IDENTIFICATION OF INDIGENOUS TREE UNDER WATER LOGGING CONDITION AND THEIR ECONOMIC USES

A THESIS

BY

Md. Gazizur Rahman

Examination Roll No.: JD-25/2002
Registration No.: 21628
Session: 1994-95
Semester: January – June, 2004

MASTER OF SCIENCE (M.S.)
IN
AGROFORESTRY

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Submitted to the
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ABSTRACT

The research was carried out in RDRS working area of Bangladesh and covered 100 farmers respondents from 8 upazilla of three district (Kurigram, Lalmonirhat and Nilphamari). Name of upazilas were Kurigram sadar, Ulipul, Chilmari, Kaliganj, Hatibanda, Domar, Dimla and Jaldhaka. Data were collected by using interview schedule during January to June-2003. The main purpose of the study was to find out the availability of indigenous tree species their economic use and compatibility of these species in an agroforestry system under water logged condition. The obtained result showed that a total of 46 indigenous tree species were grown under water logging condition. Fifteen indigenous tree species such as Pitali (*Trewia nudiflora)*, Jiga (*Lannea coromandelica*), Jarul (*Lagerstroemia speciosa*), Hijal (*Barringtonia acufangula*), Dholi (*Dipterocarpus alatus*), Sheora (*Streblus asper*), Babla (*Acacia nilotica*), Mandar (*Erythrina variegata*), Chatim (*Alstonia scholaris*), Kul (*Ziziphus mauritiana*), Dumur (*Ficus lepidosa*), Khuksha (*Ficus hispida*) and Nunia (*Aegialitis rotundifolia*) were reported to have been grown under water logging situation for a range of to 2-8 months with 1´-9´ water depth. Panisafety/panidumur was found as the only indigenous tree species which grew in any depth of water all round the year. Some of the traditional tree species such as Nunia, Charka, Khoksha etc. were very rare in the study area. Rice was the most common crop that was inter cropped with different indigenous water logging tree species. The highest rice yield (30 kg/dec) was reported with panisafety followed by Pitali (25 kg/dec). Sonalu (25 kg/dec) and Jarul (22 kg/dec). Among the best fifteen indigenous species, panisafety/Panidumur, Pitali, Jarul that are adapted to high water depth were used for making furniture, home works as per respondents experiences. Major problems as identified by the respondents were lack of sufficient land and low productivity of indigenous tree species. The first priority in their solution was more seedling production. This requires identification of indigenous trees adapted to waterlogged situation and release of new variety/species as well.

INTRODUCTION

Tree is one of the most important gifts of nature. Once there was time in history when most of the parts of the world were covered with forests. But today this status of trees has shrunk to an alarming level, threatening the earth's ecological balance. Human civilization greatly depends on the adequate forest cover on earth. In many ways tree is useful to us. Plant gives us food, fodder fuel, fruit shade and shelter. It also maintains a sustainable ecosystem.

Bangladesh our homeland is mainly an agriculture based country and agriculture plays a great role in the national economy of the country. About 32% of the GDP comes from the agriculture (BBS, 2000) and it creates 66% employment opportunity of the country. This sector is playing a vital role in achieving self-sufficiency in food production. However, the contribution of agriculture to the GDP and incremental employment is likely to diminish day by day.

Bangladesh is one of the most densely populated countries of the world having about 129.25 million people in its area of 1,47,570 km^2 (BBS, 2002). The country possesses 1.8 million hectare of cultivable land and 1.9 million hectare of forest. About 85% of the population live in the rural areas in 15.4 million households spread over 85,000 villages (FAO, 1986 & BBS, 2001).

There are only 3,99,589 hectares of homestead land (about 4.33 percent of total cultivable land) having 0.03 ha per household. Marginal, small medium & large households have an average of 0.01, 0.02, 0.04 and 0.07 ha of homestead land respectively (BBS, 1997). Due to shortage of agricultural land, homestead Agroforestry practices may be a good strategy for survival and existence of the client system because of secured supply of food and petty cash.

While forest is an important natural resources of a country requiring 25% forestland of the total area of a country for its socio-economic enlistment and maintenance of environmental equilibrium. But Bangladesh has only 12% forestland of the total area as officially recorded (FMP, 1992) where trees cover only 6.4% of the total area which is decreasing day by day. A sustainable depletion of forest resources has occurred in the last few decades, and now it is reduced to less than 0.02 ha per person, one of the lowest ratios of the world (BBS, 1996). This is a great challenge against the socio-economic and environmental development of the country.

Agroforestry is an age-old practice in the traditional farming systems in the tropics including Bangladesh Karim & Savill, 1999. Farmers of Bangladesh like many other Asian countries have been growing rice fibers, root crops, vegetables, in association with trees and other woody perennials (Gujral, 1990).

More succinctly stated Agroforestry is an approach to land use that incorporates trees into flooding system and allows the production of tree and crops from the same piece of land. True agroforestry systems are those that have been designed to enhance beneficial ecological interaction that may be manifested as improvement in yield (output per unit area), resource use efficiently (output per unit input) or an environmental manner (e.g. increased soil stabilization, benefits to wild life etc.).

Agroforestry by definition involves favorable mixture or retention of woody perennial with other production enterprises aimed at integrated land use, to obtain benefits outputs in diversified ways in a suitable manner under prevailing social, ecological and economic condition (Nair, 1984).

In Bangladesh 9.25 million hectares of the cultivated land rice is cultivated in 80% of the total agricultural land. So the farmers of this country do not like to plant trees in rice field where rice is intensively grown. Because the shade of the tree is harmful for rice. But well-planned and well-managed agroforestry (Growing indigenous tree) can play an important role in solving this actual problem of food fuel, fodder, soil fertility & ecology.

The north region of Bangladesh including the greater Rangpur district is almost devoid of natural forest & the people of this region suffer from acute shortage of fuel food & furniture wood.

The home garden, silvo-horticulture systems is the most dominant Agroforestry practice in the country. Association of tree & crops species in the home garden and crop field very with agro-ecology of the country. Like Ganges Floodplain, Tistas floodplain, Dharlas floodplain farmers in north Bengal in addition to home gardens, retain or plant trees (indigenous tree) in crop fields as an insurance crop (for cash) or for fruits & fuel wood.

Every year near about one-fifth of Bangladesh undergoes flood during the monsoon season. The geographic position, structural set-up, physiography and geomorphology all together are responsible for flooding in the country. A flood season in Bangladesh may start as early as May and can continue until November.

In the past their were various species of indigenous trees. Which would have survived in the adverse situation. There are many trees that can live easily in water all the yare round but in abundance of foreign trees all those trees of our country are in the way of extinction. Foreign species of trees cannot live for a long time in water. Some species of trees die before they come into maturity, such as sissoo. The people of the country are planting trees but the top of these are being spoilt by die-back disease it is the one kind of problem. Trees of indigenous kind are here and there all over the country and they can survive either in water or any other adverse environment. Our country is a land of rivers where may places remain under water. If we can collect all those water tolerant species of trees and plant them in the flood affected areas. Our environment will be well protected in our way and in another way our financial condition will be developed.

As the expansion of classified forest is almost impossible because of high population pressure, growing trees in crop field may serve as the best option to balance ecosystem. From the time immemorial, farmers grow a considerable number of various tree species in the crop field under rain-fed situation mainly for timber and fuel-wood production.

There are evidences indicating that several indigenous tree grow well wet and for most of the time in the year, and are found compatible with field crops. The farmer of some parts of northern Bangladesh have been growing various tree species under irrigated condition. But effect of water logging on the growth and development of the tree species as well as the interaction between the tree and the crops have not yet fully investigated. So we need to collect those variety, which are growing waterlog condition.

The present study was carried out with the following objectives:

i. To study the availability of indigenous tree species under water logging situation.
ii. To find out economic use of indigenous tree species under water logging situation.
iii. To determine the compatibility of these indigenous tree species in an agroforestry system under water logging situation.

