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Household Demography and Food Security of Jhum Farmers in Bandarban District, Bangladesh

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Abstract Farmers in the Chattogram Hill Tracts (CHT) practice jhum farming raising several crops together with upland rice being dominant. For regenerating soil fertility farmers leave the plot fallow moving to another plot. In recent years shortening of fallow length resulted in declining land productivity impacting negatively on jhum farmers' food security. This paper mapped out the food security status of jhum farmers conducting a survey of 103 farmers across 23 villages (para) in four subdistricts of Bandarban district. Farms and farmers growing jhum crops were selected. Assessment of farmers' household demography and level of food security was made conducting questionnaire-based survey and FGDs. Rice yields were estimated harvesting sample plots from the selected farmers' fields. Majority of the households (83%) had 3-6 members per family and 74% households were headed by male farmers but women take on major responsibility of jhum farming. More than 56% household heads had no formal schooling. Land holding per family varied between 0.486 ha and 6.00 ha and about 54% farmers engaged two labors in jhum operations. The extent of food security in hilly region was measured based on the amount of rice production in relation to their annual demand. Rice grain yields varied greatly between 318 kg and 4,411 kg ha^{-1} among farmers' plots across locations. Rice production per household indicated that about 93% farm households suffered from food insecurity to varying degrees. As a coping mechanism, food-insecure farmers met up their food demand scavenging uncultivated forest products collecting vegetables, fruits, roots and bamboo shoots. This study indicates that jhum system can no longer support household food security due to poor yield of rice and thus not sustainable.

Keywords: *household demography, jhum farming, food security, family size, land holding, rice yield.*

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1. Introduction

Shifting cultivation, popularly known as jhum in the Chattogram Hill Tracts (CHT) of Bangladesh and neighboring north eastern states of India, has been an indigenous practice of growing crops on sloping lands in mountainous areas by tribal and ethnic farmers for thousands of years [1,2,3,4]. For centuries, jhum farming has been the dominant land use system in the CHT. Barkat et al. [5] reported that 63.2% of total farm households in Bandarban practice jhum. Jhum is a resource management strategy involving the shifting of fields rather than crop rotation, and relying on regeneration of soil fertility keeping the land fallow. A variety of crops are grown in almost all shifting cultivation systems, but upland rice is the most common and dominant. Jhum farming is essentially a subsistence farming practice almost wholly dependent on exploitation of natural resources and deployment of family labors. Principal factors governing the system is resource conservation and reduction of production cost without applying external inputs. Jhum being a deeply rooted practice of the communities, it has been the traditional way of life on which hill farmers depend for their livelihoods.

In the CHT and adjoining regions (Assam, Mizoram, and Tripura of India, and Chin of Myanmar), jhum is practiced on communal basis. As land right established partially and individual farmers getting land allocation from village heads, community farming turned to a family farming. Moreover, farming practices have also been changed

in terms of reduced fallow period, use of fertilizers, etc. by the farmers. Yet jhum farming remains a low-input, labor intensive, subsistent agricultural production system. Gafur et al. [6] provided an account of production practices followed by the jhum farmers in the CHT of Bangladesh.

In jhum system farmers cultivate different types of crops, rice being the most common and dominant one, on a parcel of land following traditional technique. The jhum season is usually from January through November. After land selection in January, farmers slash trees and bushes and leave the debris on the field for drying. Prior to onset of rain, farmers set the dried bushes on fire to clean the land. On getting the topsoil of the field adequately soaked after the heavy rain, farmers dibble crop seeds without maintaining rows or resorting to any tillage operations. Seeds of 4-12 crops are normally planted randomly on the same field; but in recent years the number of crops grown in jhum has gone down. Jhum culture with single rice crop is also not uncommon.

