



WOMEN-LED INTEGRATED HOMESTEAD AGRO-FARMING: A DESIGNERLY PERSPECTIVE

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Abstract

A growing population with rising per capita income has intensified the competition for limited land in Bangladesh. As regulation of land use is largely absent in rural areas, agricultural land use is getting indiscriminately converted into non-agricultural uses. This conversion is threatening agro-based food security of the country in general and of the rural households in particular. Regarding this issue, the current government has emphasized the rural homestead as a 'production unit' of agro-farming. As an important source of food and nutrition, homestead farming is an integral part of rural settlements where women play a vital role. However, in most of the cases, it is done in an un-integrated and rudimentary manner. As a result, they are unable to yield the maximum from homestead farming. In this context, the research focuses on designing integrated homestead agro-farming based on case studies of two homesteads of a typical village in Batiaghata, Khulna. With an exploratory approach the research methodology is designed with a three-stage framework. Stage I includes investigation of the categories and needs of agro-products focusing on the role of women in production, processing, management and consumption; Stage II includes exploration of existing spatial-morphological patterns and extent of different types of agro-farming; while Stage III includes development of design schemes for integrated homestead agro-farming. Based on the triangulation of findings, this research contributes strategic physical-spatial design considerations for integrated homestead agro-farming towards ensuring household food security in a socially sustainable and agro-ecologically resilient manner.

Keywords: Integrated Agro-farming, Rural Homestead, Physical-spatial Considerations, Food Security

Introduction

At its current annual growth rate of ca 2 million, Bangladesh's estimated population of 163 million in 2019 could reach above 200 million within next 20 years (World Population Review, 2019). Bangladesh is already a densely settled country, experiencing strong pressure on land. In the absence of stringent planning and land use control for rural areas, crop cultivation is limited to more or less 70% of the total area of the country, which is decreasing at a rate of about 1% annually (Hossain, 2015). One of the reasons is, agricultural lands of the country are now dotted with commercial, residential, industrial, and other inappropriate uses (Hasan,

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2013). Therefore, research suggests that land use changes will reduce the area of land available for agriculture by some 1.4 million ha (17 per cent) over the next 25 years (LANDac, 2016).

Apart from population rise, almost 80% of the country is considered as floodplain, and recurrent floods and other natural hazards often destroy crops and erode agricultural land and fertile top soils (USAID, 2010). These disaster impacts affect the food security and food sovereignty of the country. Furthermore, due to sea level rise, saline intrusion, shrimp farming, and climate vulnerability, food security is already very weak in the coastal districts (Adam, 2013). Currently, more than 40 million Bangladeshis do not have access to adequate amounts of safe, nutritious food to sustain a healthy and productive life (IFPRI, 2016). Owing to this situation, the second goal of the SDGs (Sustainable Development Goals) is set to 'End hunger, achieve food security and improved nutrition, and promote sustainable agriculture' globally (Brooks, 2016). Moreover, in the 7th five-year plan and "Delta Plan 2100" (van Scheltinga, 2015), ensuring food security in the future is listed as a long-term integrated approach.

For ages, rural homesteads have accommodated different agro-farming components within the homestead territory to fulfill the household needs of food and nutrition. Sometimes, these components not only support in-house food consumption but also provide economic benefits to the rural people. Evidence shows that homestead farming has improved food security for more than 5 million vulnerable people in diverse agro-ecological zones of Bangladesh (Lennotti, 2009). However, homestead farming is mainly done by rural women in developing countries to improve household consumption (Marsh, 1998; Ferdous et al., 2016; Rahman, 2017). A recent study reported that overall participation of rural women in homestead agricultural activities in Bangladesh is 63.4%, compared to men's participation. (Mukta, 2020).

Agro-farming components are available in almost every rural homestead but are arranged in a rudimentary manner. Sometimes these arrangements are inefficient in terms of potential production. Moreover, changes in rural demography, the rural-urban continuum, and agricultural technology, including the extended supply chain and market linkages that facilitate powerful actors and corner the marginal to the peripheries, induce varied dynamics and continuously reconfigure the socio-spatial structure of rural settlement. (Alam, 2016). All of these issues point to a change in the traditional rural morphology, which leads to a drop in productivity from agriculture (Quasem, 2011).

The 'Ekti Bari Ekti Khamar' (One House, One Farm) project has been taken up by the government of Bangladesh to implement the concept of improving agriculture productivity and alleviating rural poverty through integrated family farming. This intervention has already opened the scope for built environmental professionals to analyze and visualize the socio-spatial dynamics of the agro-farming integrated homestead. Based on this scope, this study primarily investigates the current status of need and variety of agro-farming components with the focus of women's role in a peri-urban village *Choighoria*, of *Batighata Upazilla*, Khulna. Later, the research explores physical-spatial connections of agro-farming components with the rural homestead morphology in the given context. In-depth understanding of physical-spatial considerations of the agro-farming components and their integration with the homestead may help to accelerate homestead farming production in the future and regain household food security.

