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## Improvement of livelihood, food and nutrition security through homestead vegetables production and fruit tree management in Bangladesh

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### Abstract

Sustainable, safe and nutritious food productions are the major challenges for global food security which meets dietary needs and food preferences for an active and healthy life. The objectives of the study were to utilize homestead resources in scientific method for producing fresh vegetables and fruits over space and time and to meet up the food and nutritional security of the farmers. Household survey was carried out to ascertain livelihoods information of the selected farm households before intervention. The trial was conducted at six replications by the participatory approaches following vegetables production “Golapgonj Model”. Results revealed that a family consisting five members having small homestead area with some fruit trees could be capable of harnessing sufficient and diversified vegetables and fruit round the year by utilizing the all possible homestead niches and management of fruit trees. Results also suggested that the farmers consumed lion share of their products that could meet up nutrition from various vegetables and fruits, some of them distributed a portion to relatives and neighbors and also sold a portion of them. The additional income generated by selling of surplus vegetables and fruits was generally utilized to purchase supplementary food items, in turn increase the diversification of the family’s diet. Interestingly, active participation of family members (especially women and children) in their homestead vegetable production activities was also ensured. Thus, all these might be lead to full utilization of both physical & other farm resource available in the farm & mobilize resources that increased food & nutritional security, income as well as improved their livelihoods as well.

**Keywords:** Vegetables production, Food, Productivity, Income diversification, Livelihood

### Introduction

Bangladesh is a member of the least developed countries in the world with population of about 160 million (BBS, 2012). The highest proportion of food insecure people are among landless and non-farm households, which is half of the countries rural population. Shortage of food is a usual phenomenon of the country and she has to import food in almost every year at the cost of valuable foreign exchange. To feed the population it is an emergence to increase crop production. According to definition of World Food Summit (1996), food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996). Household food security is the application of this concept at the family level, with individuals within households as the focus of concern.

There are about 18-20 million families in Bangladesh, most of them live in rural areas having a homestead each (Khan *et al.*, 2009). These homesteads are the most effective and common production units for supplying food, fuel, timber and other family needs and employing family labour. Hussain *et al.* (1988) reported that only 13 percent homestead area is under vegetable cultivation in Bangladesh. Nutritional deficiency is a common phenomenon especially in rural areas of the country. Report indicated that 49.8 percent of Bangladesh’s population lives below the national poverty line (UNDP, 2008). Indeed, the prevalence of malnutrition in rural Bangladesh is among the highest in the world (HKI, 2008). The rates of childhood malnutrition in rural Bangladesh are among the highest in the world, 55% of children below 5 years old are stunted and 18% have low weight-for-height.

Chadha *et al.* (1994) reported that per capita vegetables consumption in Bangladesh is only 28g against the daily requirement of 200 g while Uddin *et al.* (2009) reported that the daily requirement of vegetables are about 220g but per capita consumption of vegetables in Bangladesh is only 50g. Now, the daily per capita vegetables consumption in the rural areas is 194 g which includes potato and leafy vegetables (Rahman and Islam, 2012). Rural consumption of leafy and non-leafy vegetables has remained more or

less the same over the past two decades after increasing over the past 30 years. Although fruit consumption has declined in rural areas after more than doubling in the 1970s but the average national per capita consumption of fruit and vegetables altogether is only of 126 g. This is far below the minimum daily consumption of 400 g of vegetables and fruit recommended by FAO and the World Health Organization (FAO/WHO, 2003). Global food demand is growing rapidly, and doubling food production and sustaining food production at this level, are major challenges for global food security (Tilman *et al.*, 2002 and 2011). Home gardens are an integral part of local food systems and the agricultural landscapes of developing countries all over the world have endured the test of time (Galhena *et al.* 2013). The global change due to climate induced disasters can also have devastating impacts on communities and disable food production systems (Iannotti *et al.*, 2009). Several studies suggest that home gardens can be an option for food and nutritional security in disaster, conflict, and other post-crisis situations (Marsh, 1998; Galhena *et al.*, 2012; Wanasundera *et al.*, 2006). Therefore, more attention towards home gardening as a strategy to enhance household food security and nutrition is to be needed.

