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ASSESSING DIMENSIONS OF FOOD SECURITY FOR FARM HOUSEHOLDS UNDER DIFFERENT LAND USE PATTERNS IN BANGLADESH

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Abstract

Dimensions of food security at household level are availability of adequate food and, access to and utilization of food. The present study was conducted to assess the dimensions of food security for farm households under different land use patterns in Bangladesh. Fourteen land use patterns which are largely practiced by the farmers were selected for the present study. In total, 730 farm households were selected from 50 villages of 18 Upazilas under 8 districts of Bangladesh. Four categories of farmers such as marginal, small, medium and large farmers who were largely involved in the present land use patterns were selected for the present study. The data and information so collected were converted into descriptive statistics such as arithmetic means, percentages and ratio. Regarding food availability all categories of farmers under the selected land use patterns were more or less self-sufficient in cereals, but they had tremendous shortages in other crops like potato, vegetables, pulses, oilseeds (mustard) and fish. The present study also assessed per capita food intake and nutritional status of different categories of farm households. The food consumption for overall land use patterns was i observed to be 1182 grams. Per capita calorie intake was relatively higher (2620-2645 kcal) for the farm households practicing alternate shrimp (golda) and rice farming, alternate rice and wheat production and alternate rice and maize production. Considering all selected land use patterns, per capita per day protein intake was 63.84 grams which was slightly higher than the national average (62.52).

I. INTRODUCTION

Availability of, access to and utilization of food are the major three dimensions of food security at household level and accordingly, food policy is gradually becoming more complex with the inclusion of all these dimensions. Ensuring food security for all is one of the major challenges in Bangladesh today. Despite the impressive achievements in foodgrains production during the last decades, food security at farm households and individual levels remains a major concern for the Government. Again, the production of necessary food crops by changing land use patterns is a great challenge for the farm household in Bangladesh. The production and availability of crop and non-crop foods to ensure a balanced diet and creating an environment for better utilization of land resources is a great challenge for Bangladesh.

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The challenge to maintain food-population balance is enormous because practically all cultivable land is in use. There is a little scope to expand the land frontier. The pressure of increasing population reduced the average size of farm holding from 1.70 to 1.48 acres in the period 1996-2005 (BBS, 2006). The growth of crop production now depends almost entirely on technological progress and intensive farming by introducing better management for all the food crops and other enterprises to be produced. The country also faces a difficult land distribution challenge to achieve food security for all groups in the society. About 20 percent of the rural households have no cultivable land and another 38 percent have less than 0.5 acre (BBS, 2006), which cannot therefore be a significant source of employment and income for the household. This bottom half of the population depends on the market for food, on which they spend nearly 60 percent of their income (HIES, 2007).Thus, maintaining a proper balance between food prices and income of the rural people is very important for providing incentives to food production and achieving food security for the farm household.

Most of the farmers of Bangladesh started to change their land use pattern since 2-3 decades and introduced new technologies and better management to ensure food security for farm households. Farmers have also changed their land use patterns and introduced new enterprises with or without rice in different areas of Bangladesh.

Bangladesh produces major agricultural crops such as rice, wheat, maize, jute, vegetables and potato, pulses, oilseed, sugarcane, etc. However, the total agricultural production is insufficient to meet domestic consumption and this is worsened by increase in total population. This means that the country has to import large amounts of different food items. Therefore, to ensure food security, small farmers should increase their farm production to improve their livelihood.

Cropping pattern and farming system have been changed by the farmers with the introduction of new technologies and better management. Under this farming situation, farmers also changed their land use patterns and introduced new enterprise combinations along with rice production. 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 shrimp farming and to some extent, alternate rice-fish farming and alternate shrimp- rice farming. Some of the crop enterprises such as wheat, maize, potato, pulses and vegetables are produced along with rice. Also, considering the market demand, farmers in different areas of Bangladesh started small scale commercial farming such as year round pangus farming, shrimp farming, floriculture and banana farming. A few studies (Rahman and Schmitz, 2007 and Riely *et al*. 1999) were conducted dealing with food availability and access to food. The present study was designed to determine the food production, availability, consumption and nutritional status of the selected farm households under different land use patterns.

