Nutritional Status and Food Security of Farm Households under Different Land Use Patterns in Bangladesh

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Abstract:

This study was aimed at estimating the impacts of changing land use patterns on food security for the farm households in Bangladesh. It was based on primary data collected from 730 households of different farm categories with direct interview method, which covered 14 existing most important land use patterns. The study revealed that households of alternate shrimp (bagda) and rice farming consumed the highest amounts of food followed by year round shrimp (bagda) farming whereas the highest per capita calorie intake was observed in households of alternate rice and wheat production. But households of year round shrimp (bagda) farming generated the highest amount of income followed by households of alternate shrimp (bagda) and rice farming, year round banana production and year round floriculture, respectively. But there were no systematic and regular patterns of relationships among income, food, protein and calorie intakes in different land use patterns. Large households consumed the highest amount of food and protein followed by medium, small and marginal households, respectively. All the land use patterns were found to increase major food security indicators and reduced poverty. All the 14 land use patterns should be made sustainable to the farmers by properly addressing environmental factors and by easing access of farmers to inputs and outputs markets by the government.

Key words: Food security, nutritional status, land use pattern.

Introduction:

Bangladesh has long history of producing almost all agricultural crops. Although farm households produce almost all agricultural crops as they need, some regions in Bangladesh are advantageous or dominant to produce certain crops than other regions. Farm households in these regions are producing those crops which are

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environmental friendly and ensure more income or profit to them. But farm households are not strict to certain crops; they are always trying to produce new crops which ensure them promising income. Thus land use patterns have been changing over the years. Land use patterns and food security are interrelated. Food security is an important aspect for the developing countries where resources are limited and technologies for developing resources are lacking. Food security is achieved if adequate food (quantity, quality, safety, socio-cultural acceptability) is available and accessible for a satisfactory utilisation by all individuals at all times to live a healthy and happy life[5]. Thus food security is related to food availability and access to food. Food availability is a function of the combination of domestic food stocks, commercial food imports, food aid and domestic food production, as well as the underlying determinants of each of these factors. Food access is influenced by the aggregate availability of food through the latter's impact on supplies in the market and, therefore, on market prices. Again, the access is further determined by the ability of households to obtain food from their own production and stocks, from the market, and from other sources. These factors are, in turn, determined by the resource endowment of the household which defines the set of productive activities they can pursue in meeting their income and food security objectives. Food access also is a function of the physical environment, social environment and policy environment which determine how effectively households are able to utilise their resources to meet their food security objectives[6].

Ensuring food security for all is one of the major challenges in Bangladesh today. Despite the impressive achievements in food grains production during the last few decades, food security at farm households and individual levels remains a major concern for the Government. With the intensive and integrated farming, total food grain production has been showing an increasing trend over the last two decades (28.81 million metric ton in 2005-06). It produces major agricultural crops, such as rice, wheat, maize, jute, vegetables and potato, pulses, oilseed, sugarcane, etc. Since total population is increasing day by day, the total agricultural production is not sufficient to meet domestic consumption. That is why, the government is importing large amount of food grain (2.0-3.0 million tons) almost in every year along with some manufacturing goods[1]. Therefore, food security is important for the farm households and they should increase their farm production to improve their livelihood.

Aiming to food security, land use patterns as well as farming systems have been changed by the farmers. As a result, agricultural crop land have been shifted and are being used for aquaculture such as pond fish farming, shrimp farming (brackish water aquaculture) and golda prawn farming and to some extent, alternate rice-prawn farming and alternate shrimp- rice farming. Some cropped areas in Mymensingh and Gazipur have been converted into large pond to cultivate pangus and other carp fishes. Alternate rice-pulse is produced in Pabna district. Similarly, farmers in Jessore and Zhenaidha districts produce alternate prawn (golda) -rice

farming, year round vegetables production and floriculture. On the other hand, in coastal areas, mainly in Khulna and Cox's Bazar regions, large areas of cropped land shifted to brakish water aquaculture and farmer practice year round shrimp (bagda) farming and alternate rice-shrimp farming. Again, farmers in Rangpur and Dinajpur practice alternate rice-potato, rice-wheat and rice-maize farming.

This study aimed at estimating the impacts of major land use patterns on nutritional status and food security in Bangladesh. In relation to the implications of land use patterns, changed socioeconomic factors (indicators) and possession of different livelihood assets may have an effect on food security and its sustainability.