REVIEW OF LITERATURE

Concept of Agroforestry

Agroforestry is an age-old and ancient concept (Haque *et al.* 1996). Many definitions have been advanced for the term agroforestry. A widely used definition given by the International center for Research in Agroforestry (Nair, 1984) is that "Agroforestry is a collective name for all land-use systems and practices where woody perennials are deliberately grown on the same land management unit with agricultural crops or animals in some form of spatial arrangement or temporal sequence".

From a bio-economic point of view, agroforestry is a combined agriculture/tree crop of tree farming system which enables a farmer to make more effective use of his land and thereby receive a higher net economic return on a sustainable basis (Harou, 1983).

Agroforestry has been practiced by many groups of people in various way under different conditions over a long period of time such as bush following, taungya, alley cropping, green hedge and fences, affoerestation blocks, protein banks, woody perennials for shelter, soil and water conservation, homestead agroforestry, cattle under woody perennials, dune fixing, aqua forestry Api-siliviculture and many others (Torquaebian, 1990). Among these, the taungya is a very ancient agroforestry system (Haque *et al.* 1996). The Burmese word "taungya" literally means hill (taung) cultivation (Ya). It describes a method of raising forest trees in combination with agricultural crops on the same piece of land (Enabor, 1973). This is the most widely used term in Asia, Africa and Latin America.

Saxena (1994) pointed out that proper agroforestry utilizes the interspaces between tree rows for agricultural crops, and this does not impair the growth and development of the trees but enable farmers to derive extra income in addition to benefits accrued from the use of fuel and timer form trees.

Agroforestry systems improve and maintain soil fertility. It was hypothesized by (Nair (1987) that an agroforestry system can play an important role in improving soil fertility by: (i) increasing organic matter content of soil through addition of leaf litter, pruning and other biomass, (ii) efficient nutrient recycling within the system, (iii) biological N_2 fixation in case of indigenous trees, and (iv) possible complementary interactions among associated species due to differences in canopy structure, root system and active zone of water and nutrient absorption.

The physical, chemical and biological conditions of the soil are greatly influenced by the addition of organic matter through pruning of hedgerow (Nair, 1985 and Young, 1984). Groot and Soumare (1995) observed that decomposition of tree roots and substances of the root exudes greatly enhance soil organic matter and thereby soil fertility. Tree lateral roots may reduce loss of nutrients from the soil by recycling them that would have been otherwise leached from the system. Taproots may take up nutrients, which are released by weathering from deeper soil layers. A common hypothesis is strongly implied to the agroforestry system that interaction of trees with annual crops improves the chemical properties of the soil (Von Maydell, 1987).

Shankarnaryan (1984) claimed that tree in agroforestry systems conserve soil moisture, increase atmospheric humidity and improve soil fertility. The process is enhanced by tree canopy cover which moderates the microclimate and enhances organic matter accumulation, microbial activity and mineralization (Verinumbe, 1987).

Bhatia and Singh (1994) observed that the agroforestry in India plays an important in increasing biomass production, maintaining soil fertility, conserving and improving soil, and averting risk.

2.1 Trees for income generation, farmers insurance and risk covers

Bhuiyan (1982) reported that the deforestation caused a great deal of soil erosion, soil degradation of both forest and adjacent agricultural land and badly affected forest and agricultural production.

Kowero and Tenu (1985) identified some major limiting factors of village forestry in Tanzania which were inadequate planning, poor follow up, lack of sufficient seedlings and lack of transportation.

Hassan and Mazumder (1987) reported that 88.5% of wood and 48.9% of fuelwood would come from homestead forest.

Hossain and Shailo (1987) observed that the present annual demand of fuel wood in the country stands in 2.04 million m^3 and the timber at 0.92 million m^3 where as the supply is presently 0.61 million m^3 and 0.76 million m^3, resulting in a deficit of 1.42 million m^3 of fuel wood and 0.16 million m^3 of timber. There is possibility of meeting this deficit through the practice of agroforestry system.

Khaleque *et al.* (1988) observed that homestead forests are being over cut to meet increasing demands for fuel wood and timber in Bangladesh. The study revealed that every homestead contained a combination of different tree species, a bamboo grove and shrubs. Farmers generally prefer to grow fruit trees because they are multipurpose and can also provide fuel, fodder and timber.

Lal (1988) mentioned that application of appropriate technology in relation to production and management of trees and crops in the homestead ensured better utilization of land with the creation of better living environment there.

Akter *et al.* (1989) reported that farmers consider trees as savings and insurance against risk of crop failure and low yield, as well as assets their children. In their study, some farmers also stated that trees would contribute toward expenses for marriage of their daughters.

Abedin *et al.* (1990) reported that agroforestry is considered as one of the strategies for augmenting tree production for a country like Bangladesh where there is a little scope of developing pure forest due to obvious priority for food crop production.

Islam (1991) reported that village forest mainly covered by homestead accounts only 0.27 million ha and out of 64 districts as estimated 28 districts had no public forest land.

Misbahuzzaman and Ahmed (1993) conducted a survey on land use categories in the homesteads of a forest rich area of Bangladesh. They observed that farmers in the marginal, small, medium and large farm categories utilized substantial portions (27-35%) of their homesteads for planting trees. Farmers in the landless farm category utilized 30% of their homesteads for cultivation of vegetables. Other land usages measured were housing, cattle sheds, ponds, threshing and drying floors and utilized. Farmers in all of the farm categories showed more interest in planting tree species than forest three species. Woodlots were very poorly managed.

Millat *et al.* (1994) reported that farmers were more interested in growing horticultural species than timber species. Landless, marginal and small farmers grew trees mainly for sale, while medium and large farmers grew trees mainly for domestic consumption.

Rahman (1995) studied on family income and women's status with the consequence of homestead crop production under homestead agroforestry practices and reported that these farm had earned substantial income and production grains. By increasing participation of homestead agroforestry practices women can take decision to improved significantly on their households and gained in terms to higher social status.

Hocking and Islam (1997) reported that all the species grew well in the rice fields, at rates comparable with their growth in plantations. Top and root pruning reduced average tree girth by up to 19% and average tree volumes by up to 41% and crops (rice, wheat, jute and pulses) yield by 7% depending on the intensity of pruning and 93% of the corresponding yields outsides the tree canopy. Pruning of root and branches significantly improved crop yields under tree by amounts proportional to the intensity of root or top pruning.

Wickramasinge (1997) reported that agroforestry is important for income, nutrition and health, for reducing economic risk, and for improving food security at household level. Home gardens were seen as having potential role to play in maintaining biological diversity at both the species and subspecies.

Ahmed *et al.* (1998) reported that farmers of the study area grown first growing tree species in homestead and farmland for improving soil organic matter and supply of timber, fruits, fodder and raw materials for cottage industries. They also suggested that trees in homestead may be managed on a relation of 2-3 years to produce fuel wood; fruit trees be retained for longer period to obtain, fruits and timber. Plantation arrangement for farmland may be single tree at the center of plot or at the four corners of a plot and may be managed through root and branch pruning with regular pollarding at 2-3 m height. The leaves of trees both in homestead and farmland should be used for increasing organic matter content in crop fields.

Hocking and Islam (1998) reported that eucalyptus affected crop yield by 12% but the species had highest wood production. The species appeared as the most profitable one on economic analysis compared to all other species. Agriculture contribution about 37% of the gross domestic product of Bangladesh. Of the total agricultural product, about 77.7% comes from various crops, 7.85 from livestock, 7.8% from fishes and 6.7% from forests.

Stizaker *et al.* (2002) reported that the success of a tree/crop mixture becomes less likely with declining crops season rainfall and increasing seasonal variability and more likely when the tree products have a direct economic benefit.

Keith (1986) reviewed the role of economic and non-commercial incentives in persuading farmers to grow trees despite risks and difficulties based on field interviews in India.