Literature Review

The physical geography of the deltaic landscape of Bangladesh is formed by the relation between nature and the river. Here, the location and spatial links between the homesteads, paddy fields, and groves are determined by the relative location, orientation, and distance of the river and the surrounding ecosystem services. Besides, the social-cultural-spatial pattern of the vernacular settlement is shaped by fertile stretches of land and an intricate network of waterscape composed of river, pond, canal, channel, stream and ocean (Mannan & Barua, 2011). The homestead is a core spatial component of this fertile settlement, defined by the land owned and/or occupied by the dwelling unit and living spaces. It is a complex spatial unit comprised of the house(s) and its surrounding areas including the courtyard, pond, pedestrian path; adjacent spaces used for cultivation of trees and vegetables and other household activities (Abdullah, 1982). Moreover, the homestead is the center of all

agricultural production activities in rural Bangladesh. It is both the dwelling place and the production unit of vegetables, fruits, fuel, timber, livestock and fisheries (Rahman, 2007).

Feeding the additional population requires priority attention to secure food and nutrition for the future. Apart from accelerating cereal crop production, measures are also needed to increase production of other crops, livestock and fish to keep pace with population growth (Brammer, 2017). On this notion, the Agriculture and Rural Development Section, PRSP, 2005 highlights the creation of an enabling environment and playing supportive roles for the intensification of major crops (i.e. cereals diversification to high value non-cereal crops, (i.e. fruits & vegetable) development of non-crop enterprises (i.e. livestock, fishery, poultry) (Mandal, 2006). Therefore, investigating the existing variety and production-consumption status of context specific agro-farming components is the primary interest of this study.

The concerning aspect is that regulation of land use is largely absent in rural areas. In 2001, for the first time, National Land Use Policy emphasized the efficient use of land to ensure minimum level of food security with a focus on minimizing loss of cropland and preparing guidelines for land use for different regions (Mandal, 2006). However, there remained plenty of room for relaxation, and the restrictions were largely ineffective (LANDac, 2016). Later, the Draft Agricultural Land Protection and Land Use Bill of 2011, which was further developed in 2015, 2016, was finally tabled in parliament at March, 2022 to ensure proper use and protection of agricultural land. The bill demonstrates a strong determination to restrict the existing agricultural land only for cultivation under any circumstance to meet the future food security. On the other hand, Ekti Bari and Ekti Khamar (EBEK) project is being emphasized to fulfill the household food consumption of rural people. One of the core objectives of EBK project is to establish each and every rural household as an agro based family farm utilizing local and natural resources.

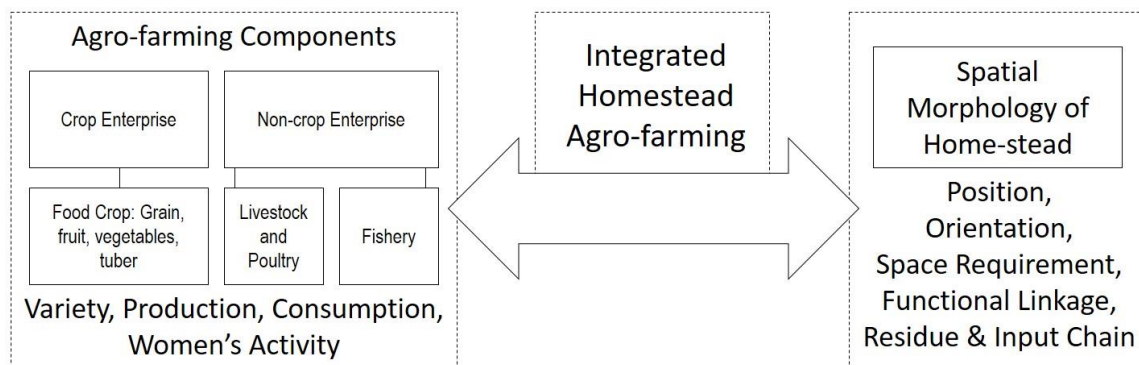


Figure 1. Conceptual Framework of the study.

It is clear that measures to increase production at the required rate are mainly agricultural and structural. In a recent study, it is stated that more attention is required to be paid to the structural measures that are less well-known and that have more serious environmental implications (Brammer, 2017). Therefore, concerns have been raised not only to ensure the region's food security but also for the sustenance of agricultural practices of the large rural demography in retaining the traditional village morphology (Alam, 2016). Furthermore, the spatial-physical relationship of different agro-farming components with rural homesteads remained untouched in other studies. Towards this concern, this research is conceptualized in such a way that agro-farming components of rural homesteads have a strong relationship with existing rural morphology, and therefore, unleashing this folded phenomenon is crucial towards formulating integrated physical-spatial considerations (See Figure 1).

