	Level Barind			Terrace Barind			Mean		
			% RFVP	Area for production (dec)	Amount (kg/dec)	% RFVP	Area for production (m^2)	Amount (kg/dec)	% RFVP	Area for production (m^2)	Amount (kg/dec)
Winter	Bottle gourd	Trellises	83.3	41	**116**	70.0	53	**168**	76.7	46.9	**142.0**
		Roof tops	40.0	52	97	73.3	63	83	56.7	57.8	89.9
		Trees	6.7	32	42	20.0	47	52	13.3	39.4	47.2
	Country bean	Trellises	73.3	38	62	70.0	45	80	71.7	41.2	70.8
		Roof tops	10.0	55	42	30.0	73	57	20.0	64.1	49.5
		Trees	6.7	85	25	16.7	31	52	11.7	58.2	38.8
	Yard long bean	Trellises	10.0	49	17	10.0	32	45	10.0	40.5	30.9
Year round	Sweet gourd	Trellises	56.7	43	**153**	50.0	63	**193**	53.3	53.1	**172.6**
		Roof tops	26.7	49	81	56.7	63	**193**	41.7	56.2	136.9
		Trees	6.7	63	70	30.0	49	91	18.3	55.9	80.4
	Indian spinach	Trellises	10.0	55	60	33.3	59	134	21.7	57.4	97.1
		Roof tops	3.3	54	42	26.7	66	46	15.0	59.9	44.1
		Trees	3.3	27	21	3.3	21	30	3.3	23.9	25.5
	Potato yam	Trees	16.7	35	39	20.0	32	37	18.3	33.6	38.1

* % RFVP= % Respondent farmers with vegetable production

Table 4.12 Net income from homestead vegetable production under unit area (Tk./m^2) in Level Barind and Terrace Barind

Season of production	Vegetable	Support system	Level Barind				Terrace Barind				Mean			
			% RFVP	Gross return (Tk)	Total cost (Tk)	Net return (Tk)	% RFVP	Gross return (Tk)	Total cost (Tk)	Net return (Tk)	% RFVP	Gross return (Tk)	Total cost (Tk)	Net return (Tk)
Summer	White gourd	Trellises	40.0	570	190	380	50.0	994	284	710	45.0	782.0	237.2	544.8
		Roof tops	13.3	318	106	212	53.3	644	184	460	33.3	481.0	145.2	335.8
		Trees	10.0	384	128	256	36.7	518	158	360	23.3	451.0	143.0	308.0
	Ridge gourd	Trellises	13.3	434	123	311	26.7	675	210	465	20.0	554.5	166.6	387.9
		Roof tops	0.0	0	0	0	13.3	465	124	341	6.7	232.5	62.0	170.5
		Trees	13.3	462	132	330	13.3	555	155	400	13.3	508.5	143.5	365.0
	Sponge gourd	Trellises	6.7	630	180	450	26.7	735	196	539	16.7	682.5	188.0	494.5
		Roof tops	3.3	448	128	320	30.0	555	148	407	16.7	501.5	138.0	363.5
		Trees	6.7	196	56	140	16.7	585	156	429	11.7	390.5	106.0	284.5
	Teasel gourd	Trellises	6.7	210	70	140	6.7	810	270	540	6.7	510.0	170.0	340.0
		Roof tops	13.3	210	70	140	0.0	0	0	0	6.7	105.0	35.0	70.0
		Trees	0.0	0	0	0	0.0	0	0	0	0.0	0.0	0.0	0.0
	Pointed gourd	Trellises	0.0	0	0	0	30.0	**1660**	332	**1328**	15.0	830.0	166.0	664.0
	Bitter gourd	Trellises	10.0	**990**	220	**770**	13.3	1180	236	944	11.7	**1085.0**	228.0	**857.0**
	Cucumber	Trellises	10.0	738	164	574	16.7	860	172	688	13.3	799.0	168.0	631.0
	Snake gourd	Trees	0.0	0	0	0	16.7	675	135	540	8.3	337.5	67.5	270.0