Blaming shifting cultivation being indigenous, low productive and destructive to forests and environment, governments and policy makers have been trying to 'modernize' upland farming by banning or discouraging jhum farming in south and south-east Asian countries [7] including Bangladesh [3,8]. As elsewhere in tropical Asia, shifting cultivation in the CHT of Bangladesh is also in transition [9,10,11]. Bandarban (and CHT in general) might be of more relevance of transition for Bangladesh. There has been rapid population growth in the hill districts over the past decades. Bandarban population increased from 230.6 thousand to 434 thousand, an annual growth of 3.53% over the past two decades [12]. Albeit very slowly, there has been diversification of cropping systems, particularly in the valley land type. Birch-Thomsen and Reenberg [13] showed that apart from population-agricultural change nexus, land use practices are also closely linked to societal institutions and their ability to adapt to changing socioeconomic conditions. However, a high degree of jhum farming still exists playing important economic and cultural role in Bandarban, Bangladesh. It is the dominant crop culture system in the highlands covering an area of 40,000 ha in three south-eastern hill districts (Bandarban, Khagrachari and Rangamati) of Bangladesh engaging as many as 200,000 farmers of ethnic communities.

Mostly small farmers engage in jhum farming, a complex phenomenon involving an intricate combination of land and labor and very often intertwined with strong cultural linkage. Land tenure system also acts as a binding force that keeps the small farmers bound with the system gainfully engaging family labors. As transformation of communal production system disaggregated into family farming, jhum farming has to depend on the supply of family labor instead of communal labors because wage labor is not available for engaging in agriculture. Chowdhury and Sundriyal [14] also mentioned the short supply of labor in jhum as a major constraint in the mountainous regions of northeastern India. But often than not, engagement of community labors during peak season time is still practiced in the form of exchange labors from the neighbors. As the country's economic growth accelerates, industries and service sectors expand; more jobs open up for skilled and unskilled labors, there will presumably be outmigration of labors from rural areas. It is likely that the economic development will intensify labor shortage in the CHT as is now being observed in the plains [15]. In view of widespread poverty and the productivity of jhum farming being low, prospect of expanding or sustaining jhum farming seems unlikely in future indicating that suitable policy advocacy is warranted for those poor farmers.

People living in rural Bandarban is generally poor; poorer than average population living in the Chattogram, Hill Tracts. Bandarban district is classified a Severe Chronic Food Insecurity area [16]. Severe chronic food insecurity is the result of the poor food consumption quantity, quality and high levels of chronic undernutrition. Bangladesh has achieved a fair degree of food security by growing high yielding cereal crops, but that is not the case of Bandarban [5]. Widespread food insecurity in Bandarban district is largely because of inadequacy in food production and buying capacity of farmers along with rapid rise in population, shortage of arable land and low productivity. Although rice is the staple food for the farmers in Bandarban district, it can barely meet 54% of their annual demand [17]. Such food insecurity is associated with declining rice yield due to shortening of jhum cycle to 2-3 years [18,19,20,21]. However, reliable statistics on annual production and supply of food grains is hardly available.

Land topography in the hills is not suitable for high yielding lowland rice culture. Farmers therefore grow upland rice in jhum depending on rainfall. In absence of high yielding modern rice varieties suitable for growing in the hills, farmers are bound to use indigenous rice varieties or landraces of low yield potential in jhum resulting in poor yield that are also associated with poor soil fertility, intermittent drought, and primitive agronomic practices. As hill farmers are challenged with multi-facet problems than other parts in the country, and the data on rice productivity in jhum and its impact on household food security inadequate or lacking, we seek to examine rice yields in relation to household food security of jhum farmers in Bandarban district.

2. Materials and Method

2.1. Study Area

Bandarban district of the Chattogram Hill Tracts (CHT) lies between 21°11′ and 22°22′ N latitude, and 92°04′ and 92°41′ E longitude. The district is located in the southeast corner of Bangladesh bordering with Myanmar on south, and Mizoram state of India, and Myanmar on the east. On the north and west, Bandarban district is bordered by Rangamati and Chattogram districts, respectively of Bangladesh. The picturesque landscape of Bandarban inhabited by 11 tribal communities is ethnically and culturally distinct from the districts in the plain land of the country. The undulating, rugged hilly and mountainous landscape of Bandarban comprises of 7 sub-districts (Upazila) covering an area of 6,203 km^2 with a total population of 434,335 of which 70% are engaged in farming.