Materials and Methods

Both social and spatial data are collected for further investigation of this empirical study. Social data is required to understand the needs of agro-farming products, with a focus on women's role in different agro-farming activities (Cranz, 2016; Kottak, 2015; Lévi-Strauss, 1977). Spatial data can give a full picture of the relationship between rural morphology and different agro-farming production systems (Ahmed, Opoku, and Aziz, 2016; Knight and Ruddock, 2009). Social attributes are diversity and type of homestead agro products; production and consumption of crop and non-crop farming; and women's role in pre-post crop harvesting, cattle rearing, and poultry-fishery raising. Spatial indicators include positioning, orientation, space requirement, functional linkage, and residue-input chain, which explore the existing spatial-physical inter-relationship between different agro-farming components and rural morphology.

The study investigates one representative village, named Choighoria (Figure 2) of Batiaghata Upazilla in the southwestern coastal district of Khulna, Bangladesh. Empirical evidence confirms that the peri-urban village and its ongoing structural and spatial transformations are representative of the villages throughout Bangladesh. Choighoria has a population of 4,100, where 52% are women. The people of this village have been dependent on agriculture for a long time. Currently, almost 83% of people are directly engaged in agricultural food production. The area of total agricultural land is 160 acres. The conversion of farmland to non-farm uses has increased by 10% in the last 20 years. The village is selected on the ground that more than 50% of the inhabitants of this village are women and they are actively involved with homestead agro-farming activities. Furthermore, Khulna is situated in the agro-ecological zone (AEZ 13) having heavy silt clay and alkaline conditions with medium-high fertility. The 'Ganges Tidal Floodplain' seems to be one of the regions with highly increased cropping intensity in the last 20 years, producing a good share of regional domestic agricultural products (Quddus, 2009).

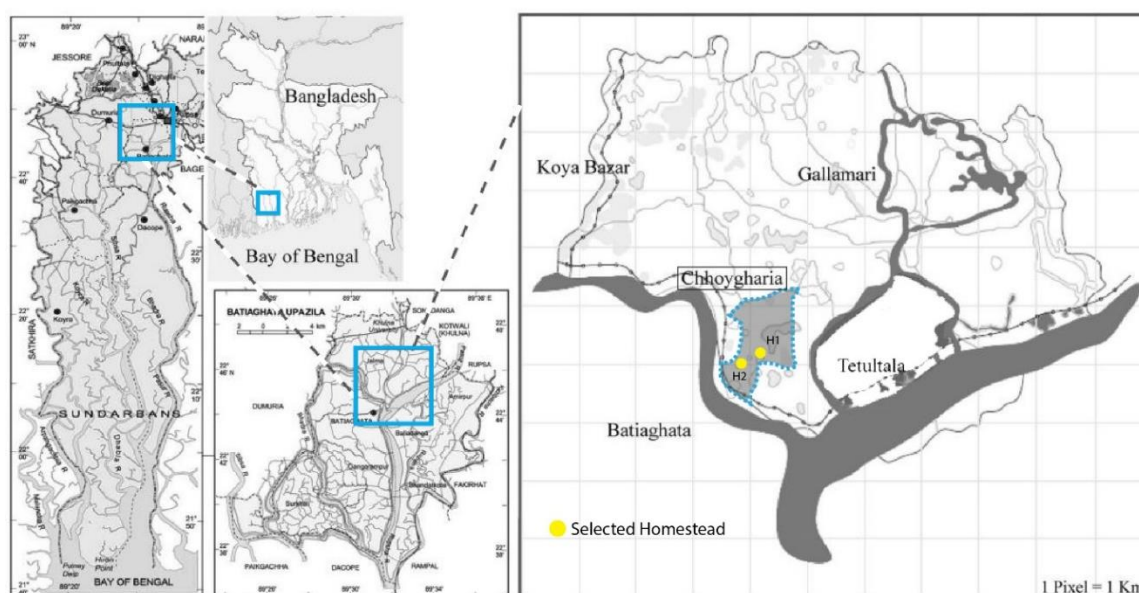


Figure 2. Location map of Choighoria villages in Bangladesh, extracted from google map.

By applying qualitative case study approaches, face-to-face interviews on semi-structured questionnaires are conducted to collect the social data from February to April 2022. For the spatial data, direct

observation and face-to-face interviews are carried out to understand the existing physical-spatial scenarios. The purpose of the study is briefly explained to the respondent before the data collection stage.

The target group for collecting data includes young and middle age women, who are actively engaged in different farming activities. Random sampling is used to collect information. A total of 30 females are randomly selected, 10 young adult women were within an age range of 18-39 years and the rest of the 20 respondents were middle age women within an age range of 40-65 years. Middle aged women are prioritized since it is identified in other literature that they are highly motivated for agricultural activities besides their household works (Rahman, 2007). Two homesteads are selected to explore the spatial morphology. The larger one has arable land and pond adjacent to the homestead while the other homestead is compact without having any agricultural land.