II. METHODOLOGY

Many land use patterns are observed in different areas of Bangladesh but depending on climate and topography, local environment and agroecosystem, 14 land use patterns which are largely practiced by the farmers were selected for the present study.

For field survey 730 farm households were selected from 50 villages of 18 Upazilas under 8 districts namely Mymensingh, Tangail, Dinajpur, Rangpur, Pabna, Jessore and Sathkira. Four categories of farmers such as marginal, small, medium and large farmers who were largely involved in 14 land use patterns were selected for the present study (Table 1).

The data and information so collected were presented in tabular form which included clarifications of tables into meaningful results by using arithmetic means, percentages and ratio. Item wise food consumption was converted into calorie and protein intake by using conversion tables of different food items (Wahed and Roy, 2008). Food production, availability, consumption and nutritional status of farm households were clarified in respect of different categories of farm households under 14 land use patterns.

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	Small	Medium	Large	All
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	na	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	na	8	21	11	40
Year round vegetables production	22	21	7	na	50
Alternate shrimp (bagda) and rice farming	2	7	14	12	35
Year round shrimp (bagda) farming	na	3	12	15	30
Total	131	252	266	81	730

'na'-Not available.

III. RESULTS AND DISCUSSION

Food Production and Its Availability to the Selected Households

Rice is the staple food crop in Bangladesh and people consume rice to derive 70.0 percent of the calories and 54.0 percent of the daily protein requirement (Islam *et al.* 2007). In other words, any threat to the production of cereal crops more particularly rice, may seriously affect the food security to its growers as well as the common people of the country. Food security, in fact, could be seen from three standpoints such as availability of adequate food, stability in food supplies and access to food. An attempt has been made in this section to assess the food production and its availability to the households under the selected land use patterns.

Since the country is blessed with the most fertile lands, many land use pattern are followed the farmers of Bangladesh. A total of 14 land use patterns, as stated earlier, were chosen this study due to limitation of time and resources. The major findings of the study from selected land use patterns and their production status are chronologically presented in following sections.

Production of cereal crops

It can be seen from Table 2 that almost all the farmers of the selected land use patterns, wt the exception of year round shrimp (Bagda), were growing cereal crops. The table shows t on an average the highest production (10459 kg/year) was by the households of alternate n and maize pattern. Similarly, the second highest production (9077 kg/household/year) cereal was by the households of alternate rice and potato pattern. It may be noted here that t farmers of alternate shrimp (Bagda) and rice pattern also got the highest production (11433 kg/household/year), but average farm size under this pattern was relatively larger than other selected patterns. The average production of cereal was the lowest (1212 kg/year) in case of the followers of year round vegetables. Since cereal was the basic need for survival of all persons, the selected farmers, as expected, were given more emphasis on cereal production in the study areas.

Table 2. **Production of cereal per household per year**

Land use patterns	Cereal production per household (kg/year)				
	Marginal	Small	Medium	Large	All farm
Year round rice	2690	5145	13075	12691	7399
Alternate rice and vegetables	1144	3906	9829	13850	6282
Alternate rice and mustard	2405	3595	9011	na	4740
Year round banana	1210	1877	3612	6993	3958
Year round pangus farming	315	510	1874	2748	1155
Alternate rice and wheat	3937	5167	10306	31933	8568
Alternate rice and maize	2579	6111	13280	36783	10459
Alternate rice and potato	2683	6000	13006	38320	9077
Alternate rice and pulse	1439	4784	9151	20490	7206
Year round floriculture	645	2369	4750	4700	2749
Alternate rice and prawn *(golda)*	na	2121	3154	7764	4215
Year round vegetables	860	1108	2631	na	1212
Alternate shrimp *(bagda)* and rice	480	1417	4271	27456	11433
Year round shrimp *(bagda)*	na	0.00	0.00	0.00	0.00

`na'-Not available.