Methodology:

Sources of Data:

This study was based on primary data collected from 730 farm households practicing 14 major land use patterns with the direct interview method. Data were collected with pre-tested structured questionnaires by trained enumerators in eight districts of Bangladesh. The questionnaires covered a wide range of questions relating to production, consumptions, land use patterns and all types of food security indicators. Tables 1 and 2 show the sampling design and major crops grown by farm households. Selected farm households constituted four categories of farmers, namely marginal, small, medium and large farmers and the selection of sample households was done by stratified random sampling procedure.

Some farmers in Mymensingh, Jessor, Pabna, and Tangail districts have converted their land to practice rice-fish farming, alternate rice-vegetables and alternate rice-pulse *(khesari*) and year round banana production, respectively. In Rangpur and Dinajpur, many farmers used their crop land for producing alternate rice- potato, rice- wheat and rice- maize. Similarly, farmers in Jessore district produce alternate prawn (golda)- rice farming. On the other hand, in coastal areas mainly in Khulna regions, large areas of cropped land shifted to brackish water aquaculture especially shrimp (bagda) production.

Table 1: Study design and sample distribution of farm households under selected land use patterns.

Land use patterns selected	Categories of sample farm households				
	Marginal farmer	**Small farmer**	**Medium farmer**	**Large farmer**	**All farmer**
Year round rice production	21	31	26	4	82
Alternate rice and vegetables production	10	18	18	4	50
Alternate rice and mustard production	11	26	13	0	50
Year round banana production	2	13	20	13	48
Year round pangus fish farming	11	22	22	5	60
Alternate rice and wheat production	8	23	26	3	60
Alternate rice and maize production	7	23	27	3	60
Alternate rice and potato production	12	26	25	2	65
Alternate rice and pulse production	10	15	21	4	50
Year round floriculture	15	16	14	5	50
Alternate rice and prawn (golda) farming	0	8	21	11	40
Year round vegetables production	22	21	7	0	50
Alternate shrimp (bagda) and rice farming	2	7	14	12	35
Year round shrimp (bagda) farming	0	3	12	15	30
Total	**131(18)**	**252(35)**	**266(36)**	**81(11)**	**730(100)**

‘0’ means respective categories of farmers were not found. Figures in the parentheses indicate percentage of total farm households.

Table 2: Major land use patterns and study areas selected.

Land use patterns selected	Study areas			Major crops grown
	Districts	Upazilas	Villages	
1. Year round rice production	Mymensingh	Mymensingh Sadar	Beltoly, Borbilarpar Fakirakanda and Sobagia	Rice and jute
2. Alternate rice and vegetables production	Mymensingh	Mymensingh Sadar	Bottola Bazar, Sutiakhali, Salakandi and Baira	Rice, Cucumber, Okra, Amaranthas, Cabbage, Cauliflower and Gourd
3. Alternate rice and oilseed (mustard) production	Tangail	Basail and Sakhipur	Naikanibari, Sunna, Kailan and Betua	Rice, Mustard
4. Year round banana production	Tangail	Sakhipur and Ghatail	Kutubpur, Malirchala, Fulmalirchala, Barochowna and Jordighi	Banana, Rice and Vegetable
5. Year round pangus fish farming	Mymensingh	Trishal	Konabari, Bagan,	Pungus fish and Rice
6. Alternate rice and wheat production	Dinajpur	Biral, Dinajpur Sadar Bochaganj	Mohbbatpur, Nashipur, Rampur and Islampur	Rice, Wheat, Maize, Mango and Litchi
7. Alternate rice and maize production	Dinajpur, Rangpur	Biral Gongachora and Rangpur Sadar	Kashidanga, Nizampur, Binbinia and Kabirajpur	Rice, Maize, Wheat, Potato and Tobacco
8. Alternate rice and potato production	Rangpur	Rangpur Sadar	Uttam Baniapara, Baniapara and Napitpara	Potato, Rice, Tobacco, Maize and Wheat
9. Alternate rice and pulse production	Pabna	Shathia and Bera	Patgari, Haria and Chinanary	Rice, Kheshari, Wheat, Onion and Garlic