* % RFVP= % Respondent farmers with vegetable production

Table 4.12 (Cont'd)

Season of production	Vegetable	Support system	Level Barind				Terrace Barind				Mean			
			% RFVP	Gross return (Tk)	Total cost (Tk)	Net return (Tk)	% RFVP	Gross return(Tk)	Total cost (Tk)	Net return (Tk)	% RFVP	Gross return(Tk)	Total cost (Tk)	Net return (Tk)
Winter	Bottle gourd	Trellis	83.3	**812**	232	**580**	70.0	1822	792	1030	76.7	1317.0	512.2	804.8
		Roof top	40.0	679	193	486	73.3	1385	610	775	56.7	1032.0	401.6	630.4
		Tree	6.7	294	84	210	20.0	955	430	525	13.3	624.5	257.0	367.5
	Country bean	Trellis	73.3	**1006**	246	**760**	70.0	2535	1276	1259	71.7	**1770.5**	761.2	**1009.3**
		Roof top	10.0	746	168	**578**	30.0	1940	1084	856	20.0	1343.0	**626.0**	717.0
		Tree	6.7	425	101	324	16.7	2145	1072	1073	11.7	1285.0	**586.4**	698.6
	Yard long bean	Trellis	10.0	680	168	512	10.0	0	0	0	10.0	340.0	84.0	256.0
Year round	Sweet gourd	Trellis	56.7	**1377**	610	**767**	50.0	2250	1000	1250	53.3	**1813.5**	**805.2**	**1008.3**
		Roof top	26.7	729	325	404	56.7	1700	880	820	41.7	1214.5	602.4	612.1
		Tree	6.7	630	280	350	30.0	1950	880	1070	18.3	1290.0	580.0	710.0
	Indian Spinach	Trellis	10.0	720	181	539	33.3	1944	936	1008	21.7	1332.0	558.3	773.7
		Roof top	3.3	504	126	378	26.7	1136	350	786	15.0	820.0	238.0	582.0
		Tree	3.3	252	63	189	3.3	0	0	0	3.3	126.0	31.5	94.5
	Potato Yam	Tree	16.7	234	118	116	20.0	1044	540	504	18.3	639.0	328.8	310.2

* % RFVP= % Respondent farmers with vegetable production

4.3.3 Competency of support systems

The respondents choose and support vegetable producing strategies based on particular benefits and drawbacks (Table 4.13). The majority of Level Barind respondents (80%) stated that they employed trellises as support systems to raise vegetables due of the high yield, ease of intercultural operation, adequate use of fallow ground, and excellent fruit. Some farmers were interested in utilizing roof tops and tree support systems due to a lack of space and funds. Economic solvency is a vital factor to avail successful crop production. Most of the farmers depend on economic return from his/her homestead production (tree, crop, livestock and occasionally fish) which helps to crop production support system. Monetary return from homestead production helps to provide crop production support system, household food security, employment and income generation opportunity to the million of households (Miah and Hussain, 2004). Generally, low income generating farmers suffers from scarcity of fund related to crop production support system compared to high income generating people (Ahmad, 1999).

It has been found that over the decades, small-scale homestead activities have become the most significant income generating activities of poor households.

Table 4.13 Advantages and disadvantages of vegetable production systems on different support systems as reported by respondents

Support systems	Study area	Respondents (%)	
		Getting Advantages	Getting Disadvantages
On Trees	Level Barind	36.7	**63.3**
	Terrace Barind	**56.7**	43.3
On Roof tops	Level Barind	40.0	**60.0**
	Terrace Barind	**76.7**	23.3
On Trellises	Level Barind	**80.0**	20.0
	Terrace Barind	76.7	**23.3**