Results

Category, need of agro-farming and women's role

At the initial stage of this study, the current status of available agro products is identified for the selected village Choighoria. As a sample, 30 randomly selected respondent women, aged between 18-65 years old, represent the agro-farming status of 300 homesteads in the village as a whole. According to the data collected from interviewed women, 90 percent are directly involved in homestead agro-farming activities. Under food crop cultivation, the presence of cereal and non-cereal food crops in homestead territory is asked. It is found that very few (20%) homesteads have adjacent large arable land and thus do not cultivate food grains (mainly rice) around their houses. But non-cereal crops like fruits and vegetables are cultivated in 97% of houses. Within these non-cereal products, a wide variety of fruit trees are identified around the homestead. Among them, mango, guava, jackfruit, papaya, sapodilla, coconut, and jujube are the most common fruits cultivated. Comparatively, the vegetables have less variety than fruit. Tomato, cucumber, chili, spinach, pumpkin, and lemon are the most widely cultivated vegetables.

To identify the variety of livestock and poultry, the total number of cattle, goat, sheep, hen, duck and pigeon is asked in each homestead. Cattle and duck are the most widely available livestock (95%) found in the settlement. Poultry raising (85%) is also very common. The area is significantly rich in fisheries as most (90%) houses have their own pond adjacent to the homestead. The white fish named Rohu, Catla, Mrigal, Tilapia, Pangasius, Climbing Perch, and diversified carps etc. are mainly farmed in the pond. From Figure 3, we can see the availability and variety of different agro-farming components. Each component of agro-farming in a homestead is counted as a single unit to prepare the following chart.

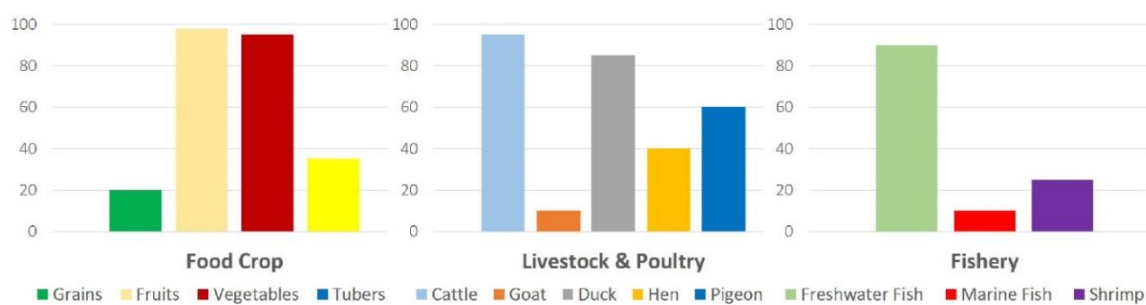


Figure 3. Agro-farming product variety in Choighoria village.

The interdependence of production and consumption determines the need. To understand the need for agro-based food in Choighoria village, monthly homestead farming production and the amount of food components bought from the market are asked in three defined categories (Crop, Livestock and Poultry, and

Fishery). In a recent study, it is identified that the availability of sufficient farm area is a vital indicator for adopting homestead gardening (Akter, 2021). People with large farms were more likely to grow their own food at home, and this is also true in Choighoria. Small homesteads without adjacent arable land were found to have an insufficient production rate. But due to geographic potential, Choighoria village is almost self-sufficient in fish farming. With the fish obtained from the ponds and nearby farms, traditionally named as Gher (95% consumption), almost all protein needs of the villagers are met. Fish remains on their regular food menu while having rice as a core meal. On the other hand, the supply of milk, eggs, and meat comes from livestock and poultry farming. Although a total of 96% of the consumed milk comes from domestic cattle, to meet the monthly demand, an average of 60% of meat and 30% of eggs have to be bought from the market. In the case of food crops, only fruit trees are present in almost all the houses. About 92 percent of the total month's fruit consumption comes from the surrounding plants. The villagers get almost all of the essential vitamins and micronutrients from a variety of native fruits.

Although grain is not produced in large quantities at homesteads, 90 percent of the villagers' rice comes from the surrounding paddy fields. The situation is quite insignificant with vegetables, because a family of 4 has to buy an average of 20 kg of vegetables from the market every month. In winter, rice as well as various vegetables are cultivated on a large scale in the surrounding agricultural land. It has been discovered that homestead vegetable farming accounts for only 50% of the supply of vegetables during that season (See Figure 4). The following chart shows the components of monthly food consumption and how much comes from homestead crop, livestock, poultry and fish farming.

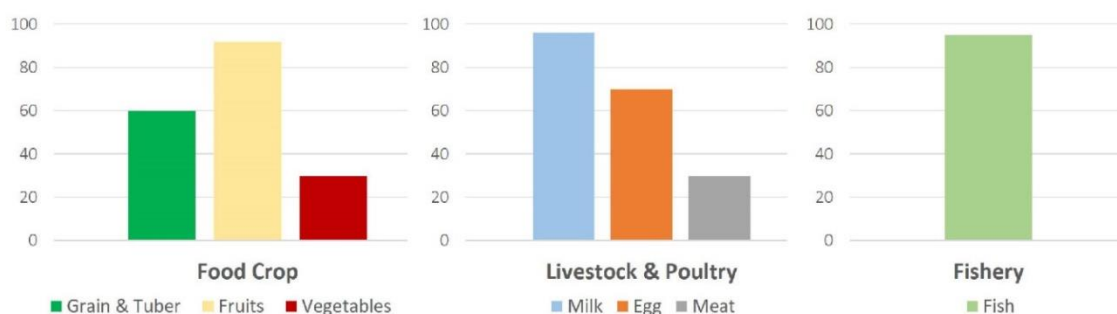


Figure 4. Monthly food consumption from homestead agro-products.