Table 3 clearly indicates that almost all the farmers (ignoring farm size), on an average, were producing surplus cereals. The quantity of average surplus cereal per household per year under different land use patterns varied from 1141 to 9626 kg. Nevertheless, the farmers belonging to the patterns of year round Pangus, year round vegetables and year round shrimp (Bagda) could not produce enough cereals to meet their basic demand. In fact, the quantity of deficit in cereals varied from 241 to 2209 kg per year. All farmers under year round shrimp (Bagda) farming could not meet their yearly household requirement for cereal crops. Similarly, marginal farmers under alternate rice and vegetables production, year round Pangus fish farming, year round floriculture, year round vegetables, and year round shrimp (Bagda)

and rice farming were in deficit in cereal crops. Small farmers of year round Pangus fish farming, year round vegetables as well as alternate shrimp (Bagda) and rice farming could not fulfill their yearly demand for cereal crops. Apart from these farmers, all of them were producing surplus cereals for themselves as well as for the society. Nevertheless, the followers of year round rice production, alternate rice and potato production, alternate rice and maize production and alternate rice and mustard production achieved better cereal production. In other words, the cereal production was quite good among the selected farmers in 2008.

Table 3. Availability of cereal per household of the followers of land use patterns

Land use patterns	Surplus/deficit cereal per household (kg/year)				
	Marginal	Small	Medium	Large	All farm
Year round rice	819	3120	10897	10875	5371
Alternate rice and vegetables	-625	2263	8286	12461	4631
Alternate rice and mustard	1145	2026	6959	na	3115
Year round banana	64	300	1707	4690	2069
Year round pangus farming	-1565	-1229	21	221	-714
Alternate rice and wheat	2463	3520	8446	29136	6799
Alternate rice and maize	758	4341	11046	34403	8437
Alternate rice and potato	1473	4704	11769	36513	7804
Alternate rice and pulse	-4	2499	6232	11440	4473
Year round floriculture	-593	792	2751	2881	1141
Alternate rice and prawn (golda)	na	647	1555	6116	2612
Year round vegetables	-439	-477	1139	na	-241
Alternate shrimp (bagda) and rice	-1011	-410	2269	25829	9626
Year round shrimp (bagda)	na	-1834	-1877	-2550	-2209

`na'-Not available.

Potato production

The results presented in Table 4 shows that none of the farmers under year round rice, year round Pangus and alternate rice and prawn (Golda) were growing potato. Apart from these patterns, other selected farmers more or less were producing potato. The households under alternate rice and potato pattern, as expected, were producing a substantial quantity of potato. In fact, per household production of potato under this pattern varied from 3765 to 46200 kg per year.

Table 4. Production of potato per household per year

Land use patterns	Potato production per household (kg/year)				
	Marginal	Small	Medium	Large	All farm
Year round rice	0.0	0.0	0.0	0.0	0.0
Alternate rice and vegetables	0.0	11	11	160	21
Alternate rice and mustard	0.0	35	46	na	30
Year round banana	0.0	0.0	16	126	41
Year round pangus farming	0.0	0.0	0.0	0.0	0.0
Alternate rice and wheat	0.0	69	1447	7083	1008
Alternate rice and maize	80	328	227	6533	564
Alternate rice and potato	3765	7610	16777	46200	11613
Alternate rice and pulse	76	13	453	143	221
Year round floriculture	0.0	198	657	560	303
Alternate rice and prawn (golda)	na	0.0	0.0	0.0	0.0
Year round vegetables	0.0	110	0.0	na	46
Alternate shrimp (bagda) and rice	0.0	31	64	175	92
Year round shrimp (bagda)	na	13	5	108	57

`na'-Not available.

Table 5 shows that only 4 out of 14 selected patterns, had some surplus production in potato, which varied from 135 to 11348 kg per year. In fact, the highest surpluses in potato (3499 to 45896 kg/year) were mainly produced by the categories of all farmers under the alternate rice and potato pattern. The remaining households from the rest 10 patterns had to purchase potato from the market to meet their household consumption. The selected marginal, small, medium and large farmers of almost all other land use patterns could not meet even the demand of their home consumption.