Mercado (1987) showed in his study of the seven northern districts (Now 23) with the lowest tree cover in the country (only about 2%) and concentrated mainly on homesteads.

2.2 Species diversity in crop field

According to Leach and Mearns (1988) and Dewees (1989), the projection of fuel wood consumption simply in line with population growth is rather unrealistic. Even when fuel wood physically scarce, households have a great deal of latitude in changing their consumption patterns in response. As scarcity worsence and wood prices or the labour cost of gathering fuels increase many new coping strategies would come into play. Tree plantation might increase consumers may use fuels more economically switch to more abundant fuels such as crop residuals or intensity efforts to encourage the natural regeneration of woody vegetation and son on.

Nair (1989) reported that the dynamics of species succession and plant density and composition of home gardens have been intensively studied by Indonesia, researchers. The total number of species in the villages was 219 in dry season and 272 in the wet season i.e., an increase of almost 25 per cent in the wet season.

Young (1989) in his study entitled “Agroforestry for soil conservation” stated that 20 percent of rainfall is checked by tree cover, whereas ground shrubbery checks about 10 percent. In addition, the forest floor also intercepts rainfall to the extent of at lest 5 percent.

Fernandes and Nair (1990) studied on diversification of agricultural crops and multipurpose trees and reported that most of the fundamental needs of the total populations and their multi-storied configuration and high species diversity avoid the environmental deterioration commonly associated with monoculture production systems. Thus, cropland agroforestry is economically efficient, ecologically sound a biologically sustainable.

Mondal (1991) in his study on development Management by Gram Panchayat Organization in Nadia and Hoogly district of West Bengal found that Gram Panchayat Pradhans (Chair persons of Local Governments at the village level) considered ‘tree plantation’ and ‘protection of tree’ important as it contributed towards improving the quality of rural life.

The Monitoring and Evaluation Cell (1992) observed that the marginal farmer’s holdings mostly were in productive lands and they took to planting trees on a large scale as the inputs were obtained either free of cost or at a sustainable rate. They were motivated to adopt an alternative use of plant.

Chowdhury and Satter (1993) in a study showed that farmers either retained or planted trees on the crop field for 17 reasons of which fruit, cash, insurance, fuel, juice of palm, timber for construction material and increase of soil fertility.

Alam *et al.* (1996) conducted a study on diversity and economic aspects of village forests in Bangladesh. Both indigenous and exotic trees are the major components of the village forests. About 40% are fruit trees, and other produce timbers, fuel woods, fodders, tannins pharmaceutical products, etc. comes from the multipurpose trees in the village. Homestead tree production system in villages is a mode of species and genetic conservation for a good number of trees.

Mullat-E-Mustafa (1997) conducted a vegetation survey in four physiographic region of Bangladesh (deltaic, dryland, hilly and plain regions). He recorded in total of ninety-two perennial species from home garden of Bangladesh. The highest number of species were recorded in deltaic region (67) followed by plain (56) and hilly region (54), and the lowest in the dry land region (46). He also mentioned that, in the dry land region, adverse environmental condition (such as low rainfall, intense heat and low soil fertility) restrict the variety of species that could e grown.

Basavaraju and Gururaju (2000) reported that selection of suitable tree species is very important for agroforestry. But selection of tree species is not always possible having all the desirable characteristics for agroforestry, because of different production and protection goals. They also suggested that agroforestry systems have to be managed through planting optimum density of trees, proper spatial arrangement and pruning and thinning of tree crowns and roots reduce the negative effect of trees.

2.3 Abundances of trees in homestead and crop field

Hocking (1986) observed that some 15 million household of the country occupy about 0.3 million hectare under traditional agroforestry practice in homestead.

Dasgupta *et al.* (1988) reported that farmers grew various fruits and vegetables on their homestead and farms varied according to their size and categories. Large farmers prefer growing a wide range of fruits and vegetables. They also found that the potential of the homestead was great which could be improved by replacing the less productive plants with fast growing nitrogen fixing species to provide more fuel fodder and green manure.

Ahmed and Ali (1993) reported that trees are used for fencing homestead, controlling soil erosion both in homestead and crop field.

Bhuiyan (1997) studied on cropland agroforestry modules for plain land agroforestry and hill agroforestry. He found that boundary planting model consisted to trees planted along the boundary, while plantation in wide spaced scattered planting model usually in wide square spacing so that dense continuous shade casting was avoided and the tree crown could be managed by lopping of branches and rood competition is minimized by root pruning through circular trenches around trees base. The long term tree crops, both fruit and timber in crop site planting model are either widely spaced to permit interference free growth or they form different stories vertically on account of their differential height growths. This model is similar to common homestead models, needs intensive care and attention. It generated continuous cash flow to the farmer.

Das and Oli (2001b) reported that suitable species were also considered for growing on farmland. The species richness was observed higher in Chitwan than the other two districts for lack of timely technical advice on selection and management of appropriate tree species by the farmers. They energy used by pattern in all the three sites was mostly traditional. Government-managed forests together with community forests and trees and farmland were found to be main source of forest products in the study sites.

Koirala *et al.* (2001) reported that landholding size, education level and forestry extension media play an important motivational factor in varying degrees in plantation programmes in cropland agroforestry.

Murniati *et al.* (2001) reported that the village forests were formerly managed as production forests and provided significant cash income to the village. On the other hand natural forest coverage were declined to 10% of the former area within village forestland. They also found that households that farmed only wetland rice fields registered the highest value of forest products and park. Households that farmed only mixed gardens had an

intermediate level of park resource while the both components had a dramatically lower level of economic dependency on park resources than households in either of the other two categories.

Marris *et al.* (2002) reported that boundary vegetation is an important resource for farmland wildlife for biodiversity and as landscape component. In commercial aspects field boundary management is generally dominant farmers, professionals and the wider public, it also appreciated hedgerows as landscape or countryside features. The study suggests that it may be useful to build on or influence these attitudes to maintain or enhance the conservation value of field boundary vegetation.

Shrestha (2002) studied and found that trees retained in the middle of terrace riser and outside terrace on the terrace edge were ranked first and second, respectively for soil conservation, and fodder and fuel wood production.

METHODOLOGY

Selection of the study area

In any research, methodology plays an important role. Appropriate methodology enables the researcher to collect valid and reliable information properly in order to arrive at correct conclusions.

Eight Upazilla (Fig.1) namely Kurigram sadar, Ulipur and Chilmari of Kurigram district; Domar, Dimla, and Jaldhaka of Nilphamari District; and Kaligong, Hatibanda Upazilla of Lalmonirhat district were selected as the locale of research were RDRS programmes are concentrated. Each upazilla consists of many different unions and each union consists of different villages.

Climate of the study area

The study area is located in the tropical belt and enjoys fairly equitable tropical monsoon climate. The temperature is almost uniform throughout the year. The maximum and minimum temperatures recorded are 33^0C and 10^0C, respectively. The temperature is high during April to May (summer) and that is low in month of December and January (winter). The mean monthly temperature ranges from 10^0C to 28^0C. Pleasant weather begins form November and continues up to February. Rainfall starts in May and continues up to September. These cause flooded in different area of north region. About 95% of the annual rainfall occurs during the monsoon. The average annual rainfall varies from 1500 to 3000 mm. Humidity during monsoon more than 80% and lowest in the month of February. The winter starts from the middle of November and continuous till late February. The average rainfall is 110 mm. The rainfall of this district is good compared to some of the northern district. The mean average lowest rainfall occurs from December to January represented Fig. 2. The annual rainfall for ten years from 1992 to 2002 is represented in Appendix Table-II.

ig. 1

ig. 1

Agroecological zone

Agroecological zone of Bangladesh have been identified based on soils, rainfall regime, agroclimatology, land levels in relation to flooding and physiography. Combining the first four level of information, 30 agroecological regions have been recognized (FAO, 1988). The study area is under Active Tista Floodplain (AEZ-2) and Tista Meander Floodplain (AEZ-3). Main features of these agroecological zones are as follows:

1. Active Tista Floodplain (AEZ-2: The region includes the active floodplains of Tista, Dharala, Buri Tista and Dudkumar rivers. It has complex pattern of low, generally smooth rides, inter-ridge depressions, river channels and cutoff channels. The area has irregular patterns of grey stratified sands and silts. They are moderately acidic throughout and parent alluvium is rich in weatherable minerals.
2. Tista Meander Floodplain (AEZ-3): This region occupies major part of the tista floodplain as well as the floodplain of the Attrai, little Jamuna, Karatua, Dharala and Dhudkumar rivers. There is overall patterns of olive brown rapidly permeable, loamy soils on the floodplain rides and grey or dark grey slowly permeable, heavy silt loam or silty clay loam soils on the lower lands and parent material rich in weatherable minerals.