2.2. Conducting Survey

A jhum cultivation-specific study was conducted in four contiguous sub-districts - Bandarban sadar, Rowangchari, Ruma and Thanchi of Bandarban district in May 2019 through October 2019. The study included questionnaire- based survey, focal group discussions (FGDs), sampling and crop cutting for determining rice grain yield. FGD and survey instrument included questions to understand shifting cultivators' socio-economic status including the state of household food security.

A total of 103 jhum farmers were selected from across the study area covering dispersedly located 23 paras (analogous to villages in the plain land). Initially standing jhum crop fields selected and thereafter selected the farmers growing the crops. The plots were selected at random and thus the respondent farmers were also randomly selected. After the selection of jhum plots, farmers owning the plots were identified and invited to participate in FGD. In view of inconvenience in conducting household survey visiting every household, FGDs were conducted for gathering information on jhum farmers' socioeconomic status, household income, agricultural practices they follow etc. A total of 11 FGD sessions were held, each session having 7-16 participants depending on location. Instead of group discussion, individual respondents were asked to share their information. This was necessary because selected farmers of different ethnicity background having diversified languages participated in a single session.

Table 1. Sampling villages (para) and sub-districts with number of FGDs conducted

Sub-district (Upazila)	Villages (para)	Number of FGDs
Bandarban sadar	Bakichara, Camelong, Tunkhongpara, Tigerpara, Reicha, Seniorpara, Nilachal, Mrolongpara, Baganpara, Ramripara,	4
Rowangchari	Jadipara, Rajakhamar, Hansamapara, Jaminipara, Krykhyongpara	3
Ruma	Bot tali, Royalpara, Jaminipara (East),	2
Thanchi	Bolipara, Daksuipara, Commanderpara, Jiban nagar, Nilgiri,	2

A structured questionnaire was developed and pre-tested prior to conducting FGDs. Since majority participants were illiterate, enumerators filled out the questionnaire discussing with the participating farmers. For the purpose of our study, household indicates a group of people living in the same roof, prepare and take food of same cooking arrangements, work together at farming or sparingly earning through off-farm activities but share provisions. Traditionally, in ethnic minority communities, household is led by the able-bodied senior most member of the family although decisions relating to farming or other family business are taken jointly.

Throughout the growing season, agronomic practices the selected farmers administered in the selected plots were monitored through field visits and discussing with farmers. Rice planted in jhum plots started maturing beginning mid-August and continued till early October, depending on location, topography, and variety/landraces. Turning peduncle of rice panicle from green into straw color is indicative of maturity. But farmers in the Bandarban hills are used to harvest rice when leaves turn to yellow color and the culms to straw color, approximately 15-20 days later than standard field maturity date. Instead of harvesting the plants cutting at the base, hill farmers traditionally cut the panicles only leaving the plants on the field. At maturity, we harvested three samples from each selected farmer's plot, each sample measuring 5 m^2. After the harvest, samples were threshed, grain weight of each individual sample taken and grain moisture content recorded using a portable moisture meter. Rice grain weight was adjudged at 13% moisture content and expressed in kg ha^{-1}.

Food security means access by all people at all times to enough food for an active, healthy life. But in our study, jhum farmers having enough rice for a certain period is considered food secured without taking into account of the nutrition aspect of the food intake. Ethnic communities consider jhum farming as one of the best livelihood options to ensure food security because rice, vegetables and cash crops are available from jhum that they use for home consumption, and commodity crops for cash generation. To jhum farmers, food security means availability of sufficient rice to meet their household demand. The extent of food security is measured based on the amount of rice production in relation to their annual demand. Thus, household food security referred to in this study does not take into account of 'amount of food for an active, healthy life—necessary for a population to be healthy and well nourished' [22]. We did not generate historical or periodic data measuring household food stock and consumption, rather we recorded data on the amount of rice production of jhum farm households interviewing farmers participating in FGDs.