Table 5. Availability of potato per household of the followers of land use patterns

Land use patterns	Surplus/deficit potato per household (kg/year)				
	Marginal	Small	Medium	Large	All farm
Year round rice	-148	-197	-206	-226	-188
Alternate rice and vegetables	-149	-158	-165	19	-145
Alternate rice and mustard	-141	-87	-184	na	-123
Year round banana	-157	-147	-134	-92	-127
Year round pangus farming	-140	-146	-139	-101	-139
Alternate rice and wheat	-291	-189	1208	6846	750
Alternate rice and maize	-177	43	-86	6101	260
Alternate rice and potato	3499	7355	16505	45896	11348
Alternate rice and pulse	-41	-190	193	-366	-5
Year round floriculture	-146	15	494	375	135
Alternate rice and prawn (golda)	na	-146	-184	-169	-174
Year round vegetables	-97	-72	-147	na	-95
Alternate shrimp (bagda) and rice	-130	-188	-249	-350	-272
Year round shrimp (bagda)	na	-256	-255	-223	-239

`na'-Not available.

Production of vegetables

It can be seen from Table 6 that farmers under the land use patterns of alternate rice, alternate rice and pulse, and alternate rice and prawn (Golda) did not grow any vegetables. Similarly, the vast majority of the marginal and small farmers were not interested to grow vegetables. A greater proportion of production of vegetables came from the land use pattern alternate rice and vegetables (7668 to 10925 kg per household per year). Farmers under the alternate rice and maize pattern were also growing vegetables and its production varied from 429 to 11667 kg per household. A small quantity of vegetables was also produced by other farmers of different land use patterns.

Table 6. Production of vegetables per household per year

Land use patterns	Vegetables production per household (kg/year)				
	Marginal	Small	Medium	Large	All farm
Year round rice	12	12	0.0	0.0	8
Alternate rice and vegetables	1080	1932	7668	10925	4546
Alternate rice and mustard	0.0	0.0	0.0	na	0.0
Year round banana	0.0	0.0	416	645	348
Year round pangus farming	0.0	0.0	211	0.0	78
Alternate rice and wheat	0.0	2	462	0.0	201
Alternate rice and maize	429	878	450	11667	1173
Alternate rice and potato	750	1254	440	0.0	809
Alternate rice and pulse	0.0	0.0	0.0	0.0	0.0
Year round floriculture	16	0.0	171	640	117
Alternate rice and prawn (golda)	na	0.0	0.0	0.0	0.0
Year round vegetables	5143	6556	8314	na	6181
Alternate shrimp (bagda) and rice	0.0	70	435	302	292
Year round shrimp (bagda)	na	135	149	237	192

`na'- Not available.

Table 7 shows that the marginal, small, medium and large farmers of alternate rice and vegetables as well as alternate rice and maize pattern have produced surplus vegetables. The surplus vegetables, on an average, varied from 47 to 4177 kg per household. Unfortunately, the selected all categories of farmers under year round vegetables pattern were not able to produce enough vegetables to meet their home consumption. Most of the farmers were deficit in vegetables production and they had to depend on market to meet their household consumption.

Table 7. Availability of vegetables per household of the followers of land use patterns

Land use patterns	Surplus/deficit vegetables per household (kg/year)				
	Marginal	Small	Medium	Large	All farm
Year round rice	-227	-297	-395	-281	-309
Alternate rice and vegetables	758	1572	7268	10534	4177
Alternate rice and mustard	-208	-272	-361	na	-280
Year round banana	-444	-226	159	206	47
Year round pangus farming	-315	-395	-180	-450	-306
Alternate rice and wheat	-237	-293	200	-656	-89
Alternate rice and maize	115	566	121	11247	843
Alternate rice and potato	416	923	89	-341	469
Alternate rice and pulse	-236	-330	-400	-821	-371
Year round floriculture	-218	-289	-83	393	-143
Alternate rice and prawn (golda)	na	-294	-388	-504	-398
Year round vegetables	4846	4886	6300	na	5922
Alternate shrimp (bagda) and rice	-280	-364	-36	-194	-172
Year round shrimp (bagda)	na	-281	-370	-539	-445

`na'- Not available.

Production of pulses

Table 8 indicates that 3 (alternate rice and mustard, alternate rice and pulse, and year round floriculture) out of the selected 14 land use patterns were cultivating pulses. Its average production was as high as 5301 kg per household.