Soils of the study area

Irregular patterns of grey, stratified, sands and silts predominate, with some developed, grey silty soils near the boundaries with the Tista Meander Floodplain. The proportions of sandy and silty alluvium on *char* land vary from year to year. On average, sandy and silty deposits are roughly equal on the active Tista and Dharala floodplains, whereas sands predominate on the

active Dudhkumar floodplain. The parent alluvium is rich in weatherable minerals, near neutral in reaction and low in organic matter.

Topographical feature of the study area. The study area is comprising of household group with their homestead, total land, area under waterlog, vegetables, livestock, courtyard, tree crop forest etc. The platforms of homestead and crop field are usually above normal flooding and are thus suitable for planting of trees species especially indigenous tree. The homestead of Bangladesh do generally small, most of them comprise not more than 0.16 ha (Khan, 1996). Planting of different trees homesteads and crop field is a traditional land use practices, the prevailing production systems of trees and crops being primarily dependent on indigenous technology.

Physiography

Bangladesh is primarily a floodplains of the Ganges-Brahmaputra-Jamuna and Meghna river system with only some hilly areas in the southern and north-eastern parts of the country. In relation to seasonal flooding land types are as follows:

- Highland (HL) : Normally not flooded
- Medium high land (MHL) : Normally flooded up to 90 cm
- Medium low land (MLL) : Normally flooded between 90 cm and 180 cm
- Low land (LL) : Normally flooded between 180 cm and 300 cm
- Very low land (VLL) : Normally flooded deeper than 300 cm

Bangladesh is comprised of three major soil physiographic units. The floodplain soils alone cover 80 per cent of the total land. Rest of the 20 per cent lies under hill (12 per cent) and terrace soils (8 per cent). So far 20 general soil types and 500 soils series have been identified. Most soils have been formed and developed in seasonally of tertiary and quaternary age.

Preparation of the questionnaire

It is very important to construct a questionnaire for conducting any study. In order to collect the desired data, two different types of questionnaire were carefully prepared; one for farmers and the other for traders. Before preparing a final questionnaire at first a preliminary or draft schedule was made. And after protesting, the final questionnaire, were prepared with necessary corrections, modifications and changes.

Data collection

Data for this study were collected through personal interview by the villagers with the active help of Extension officer (crop), RDRS during the 1 January to 30 June, 2003 using interview schedule (Fig. 3a, 3b). All possible efforts were made to explain the purpose of the study of the respondents in order to get actual and valid information from them. The interviews were conducted with the respondents in their houses and field in the face to face situation. Proper rapport was established with respondents so that they did not hesitate to finish proper response to the questions and statements in the schedule. The questions were explained and clarified whenever any respondent fell difficulty in understanding the question. There were 100 household participants who were the village people in the study area.

Fig. 2

The respondent farmers were categorized based on tree farm size that includes: Large (>0.34 acre), Medium (0.15-0.33 acre) and Small (0.00-0.12 acre). From each category households were selected randomly.

Most of the information was obtained through interviews of household members. In each household, the head of household in most cases made was respondent and in about some cases, his wife also present at the time of interview and contributed to some of responses. Some parameters specially structure and spatial arrangement of home garden and crop field. Homestead land use and crop field pattern were measured using simple techniques and visual observations.

Identification of indigenous tree species in water logging situation

Identification of the existing indigenous trees species in water logging situation was done by the help of rural aged people (Fig. 4) and also with the consultation of Local Extension Officer and Block Supervisor. Most of the species was finally identified with the help of the Bangladesh Forest Department, district office, Kurigram, Lalmonirhat and Nilphamari.

The interview schedule of farmers

i) Socio-economic background i.e. family size, level of education, and size of the tree farm and family income of the farmers.
ii) Size of the tree farm
iii) Water logging area
iv) Cultivated land
v) Fallow land
vi) Household information
vii) Annual income and expenditure of the family
viii) Indigenous tree species in the homestead and crop field

Fig. 4

Data analysis

Data collection for the study area were compiled, tabulated and analyzed in according with the objectives of the study. Local units were converted into standard units. The responses of the questions in interview schedules were transferred to a master to facilitate tabulation. Some statistical analysis was also done for ranking and other purposes.

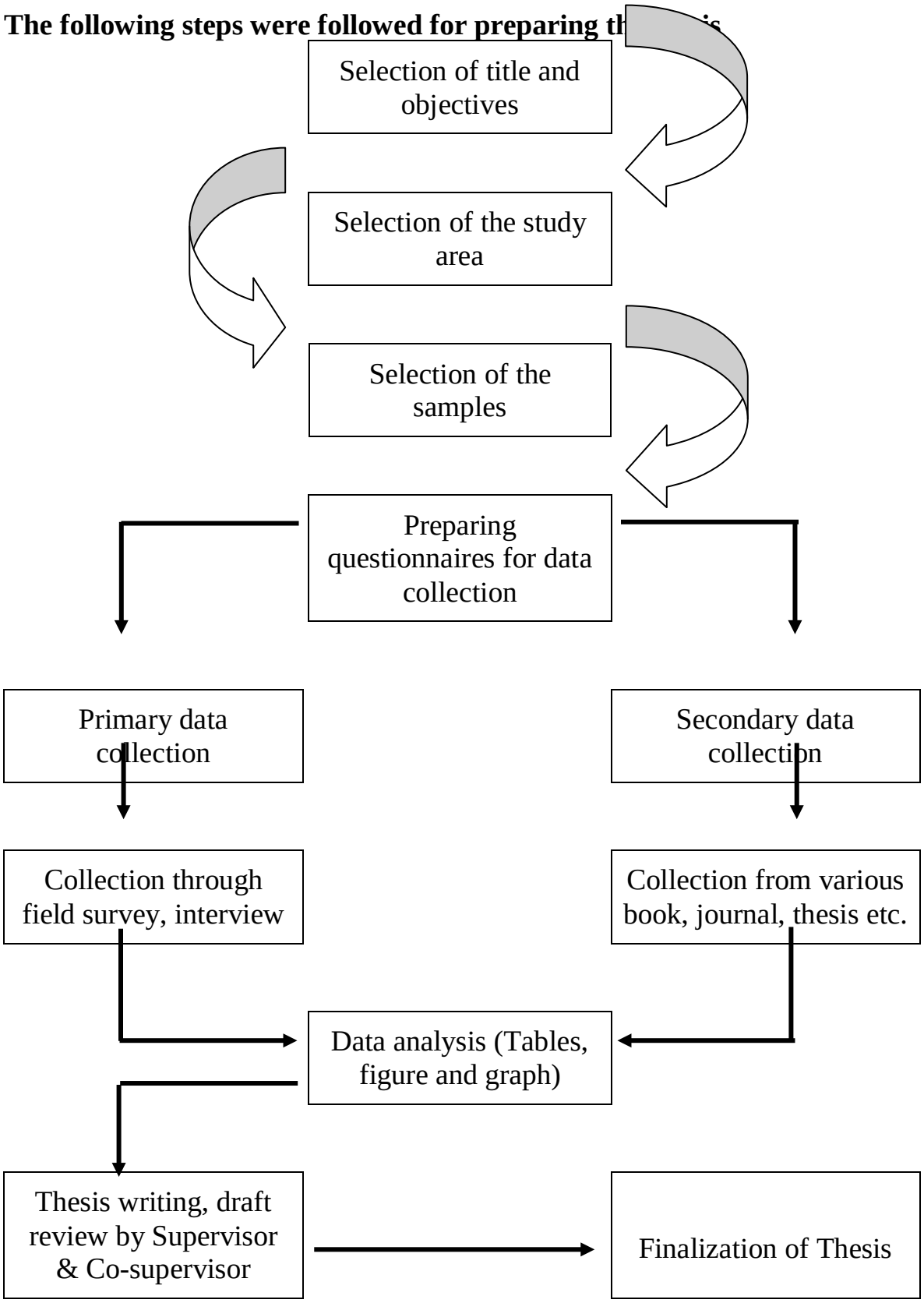
Relative prevalence of tree species was determined by multiplying the number of trees per farm by the percentage of farm containing that species. MS-Excel and SPSS programs were used to process all collected information by microcomputer. Responses of the completed questionnaires were numerically coded and analyzed. Descriptive statistics, frequency, percentage were used to analyze data. In addition graphs and tables are used to interpret the findings.