Many homestead areas from small to large farmers of Bangladesh remain fallow or unutilized, which is a common phenomenon. There is a chance to bring these homesteads under vegetable production round the year including growing and/or management of quick growing fruit trees in a scientific way. This ultimately will play a vital role of reducing poverty and malnutrition and also can provide household with food and nutritional security (ARR, 2011 and 12). The fresh vegetables and fruits produced in the homestead can contribute more by providing increased opportunities for economic empowerment, household food security, and access to nutrition round the year and conservation of the natural environment. Under these circumstances, the research work was undertaken with the objectives i) to utilize homestead resources in scientific way for producing fresh vegetables and fruits over space and time, ii) to meet up the food security and nutritional requirements of the farmer's family & their livelihood improvement and iii) to create employment particularly for women and children.

## Materials and Methods

The year round vegetable production was carried out at farmers' homestead in Moulvibazar, Bangladesh during the year 2010-12. The experiment was conducted at six farmers' homesteads which were randomly selected among the farmers of Kodupur Integrated Crop Management club with the help of Department of Agricultural Extension, Moulvibazar. Before intervention, a household survey was carried out among the 50 farm households and detail information in respect of livelihoods of farmers maintained by the households was collected. All of the farmers had some fruit trees like jackfruits, litchi, mango, lemon etc. Some of them were used to produce vegetables partially with poor managements others were not involved in produce vegetables. All of them were not taken care of their fruit trees and were totally dependent on nature. The co-operative farmers (both male and female including their children) were given orientation on the programme activities prior to intervention. The trial was conducted with participatory approaches with farmers under the researchers' active supervision during the project period. The five years weather data are also described in Fig. 1. The study was designed by the "Golapgonj Model" developed (research conducted from 2002-09) by the scientist of On-Farm Research Division, Bangladesh Agricultural Research Institute, Sylhet (Choudhury *et al.*, 2011) and followed to full utilization of homestead under Agro-Ecological Zone-22. The production units of the homestead, crops and trees that were utilized and nourished in these homesteads in available spaces are presented in Table 1. Farmers were encouraged to use organic manure from their own sources in vegetables cultivation and management of fruit trees. Inorganic fertilizers viz. nitrogen, phosphorus, potassium, calcium etc. were applied in each crop and fruit trees at recommended rates (BARI, 2006). Irrigation and all other intercultural operations including plant protection measures were taken accordingly where necessary. Data on yield, consumption, distribution, and selling of different types of vegetables were collected by using pre-designed schedule and regular monitoring. The nutrient contribution from vegetables and fruits per capita per day was calculated by converting the total edible yield into standard units. Means, averages and percentages were used for interpretation of the data by using MS Excel software.

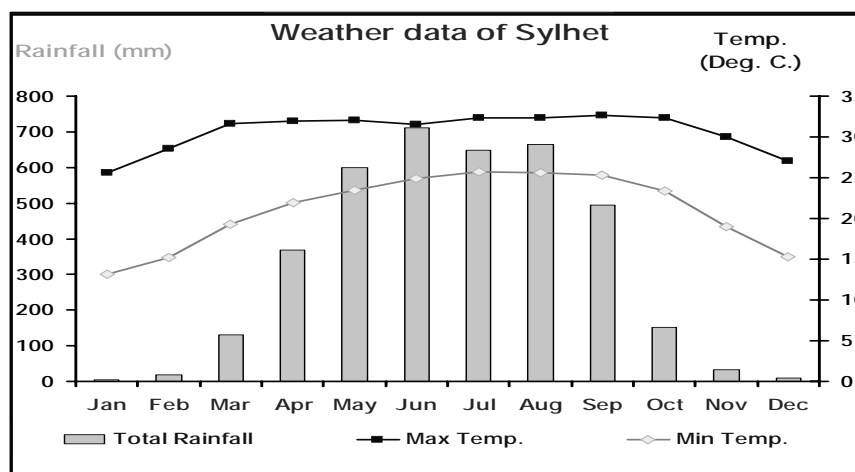


Fig.1. Average maximum and minimum temperatures and monthly total rainfall (2007-2012) in Sylhet