Table 8. Production of pulses per household per year

Land use patterns		Pulse production per household (kg/year)			
	Marginal	Small	Medium	Large	All farm
Year round rice	0.0	0.0	0.0	0.0	0.0
Alternate rice and vegetables	0.0	0.0	8	0.0	3
Alternate rice and mustard	241	157	589	na	288
Year round banana	0.0	0.0	17	17	12
Year round pangus farming	0.0	0.0	0.0	0.0	0.0
Alternate rice and wheat	0.0	17	17	0.0	14
Alternate rice and maize	0.0	0.0	0.0	0.0	0.0
Alternate rice and potato	0.0	0.0	0.0	0.0	0.0
Alternate rice and pulse	348	738	1411	5301	1308
Year round floriculture	20	160	26	228	87
Alternate rice and prawn (golda)	na	0.0	0.0	0.0	0.0
Year round vegetables	0.0	0.0	23	na	3
Alternate shrimp (bagda) and rice	0.0	0.0	0.0	5	2
Year round shrimp (bagda)	na	0.0	0.0	0.0	0.0

`na'- Not available.

The followers of alternate rice and pulse production, as expected, have produced surplus pulse in the study areas and it varied from 335 to 5184 kg per household per year (Table 9)

Similarly, producers under the alternate rice and mustard pattern had also a bit surplus pulse. Apart from the followers of these two patterns, all other farmers could not meet their household demand for pulses. In other words, most of the selected farmers had to purchase pulse from the market to meet their household consumption.

Table 9. Availability of pulses per household of the followers of land use patterns

Land use patterns	Surplus/deficit ¯julse per household (kg/year)				
	Marginal	Small	Medium	Large	All farm
Year round rice	-55	-58	-69	-53	-61
Alternate rice and vegetables	-42	-40	-29	-54	-38
Alternate rice and mustard	204	125	546	na	251
Year round banana	-22	-41	-29	-40	-35
Year round pangus farming	-37	-32	-39	-72	-39
Alternate rice and wheat	-31	-17	-30	-35	-25
Alternate rice and maize	-36	-28	-45	-105	-39
Alternate rice and potato	-13	-19	-16	-12	-17
Alternate rice and pulse	335	704	1380	5184	1275
Year round floriculture	-17	106	-23	193	42
Alternate rice and prawn (golda)	na	-20	-25	-38	-27
Year round vegetables	-29	-22	-5	na	-23
Alternate shrimp (bagda) and rice	-11	-34	-45	-66	-49
Year round shrimp (bagda)	na	-38	-28	-35	-33

'na'- Not available.

Production of oilseeds

Table 10 clearly indicates that mustard is not grown in many areas of the country. Only mustard is grown in alternate rice and mustard land use pattern. Its production varied from 257 to 383 kg per household. None of the farmers of other selected land use patterns were growing mustard (Table 10) and hence, they had to depend on market to meet their household demand of mustard.

Table 10. Production of oilseed per household per year

Land use patterns		Oilseed production	per household	(kg/year)	
	Marginal	Small	Medium	Large	All farm
Year round rice	0.0	0.0	0.0	0.0	0.0
Alternate rice and vegetables	0.0	0.0	0.0	0.0	0.0
Alternate rice and mustard	257	366	385	na	375
Year round banana	0.0	0.0	6	37	13
Year round pangus farming	0.0	0.0	0.0	0.0	0.0
Alternate rice and wheat	0.0	4	9	0.0	6
Alternate rice and maize	0.0	0.0	50	0.0	23
Alternate rice and potato	0.0	0.0	0.0	0.0	0.0
Alternate rice and pulse	0.0	23	18	0.0	14
Year round floriculture	0.0	0.0	0.0	40	4
Alternate rice and prawn (golda)	na	0.0	0.0	0.0	0.0
Year round vegetables	0.0	0.0	0.0	na	0.0
Alternate shrimp (bagda) and rice	0.0	0.0	1	14	5
Year round shrimp (bagda)	na	0.0	0.0	0.0	0.0

`na'- Not available.

Results presented in Table 11 reveal that all the farmers of the study area, with the exception of alternate rice and mustard pattern, were deficit in mustard production. Per household production of mustard varied from 257 to 385 kg (Table 3.17). However, very negligible surplus of mustard was also grown by some farmers under different land use patterns.