Problems faced in data collection

Some problems and difficulties were faced by the participant during the period of data collection. These problems are discussed below:

1. Most of the respondents were always doubtful about the purpose of the study because they had no previous idea about such study. So it was difficult to make them understand the purpose of this research.
2. Most of the respondents hesitated to give their actual information about production, income, capital and profit. Because, they were always afraid of tax imposition. They considered researcher as an officer of taxation.
3. Illiteracy of the respondents posed a serious problem during data collection. Due to illiteracy, they did not feel easy to properly respond to the questions of the researcher.
4. Most of the respondents were not available at farm and most of the time they were busy with the personnel activities.

The following steps were followed for preparing th is



RESULTS AND DISCUSSION

Education level

The education level of the respondents observed in the study area. There were 5 (five) categories of education levels in the study area. These were illiterate (no formal education), primary level, secondary level, higher secondary level and above. The category of the respondents, number of respondent, percent, mean and standard deviation are shown in table-1.

Table-1. Distribution of respondent according to their education level

Category	Respondent	Percent	Mean	Standard deviation
No formal education	46	46.0		
Primary	41	41.0		
SSC	5	5.0	1.7800	0.97006
HSC	5	5.0		
Above	3	3.0		

Tree farm size

The tree farm size of the respondents varied from 0.01-0.66 acre with the meat of 0.1006 and standard deviation of 0.14023. There were five categories of the respondents on the basis of their tree farm area. The distribution of the respondents with number, percent, man and standard deviation is shown in Table-2.

Table-2. Distribution of respondents according to their tree farm size

Tree farm category	Farm size	Respondent	Percent	Mean	Standard deviation
Marginal	0.01-0.05	55	55%		
Small	0.05-0.12	29	29%	0.1006	0.14023
Medium	0.15-0.33	10	10%		
Large	0.34-0.66	6	6%		

Data presented in Table-2 shows that the highest proportion (55%) of the respondent were marginal compared to 29%, 10% and 6% of small, medium and large tree farm categories respectively.

Table-3. Distribution of the respondents according to district in the study area

Name of district	Name of upazila	Respondents	Total	Rank order
Kurigram	Kurigram sadar	9	43	1
	Ulipur	30		
	Chilmari	3		
	Phulbari	1		
Lalmonirhat	Hatibanda	28	40	2
	Kaliganj	12		
Nilphamari	Jaldhaka	10	17	3
	Domer	3		
	Dimla	4		

The main study area was Kurigram district (43 respondent) second was Lalmonirhat district (40 respondent) and then Nilphamari district (17 respondent).

Homestead size

The homestead size of the respondents varied from 0.07 to 2 acre. The average homestead size was 0.18 acre with a standard deviation of 0.17. There were four categories of homestead size on the basis of farm categories. The range, category, percent, mean and standard deviation are given in Table-3.

Table-4. Distribution of respondents according to their homestead size

Category	Farm size	Respondents	Percentage	Mean	Std.	Minimum	Maximum
Marginal	0.07-0.15	21	21%				
Small	0.16-0.25	28	28%	0.3531	0.07	0.07	2.00
Medium	0.25-0.50	27	27%				
Large	0.51-2	14	14%				

Cultivated land size

The cultivated land size of the respondents varied from 0.00 to 18 acre. The average cultivated land area was 2.6493 acre with a standard deviation of 3.40880. There were four categories of cultivated land size on the basis of farm categories. The range, category, percent, mean and standard deviation are given in Table-4.

Table-5. Distribution of respondents according to their cultivated land size

Category	Farm size	Respondents	Percentage	Mean	Std.	Minimum	Maximum
Landless	0.00-0.60	24	24%				
Small	0.61-2	33	33%	2.6493	3.40880	0.00	18
Medium	2.1-7	36	36%				
Large	8-18	7	7%				

Problems Faced and their Probable Solution, which are absence of indigenous tree under water logging situation in land by the respondents

The respondents were asked to mention the problems faced by them due to using of flood prone lands to indigenous tree production. They mentioned as many as 11 to 15 problems in this regard and they gave some solution for answering the problem. Frequency of citation and their respective rank order of the problems and their problem solution are presented in table-1 and table-2 respectively.

Table-1. Problems faced by the respondents in using water logging lands to indigenous tree species production

Sl. No.	Problem	No. of citation	Rank order
1.	Lack of available land for growing indigenous tree	34	1
2.	Indigenous tree species are low productive	28	2
3.	Land cultivation for food crops	25	3
4.	Tree problems in the crop field	24	4
5.	Lack of seedlings	16	5
6.	Number of plant decrease due to breakdown of river bank	16	6
7.	Lack of variety	16	7
8.	Present of foreign tree species	12	8
9.	Dividation of land	10	9

10.	Cutting tree for poverty	9	10
11.	Lack of curiosity of planting indigenous tree	8	11

Table-2. Conservation aspect in the respondent collection of indigenous tree

Sl. No.	Suggested by the respondent	No. of citation	Rank order
1.	More seedling production	34	1
2.	Growing indigenous tree ail side	25	2
3.	Evaluation of indigenous tree	18	3
4.	It will have to make dam on river	17	4
5.	To protect the foreign tree species	16	5
6.	Proper utilization of indigenous tree	15	6
7.	New variety release of indigenous tree	12	7
8.	Identification of the indigenous tree	8	8
9.	It will have to take a step in G. O & NGOs way	7	9
10.	Aforestation	6	10

It was found that “lack of available land” was the most cited problems of the respondents. Indigenous species “low productive” was the second most cited problem of the respondents. “Land cultivation for food production” was the third problem. “Lack of seedlings” and “tree problems in the crop field” was the 4th and 5th cited problems respectively.

To overcome the problems observed by respondents some suggestion were given by themselves. The first solution of the as was mentioned by the respondents “seedlings production” seems to be essential to using water logging indigenous tree production. Otherwise, the respondents will have to face miserable condition for a long time.

4.1.4 Homestead utilization pattern

The average size of the homestead of the study area was 0.3531acre and it regard to 0.07 to 2 acre. Among the different uses, house area and pond occupied the major portion (42% and 13% respectively). Only a very little i.e. 2% homestead area was kept fallow (Fig. 5). Table-5 shows different uses of homestead by farmers category. The data revealed that tree coverage both irrigated and non irrigated increased with the increase of homestead size (marginal to large). Irrespective of homestead category, house and dwelling occupies the highest area.