4.3.4 Vegetable production in association with trees

In the Level Barind research region, however, 25% (3 out of 12 people) of the respondents produced vegetables in conjunction with bamboo, followed by 17% (2 out of 12 individuals) in conjunction with mango and guava trees. On the other hand, in Terrace Barind, 30 % (8 out of 27 individuals) of the respondents cultivated vegetables in association with *ipil ipil* tree followed by 22 % (6 out of 27 individuals) in association with *kalo koroi* tree and 15 % (4 out of 27 individuals) in association with mango, *babla* and *neem* tree. In some cases, none of the respondents cultivated climbing vegetables in association with trees. Overall in the study areas, respondents cultivated vegetables in association with mango, jackfruit, guava, jujube and *kalo koroi* trees.

Table 4.14 Vegetable production in association with trees in Level Barind and Terrace Barind

Associated trees	Level Barind (Cultivation with 12 respondents)		Terrace Barind (Cultivation with 27 respondents)	
	Percent	Vegetables	Percent	Vegetables
Mango	17(2)	Bean Purple yam	15(4)	Bottle gourd, Bean, sweet gourd, wax gourd
Jackfruit	8(1)	Bottle gourd Sweet bitter gourd	4(1)	Sweet gourd, wax gourd
Guava	17(2)	Indian spinach Bean Sweet bitter gourd	7(2)	Sweet gourd, Bottle gourd
Wood apple	8(1)	Sweet gourd, Bean	4(1)	Bean

Table 4.14 (Cont'd)				
Associated trees	**Level Barind** (Cultivation with 12 respondents)		**Terrace Barind** (Cultivation with 27 respondents)	
	Percent	Vegetables	Percent	Vegetables
Jujube	-	-	11(3)	Purple yam Snake gourd, wax gourd
Palmyra palm	-	-	7(2)	Purple yam
Drumstick	-	-	7(2)	Snake gourd
Indian black berry	8(1)	Sweet gourd	-	-
Kalo Koroi	8(1)	Purple yam	22(6)	Bottle gourd, Wax gourd, Purple yam
Ipil ipil	-	-	30(8)	Sweet gourd, Wax gourd
Babla	-	-	15(4)	Bean, Purple yam
Neem	-	-	15(4)	Bean, Wax gourd
Bamboo	25(3)	Purple yam, Sweet bitter gourd	-	-
Jiga	8(1)	Purple yam	-	-
Eucalyptus	8(1)	Bean	-	-
Goraneem	8(1)	Purple yam	-	-

4.3.5 Disposal pattern of homestead products

The findings of the study indicate that homestead products were used differently i.e., own use, sale, distribution to neighbors and relatives (Table 4.15). In the study areas, most of the respondents (43.3% and 50% in Level Barind and Terrace Barind, respectively) utilized their products for own use + sale whereas 36.7% and 33.3% of the respondents utilized their products as own use alone in Level Barind and Terrace Barind, respectively. In addition, 36.7 and 40% of the respondents utilized their products as own use + sale + distribution to neighbors and relatives, respectively, in Level Barind and Terrace Barind, respectively. From this Table, it might be suggested that the respondents disposed their products as own use + sale as well as for gaining additional benefits.

Table 4.15 Disposed pattern of homestead products in Level Barind and Terrace Barind

Disposed pattern	Respondents (%)		
	Level Barind	Terrace Barind	Mean
Own use	36.7	33.3	35.0
Own use + sale	**43.3**	**50.0**	46.7
Own use + distribution to neighbors + relatives	16.7	10.0	13.3
Own use + Sale + distribution to neighbors + relatives	36.7	40.0	38.3

4.4 Importance of homestead agroforestry systems

4.4.1 Contribution of homestead agroforestry

The study's findings demonstrated that homestead agroforestry has helped households enhance their income and livelihood (Table 4.16). The majority of respondents (93.3%) in the Level Barind study region believed that the homestead agroforestry production system enhanced vegetable productions as a result of greater financial assistance to send children to school (80%). In Terrace Barind, the majority of respondents (93.3%) said that homestead agroforestry production enhanced vegetable

production and increased tree resources (93.3%). Other highlighted contributions in Level Barind and Terrace Barind were improved supplies of timber, fuel wood, and fodder, financial capability for building new housing and sanitary systems, and new work opportunities.