**Table 1. Production units of Golapgonj vegetable production model, Sylhet**

Production units	Name of crops, vegetables and trees			
	Bed	Cropping pattern		
		Rabi	Kharif-I	Kharif-II
Sunny area	Bed-1	Radish	Tomato	Amaranth
	Bed-2	Laishak	Cabbage	Okra
	Bed-3	Brinjal	Lalshak	Gimakalmi.
	Bed-4	French bean	Lalshak	Yard long bean
Marshy land	Lotiraj (Pani kochu)			
Shady place	Ginger			
House Roof	Ash gourd			
Trellis	Yard long bean- BARI Lau-Country bean			
Under trellis	Turmeric and Mukhikachu			
Homestead boundary	Plantation of guava, litchi, lemon, orange, pumello etc.			
Non fruit tree	Potato yam			

## Results and Discussion

### Vegetable production and cost and return analysis

The production of vegetables in the homestead is presented in Table 2. The mean yield of vegetables was higher at open sunny space (206 kg) followed by that under trellis (58 kg). Among the vegetables cropping pattern in four bed, radish-tomato-amaranth vegetable pattern (Bed-1) produced the highest yield (91kg) followed by French bean-red amaranth (51kg) (Bed-2). It was observed that more crops and production units were covered in *rabi* season than *kharif*. Analysis of benefit-cost ratio revealed that among the eight production units, the highest gross return (Tk. 4315) and gross margin (Tk. 2999) were recorded in open place of the homestead while the other production units altogether contributed the gross return (Tk. 5752) and gross margin (Tk.3616). The benefit cost ratio (BCR) is also found the highest (3.28) in the vegetables cultivation at open space. However, the mean yield of vegetables harvested from the homestead was 423 kg and the gross return and gross margin were Tk.10067 and 6615, respectively and the BCR was 2.92 (Table 2). By growing their own vegetables, households were able to supplement their income by lessening the need to purchase food from the local market and used this extra income for other purposes. The findings of the present study are also conformed the finding of Islam *et al.* (2003), Khan *et al.* (2009) and Berning *et al.* (2008). Talukder *et al.* (2000) reported that the number of varieties and vegetable production was three times higher in the developed garden than traditional garden and child consumption was also 1.6 times higher. Alam (2011) documented that farmers obtained their main staple root crops from home gardens in Bangladesh. Resource-poor families often depended more on home gardens for their food staples and secondary staples than those endowed with a fair amount of assets and resources such as land and capital (Wiersum, 2006).

**Table 2. Performance and cost and return of year round vegetables production**

Place	Crop	Price (Tk.)	Amount harvested (kg)	Gross return (Tk.)	Total variable cost (Tk)	Gross margin (Tk)	BCR	
Open Place	Bed -1	Radish	15	40	600	170	430	3.53
		Tomato	22	35	770	236	534	3.26
		Amaranth	14	16	216	80	136	2.70
	Bed -2	Lalshak	30	10	300	70	230	4.29
		Cabbage	15	26	390	140	250	2.79
		Okra	30	15	450	150	300	3.00
	Bed -3	Brinjal	25	19	475	180	295	2.64
		Lalshak	20	10	200	75	125	2.67
		Gimakalmi	18	13	234	80	154	2.93
	Bed -4	French bean	40	12	480	60	420	8.00
		Lalshak	20	10	200	75	125	2.67
	Sub-total (A)			206	4315	1316	2999	3.28
Trellis	Yard long bean	20	25	500	450	50	1.11	
	Country bean	28	24	672	408	264	1.65	
Under trellis	Turmeric	25	20	500	100	400	5.00	
	Mukhikachu	20	20	400	175	225	2.29	
	Ginger	60	18	1080	194	886	5.57	
Marsh land	Lotiraj	20	25	500	150	350	3.33	
Shady place	Ginger	50	20	1000	309	691	3.24	
Roof	Ash gourd	15	40	600	250	350	2.40	
Tree	Potato yam	20	25	500	100	400	5.00	
Sub-total (B)			217	5752	2136	3616	2.69	
Total (A+B)			423	10067	3452	6615	2.92	