Table 11. Availability of oilseed per household of the followers of land use patterns

Land use patterns	Surplus/deficit oilseed production per household (kg/year)				
	Marginal	Small	Medium	Large	All farm
Year round rice	-41	-57	-62	-73	-55
Alternate rice and vegetables	-36	-39	-43	-52	-41
Alternate rice and mustard	240	328	333	na	333
Year round banana	-25	-30	-35	-19	-28
Year round pangus farming	-42	-45	-55	-119	-54
Alternate rice and wheat	-33	-36	-44	-66	-40
Alternate rice and maize	-41	-37	5	-85	-21
Alternate rice and potato	-31	-37	-39	-49	-37
Alternate rice and pulse	-27	-26	-33	-159	-37
Year round floriculture	-28	-36	-41	1	-31
Alternate rice and prawn (golda)	na	-33	-39	-49	-41
Year round vegetables	-33	-34	-37	na	-34
Alternate shrimp (bagda) and rice	-26	-38	-42	-45	-42
Year round shrimp (bagda)	na	-35	-38	-76	-57

'na'- Not available.

Fish production

Since fish is the most common and important food item in the diet of Bangladeshi people, the followers of 12, out of the selected 14 land use patterns, were more or less cultivating fish in the study areas (Table 13). The adopters of year round (Bagda), alternate rice and prawn (Golda), year round Pangus farming were cultivating fish intensively. The highest quantity (95018 kg per household) of fish was caught annually by the large farmers under year round shrimp (Bagda) farming.

Table 12. Production of fish per household of the followers of land use patterns

Land use patterns		Fish production per household (kg/year)			
	Marginal	Small	Medium	Large	All farm
Year round rice	46	178	2870	225	888
Alternate rice and vegetables	17	99	90	185	86
Alternate rice and mustard	0.0	18	68	na	27
Year round banana	0.0	0.0	205	35	95
Year round pangus farming	5109	9004	20175	30880	14209
Alternate rice and wheat	25	22	80	267	60
Alternate rice and maize	40	43	1193	80	562
Alternate rice and potato	0.0	0.0	0.0	0.0	0.0
Alternate rice and pulse	0.0	0.0	0.0	0.0	0.0
Year round floriculture	0.0	0.0	286	1200	200
Alternate rice and prawn (golda)	na	3205	3926	62404	19863
Year round vegetables	0.0	0.0	0.0	na	0.0
Alternate shrimp (bagda) and rice	360	2563	2139	7567	3975
Year round shrimp (bagda)	na	1263	2085	95018	48469

`na'- Not available.

Table 13 shows that the farmers of year round Pangus fish, alternate rice and prawn (golda) farming, alternate shrimp (Bagda) and rice farming as well as year round shrimp (Bagda) farming patterns, as expected, produced huge surplus fish per year. Per household, on an average, had a surplus fish from 79 to 48048 kg per year. This means that these farmers had huge quantity marketable surplus fish and they coukd make more money by selling their surplus fish to the market. Apart from these fish-based four land use patterns followers, no other pattern followers could meet their household demand for fish.

Table 13. Availability of fish per household of the followers of land use patterns

Land use patterns	Surplus/deficit fish		'noduction per household (kg/year)		
	Marginal	Small	Medium	Large	All farm
Year round rice	-112	-1	2697	10	714
Alternate rice and vegetables	-140	-75	-67	57	-75
Alternate rice and mustard	-163	-123	-164	na	-143
Year round banana	-170	-103	73	-180	-51
Year round pangus farming	4894	8751	19894	30495	13943
Alternate rice and wheat	-96	-113	-48	85	-74
Alternate rice and maize	-67	-72	1041	-37	431
Alternate rice and potato	-99	-130	-140	-195	-131
Alternate rice and pulse	-118	-170	-180	-523	-185
Year round floriculture	-89	-139	152	1078	79
Alternate rice and prawn (golda)	na	3002	3711	62167	19643
Year round vegetables	-75	-93	-117	na	-88
Alternate shrimp (bagda) and rice	196	2241	1761	7192	3629
Year round shrimp (bagda)	na	880	1757	94516	48048

`na'- Not available.

It is evident from the above-mentioned discussions and results presented in Tables 2 to 13 that all categories of farmers under the selected land use patterns were more or less self-sufficient in cereals, but they had tremendous in other crops like potato, vegetables, pulses, oilseeds

(mustard) and fish. In addition to cereal crops, more attention should immediately be given to increase vegetables, pulses, oilseeds and fish production of Bangladesh.