We have already learned from existing literature that the participation of women in homestead farming activities is comparatively much higher than that of men. Of the three agro-farming components we have explored in this study, the women of Choighoria village are making significant contributions in crop cultivation, cattle rearing, and poultry raising. Rural women regularly participate in activities like harvesting, weeding, mulching, irrigation, cattle and poultry house cleaning and feeding. But insignificant participation is found in fish farming activities. Men are found to be more active than women in homestead fish farming. To understand the participation of women in homestead farming, Figure 5 highlights the position of women in different farming activities.

Existing spatial-morphological pattern

The paradox of a sustainable rural future depends on our sensitivity to recognizing the context-specific dynamics that drive the socio-spatial changes (Alam et al., 2016). To explore the rural morphology, two homesteads from the village of Choighoria have been taken as cases for spatial analysis. To understand the existing spatial-morphological pattern, the position, orientation, functional linkage, and space requirement of crop land, cattle and poultry shed, and farming pond, subject to the internal built and natural setting of the

Crop Cultivation	Activity	Land Selection	Weeding	Bed Preparation	Sowing	Mulching	Irrigation	Application of fertilizer	Support Arrangement	Harvesting	Collection & preservation of seed
	Women's Participation	0	✓	✓	✓	✓	✓	✓	0	✓	✓

Cattle Raising & Poultry Rearing	Activity	Collection of Cattle & Poultry	House making	Cattle & Poultry in-out	Collecting and Storing Eggs	House Cleaning	Food Preparation	Feeding	Cattle Bathing	Cleaning & Collecting Feces
	Women's Participation	0	0	✓	✓	✓	✓	✓	0	✓

Fish Farming	Activity	Pond Preparation	Uproot Weed	Eradicate Unexpected Fish	Fertilizer Application	Spreading Fingerling	Feeding	Water Clearing	Spreading Lime	Harvesting
	Women's Participation	0	0	0	✓	0	✓	0	✓	0

Figure 5. Women's role in different homestead agro-farming activities,

homestead, have been observed.

The large homestead adjacent to the arable land shows that its extension is elongated east-west. In terms of zoning, the two larger zones of cultivable land are to the east and the house forms are to the west. A typical morphological feature of the rural homestead is the arrangement of a number of closely spaced single-storied (or sometimes double-storied) one-to-two-room rectangular buildings around a square or rectangular open courtyard (Sultana, 1993). Similar characteristics are evident in this homestead: single-story built forms with functions like sleeping area, dining, kitchen, haystack, worship house, livestock-poultry house, toilet, bathing area, and storage are arranged around the central courtyard (See Figure 6). Of all these functions, livestock and poultry houses are located in the north-west. This position and orientation help to keep the inner environment dry and the bad smell from entering the other functions.

The homestead's total area is 33375 sq. ft., of which a dominant 46 percent is the crop farming area. The remaining 17888 sq. ft. includes functional built form area (8%), a farming pond (10%), courtyard and circulation (14%), and unused space (22%). Due to the presence of agricultural land next to the house, a small amount of vegetable cultivation has been observed inside the built-form cluster. All those cultivations are placed on the south side to ensure direct sunlight for the growth of the plants throughout the year. Moreover, these small lands are very near to the kitchen, as they can be reached multiple times by the women of the homestead. The presence of adequate fruit plants can be seen around the house. Mostly, they prefer to grow large trees on the northern side of the homestead. This is done so that the trees do not damage the house during strong winds or in the event of natural calamities. But this characteristic is not maintained in this homestead. Fruit trees are cultivated randomly around the homestead. However, according to the respondent's interview, large folly trees are not planted around the yard so that the shade of the tree does not interfere with the drying of the paddy in the yard and other post-harvesting activities. Since the yard is large enough, almost all the work post-harvesting is done by the women of the house in this yard.

Farming pond size: 3300 sq. ft. and depth of 10 ft. Apart from fish farming, the pond is also used for small household chores such as washing dishes and bathing cattle. This is another reason for positioning the kitchen adjacent to the pond. Besides, the residual waste from the kitchen and dining is used to make fish food and fertilizer. Cattle house size is 18 ft. by 10 ft., height is 10 ft., and the area can serve a total of 6 cattle. As a supporting function, a haystack for food and a pond for bathing water are located next to this cattle house.