2.3. Data Analysis

Data on household demography, land holdings, family labors engaging in jhum and household food security estimates generated conducting focus group discussions (FGDs) were compiled and tabulated. Tabulated data were further condensed and grouped for meaningful presentation and interpretation.

Rice yield data collected from field survey and crop cuttings were tabulated and mean values for individual farmers are presented in scattered diagram. Rainfall data for the year 2019 were collected from Soil and Water Conservation Center of Soil Resource Development Institute, Meghla, Bandarban.

3. Results and Discussion

Respondent farmers were drawn from widely dispersed communities in four sub-districts (Upazila) - Bandarban sadar, Rowangchari, Ruma and Thanchi of Bandarban district. Southern part of Bandarban sadar and Rowangchari upazila, and Ruma and Thanchi sub-district in entirety represent high hill and mountain ranges. All the farmers sampled and participated in the study were indigenous people belonging to ethnic Marma, Mro, Chakma, Tripura, Tanchangya, and Bawm tribes. Bangalee population, overwhelmingly greater majority in the country, is not found in the rural areas in the four subdistricts in the study,

and hence no Bangalee farmers could be sampled. Jhum is the component of traditional agro-ecosystem encompassing diverse set of knowledge and practices of indigenous communities embodying traditional life-styles relevant for the conservation and sustainable use of natural resources for their livelihood [23]. All the farmers practice some form of jhum cultivation but we do not disaggregate them based on their tribe, religion, income or adopted crop production practices.

3.1. Family Size

Table 2 shows the distribution of family size of the sample households. Among the farm households, the family size ranged between 1 and 12 with an average of 5.34 (±1.07). Overwhelming majority (83%) households had 3-6 members per family. Our observations compare favorably with those of Barkat et al. [24] who reported an average household size of 5.2 in the CHT.

Table 2. Distribution of family size

Number of family members	Number of families	% of total families
>10	2	1.94
7 to 9	9	8.74
5 to 6	43	41.75
3 to 4	42	40.78
2	5	4.85
1	2	1.94

3.2. Head of Household

Out of 103 households, 27 were headed by female and the rest by male farmers. Although women in most ethnic communities perform major role in production, post-harvest processing and marketing of agricultural products apart from rendering the services of food preparation and other household activities, they are not decision makers for the households. Statistics on household leadership, however, does not reflect the role of women in conducting agronomic operations in jhum farming [25]. Observations and FGD results suggest that in the ethnic communities, apart from child rearing and house management, women take on major responsibility of jhum farming including land clearing, dibbling seeds, harvesting crops and post-harvest processing and marketing. Decision on land selection, selection of crops to be grown and performing rites and rituals [6] are taken jointly by the adult members of the family. Working in Lao PDR, Hakangard [26] showed that women engaged in shifting cultivation perform manifold tasks with long working-days with a very few choices.

3.3. Education

Data on educational attainment of the heads of jhum farm families have been presented in Table 3. Most household heads (≥56%) did not have formal schooling. Only 17% household heads were high school graduates. The observations compare favorably with that of Barkat et al. [24] who reported that only 7.8 % of all CHT people completed primary education and 2.4% completed secondary education. Educational attainment of farmers' in the CHT in general and Bandarban in particular is usually poorer than the members engaged in service sectors.

Table 3. Educational attainment of the heads of jhum farm families

Educational attainment	Number of household heads	% of total household heads
Higher Secondary School Certificate	5	4.9
Secondary School Certificate	13	12.6
8th grade	9	8.7
5th grade	18	17.5
No schooling	58	56.3

3.4. Land Holdings

Land holding per family varied between 0.486 ha and 6.00 ha with an average of 2.08 ha (Table 4). About one half of the total sample farmers owned 1.0 to 2.5 ha, while over 27% had 2.5 to 5.0 ha land holdings. The average holding appears to be somewhat larger than national average holding per capita [27]. However, in view of shifting cultivation and poor soil quality of fragile hilly lands, the average holding per family is not adequate to produce food for the household year-round. Since jhum farmers shift their lands for growing crops keeping part of their land fallow, the land use potentiality is lower than that in the plains. Given the harsh environment facing jhum cropping and low yield potentials, household owning 5.0 ha may be classified as poor. Thus, from jhum farming perspective, 98% farmers cannot depend on farming alone for their livelihood. Considering a fallow period of 7 years for bush growth for regenerating soil fertility, and capability of a couple handling jhum farming on a parcel of 1 ha, there should have been at least 7 ha of land for household of 5 members or less.