### Fruits production and cost and return analysis

The result revealed that the total amount 218 kg of fruits were harvested from the farmers household in which gross return and gross margin were recorded Tk. 8635 and 6725, respectively. Therefore, the BCR of the fruits was recorded 4.52 (Table 3). Consumption of fruits and vegetables is vital for a diversified and nutritious diet for a family. Increasing dietary diversification is the most important factor in providing a wide range of micronutrients and this requires an adequate supply, access to and consumption of a variety of foods. Iannotti, *et al.* (2009) reported that homestead food production programs assisted and addressed vitamin A deficiency and improved the quality of diet by facilitating a year-round production of vegetables and fruits.

**Table 3. Performance of quick growing fruit trees in homestead area**

Tree	Price (Tk/kg)	Amount harvested (kg)	Gross return (Tk.)	Total variable cost (Tk)	Gross margin (Tk)	BCR
Guava	20	10	200	115	85	1.74
Litchi	120/100 pc.	2500 pc/50kg	3000	1100	1900	2.73
Lemon	45	3	135	65	70	2.08
Mango	60	55	3300	365	2935	9.04
Jackfruit	20	100	2000	265	1735	7.55
Total		218	8635	1910	6725	4.52

Note: 50pc litchi=1 kg, 15pc lemon = 1kg (Approx.) Source: Field survey 2012

### Farm Resource Utilization

During the pre-intervention period, most of the farms did not utilize resources in scientific way. In integrated farming system farmers are preserved the kitchen wastes, manures, crop residues, animal waste, poultry litter, cowdung etc. at their farm level scientifically. Farmers used these resources properly for crop production, which ultimately helped to improve soil fertility and moisture conservation of the

homestead production units, thereby, reducing environmental pollution in order to get sustainable agricultural production. Homestead garden benefits family nutrition, increase household income, provide a buffer to food insecurity during lean season (agriculture off-season), provide habitat protection and soil conservation (Marsh, 1996). Women are the main care-takers of the garden, which empowers them, ensures better utilization of the income from the garden for food, and increases family welfare. However, after intervention, full utilization of both physical & other farm resource available in the farm & resources were mobilized for food security, income generation and improvement of their livelihoods. All these benefits are important contributions towards poverty alleviation.

### Farm Productivity

Farm productivity increased due to increase of yield per unit area as well as addition of new alternative enterprises, maximizes the farm productivity etc. Firstly, the crop yields increased due to adoption of recommended technologies & better use of farm resources. Secondly, addition of new enterprises added new commodities.

### Disposal pattern of harvested vegetables and fruits

The utilization pattern of vegetables showed that the farmers not only consumed their products but also distributed a portion of the product to relatives and neighbors and a portion of them were sold for meeting family needs. Disposal pattern of vegetables revealed that farm family did intake more vegetables (298kg) than distribution (46kg) to neighbors and relatives and sale (79kg) (Table 4). It was observed that 70% of the harvested vegetables were consumed by the farmer's family followed by sale (19%) and the lowest amount (11%) of vegetables was distributed to relatives and neighbors (Fig. 2). The results are in conformed to the finding of Khan *et al.* (2009) who asserted that farmers consumed their harvested vegetables, sold some of them and also distributed to other to strengthen social relation. The findings also agreed with Islam *et al.* (2003). Similar results were also observed in case of harvested fruits. Results found that farm family did intake 111.5kg (> 50%) of fruits that was almost two times and two and half times more than that of the fruits sold (27%) and distributed (22%), respectively (Table 5 and Fig. 3). Bloem *et al.* (2001) reported that vegetables and fruits production and consumption increased among the beneficiaries of the homestead food production programme in Bangladesh.