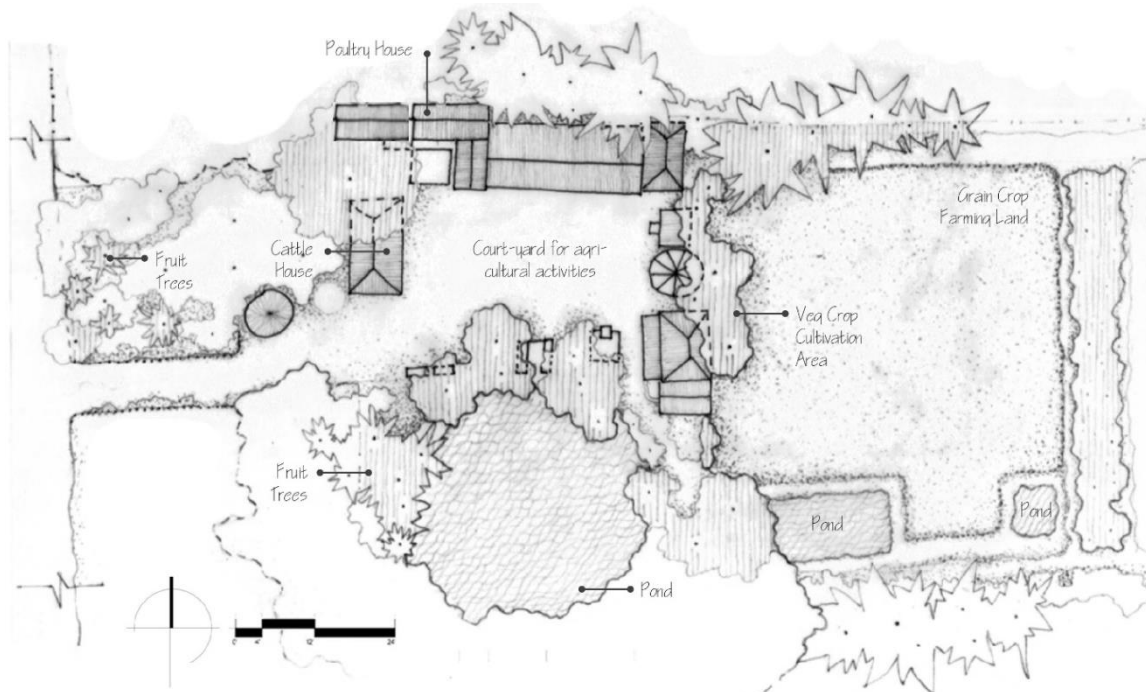


Figure 6. Existing agro-farming components of homestead 1.

Likewise, at other homesteads, the cattle shed is the first approachable function after entering the house. As a result, it is convenient to repeatedly bring cattle out of the house for plowing the farm land or bathing in the river, and this keeps the yard clean and dry. All agro-farming components are scattered around the large homestead and sometimes it becomes difficult for the housewife to manage different farming activities.

The other homestead taken for case study is very compact, there is no agricultural land and farming pond with this homestead. Moreover, since the main earner of the household is not a farmer, they do not have food crop and fish production (See Figure 7). As a result, like previous case, the presence of a storehouse where the produce is kept was not found here. With limited land area and limited function, the homestead includes bedrooms, kitchens, cattle-poultry houses, toilets and biomass fuel storage rooms. The functional distribution of this house extends to the east-west and the location of the bedrooms is to the north. The location of the kitchen and toilet as a service function is on the north-west side.

The Homestead's total area is 7073 sq.-ft., of which 33% is covered by the functional built form. The remaining 4773 sq. ft. includes courtyard and circulation (18%) and unused space (39%). Due to a lack of arable land, there is a dedicated crop cultivation area on the west side of the backyard of this house. The area is quite large, accounting for approximately 10% of the total land area. Facing to the south, these areas are not shaded by large canopies of trees. Surrounded by nets, the woman of the family cultivates a variety of fruits and vegetables to meet the family's food needs. However, the number and variety of fruit plants is negligible. There are no fruit trees except Bael, Sapodilla, Mango, and Coconut trees. But most of them are located on the north side of the house.

In the absence of agro-based occupation, no pre-post harvesting activities are observed in the yard. In addition, there is no noticeable family activity at different times of the day. This is the main reason why part of the dedicated crop cultivation area has moved forward. Along with the homestead there are houses for