Schreinemachers *et al*., (2015), the Rangpur model of year round production helped enhance food security and access to adequate, safe and nutritious food among the studied farmers of Rangpur region in Bangladesh. It has been reported that year round homestead production help solve food and nutritional problem by increasing household food availability, enabling greater physical, economic and social access, protecting and buffering the household against food shortages.

Table 4.16 Contribution of homestead agroforestry on income and household's livelihood in Level Barind and Terrace Barind

Contributions	Respondents' opinion (%)		
	Level Barind	Terrace Barind	Mean
Increased vegetable production	73.3	90.0	81.7
Increased tree resources	76.7	**93.3**	85.0
Increased supply of timber, fuel wood and fodder	53.3	56.7	55.0
Increased family income	63.3	60.0	61.7
Increased financial capability for making new housing and sanitation systems	36.7	33.3	35.0
Increased financial capacity of sending children to the school	80.0	86.7	83.3
Mitigated malnutrition of family members	**93.3**	90.1	91.7
Created job opportunities	40.0	53.3	46.7

4.5 Problems and suggestion for climbing vegetable production

4.5.1 Problems faced by the farmers

Farmers encountered a variety of issues while cultivating climber type vegetables in their homesteads (Table 4.17). In Level Barind, the majority (60%) of respondents cited lack of knowledge about production technology, cultural operations, and variety selection as important issues, followed by roof damage (40%) and conflicts with neighbors (43.3%). In Terrace Barind, on the other hand, the majority (53.3%) of respondents listed lack of understanding about production technology, cultural operations, and variety selection as the most serious issues, followed by a lack of irrigation water during seedling planting (50%) and lack of good planting materials (46.7%).Other issues raised by the respondent included a lack of room, insect pest damage, and a lack of funds for vegetable cultivation. The problems faced by the respondents of both the study area are similar. Lack of knowledge on production technology, proper cultural operations and variety selection were identified as the major problems for vegetable production in the study areas. Social problem like tenant farmer and lack of motivation hinder the vegetable production (BARI, 1999). Production of crops especially vegetable and fruits may well be the answer to the potential problems of hung and malnutrition in Bangladesh (Ahmad, 1999).

Table 4.17 Problems faced by the respondents during vegetable cultivation in the homesteads of Level Barind and Terrace Barind

Problems	Respondents' opinion (%)		Mean (%)
	Level Barind	Terrace Barind	
Conflict with neighbours	**43.3**	30.0	36.7
Lack of good planting materials	**40.0**	**46.7**	43.4
Unavailability of space	20.0	23.3	21.7
Lack of irrigation water during planting of seedlings	13.3	**50.0**	11.7
Damage by animals	20.0	26.7	23.4
Damage by storm	36.7	40.0	38.4
Damage by insect pest	23.3	26.7	25.0
Lack of knowledge about technology, proper cultural operations and variety selection	**60.0**	**53.3**	56.7
Lack of money due time	20.0	26.7	23.4
Roof tops damage	46.7	40	43.4

4.5.2 Farmers' suggestions to increase vegetables production

The respondents gave their opinions to increase climbing vegetables production. These were mostly supply of quality seeds /seedlings, organizing training program on vegetable production technology such as fertilizer application, irrigation, and dose of pesticide, selection of improved variety and site selection (Table 4.18). However, in Level Barind more than one-half of the respondents (60%) mentioned that planting healthy seed/seedling was more effective to increase vegetable production followed by taking proper management practice (46.7%) and organizing training program in proper time on production practices such as fertilizer application, irrigation, dose of pesticide, selection of improve variety, site selection; and easy access to technology and modern cultivation methods (46.7%). On the other hand, in Terrace Barind, 56.7% of the respondents mentioned that planting healthy seed/seedling and organizing training program in proper time on production practices such as fertilizer application, irrigation, dose of pesticide, selection of improved variety and site selection were more effective to increase vegetables production followed by easy access to technological information on modern cultivation method; ensuring supply of irrigation water in dry period. Shafique and Hossain (2002) reported that adoption of modern technologies, resource mobilization and participation, family labour utilization were increased and net income and food habit was improved remarkably.