Table 4. Jhum farmers' land holding

Land holding (ha)	Number of farmers	% of farmers
<0.25 ha - 1.0 ha	18	17.48
1.0 ha - 2.5 ha	51	49.51
2.5 ha - 5.0 ha	32	31.07
>5.0 ha	2	1.94

3.5. Family Labors Engaging in Jhum

Figure 1 shows that majority of jhum farmers (54.4%) engage 2 workers in jhum operations. Family engaging 4 or more workers represent 7% of farmers. Only 12% families engage a single worker in jhum. Farmers present in the FGDs suggested that a household deploying 2 family labors can manage jhum farming of at best 2.0 ha of land indicating that they have to either hire labors or share with community if farm size is bigger than 2 ha. Normally wage labors are not available in hilly areas. Planting, weeding and harvesting are the most labor-intensive farm activities in the jhum system. Herbicides are being increasingly used in land clearing before seed planting. Similarly, for augmenting labor shortage selective herbicides may be used for weeding during the growing season.

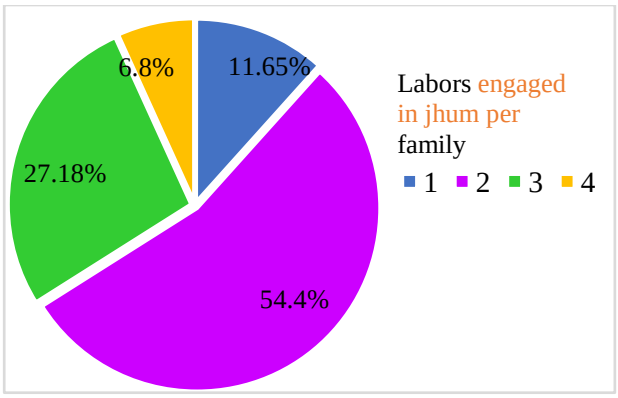

Figure 1. Patterns of family labors engaged in jhum farming in Bandarban, Bangladesh)

3.6. Rice yields Across Fields

Rice grain yields ranged between 318 kg and 4,411 kg ha^{-1} across locations with an average of 1,358 (± 720.65) kg ha^{-1} (Figure 2). Most yields, hovered, around 1,000 kg ha^{-1} and only 14 farmers crossed yield level of 2,000 kg ha^{-1} while five farmers obtained less than 500 kg ha^{-1}. The high degree of variability (cv 53.08%) in yield might be due to wide variation in locations, land topography (elevation of hills and mountains), farmers' agronomic practices, varieties/landraces used. Growth and yield of upland rice is largely dependent on rainfall and weed control at the right time. Figure 3 shows that there was an annual rainfall of 2,624 mm in Bandarban in 2019 of which 2,311 mm (87.5%) was received during May through September corresponding to jhum season. Apparently, the amount and distribution of rainfall was favorable for rice growth; but in mountainous terrain, particularly on the upper elevation of the hills, soil moisture runs out quickly depending on prevailing sunny dry spell for a few days and thus may affect rice growth. During the jhum season, the highest rainfall (Figure 3) was in July accumulating 1,024 mm (38.76% of total) of which 30% of total annual rainfall was received as rainstorms in two spells, 8-10 July (438 mm) and 12-14 July (352 mm). Water stagnation or excessive rain is not conducive of growth of upland rice [28]. Rice crop in early July was at vegetative stage and thus resistant to lodging, but in some patches excessive rain might have caused physiological damages.