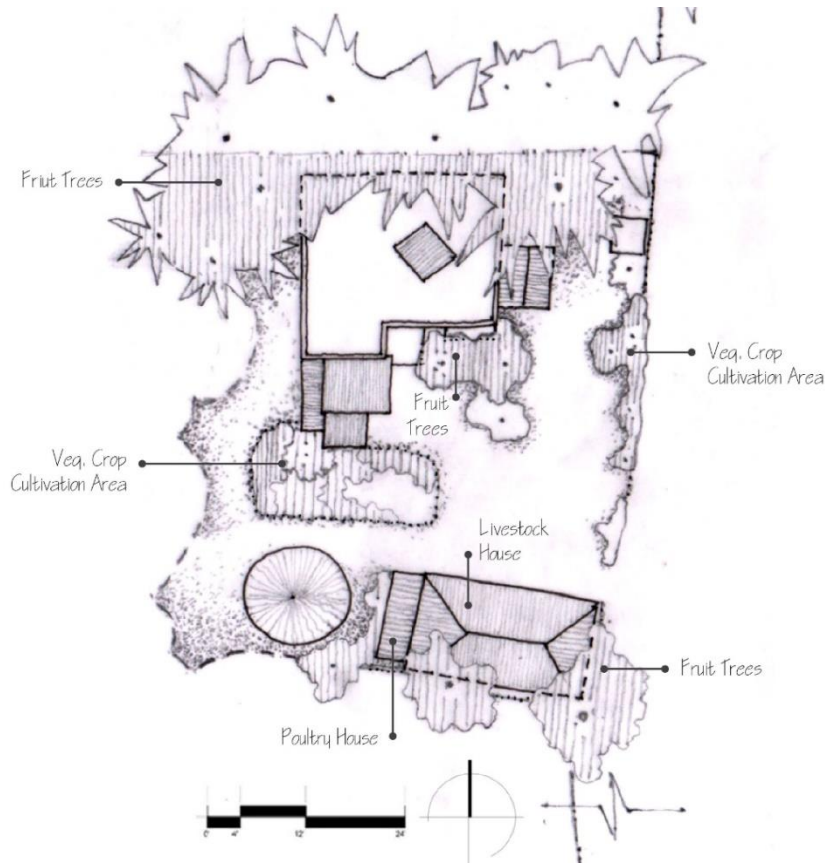


Figure 7. Existing agro-farming components of homestead 2.

livestock and poultry. The size of these two houses is 25 ft. by 12 ft. and 12 ft. by 6 ft respectively. The height of the houses is 10 ft. and 8 ft respectively. They are placed near the entry as like found in the previous case. The problem is that the cattle and poultry houses are on the south side, so the yard is always smelly. In addition, the barn is damp, which can lead to animal diseases.

Design Scheme for integrated homestead agro-farming

The notion of design is understood, among competing views, as making choices among available options for outlining a physical-spatial setting for appropriation by people (Ghafur et al, 2015). Again, extracting primary data of a recent study has identified two major features of an integrated farming System. They are: 1) waste or by-product utilization in which the wastes or by-products of one subsystem become an input to a second subsystem; and 2) improved space utilization in which the two subsystems essentially occupy part or all of the space required for an individual subsystem (Kumar & Paramesha, 2021).

In order to propose design scheme, and to promote the inter-relationship among crop land, livestock- poultry shed and farming pond, all these components are clustered in a defined farming zone (See Figure 8). This integrated farming area is placed near the kitchen, where the rural women spend the majority of time. Rural women can play a significant role in homestead agricultural activities to accelerate production if facilities are created for their active participation (Sarkar, 2014). The connection and proximity not only

enhance the easy movement and operation of farming activities by women, but also make efficient residue-input distribution and management (Sultana, 2002; Kabir, 2006; Islam, 2015).

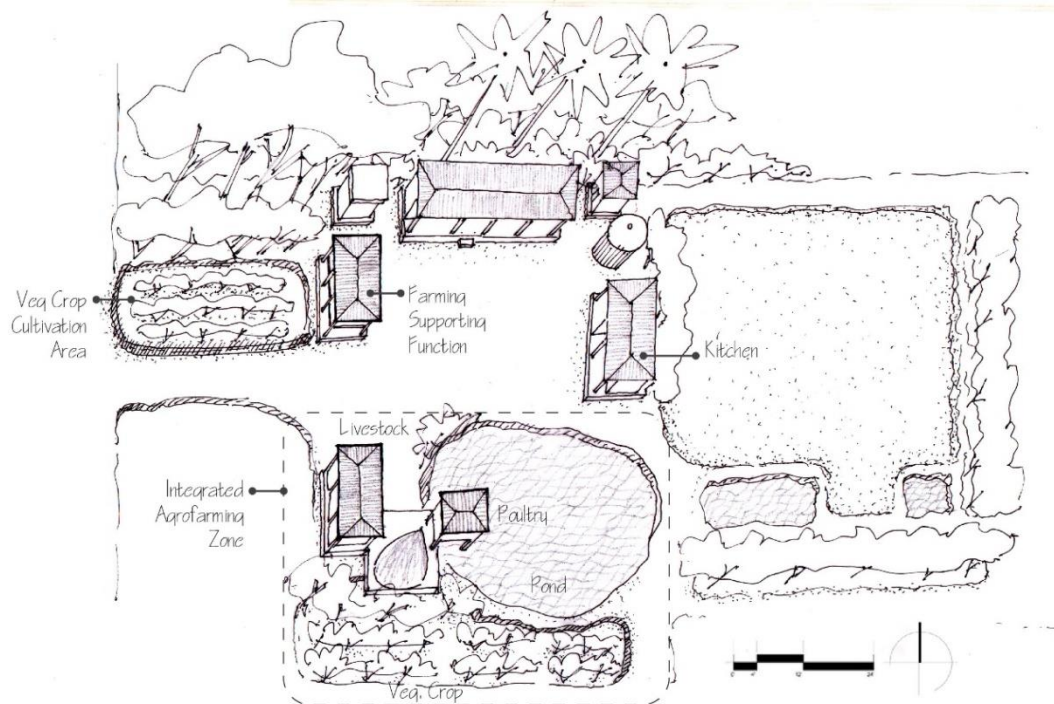


Figure 8. Proposed design scheme of 'Integrated Homestead Agro-farming' for homestead 1,

The proposed integrated system facilitates easy operational distance for women, so that they can perform different farming activities efficiently. This convenient location and distance can save time and labor for the rural women and can offer time for relaxation and enjoyment, which is a prerequisite for the improvement of their way of life. Moreover, space utilization can maximize production by enabling efficient residue-input distribution among different agro-farming components.