Food Consumption and Nutritional Status of Farm Households

Food utilization 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.

Intake of food

Intake of food by the households per capita per day for the year *2007-2008* have been presented in Table *14*, disaggregated by different land use patterns. It was observed that aggregate food consumption was the highest for the land use pattern alternate shrimp (bagda) and rice farming and it was *1361* grams followed by year round shrimp (bagda) farming *(1352* grams) and alternate rice and wheat production (1311 grams), respectively. On the other hand, per capita per day food consumption was the lowest for the land use pattern year round vegetables production and it was *1022* grams but the food consumption for overall land use patterns was observed to be *1182* grams. The average per capita per day food intake was relatively higher than that of national average as reported in Poverty Monitoring Survey PMS, *2004* and Household Income and Expenditure Survey (HIES), *2005*. Poverty Monitoring Survey (PMS) *2004* reported that national average per capita per day food consumption was *966.0* grams whereas it was *947.8* grams in HIES, *2005*. The result of the study is quite consistent with the above two sources since both the sources revealed that per capita per day food consumption was relatively higher for the rural areas than those of urban areas. Overall per capita per day food consumption was the highest for large farmers followed by medium, small and marginal farmers,.

Table 14. Food intake by farm households (grams /day/capita)

Land use patterns	Farm category				
	Marginal	Small	Medium	Large	All
Year round rice production	1069	1205	1273	927	1178
Alternate rice and vegetables production	1214	1143	1049	973	1110
Alternate rice and mustard production	1268	1157	1270	na	1211
Year round banana production	936	1222	1175	1359	1228
Year round pangus fish farming	1062	1100	1189	1446	1155
Alternate rice and wheat production	1320	1350	1252	1511	1311
Alternate rice and maize production	1155	1310	1214	1461	1256
Alternate rice and potato production	1007	1122	1186	1090	1124
Alternate rice and pulse production	963	1099	1219	1512	1155
Year round floriculture	969	1167	1151	1368	1123
Alternate rice and prawn (golda) farming	na	1239	1093	1072	1117
Year round vegetables production	890	1161	1023	na	1022
Alternate shrimp (bagda) and rice farming	978	1174	1302	1602	1361
Year round shrimp (bagda) farming	na	1130	1155	1669	1352 _
All average	1057	1189	1192	1389	1182

`na'-Not available.

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 *15.* 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 (PMS, *2004;* HIES, *2005).* The average calorie intake reported by the PMS, *2004* and HIES, *2005* were respectively *2308* k.cal. and *2238.5* k.cal. The present study shows that calorie intake was the highest for large farmers *(2562* k.cal) followed by small *(2474* k.cal), medium *(2455* k.cal) and marginal *(2263* k.cal) farmers. The above two national studies showed that calorie intake was relatively higher for the rural people compared to urban people. The present study showed that per capita calorie intake was the highest for the farm households practicing alternate rice and wheat production *(2645* kcal) followed by alternate shrimp and rice farming *(2622* k.cal) and alternate rice and maize production *(2620* k.cal). For the farm families of other land use patterns, per capita daily calorie intake was found to be almost f smallilar.

Table 15. Calorie intake by the members of farm households (K.caUday/capita)

Land use patterns			Farm category		
	Marginal	Small	Medium	Large	All
Year round rice production	2434	2600	2700	2417	2558
Alternate rice and vegetables production	2415	2303	2101	2355	2258
Alternate rice and mustard production	2584	2426	2546	na	2492
Year round banana production	1691	2547	2483	2665	2516
Year round pangus fish farming	2371	2214	2370	2860	2354
Alternate rice and wheat production	2626	2720	2578	2702	2645
Alternate rice and maize production	2388	2731	2563	2814	2620
Alternate rice and potato production	1849	2098	2116	2218	2063
Alternate rice and pulse production	2060	2430	2678	2617	2475
Year round floriculture	2129	2534	2639	2152	2404
Alternate rice and prawn (golda) farming	na	2694	2347	2207	2378
Yearround vegetables production	2022	2595	2175	na	2284
Alternate shrimp (bagda) and rice farming	2206	2383	2571	2890	2622
Year round shrimp (bagda)farming	na	2286	2269	2799	2536
All average	2263	2474	2455	2562	2439

'na' – Not available.