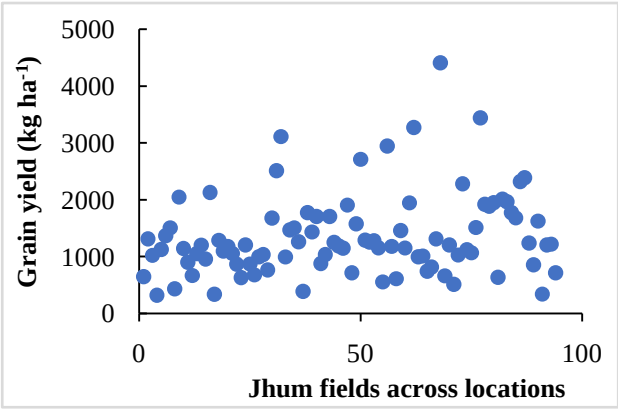

Figure 2. Variation in rice grain yields among farmers and across locations, Bandarban, Bangladesh

Government extension service does not recognize or encourage jhum farming, and hence farmers get no technical support for growing upland rice [18]. High yielding modern varieties (MV) suitable for jhum farming have not been evolved yet. Farmers use indigenous varieties and land races, and keep their own seeds for growing in successive seasons and thus seed quality deteriorate. However, CHT is a biodiversity hotspot; farmers grow a range of rice varieties/landraces that can be used in breeding program for development and release of location specific high yielding varieties especially for hilly regions of Bangladesh.

In the present study, farmers planted as many as 38 varieties/landraces of upland rice. Wide variation in grain yield as was observed might be attributed to genotypic differences, apart from environmental and management factors. Indigenous rice varieties/landraces are well adapted to hill ecosystems and perform well for generations. Most farmers reported that rice yields declined over time might be related with reduced soil fertility and climate change impact. In the past when land was abundant, jhum farmers use to shift the place leaving the land fallow for 20 years or longer. Forest/shrub regrowth thus recuperated soil fertility from decomposing biomass. Over time, fallow length is shortened resulting in degenerated soil health, poor rice yields and thus making the jhum system unsustainable. Mishra and Ramakrishnan [29]; Saito et al. [21]; Osman et al. [30] also reported yield decline because of shorter length of fallow period. Moreover, a sizeable percentage of farmers currently do not leave the land fallow, many of them apply chemical fertilizers on their jhum fields, albeit disproportionately which have generated variability in rice yields. Fallow period varied enormously across locations and among farmers. Usually poorer the farmers, higher is the intensity of jhum cropping indicating reduced fallow periods for recuperation of soil fertility. Without proper land management controlling soil erosion and addition of organic matter and adequate amount of fertilizers, intensive cropping causes soil degradation [20,31].

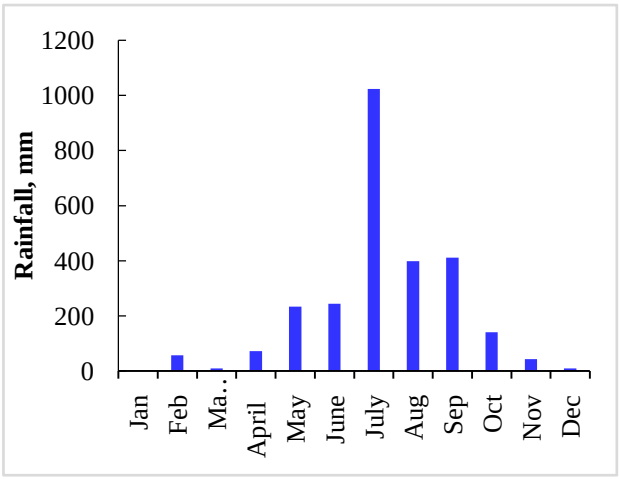

Figure 3. Monthly rainfall patterns in Bandarban, 2019

3.6 Food Security Status

Results of the survey on household food security are summarized in Figure 4. In the four sub-districts we