Table 4.18 Respondents' suggestions to increase of homestead vegetable production systems in Level Barind and Terrace Barind

Suggestions	Respondents' opinion (%)		Mean (%)
	Level Barind	Terrace Barind	
Easily availability of technological information and modern cultivation methods	43.3	40.0	41.7
Easy loan facilities	36.7	33.3	35.0
Using of fallow land in homestead	33.3	30.0	31.7
Planting healthy of seeds/seedlings/ planting materials	**60.0**	**56.7**	58.4
Taking proper management practices	46.7	46.7	46.7
Availability of getting seedling, fertilizer, pesticide in right time	3.3	3.3	3.3
Ensuring supply of irrigation water in dry period	20.0	16.7	18.4
Organizing training program in proper time on production practices such as fertilizer application, irrigation, dose of pesticide, selection of improve variety, site selection etc.	46.7	43.3	45.0
Influencing of the people by media, TV, Radio etc.	6.7	3.3	5.0
Vegetable production with co- operative systems	6.7	6.7	6.7
Following mixed cropping systems	10.0	10.0	10.0

CHAPTER 5

SUMMARY AND CONCLUSION

Summary

The study was conducted at two areas in Barind Tract *viz*. Level Barind and Terrace Barind. Two villages of two Upazilas were selected from two Agro Ecological Zone (AEZs) in consultation with the officials of Department of Agricultural Extension and Non-government organizations working over there.

The sample climbing vegetable growers were classified into three age groups such as 18 - 35, 36 - 50 and above 50 years. The result showed that middle age group (36 - 50 years) was mostly involved with climbing vegetable production in both Level Barind and Terrace Barind. Considering education level, the highest proportion (40%) of the respondents were primary education, while 36.7% and 20% of the respondents had illiterate and had no formal and secondary levels of education, respectively in Level Barind. In case of Terrace Barind, the highest proportion (40%) of the respondents had no formal education followed by primary level (30%), secondary level education (23.3%) and above secondary level (6.7%). Agriculture was the main occupation of the respondents for their livelihood in both Level Barind (40%) and Terrace Barind (50%) areas. Overall in the study area, most of the respondents (48.35%) had medium families, while 33.3% and 18.35% of the respondents had small and large families, respectively. The findings of the study indicated that in Level Barind about one-half (50 %) of the respondents were in the landless farm category followed by small (33.3%) and medium (16.7%) farm categories. On the other hand, in Terrace Barind, about one-half of the respondents (56.7 %) were in the landless farm category followed by small (26.7%), medium (13.3%), and large (3.3 %) farm categories.

Most of the respondents established their homestead in 53.3% and 53.3% in 11-25 years in Level Barind and Terrace Barind, respectively. Homestead size ranged from 10.0 decimal for landless farmer to 42.3 decimal for medium farmer in Level Barind, while it varied from 11.3 decimal for landless farmer to 47.30 decimal for large farmer in TerraceBarind. Regarding the species abundance, mango (9.72) and jackfruit (5.80) were the most prevalent fruit species in Level Barind whereas in Terrace Barind, the most prevalent fruit species were mango (7.73) and guava (2.60). In case of timber species, the most prevalent timber species was eucalyptus (3.25)

followed by mahogony (1.0), goraneem (0.59) in Level Barind. On the other hand, in Terrace Barind, the most prevalent timber species was *babla* (1.51) followed by sissoo (0.60), and mahogony (0.58). Among those, most of the tree species were fruit species (62.8 %), which was followed by timber (25.5%), fuel wood (7.3%), medicinal (3.5%) and ornamental (0.8%) species in Level Barind study area. In Terrace Barind, 55.1% were fruit species followed by 24.8%, 12.2% and 7.4% of timber, fuel wood and medicinal species, respectively, while only 0.5% was aesthetic species.