Table-5. Land utilization pattern according to homestead area

Homestead	Area of homestead under different uses (acre)								
	House	Court yard	Vegetable	Irrigated tree	Non-irrigated tree	Pond	Livestock	Fallow	Others
Marginal (0.7-0.15)	0.0476	0.0224	0.0155	0.0062	0.0300	0.0010	0.0024	0.005	0.0124
Small (0.16-0.25)	0.0854	0.0400	0.0214	0.0042	0.0386	0.0061	0.0043	0.0014	0.0129
Medium (0.26-0.50)	0.1062	0.0722	0.0300	0.0151	0.0530	0.0632	0.0089	0.0035	0.0189
Large (0.51-2)	0.6636	0.1157	0.1171	0.0321	0.1279	0.2071	0.0200	0.0286	0.0579

Fig. 5

Table-3. Land utilization pattern according to farm category

Distribution of land according to farm category

Farm category	Average land resources of the respondents (acre)			
	Homestead	Cultivated land	Tree coverage	Fallow land
Marginal (0.16 -1)	0.1740	0.4893	0.0563	0.0157
Small (1.2-4)	0.3491	1.7760	0.1040	0.1042
Medium (4.1-10)	0.5052	4.4395	0.0990	0.4081
Large (11-27)	0.7450	13.4417	0.3217	0.5367
Total Average	0.3531	2.6493	0.1006	0.1674

The average size of the farmers land was 3.7062 acre. The average size of the tree coverage area was 0.1006 ranged from 0.0563 acre to 0.3217 acre (Table 3).

Among the all utilization pattern cultivated land area was 66%, homestead area 24%, tree coverage area 8% and only very little area i.e. 2% farm land area was kept fallow (Fig. 6).

Table 4. Family income scores of the crop field ranged from Tk. 0.00 thousand to 90 thousand with an average Tk. 27.4700 thousand standard deviation of 15.16206. Table 4 indicate that annual income of the crop field depends on farm categories. The annual income of landless small, medium and large categories was Tk. 17.9167, 23.9098, 29.6667, 65.7143 thousand respectively.

Fig. 6

Best indigenous tree species, which are growing under water logging situation

Sl. No.	Name of trees	Scientific name	Duration under water (month)	Depth of water	Rank order
1.	Pani safety/Pani dumur	*Ficus clavata*	All time	Any depth of water	1
2.	Pitali	*Trewia nudiflora*	4-8	4´-9´	2
3.	Jiga	*Lannea coromandelica*	4-8	4´-8´	3
4.	Jarul	*Lagerstroemia speciosa*	4-7	3´-8´	4
5.	Hijal	*Barringtonia acufangula*	3-7	3´-5´	5
6.	Dholi	*Dipterocarpus alatus*	3-6	3´-4´	6
7.	Sheorah	*Streblus asper*	3-6	2´-5´	7
8.	Babla	*Acacia nilotica*	3-6	2´-5´	8
9.	Mandar	*Erythrina variegata*	3-5	2´-3´	9
10.	Chatim	*Alstonia scholaris*	2-5	2´-3´	10
11.	Bohala		2-4	2´-3´	11
12.	Kul	*Ziziphus mauritiana*	2-4	2´-3´	12
13.	Dumur	*Ficus lepidosa*	2-4	1´-3´	13
14.	Khoksha	*Ficus hispida*	2-4	1´-2´	14
15.	Nunia	*Aegialitis rotundifolia*	2-4	1´-2´	15

Comparatively low indigenous tree species, which are growing under water logging situation

Sl. No.	Name of trees	Scientific name	Duration under water (month)	Depth of water	Rank order
1.	Shimul	*Bombax ceiba*	2-4	1′- 1 1/2′	1
2.	Kadam	*Anthocephalus chinensis*	2-3	1′- 1 1/2′	2
3.	Makrijam/Butyjam	*Syzygium balsameum*	2	1′	3
4.	Pakur	*Ficus lacor*	1-2	1′	4
5.	Bot	*Ficus benghalensis*	1-2	1′	5
6.	Palas	*Butea monosperma*	1-2	10″-1′	6
7.	Sonalu	*Cassia fistula*	1-2	10″- 1′	7
8.	Khori/Kori	*Xerospermum noronhianum*	1-2	8″- 10″	8
9.	Jam	*Syzygium cumini*	1-2	8″- 10″	9
10.	Bel	*Aegle marmelos*	1-2	8″- 10″	10
11.	Haritaki	*Terminalia chebula*	1-2	8″- 10″	11
12.	Paniala	*Flacourtia jangomas*	1-2	8″- 10″	12
13.	Kanchan	*Bauhinia acuminata*	1-2	6″- 10″	13
14.	Bankanthal	*Artocarpus lacucha*	1-2	6″- 10″	14
15.	Latka	*Baccaurea ramiflora*	1-2	6″- 10″	15
16.	Jalpai	*Elaeocarpus floribundus*	1-2	6″- 10″	16
17.	Chalta	*Dillenia indica*	1-2	6″- 10″	17
18.	Jigni	*Trema orientalis*	1	6″- 8″	18
19.	Koroi	*Albizia procera*	1	6″- 8″	19
20.	Aam	*Mangifera indica*	1	6″- 8″	20
21.	Deshi neem	*Azadirachta indica*	1	6″- 8″	21
22.	Pitraj	*Aphanamixis polistachya*	1	4″- 6″	22

The selected parameters of respondent s and homestead and crop field components were considered as the independent variables, whereas, total land observed in agroforestry system was considered as the dependent variable. Hence, the co-efficient of correlation “r” was computed in order to determine interrelationship among the selected variables. The summary of the results of the inter-correlation analyses has been presented in Table 1.

Table-4. Annual income from crop field

Category	Farm size	Average income (thou Tk.)	Mean	Standard deviation
Landless	00-0.60	17.9167		
Small	0.61-2	23.9091	27.4700	0.97006
Medium	2.10-7	29.6667		
Large	8-18	65.7143		

From the above discussion, it is obvious that the annual income was highest when the farm category was large and landless farmers earn less money from their less land property and lower income sources while the large farmers have many income sources with higher land properties. In the rural areas, new avenues have hardly been created for earning cash. Mostly farming and farm related part time activities are common for earning, very few non-farm jobs are available in the villages. As a result overhelming proportion of the farm families or respondents constitutes low and marginal and landless categories of income.

Table-5. Annual income from tree coverage area

Category	Farm size	Average income (thou Tk.)	Mean	Standard deviation
Marginal	0.01-0.05	2.5345		
Small	0.06-0.25	4.6667	3.5800	6.38761
Medium	0.30-0.50	4.8000		
Large	0.50<	8.2500		

Family income scores of the tree coverage area average income 2.5345 to 8.2500 thousand Taka and its total average mean 3.5800 and its standard deviation 6.38761.