10. Year round of floriculture	Jessore	Jhigarghacha	Panishara, Rangunathpur, Ragunathnagar and Kulia	Flower (Rose, Gladiolus, Tuberose, Marigold) and rice
11. Alternate prawn (golda) and rice farming	Jessore	Keshobpur	Pathorghata, Monoharnagar	Golda and Rice
12. Year round vegetables production	Jessore	Jessore Sadar	Chotohoibatpur, Borohoibatpur, Churamankati and Shahbajpur	Vegetables (cabbage, Cauliflower, Bean, Radish, Brinjal, Okra)
13. Alternate shrimp (bagda) and rice farming	Khulna, Sathkira	Paikghacha	Soladana, Amurkata, Sonkhali and Digha	Shrimp, Rice and Vegetables
14. Year round shrimp (bagda) farming	Khulna, Satkhira	Shamnagar	Abatchandipur, Ghenra ghar, Gobintolly and Dhatinakhali	Bagda and rice

Analysis of Data:

Both descriptive and functional analyses were carried out in this study. As descriptive statistics, some tabular analysis, average, percentage, ratios, standard deviations, etc were calculated. Item wise food consumption was converted into calorie and protein intake by using conversion factor[7]. Poverty was assessed Direct Calorie Intake (DCI) method[4]. There are several measures of poverty, all of them belonging to the so-called Foster-Greer Thorbecke (FGT) poverty indices[2]. The Direct Calorie Intake (DCI) is one of the measures of poverty. The threshold per capita per day calorie intake is 2122 k.cal. A person, whose daily calorie intake is less than 2122 k.cal. is considered to be in the 'Absolute Poverty'. Similarly, a person having daily calorie intake less than 1805 k.cal, is considered to be in the 'Hard Core Poverty'. Food consumption and nutritional status of farm household and socioeconomic factor influencing sustainability of food security for targeted farm households were clarified in respect of different categories of farm households under 14 land use patterns. Secondly, for consumption and calorie intake, functional analysis was employed to determine the parameters of food consumption and calorie intake of selected farm households.

Determining Parameters of Food Consumptions and Calorie Intake:

For determining the factors that influence the food consumption and calorie intake, Cobb-Douglas type functions in double-log forms were employed. Normally functions in double-log forms give better results than other functional forms since transformation of variables ensures validity of normality assumptions. Separate models were fitted for food consumption and calorie intake in which food consumption and calorie intake were considered as dependent variables, and education of farm households' head, respective land use patterns, main occupation of households head, farm size, family size, households' income and age group of family members were considered as independent variables. Along with the estimated parameters, standard errors of individual coefficients were estimated. Besides, F statistic was calculated to show the goodness of fit of data with different independent variables.

Theoretical model for food consumption:

$$\ln \text{Food consumption} = \beta_0 + \beta_1 \text{Edn} + \beta_2 \text{land use dummy} + \beta_3 \text{occupation dummy} + \beta_4 \ln \text{farm size} + \beta_5 \ln \text{family size} + \beta_6 \ln \text{income} + \beta_7 \ln \text{No. of family members between certain age groups} + u.$$

Theoretical model for calorie intake:

$$\ln \text{calorie intake} = \beta_0 + \beta_1 \text{Edn} + \beta_2 \text{land use dummy} + \beta_3 \text{occupation dummy} + \beta_4 \ln \text{farm size} + \beta_5 \ln \text{family size} + \beta_6 \ln \text{income} + \beta_7 \ln \text{No. of family members between certain age groups} + u.$$

Results and Discussion:

Food utilisation is one of the important components of food security. Usually food is consumed to maintain health and to revive strength. Food is consumed by individual as essential item of living. Every food item has its own calorie, protein and other nutrients which are essential for health. Nutritional values vary from food item to food item. That is why, people would like to take different food items to balance their calorie, protein and other nutritional need. But in Bangladesh, a large segment of the people can not consume required amount of different necessary food items for various reasons and they are malnourished. Poverty and malnutrition in Bangladesh are characterised by regional variation. Factors such as proneness to natural disasters, distribution and quality of land, access to education and health facilities, level of infrastructure development, employment opportunities, and dietary and hygiene practices provide possible explanations for the variation of food and calorie intake, and poverty and malnutrition. Poverty hinders and influences the consumption of essential and quality food. However, this section is designed to discuss about food utilisation such as food intake, nutrition and poverty.