surveyed, an estimated 7% of jhum farm households were food secure throughout the year and the remaining 93% farm households suffer from food insecurity to varying degrees. About 1% farmers cannot produce rice enough even for six months. Median group of farmers (35%) are capable of securing enough rice for 9 months. With an average yield of 1,358 kg per ha, a household of 5 members owning 2.08 ha land may produce an amount of rice that can barely support 8 months. Our results are in agreement with Nath et al. [3] who reported that food production of an average farmer could hardly fulfill household rice demand for six to seven months in a year. Miah et al. [32] reported that small households and the households with more earning members were better food-secured than large ones. In view of shrinkage of jhum area and declining rice grain yield, jhum can support household food security only for about 3-6 months [18]. Earlier, studying livelihood patterns of ethnic minorities of the CHT, Jamaluddin et al. [17] found that in three districts, 54% of jhum farm households were food secure. In the hilly terrains of Bandarban, small farmers do not have amenities or convenience to grow crops during dry season. For food they rely on the outcomes of jhum cropping alone. Planting a set of crops in May with the onset of monsoon the first crop that farmers harvest towards the end of July is marpha - a cucurbit. Immature maize ears are harvested for consumption and selling in market July through August. The main crop rice matures in September. Farmers having not enough food to eat meet their food demand collecting and using uncultivated forest products [33]. Jhum farmers whom we discussed told that majority households meet their food demand to the extent of 30-40% by collecting vegetables, fruits, roots and bamboo shoot. Non-farm job opportunity being extremely limited [34] and in absence of cash flow, gathering food become more important when the question of quality of food stands secondary. While most hill dwellers still believe jhum as one of the best livelihood options to ensure food security [18], for them collection of food from uncultivated forest or fallow land remains a viable livelihood strategy.

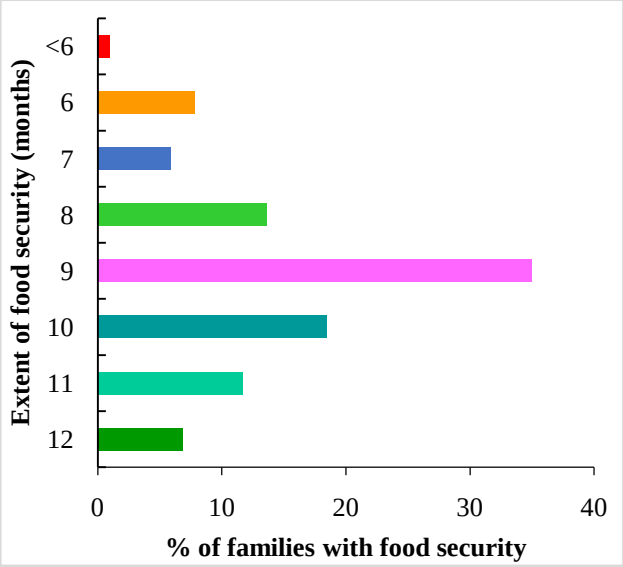

Figure 4. Extent of food security (in percentage of households and duration in months) in a year in Bandarban district, Bangladesh

4. Conclusion and Policy Implication

The study was an attempt of mapping out of the extent of food security among the jhum farmers of Bandarban district in relation to household demography, land holdings and yields of upland rice grown in association with other crops in jhum. From the study it becomes apparent that two major factors contributing to high incidence of poverty are low yields of rice and smaller land holdings. Lower yields of crops in jhum reassert that the system being uneconomical is not sustainable. As population increases the size of land holding will shrink leading to further intensification of jhum reducing the length of fallow period causing soil degradation and poorer yields. As economy improves, industrial and service sectors expand demanding more labors, there will be outmigration of labors from the hills to the urban sectors. This will intensify labor crisis further presenting challenge to sustainability of jhum system aggravating farmers' food security. Responding to market economy, Bandarban farmers may opt to transform jhum farming to commercial agriculture provided Government comes forward with required investment.

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Statement of Competing Interests

Authors declare no competing interests.

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