Table- Agroforestry system and its benefits with popular indigenous water logging tree at crop field

Species	Cropping system	Intercrops name	Population/decimal		No of respondent for each cropping system	Yield/decimal		Price		Outcome (Tk)/intercrop cycle		
			Tree	Crop		Tree (cft)	Intercrop (kg)	Tree yield (Tk/cft)	Crop yield (Tk/kg)	Tree	Crop	Total
Chatim	Inter	Rice	1	1000	4	7	25	500	10	3500	250	3750
Jiga	Inter	Rice	2	900	11	6	20	400	10	2400	200	2600
Pitali	Inter	Rice	2	950	9	5	25	500	10	2500	250	2750
Pani safety	Inter	Rice	1	1000	5	6	30	500	10	3000	300	3300
Hijal	Inter	Rice	1	950	7	5	22	500	10	2500	220	2720
Jarul	Inter	Rice	2	900	9	6	20	500	10	3000	200	3200
Kadam	Inter	Maize	1	1000	3	7	25	300	8	2100	200	2300
Sheora	Inter	Rice	2	900	4	7	20	300	10	2100	200	2300
Sonalu	Inter	Rice	2	1000	4	6	25	250	10	1500	250	1750
Shimul	Inter	Rice	1	900	5	8	20	200	10	1600	200	1800
Mandar	Inter	Rice	3	850	7	9	18	200	10	1800	180	1980
Dumur	Inter	Rice	2	900	5	8	20	300	10	2400	200	2600

Uses of water logging indigenous tree against human attitude

Sl. No.	Name of tree species		Plant parts uses	Timber	Fuel	Medicine	Others
	Local name	Scientific name					
1.	Pani safety/Pani dumur	*Ficus clavata*	All parts of tree	Stem	Branch and leaves		Furniture, house works an others
2.	Pitali	*Trewia nudiflora*	All parts of tree	Stem	Branch and leaves		Furniture, house works, hedge
3.	Jiga	*Lannea coromandelica*	All parts of tree	-	Stem, Branch and leaves		Hedge, fence, supporting stick etc.
4.	Jarul	*Lagerstroemia speciosa*	All parts of tree	Stem	Branch and leaves		Furniture, window, door, housework
5.	Hijal	*Barringtonia acufangula*	All parts of tree	Stem	Branch and leaves		Furniture, window, door, housework
6.	Dholi	*Dipterocarpus alatus*	All parts of tree	Stem	Branch and leaves		Furniture, window, door, housework
7.	Sheorah	*Streblus asper*	All parts of tree	Stem	Branch and leaves		Hedge, fence, supporting stick etc.
8.	Babla	*Acacia nilotica*	All parts of tree	Stem	Branch and leaves		Hedge, fence, supporting stick etc
9.	Mandar	*Erythrina variegata*	All parts of tree	Stem	Branch and leaves	Flower use for medicine	Hedge, fence, supporting stick etc
10.	Chatim	*Alstonia scholaris*	All parts of tree	Stem	Branch and leaves	High blood pressure, fever, Diarrhoea	Furniture, window, door, housework

Contd.

Sl. No.	Name of tree species		Plant parts uses	Timber	Fuel	Medicine	Others
11.	Bohala		All parts of tree	Stem	Branch and leaves	Fruits are use for medicine	House building, suitable for constructional work
12.	Kul	*Ziziphus mauritiana*	All parts of tree	Stem	Branch and leaves	Fruits are use for medicine	Fruit is edible wood is heavy used in house construction
13.	Dumur	*Ficus lepidosa*	All parts of tree	Stem	Branch and leaves	Fruits are use for medicine	Furniture, agricultural implementation
14.	Khoksha	*Ficus hispida*	All parts of tree		Stem branch and leaves		Leaf is used for fodder, constructional work
15.	Nunia	*Aegialitis rotundifolia*	All parts of tree	Stem	Branch and leaves		Leaf used for commercial purpose wood is light hard used for construction material
16.	Shimul	*Bombax ceiba*	All parts of tree	Stem	Branch and leaves	Seedling roots are use for constipation	Leaf is used for product wood are used for matchstick
17.	Kadam	*Anthocephalus chinensis*	All parts of tree	Stem	Branch and leaves	Fruits are use for medicine	Suitable for constructional work, ornamental
18.	Makrijam/Butyjam	*Syzygium balsameum*	All parts of tree	Stem	Branch and leaves	Fruits are use for medicine	Furniture, door and window frames etc.
19.	Pakur	*Ficus lacor*	All parts of tree	Stem	Branch and leaves		Chair, bench, furniture, and flooring etc.
20.	Bot	*Ficus benghalensis*	All parts of tree	Stem	Branch and leaves		Chair, bench, furniture, and flooring etc.

Contd.

Sl. No.	Name of tree species		Plant parts uses	Timber	Fuel	Medicine	Others
11.	Bohala		All parts of tree	Stem	Branch and leaves		House building, suitable for constructional work
21.	Palas	*Butea monosperma*	All parts of tree	Stem	Branch and leaves		Wood is find texture, furniture, house building etc.
22.	Sonalu	*Cassia fistula*	All parts of tree	Stem	Branch and leaves		It is very hard used for agricultural implementation, house post etc.
23.	Khori/Kori	*Xerospermum noronhianum*	All parts of tree		Stem branch and leaves		Leaf is used for fodder, wood is used construction materials
24.	Jam	*Syzygium cumini*	All parts of tree	Stem	Branch and leaves		Fruit is edible, wood is hard & heavy use in foundry, furniture etc.
25.	Bel	*Aegle marmelos*	All parts of tree	Stem	Branch and leaves		Fruit is edible, wood is hard & heavy use in foundry, furniture etc.
26.	Haritaki	*Terminalia chebula*	All parts of tree	Stem	Branch and leaves	Fruit is used for medicine	Wood is heavy & hard used for furniture, door, window frames etc.
27.	Paniala	*Flacourtia jangomas*	All parts of tree	Stem	Branch and leaves		Fruit is edible, wood is hard & heavy use in foundry, furniture etc.
28.	Kanchan	*Bauhinia acuminata*	All parts of tree	Stem	Branch and leaves		It is a ornamental tree
29.	Bankanthal	*Artocarpus lacucha*	All parts of tree	Stem	Branch and leaves		Wood is very fine used for furniture, door & window frames etc.
30.	Latka	*Baccaurea ramiflora*	All parts of tree	Stem	Branch and leaves		Fruit is edible, wood is hard & heavy use in foundry, furniture etc.

Contd.

Sl. No.	Name of tree species		Plant parts uses	Timber	Fuel	Medicine	Others
31.	Jalpai	*Elaeocarpus floribundus*	All parts of tree	Stem	Branch and leaves		Fruit is edible, wood is hard & heavy use in foundry, furniture etc.
32.	Chalta	*Dillenia indica*	All parts of tree	Stem	Branch and leaves		Fruit is edible, wood is hard & heavy use in foundry, furniture etc.
33.	Jigni	*Trema orientalis*	All parts of tree		Stem branch and leaves		Wood is used constructional materials
34.	Koroi	*Albizia procera*	All parts of tree	Stem	Branch and leaves		Wood is extremely hard & heavy, used for furniture, decorative work
35.	Aam	*Mangifera indica*	All parts of tree	Stem	Branch and leaves		Fruit is edible, wood is hard & heavy use in foundry, furniture etc.
36.	Deshi neem	*Azadirachta indica*	All parts of tree	Stem	Branch and leaves	Fruit leafs used for medicine purpose	Wood is extremely hard & heavy, used for furniture, decorative work
37.	Pitraj	*Aphanamixis polistachya*	All parts of tree	Stem	Branch and leaves	Fruit used for medicine purpose	Wood is extremely hard & heavy, used for furniture, decorative work
38.	Bizal ghanta	*Bizal sp.*	All parts of tree	Stem	Branch and leaves	Leafs and bakhal used for medicine purpose	Wood is extremely hard & heavy, used for furniture, decorative work
39.	Bakul	*Mimosop elengi*	All parts of tree	Stem	Branch and leaves	Fruit used for medicine purpose	Fruit is edible, wood is hard & heavy use in foundry, furniture etc.

Contd.