Intake of food by food items:

Intakes of food according to food items by the households per capita per day for the year 2007-2008 have been presented in Table 3. It reveals the detailed explanation of food consumption by households considering major food items. Rice is the main item of foods for human consumption in the rural areas. Average per capita per day intake of rice was 548 gm, which was relatively higher than the national average (439.6gm)[3,4]. The second important food item was observed to be potato and the consumption rate was about 109 gm. per capita per day at the aggregate level. The next important food item was milk followed by fish and leafy vegetables, respectively. The various food items consumed by the farm households were similar and consistent with PMS, 2004 and HIES, 2005 with a few exceptions. Overall per capita per day food consumption was the highest for large farmers followed by medium, small and marginal farmers, respectively.

Table 3: Consumption of food items by farm households (gm/day/capita).

Food items consumed	**Marginal farm households**	**Small farm households**	**Medium farm households**	**Large farm households**	**All farm households**
Rice	514	554	546	588	548
Wheat	9	12	10	8	10
Maize	2	0	1	0	1
Potato	93	110	107	135	109
Leafy vegetables	80	86	81	103	85
Cabbage/ cauliflower	23	29	31	36	29
Cucumber	26	31	32	43	32
Brinjal, bean, *kachu*, *patal*, *kakrol*, okra, etc.	27	26	28	54	30
Lentil	13	14	13	18	14
Maskalai/*khesari*	7	5	7	6	6
Mustard oil	6	7	7	10	7
Soyabean oil	14	15	16	20	16
Beef/mutton	9	13	16	24	15
Poultry meat	16	21	19	21	19
Egg	9	11	10	10	10
Fish	74	86	91	138	91
Onion	21	26	25	22	24
Garlic	7	8	7	9	7
Chilli	8	9	8	9	8
Fruits	10	13	15	23	14
Sugar	13	16	15	20	15
Milk	76	98	109	92	98
Total	1057	1189	1192	1389	1182

Intake of calorie:

Food energy intake is measured by the unit of kilo calorie. Every food item has its own calorie value and these are different from each other. Total calorie intake is derived from total consumption of food for all food items and is presented in terms of per capita per day basis. Average daily per capita intake of calorie for all food items is shown in Table 4. The overall average daily per capita calorie intake by households was observed to be 2439 k.cal., which was slightly higher than the national average[3,4]. The average calorie intake reported by the PMS, 2004 and HIES, 2005 were respectively 2308 k.cal. and 2238.5 k.cal. The study showed that calorie intake was the highest for large farmers (2562 k.cal) followed by small (2474 k.cal), medium (2455 k.cal) and marginal farmers (2263 k.cal), respectively. The above two national studies showed that calorie intake was relatively higher for the rural people compared to urban people.

Intake of calorie by food items:

Considering all land use patterns the food energy received from individual food items was the highest for rice (1761 k.cal) followed by potato (100 k.cal), fish (96 k.cal), vegetables (78 k.cal), oil (69 k.cal), milk (64 k.cal) and sugar (57 k.cal), respectively (Table 4). The overall per capita per day calorie intake for rice was observed to be 1761 k.cal., which was about 72 percent of the total energy intake. It has the similarity with the calorie intake at the national level reported by PMS (2004) and HIES (2005) with a few exceptions. The above two national studies revealed that edible oil was the second important energy supplying food item but the study observed that edible oil was the fifth important food in terms of energy for subjects under study.

Table 4: Calorie intake from different food items by the members of farm households (K.cal/day/capita)

Food items	Marginal farm households	Small farm households	Medium farm households	Large farm households	All farm households
Rice	1671.5 (74%)	1799.7 (73%)	1775.0 (72%)	1742.3 (70%)	1761.3 (72%)
Wheat	28.6	38.7	31.2	26.6	32.8
Maize	6.9	0.0	3.1	0.0	2.3
Potato	85.7	101.3	98.3	121.9	99.7
Leafy vegetables	24.1	25.9	24.3	30.9	25.6
Cabbage/cauliflower	10.1	12.7	13.6	15.7	12.9
Cucumber	8.8	10.5	10.8	14.5	10.7
Brinjal, bean, *kachu*, *patal*, *kakrol*, okra, etc.	28.1	27.2	28.5	35.6	28.8
Lentil	42.2	46.2	41.4	59.4	45.2
Maskalai/*khesari*	22.9	17.3	22.1	20.1	20.4
Mustard oil	1.9	2.4	2.2	3.3	2.4
Soyabean oil	61.6	63.6	67.7	78.1	66.3
Beef/mutton	14.2	20.3	24.6	36.2	22.6
Poultry meat	19.2	25.0	22.5	25.5	23.1
Egg	15.3	18.5	17.0	16.8	17.2
Fish	78.2	91.0	96.0	145.3	95.5
Onion	10.0	12.0	11.7	10.4	11.4
Garlic	9.5	10.3	9.5	12.7	10.1
Chilli	18.1	20.2	17.9	20.5	19.0
Fruits	6.5	8.0	9.4	14.2	8.9
Sugar	49.7	58.4	55.7	70.5	57.2
Milk	50.0	64.7	72.1	61.0	64.4
Total	2263	2474	2455	2562	2439