Intake of protein

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.

There were positive relationships between protein intake and farm groups for some land use patterns. Table 16 reveals that per capita per day protein intake increased with the increase in farm size for the year round pangus farming, alternate rice and vegetables, alternate rice pulse, year round vegetables, and alternate rice and shrimp (bagda) farming groups of farmers. Farmers with larger farm size had higher incomes, which might have contributed to the purchase of higher protein content food items for consumption. Considering all selected land use patterns, there are also positive relationships between protein intake and farm income groups. That is, large farm group had higher income and consumed more protein followed by medium, small and marginal groups of farms.

Table 16. Daily per capita protein intake (grams/day/capita) by different categories of fa households under different land use patterns

Land use patterns			Farm category		
	Marginal	Small	Medium	Large	All
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
Average of all households	58.0	64.3	64.7	69.1	63.8

`na'-Not available.

Table 17 reveals that there are no systematic and regular pattern of relationships among household income, food intake, calorie intake and protein intake in different land use patterns.

Accordingly, these four factors should be explained separately. Table 17 shows that protein intake per capita per day was *63.8* grams for all selected land use patterns but per capita per day protein intake was relatively higher (about *68* grams) for alternate rice and mustard; alternate rice and wheat, alternate shrimp and rice farming and year round floriculture. However, other than year round vegetables production and alternate rice and potato production, per capita per day protein intake were relatively higher and almost same for the household members under these land use patterns.
The lower intake of protein by year round vegetable farmers may be caused for two reasons: i) vegetables are not protein rich but vitamin rich and ii) most of the vegetable farmers *(86%)* were marginal and small farmers. Accordingly, their calorie intakes were lower compared to other farmers belong to different land use patterns.

Table 17. Average annual household income and nutritional status of farm household under different land use patterns

Land use patterns	Average household income (Tk/year)	Food intake (gm/day/capita)	Calorie intake (K.CaI/day/capita)	Protein intake (gm/day/capita)
Year round shrimp (bagda) farming	391759	1352	2536	66.6
Alternate shrimp (bagda) and rice farming	326942	1361	2622	67.9
Year round banana production	292857	1228	2516	65.5
Year round floriculture	250539	1123	2404	67.9
Alternate rice and potato production	243802	1124	2063	56.9
Alternate rice and pulse production	231327	1155	2475	59.5
Alternate rice and maize production	229237	1256	2620	64.4
Alternate rice and prawn (golda) farming	227892	1117	2378	64.8
Alternate rice and wheat production	189428	1311	2645	68.2
Alternate rice and vegetables production	165347	1110	2258	59.8
Year round rice production	154679	1178	2558	65.7
Alternate rice and mustard production	138636	1211	2492	68.2
Year round vegetables production	111919	1022	2284	54.8
Year round pangus fish farming	80590	1155	2354	65.7
Average of all households	205127	1182	2439	63.8

IV. CONCLUSION

While agricultural production had increased manifolds, it is showing signs of diminishing marginal returns. Given the scarcity of cultivable land and a still growing population, land use and cropping intensity is approaching a maximum. This severely limits the possibility of many farmers to earn livelihood from farming. It is evident that all categories of farmers under the selected land use patterns were more or less self-sufficient in cereals, but they had tremendous shortages in other crops like potato, vegetables, pulses, oilseeds (mustard) and fish: In addition to cereal crops, more attention should immediately be given to increase vegetables, pulses, oilseeds and fish production of Bangladesh. the present study shows that changing land use pattern with scientific culture and efficient management is a path way to increase food production as well as to ensure food security of farm households.

Farmers in the study areas were gradually changing their land use patterns. In fact, foodgrain production, food security and its availability as well as farm income per household have increased substantially. This implies that the changing land use patterns had some positive impacts not only on food production and consumption, but also per capita daily calorie intake and nutritional status have of the people.

Almost in every year different kinds of natural calamities and disaster such as flood, drought, cyclone and Sidor, and hail storming occurred in Bangladesh which caused severe damage of crops and livestock of the farmers. Secondly, climate and topography are also changing. Under these circumstances, farmers had to change their land use patterns to get adjusted the risk and uncertainty and to increase the food production as well as household income.

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