**Table 4. Production and utilization pattern of vegetables**

Place		Crop	Amount harvested (kg)	Disposal pattern		
				Amount distributed (kg)	Own consumption (kg)	Amount sold (kg)
Open Place	Bed -1	Radish	40	3	32	5
		Tomato	35	2	30	3
		Amaranth	16	5	11	0
	Bed -2	Laishak	10	2	8	0
		Cabbage	26	4	18	4
		Okra	15	1	12	2
	Bed -3	Brinjal	19	0	15	4
		Lalshak	10	1	8	1
		Gimakalmi	13	1	10	2
	Bed -4	French bean	12	2	8	2
Lalshak		10	0	8	2	
Trellis	Yard long bean	25	1	20	4	
	Country bean	24	2	18	4	
Under trellis	Turmeric	20	2	6	12	
	Mukhikachu	20	0	18	2	
	Ginger	18	2	4	12	
Marsh land	Lotiraj	25	4	15	6	
Shady place	Ginger	20	3	12	5	
Roof	Ash gourd	40	6	25	9	
Tree	Potato yam	25	5	20	0	
		Total	423	46	298	79

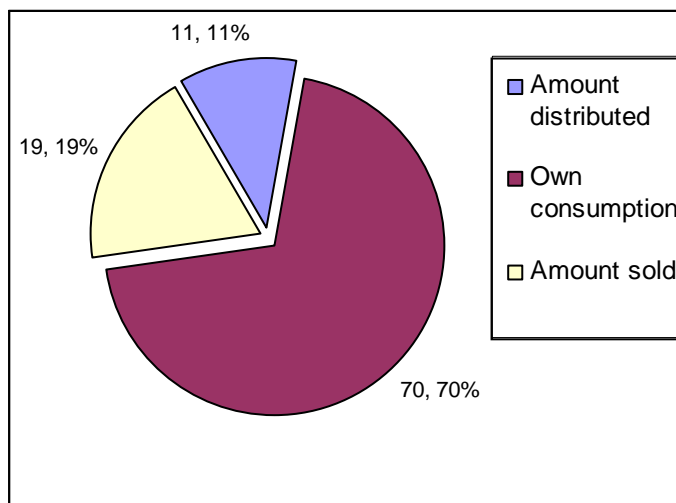


Fig. 2. Disposal pattern of vegetables by the farm households

Table 5. Production and utilization of quick growing fruit trees

Crop	Amount harvested (kg)	Disposal pattern		
		Amount distributed (kg)	Own consumption (kg)	Amount sold (kg)
Guava	10	2	5	3
Litchi	2500 pc./50kg	750 pc./15 kg	1250 pc./25kg	500 pc./10kg
Lemon	3	0.5	1.5	1
Mango	55	10	25	20
Jackfruit	100	20	55	25
Total	218	47.5 (22%)	111.50 (51%)	59 (27%)