Intake of protein by farm households:

Protein is an important nutrient in human diet. Lack of protein in diet retards growth and development of health and causes numerous diseases. Food items which provide more protein to people are costlier than other food items providing less protein. Table 5 reveals that there are no systematic and regular pattern of relationship among income, food intake, calorie intake and protein intake in different land use patterns. Accordingly, these four factors should be explained separately. Table 5 shows that average protein intake per capita per day was 64.84 grams considering all selected land use patterns but per capita per day protein intake was the highest (68.26 grams) for alternate rice and mustard production. The second highest per capita per day protein intake was observed for alternate rice and wheat production but the lowest protein intake was observed for year round vegetables farming. Yearly household income was the highest for the year round shrimp (bagda) farming (Tk. 391759) followed by alternate shrimp (bagda) and rice farming (Tk. 326942) and year round banana production (Tk. 292857), respectively.

The intake of lower amount of protein by year round vegetable farmers might have two reasons: i) vegetables are not protein rich but vitamin rich and ii) most of the vegetable farmers (86%) are marginal and small farmers. According their food consumption were lower compared to other farmers belong to different land use patterns.

Table 5: Average annual household income and nutritional status of farm household

Land use patterns	Average household income (Tk/year)	Food intake (gm/day/capita)	Calorie intake (K.Cal/day/capita)	Protein intake (gm/day/capita)
Year round rice production	154679	1178	2558	65.68
Alternate rice and vegetables production	165347	1110	2258	59.80
Alternate rice and mustard production	138636	1211	2492	68.26
Year round banana production	292857	1228	2516	65.55
Year round pangusfish farming	80590	1155	2354	65.08
Alternate rice and wheat Production	189428	1311	2645	68.22
Alternate rice and maize production	229237	1256	2620	64.40
Alternate rice and potato production	243802	1124	2063	56.89
Alternate rice and pulse production	231327	1155	2475	59.50
Year round floriculture	250539	1123	2404	67.92
Alternate rice and prawn (golda) farming	227892	1117	2378	64.84
Year round vegetables production	111919	1022	2284	54.82
Alternate shrimp (bagda) and rice farming	326942	1361	2622	67.94
Year round shrimp (bagda) farming	391759	1352	2536	66.62
All average	205127	1182	2439	64.84

There are positive relationships between protein intake and farm groups for some land use patterns. Table 6 reveals that per capita per day protein intake increased with the increase in farm size such as in year round pangus farming, alternate rice and pulse, alternate rice and shrimp (bagda) farming and year round shrimp (bagda) farming. Farmers with larger farms have higher incomes, which might have contributed to the purchase of food items were higher protein content for consumption. Considering all selected land use patterns, there are also positive relationships between protein intake and farm groups. That is, large farm group had higher income and consumed more protein followed by medium, small and marginal farm group, respectively.

The hard core poverty observed in the study was 18 percent. The hard core poverty measurement had similarity with the PMS (2008), HIES (2005), Rahman and Schmitz (2007). PMS (2004) showed that the hard core poverty at the national, urban and rural levels were respectively 18.7, 20.8 and 18.2 percent in 2004. The absolute poverty observed in the study was 37 percent, which was also similar with the PMS (2004), HIES (2005), and Rahman and Schmitz (2007).