Priority has been given to increase vegetable crop cultivation area and crop production intensity (See Figure 9). In the context of ever increasing problems of malnutrition and smaller farm size for field crops production, the only feasible option for farm households is to grow vegetables intensively in the homestead, which can provide household food security (Rahman, 2008). By rearranging the spatial arrangement, dedicated vegetable crop cultivation zones have been proposed in both the houses. Fruit trees are repositioned at the north-west side to keep the house courtyard free from shadow.

Conclusion

From the social data, this study shows that livestock and fishery are dominant agro-farming elements in *Choighoria* village while the intensity of vegetable cultivation at homestead is comparatively lower than the other agro-farming components. The percentage of unused space in two selected homesteads is 22% and 39%. Besides, it has been observed that women are directly involved in the production, processing, management and consumption of different agro-farming activities except fishery. The spatial analysis shows that in rural morphology the agro-farming elements have specific position and orientation which is the legacy of the villagers' age old socio-cultural and climate responsive farming practices at homestead level. The agro-farming

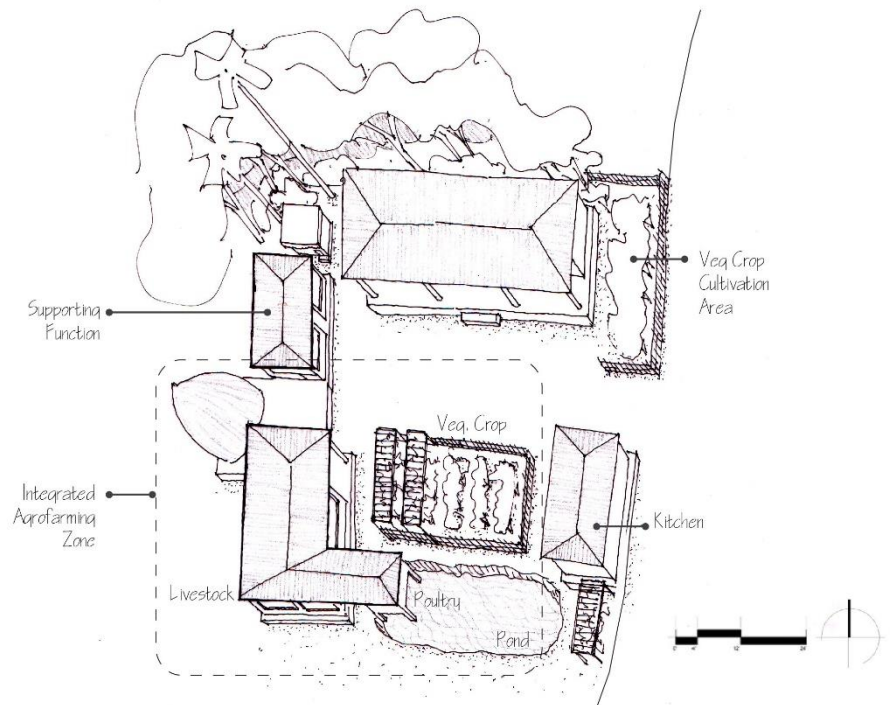


Figure 9. Proposed design scheme of 'Integrated Homestead Agro-farming' for homestead 2.

elements are integrated with the way of living through spatial and functional linkages. However, some components are found to have located at inconvenient location and distance.

Based on empirical findings this research reveals, context and gender sensitive micro-scale land use and physical-spatial planning interventions are crucial to safeguard the agro-based way of life, livelihood, and food security. Through efficient spatial organization, orientation and connectivity it is possible to increase the production of homestead agro-farming significantly. It is clearly evident that women have a significant contribution to production and consumption activities, which is required to be acknowledged in the relevant national policy documents. The proposed design schemes thereby emphasize the significance of women's role in home-based agro-farming and suggest spatially efficient, financially viable, and agriculturally productive options for future detailed physical-spatial (re)planning of rural settlements at homestead level. This approach has the flexibility to be adopted as a guiding framework towards spatially-integrated regeneration of traditional agro-based homesteads.

The spatial-physical design considerations of the proposed schemes are derived with regard to the existing spatial morphology and agro-climatic conditions of Choighoria village. There are 31 agro-ecological zones in Bangladesh, where agro-farming components, farming activities, and the role of women vary in different zones. Therefore, adoption of this approach at scale in villages located in different agro-ecological zones would require further similar research to formulate spatial-physical schemes appropriate for the given social-spatial and agro-climatic contexts.

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