Vegetables on roof tops (40 %) and on trellises (46.7 %), while 13.3 % of the farmers cultivated these vegetables on trees. Overall in the study areas, the major climbing vegetables were white gourd; bottle gourd and country bean; and sweet gourd in summer, winter and year round, respectively. Level Barind production of sweet gourd per decimal (153 kg) was the highest rank. On the other hand, in Terrace Barind, production of sweet gourd per decimal (193 kg) was the highest when grown on trellises. The average production of sweet gourd per decimal (172.6 kg) was the highest followed by bottle gourd (142 kg), and white gourd (118.4 kg) on trellises in the study area. Some vegetables such as pointed gourd, sponge gourd, and potato yam were cultivated on only support such as bamboo stick and tree branch. In the study area of the Level Barind, respondents got the highest gross and net returns from sweet gourd (Tk 1377 and 767) with the trellises support systems followed by county bean (Tk 1006 and 760), bottle gourd (Tk 812 and 580) and white gourd (Tk 570 and 380) whereas, respondents got the highest benefit from country bean (Tk 760 and578). Similarly in the study area of Terrace Barind, respondents got the highest benefit from sweet gourd (Tk 1813.5 and 1008.3) with the trellises support system followed by county bean (Tk 1770.5 and 1009.3) on the basis of gross and net return.

In the study areas, most of the respondents (43.3% and 50% in Level Barind and Terrace Barind, respectively) utilized their products for own use + sale. 36.7% and 33.3% of the respondents utilized their products as own use alone in Level Barind and Terrace Barind, respectively. It may be concluded that the respondents utilized their products as own use as well as for gaining additional benefits.

Conclusion

Among different vegetables, growing creeper/climber type vegetables on the climbing support systems such as trellises, roof tops and trees species are the common pictures in the homesteads of those resource poor farmers in Barind area. In the study area, most of the respondents cultivated climbing vegetables on trellises support system (53.4%) followed by on roof tops (35.0%) and on trees support system (11.7%). Because of resource constraints, usually, such poor farmers grow creeper vegetables in association with trees and on the roof tops of houses with the assumption that the association would not affect either of the components or would have little effect on them. Summer climbing vegetables (sweet gourd, white gourd and sponge gourd) and winter climbing vegetables (bottle gourd, country bean and sweet gourd) can be grown on climbing support systems like trellises, roof tops and trees in the homestead area of Barind Tract. This practice helped to increase the homestead vegetable production for contribution to the improvement of livelihood. The farmers with higher livelihood status spend a significant amount of money for productive purpose (land and capital expenditure) reducing food expenditure with a consumption of balanced nutrition. Therefore, the farmers practicing homestead vegetables can increase their per capita return and savings as well as livelihood status having balanced nutrition for a better future.

5.3 Recommendation

In spite of the immense scope and prospects of production of climber vegetables in homestead and livelihood improvement of the farmers in Barind Tract, no systematic research program has so far been undertaken. The following are some from the research aspects that deserve immediate attention.

- Research is needed for better utilization of different supporting system (trellises, roof tops and trees) for better production of climbing type vegetables.
- The research is needed to compatibility of tree-crop association in terms of agronomic and economic performance.
- More studies are necessary with the active participation of the resource poor farm households which ultimately will improve their existing livelihood.
- More research is needed to determine appropriate choice of species and different components of home gardens in Barind Tract of Bangladesh.