Table 6: Daily per capita protein intake by different categories of farm households

Land use patterns	Farm category				
	Marginal	Small	Medium	Large	All
Protein intake (gm/day/capita)					
Year round rice production	60.0	67.9	69.3	54.5	65.7
Alternate rice and vegetables production	65.4	61.8	55.3	56.8	59.8
Alternate rice and mustard production	74.0	64.6	70.6	na	68.2
Year round banana production	49.8	64.4	62.6	na	65.5
Year round pangus fish farming	61.7	61.9	68.6	78.2	65.7
Alternate rice and wheat production	67.8	66.4	69.2	74.1	68.2
Alternate rice and maize production	58.9	65.5	62.3	86.8	64.4
Alternate rice and potato production	48.3	57.4	60.2	59.6	56.9
Alternate rice and pulse production	50.7	59.9	61.6	68.3	59.5
Year round floriculture	58.0	72.5	73.7	66.7	67.9
Alternate rice and prawn (golda) farming	na	73.8	63.2	61.4	64.8
Year round vegetables production	48.7	60.9	55.8	na	54.8
Alternate shrimp (bagda) and rice farming	52.7	65.2	68.1	71.7	67.9
Year round shrimp (bagda) farming	na	62.7	62.3	70.8	66.6
All average	58.0	64.3	64.7	69.1	63.8

'na'-not available.

Factors influencing food consumption and calorie intake

For determining the factors influencing the food and calorie intake, the study used Cobb-Douglas type functions in double-log forms. In these functions food and calorie intakes were used as dependent variables, whereas education level of households' head, land use patterns, occupation of the households' head, farm size, family size and number of family member below 15 years, and households' income were used as independent variables.

Estimated model for food consumption:

ln (per capita food consumption) = 6.835 - 0.001 Edn - 0.009 land use dummy
(0.0140) (0.003) (0.036)
- 0.061^{*} occupation dummy + 0.062^{**} ln farm size
(0.030) (0.014)
- 0.242^{**} ln family size + 0.027^{*} ln income
(0.041) (0.013)
- 0.05^{*} ln no. of family member below 15 years
(0.026)

The above consumption function shows that farm size and households' income had positive impact on the consumption of various foods. In other words, the increase of farm size and income of farm households results in the corresponding increase of food intake. On the other hand, per capita consumption decreases with the increase in family members and also decreases with the increase in the number of family members below fifteen years of age. Family members below fifteen years consumed less food than members of other age groups. Occupation dummy which received 1 if main occupation was farming and zero otherwise, had negative impact on per capita food consumption. The result is quite consistent since farmers with main occupation other than farming had more income than farmers with farming as main occupation. As for example, suppose a farmer has a service as main occupation but he has also farming as subsidiary occupation, in that case he might have more income than a farmer with only occupation with farming. In the above model, figures in the parentheses indicate standard errors of respective coefficients. Above function was well fitted to the data since F-value (12.81^{**}) was found to be highly significant.

The per capita calorie intake model showed that farm size had the positive impact on per capita calorie intake whereas family size had the negative impact on it. Other variables had no significant impact on per capita calorie intake. The per capita calorie intake function was also well fitted to the data since F-value (5.071^{**}) was found to be highly significant.

Conclusions and Policy Implications:

Being an agricultural country, measuring impacts of different land use patterns on food security of farm households is very important for Bangladesh. This study covered 14 most important land use patterns, which the farm households have been practicing for several years. The study showed that farm households practicing alternate shrimp (bagda) and rice farming consumed the highest amount of food followed by year round shrimp (bagda) farming whereas the calorie intake was the highest for households of alternate rice and wheat production followed by alternate shrimp (bagda) and rice farming. But income of farm households of year round shrimp (bagda) farming was the highest followed by households practicing alternate shrimp (bagda) and rice farming, year round banana production and year round floriculture, respectively. But there were no systematic and regular pattern of relationships among income, food intake, protein intake and calorie intake in different land use patterns. Large farm households were found to consume the highest amounts of food and protein followed by medium, small and marginal farm households respectively at the aggregate level. Farm households of all land use patterns consumed higher amount of food, protein and calorie than the national average. These land use patterns reduced income poverty although the country's average poverty level has been increasing because of the prices hikes of essentials for the last few years. The farm households' food was dominated by rice followed by potato, milk, fish and leafy vegetables respectively and rice ensured more calorie followed by potato, fish and soybean oil respectively to the farm households.

All land use patterns except year round shrimp (bagda) farming are environmental friendly. There are some critiques about practicing year round shrimp (bagda) farming that it deteriorates resources, reduces biodiversity and hampers environment by increasing salinity in the soil. This land use pattern should be made sustainable by properly addressing the environmental factors and reducing adverse effects arising from producing shrimp by the government. Since other 13 land use patterns are environmental friendly, these patterns should be made sustainable to the farmers by putting interventions in the inputs and outputs markets by the government.

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