Sl. No.	Name of tree species		Plant parts uses	Timber	Fuel	Medicine	Others
11.	Bohala		All parts of tree	Stem	Branch and leaves		House building, suitable for constructional work
40.	Charka		All parts of tree	Stem	Branch and leaves		Wood is fine texture used for house building, furniture, decorative work etc.
41.	Dhud bot		All parts of tree	Stem	Branch and leaves		Wood is fine texture used for house building, furniture, decorative work etc.
42.	Pathuri		All parts of tree	Stem	Branch and leaves		Wood is extremely hard & heavy and used for decorative work, furniture, door and window frames
43.	Jamrul		All parts of tree	Stem	Branch and leaves		Fruit is edible, wood is hard & heavy use in foundry, furniture etc.
44.	Tetul		All parts of tree	Stem	Branch and leaves		Fruit is edible, it used for commercial purpose like achar, jelly, wood is hard & heavy use in foundry, furniture etc.
45.	Khat gua		All parts of tree	Stem	Branch and leaves		Wood is very hard & heavy and used for decorative work, furniture, door and window frames
46.	Guti		All parts of tree	Stem	Branch and leaves		Wood is very hard & heavy and used for decorative work, furniture, door and window frames

Species conservation

From the study more than 50 useful indigenous water logging tree species were found to be conserved in the homestead and crop field of the study area. The present study revealed that maximum tree species like dewa, deshigab, belatigab, lotka, dumar, chalta, panifal, kazubadam, pani safety were found very rare in homestead and crop field. Some farmers reported that they had felled some of the indigenous species for their slow growing and low economic value and replaced by planting exotic species. Ahmad 1997 indicated in his study that about 31 minor fruit species, have reached a stage of near extinction from the homestead in Bangladesh. There is no strategy and policy have been taken by government/non-government institute to preserve the indigenous and minor species from the verge of extinction, except traditional homestead practice by farmers. Moreover a wide array of productive plant species with different phenology of offers a great deal of food stability to livestock and wild animals including insects, reptiles, birds, and small mammals throughout the year.

Relationship among the independent and dependent variables

The selected parameters of respondents and homestead & crop field components were considered as the independent variables, whereas, total land system was considered as the dependent variable. Hence, the co-efficient of correlation ‘r’ was computed in order to determine interrelationship among the selected variables. The summary of the results of the inter-correlation analyze have been presented in Table ---.

Table-1. Correlation between the independent and dependent variables

Variable	Total land	Homestead area	Cultivation land	Tree coverage area	Fallow land	Area under waterlog	Education level	Tree income	Crop income	Subsistence cost	Education cost	No of tree in homestead	Tree yield in homestead	Number of tree in the crop field	Tree yield in the crop field
Total land															
Homestead area	0.524**														
Cultivation land	0.948**	0.440**													
Tree coverage area	0.447**	0.520**	0.416**												
Fallow land	0.323**	0.206**	0.099	0.065											
Area under waterlog	0.513**	0.299**	0.303**	0.197*	0.730**										
Education level	-0.038	0.266**	-0.027	0.176	-0.006	0.046									
Tree income	0.213**	0.124	0.101	0.170	0.249**	0.516**	0.085								
Crop income	0.765**	0.421**	0.812**	0.392**	-0.004	0.194	0.057	0.104							
Subsistence cost	0.468**	0.309**	0.475**	0.347**	0.025	0.202*	0.181	0.050	0.572**						
Education cost	0.657**	0.442**	0.692**	0.482**	0.032	0.192	0.128	0.210*	0.752**	0.520**					
No of tree in homestead	0.055	0.111	-0.024	0.129	0.187	0.235*	0.118	0.338**	0.093	0.154	0.157				
Tree yield in homestead	0.176	0.063	0.055	-0.036	0.323**	0.408**	-0.003	0.230	0.061	0.214	0.047	0.430*			
No of tree in crop field	0.341	0.191	0.247	0.379**	0.262**	0.353**	0.007	0.215*	0.237*	0.256	0.272**	0.360**	0.309**		
Tree yield in the crop field	0.164	0.138	0.092	0.153	0.144	0.224*	0.100	0.268**	0.089	0.072	0.034	0.402**	0.298**	0.421**	

** Correlation is significant at the 0.01 level (2-taild)

* Correlation is significant at the 0.05 level (2-taild)

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APPENDICES

Appendix I: Indigenous tree species that was identified in the study area

Sl. No.	Name of tree species		
	Local name	Scientific name	Family name
1.	Pani safety/Pani dumur	*Ficus clavata*	Moraceae
2.	Pitali	*Trewia nudiflora*	Euphorbiaceae
3.	Jiga	*Lannea coromandelica*	Anacardiaceae
4.	Jarul	*Lagerstroemia speciosa*	Lythraceae
5.	Hijal	*Barringtonia acufangula*	Lecythidaceae
6.	Dholi	*Dipterocarpus alatus*	Dipterocarpus
7.	Sheorah	*Streblus asper*	Moraceae
8.	Babla	*Acacia nilotica*	Mimosaceae
9.	Mandar	*Erythrina variegata*	Fabaceae
10.	Chatim	*Alstonia scholaris*	Apocynaceae
11.	Bohala	*Intsia bijuga*	Caesalpiniaceae
12.	Kul	*Ziziphus mauritiana*	Rhamnaceae
13.	Dumur	*Ficus lepidosa*	Moraceae
14.	Khoksha	*Ficus hispida*	Moraceae
15.	Nunia	*Aegialitis rotundifolia*	Plumbaginaceae
16.	Shimul	*Bombax ceiba*	Bombacaceae
17.	Kadam	*Anthocephalus chinensis*	Rubiaceae
18.	Makrijam/Butyjam	*Syzygium balsameum*	Myrtaceae
19.	Pakur	*Ficus lacor*	Moraceae
20.	Bot	*Ficus benghalensis*	Moraceae
21.	Palas	*Butea monosperma*	Fabaceae
22.	Sonalu	*Cassia fistula*	Caesalpiniaceae
23.	Khori/Kori	*Xerospermum noronhianum*	Sapindaceae
24.	Jam	*Syzygium cumini*	Myrtaceae
25.	Bel	*Aegle marmelos*	Rutaceae

Appendix I: (Contd.)

Sl. No.	Name of tree species		
	Local name	Scientific name	Family name
26.	Haritaki	*Terminalia chebula*	Combretaceae
27.	Paniala	*Flacourtia jangomas*	Flacourtiaceae
28.	Kanchan	*Bauhinia acuminata*	Caesalpiniaceae
29.	Bankanthal	*Artocarpus lacucha*	Moraceae
30.	Latka	*Baccaurea ramiflora*	Euphorbiaceae
31.	Jalpai	*Elaeocarpus floribundus*	Elaeocarpaceae
32.	Chalta	*Dillenia indica*	Dilleniaceae
33.	Jigni	*Trema orientalis*	Ulmaceae
34.	Koroi	*Albizia procera*	Mimosaceae
35.	Aam	*Mangifera indica*	Anacardiaceae
36.	Deshi neem	*Azadirachta indica*	Meliaceae
37.	Pitraj	*Aphanamixis polistachya*	Meliaceae
38.	Bizal ghanta		
39.	Bakul	*Mimosop elengi*	Mimosaceae
40.	Charka	*Albizia lucidor*	Mimosaceae
41.	Dhud bot		
42.	Pathuri		
43.	Jamrul		
44.	Tetul	*Tamrindus indica*	Caesalpiniaceae
45.	Khat- goa	*Eh retia Serrata*	Ehretiaceae
46.	Guti		

Appendix-II: Annual rainfall for the year 1992-2002 in the study area

Year	1992	1993	1994	1995	1996	1997	1998	1999	2001	2002
Rainfall (mm)	2488	2225	2006	2440	1301	2811	2036	1968	2565	2961

Source: Agricultural Office, Rangpur district

Unlike the tropical fruit trees of American and Asian origin, indigenous fruit trees (IFT) of tropical Africa have scarcely achieved the status of international recognition...Â We use cookies to offer you a better experience, personalize content, tailor advertising, provide social media features, and better understand the use of our services. To learn more or modify/prevent the use of cookies, see our Cookie Policy and Privacy Policy. Accept Cookies. top. The indigenous systems and participatory approaches to conservation, documentation and promotion of indigenous knowledge with due respect of intellectual property rights of these indigenous people require immediate attention. This is a report of a rather quick and preliminary investigation through farmer consultation and field visits to Kutai Barat district in East Kalimantan supplemented with some literature review.Â The environment has shaped their complex cultures and beliefs. The vice versa is equally true. The Dayak people created a mosaic of land use systems including swidden agriculture, mixed fruit orchards, rubber and rattan plots and woodlots.