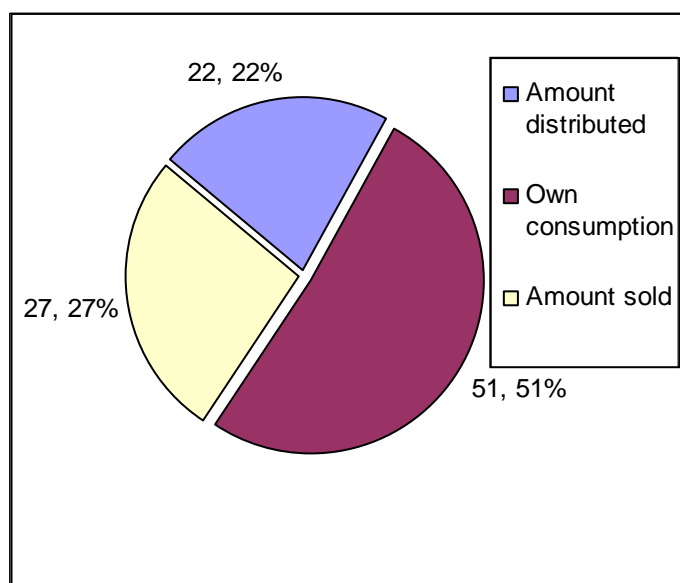


Fig. 3. Disposal pattern of fruits by the farm household

### Income diversification

Result revealed that there was great scope and potential of increasing yields of short-term cash crops, like vegetables produced and marketed in the nearest urban areas. Kaspersma (2007) reported that the promotion of income generating activities could be successful to improve income diversification and food security. The income from those activities in the homestead could be used to have access to food and to improve their livelihood. (UN, 2000). Homestead production of fruits and vegetables provides the household with direct access to important nutrients that may not be readily available or within their economic reach. Studies suggest that this additional income is generally utilized to purchase supplementary food items, in turn increasing the diversification of the family's diet (Talukder, 2000). Bibliographic evidence suggests that home gardens contribute to income generation, improved livelihoods, and household economic welfare as well as promoting entrepreneurship and rural development (Eyzaguirre *et al.*, 2010 and Calvet-Mir *et al.*, 2012).

### Nutrient contribution

Month wise nutrient contribution from the vegetables grown in different production units of homestead are presented in Fig. 4 and 5. The highest amount of vegetables (55kg) produced in the month of December followed by May (50kg) and January (45kg) and the lowest (25kg) was recorded in the month of October (Fig. 4). It might be due to more production of winter vegetables in *rabi* season. It is revealed that farmers intake less vegetables compared to harvest. Uddin *et al.* (2009) reported that the recommended dietary allowances (RDA) of vegetables is 220g per person per day and it was calculated by considering five members per family during the study. Considering percentage over RDA, the highest amount of vegetables (-12.02%) was consumed in the month of March followed by June (-12.12%), while the lowest amount of vegetables was consumed in October (-35.48%) compared to RDA required for month basis (Fig. 5). Results cleared that the production of vegetables were much more than RDA (month basis) required for 5 members of a family except in the month of October and September where the production of vegetables were 26.69% and 9.09%, respectively less than that of RDA required (month basis). It is also mentionable that 61.29% more vegetables were produced in the month December compared to total RDA required to the month followed by May (46.63%).

Talukder *et al.* (2000) asserted that children in households with garden consumed vitamin A-rich foods, such as green leafy vegetables and yellow fruits, more frequently than did children in households without a garden or with a traditional garden. In Bangladesh, consumption of fruits was very low and highly seasonal, and oil consumption, a requirement for adequate absorption of the beta-carotene, was also well below the recommended intake level. On the other hand, family consisting five members, the total RDA for 365 days required was 164.25kg but the people took only 111.50kg of edible fruits (51%) out of 218 kg total mean yield of harvested fruits in the homestead. The RDA 85-90g fruits per person per day were taken under consideration as per Bari *et al.* (2005). Farmers took less fruits (-32.12%) for the whole year compared to RDA although the production of fruits due to management increased by 32.72% over RDA (Table 6). Melina (2012) suggested that "a menu filled with seasonal fruits and vegetables could provide a big nutritional boost," and vegetables were packed with fiber and water, and were low in fat, they decreased the calorie density of diet, while boosting overall nutrition. It was evident from the literature that home gardens are a part of agriculture and food production systems in many developing countries and are widely used as a remedy to alleviate hunger and malnutrition in the face of a global food crisis (Johnson *et al.* 2000). Mitchell and Hanstad (2004) reported that home garden provided multiple social benefits such as enhancing food and nutritional security, empowering women, promoting social justice and equity, and preserving indigenous knowledge and culture etc.