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APPENDICES

Appendix 1. Interview schedule used in this study to assess farmer's agro-economic productivity

Department of Agroforestry and environmental science Sher-e-Bangla Agricultural University

Dhaka-1207

An English version interview schedule for "**Study on climber vegetables and their agro-economic productivity in homestead area of Barind tract".**

Serial No. :

Please provide information on the following aspects

Category of interviewer: Landless/Small/Marginal/Large Farmer.

1. Personal information of the respondent:

Name:	Father's name:
Village :	Post Office:
Upazila:	District :

Age of the respondent:

Educational Qualification:

Occupation of the respondent:

Agriculture (1)

Business (2)

Agriculture plus business (3)

Agriculture plus service (4)

only service (5)

5. Family size: How many family member you have?

06. Area of land(Decimal)

Please indicate the area of land under your possession:

i)	Homestead area
ii)	Own land under own cultivation
iii)	Land given to others on *borga*
iv)	Land taken from others on *borga*
v)	Others
Total land:	
Total	

07. Description of homestead property:

Sl no.	**Property**	**Number**	**Approximate Value**
1	**Domestic animal**		
	i) Cow		
	ii) Goat/ Ram		
	iii) Buffalo		
2	**Poultry**		
3	**Tree**		
4	**Pond**		
5	**House (Living house + Kitchen + Cattle house+ Others)**		

8. Description of Tree plantation

1) How old of your homestead? .....Month/year

2) Who is the main responsible for tree plantation? : Husband/wife/Parents/Grandfather/Grandmother/Children (Tick mark)

3) Why do you make plantation in your homestead? For

own/Sale/Both/Security/For shade (Give tick mark)

9. Source of sapling/grafting/seed:

Sl no.	Source	Distance from housetop source	Transporting cost	Which species you collected
i)	Government Nursery			
ii)	Private Nursery			
iii)	NGO Nursery			
iv)	Own production			
v)	Local market			
vi)	Others			

10. Homestead area and their utilization

Sl no	Types	Amount (Decimal)	Total area of land
i)	Home		
ii)			
iii)	Vegetable garden		
iv)	Tree and shrub		
v)	Pond Area of water bodies		
	Area of land		
vi)	Fallow land		
Total			

11. Description of Tree plantation

i) Fruits tree

ii) Wood tree

iii) Medicinal plan

iv) Spices tree

v) Tree like bamboo

vi) Fuel wood and other plants

12. Do you cultivate vegetable under tree? Yes/No

(If yes, then Name different vegetables cultivated under different seasons)

i) Winter vegetable:

ii) Summer vegetable

iii) Year round vegetable

13. In your homestead, which vegetable you cultivate and under which tree

Name of tree	Name of vegetable	Area	Vegetable production (Amount)	Total cost (taka/year)	Total sell (taka/year)

14. Do you cultivate vegetable in tree or upper level of tree? Yes/No If you did than

i) Name winter vegetable:

ii) Name summer vegetable:

iii) Name year round vegetable:

15. Which vegetable you cultivate and with which tree or upper part of tree?

Name of tree	Name of vegetable	Area	Vegetable production (Amount)	Total cost (taka/year)	Total sell (taka/year)

16. i) What are the advantages and disadvantages of vegetable cultivation under tree

Advantages		Disadvantages	
*		*	
*		*	
*		*	
*		*	
*		*	

17. i) what are the advantages and disadvantages of vegetable cultivation at upper level of tree

Advantages		Disadvantages	
*		*	
*		*	
*		*	
*		*	

18. Do you cultivate vegetable in trellis? Yes/No

(If yes, than Name the different vegetables cultivate in different season in Match)

i) Name winter vegetable

ii) Name summer vegetable

iii) Name year round vegetable IV)

19. Vegetable production in trellis

i) Winter vegetable

Vegetable name	Total cost of production	Total production	Total land	Selling price /Kg	Total selling price

ii) Summer vegetable

Vegetable name	Total cost of production	Total production	Total land	Selling price /Kg	Total selling price

iii) Year round vegetable

Vegetable name	Total cost of production	Total production	Total land	Selling price /Kg	Total selling price

20) What are the advantages and disadvantages of vegetable cultivation on trellis?

Advantages		Disadvantages	
*		*	
*		*	
*		*	
*		*	
*		*	

21) Influence of Agroforestry (Family income and livelihood status)

i) In your own opinion, have you more profit in production agroforestry system? (Yes/No)

ii) Give on your opinion about the contribution of use Agroforestry system on your family income and livelihood status

Subject	Highly change	Moderately change	Slightly change	No change
Increased vegetable production				
Increase tree plantation				

Increase the supply of wood, fuel wood and cattle feed				
Increase family income				
Make new house and Increase use of sewage management				
Increase the efficiency of sending children in school				
Removal of malnutrition from family				
Create employment opportunity				

iii) How do you use your homestead product? Own consumption/Sell/ both/Distribution to neighbor and relatives

iv) State your family income from homestead: From vegetable/ fruit/ cultivation:

Use	**Amount (kg)**	**Value (taka)**
Own use		
Sell		
Distribution to neighbours and relatives		
Others		

22. Answer the following question

Sl No.	Description	Completely agree	Agree	No opinion	Disagree	Completely disagree
1.	Tree giving shade					
2.	It conserve soil moisture					
3.	It protect soil erosion					
4.	It protect from storm					
5.	It protect animal and animal shelters					
6.	It increase soil organic matter					
7.	It decrease environmental temperature					
8.	It increases rainfall					
9.	It increases supply of O2					
10.	It decreases CO2					
11.	It keeps nice the environment					
12.	It awareness of the natural equilibrium					

23. What difficulties you face in homestead agroforestry management?

i)

ii)

iii)

iv)

24. Please give your suggestion about the improvement of Agroforestry system?

i)

ii)

iii)

iv)

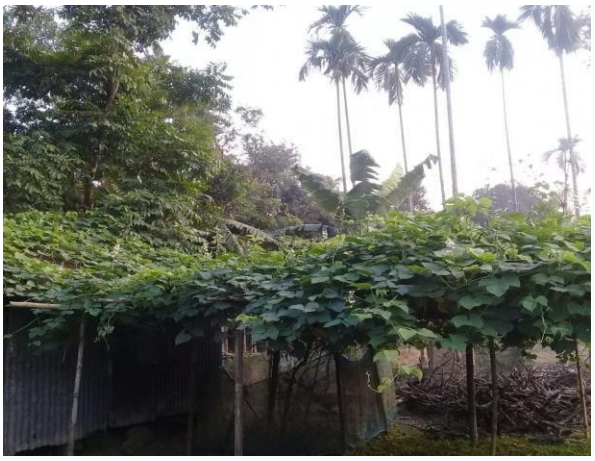
Thank you for your kind cooperation.

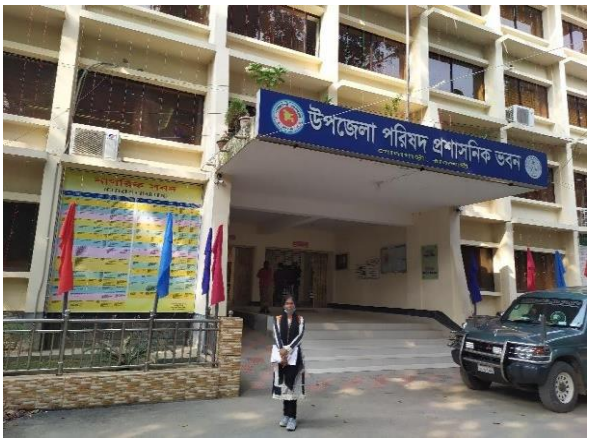
_____

Signature of the interviewer

Date:





Pictorial view of data collection