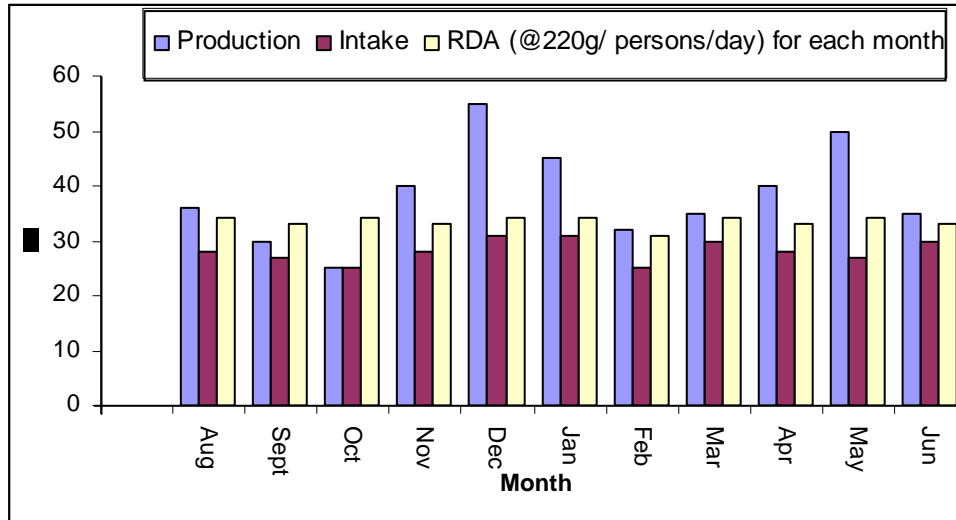


Fig. 4. Month wise vegetable production and intake against RDA by farm household

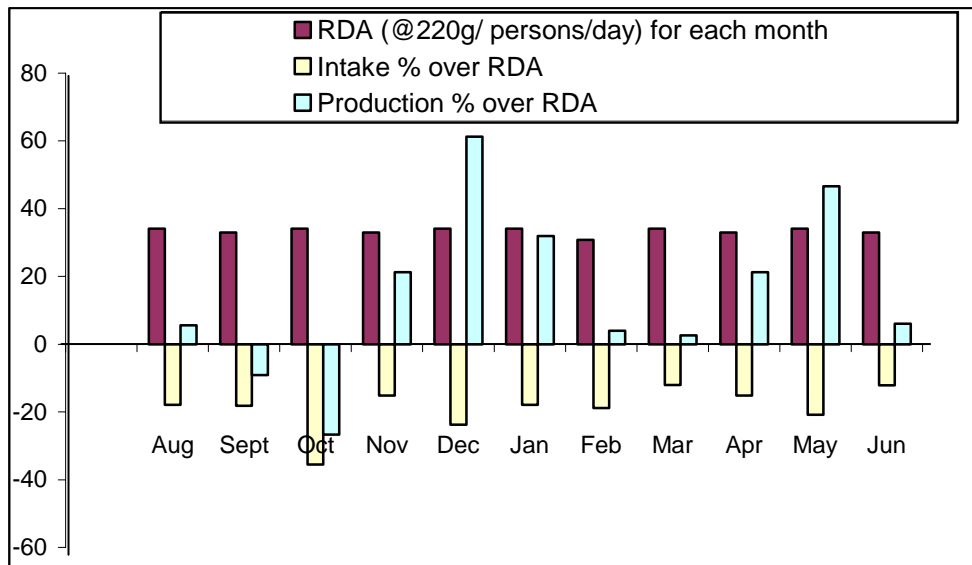


Fig. 5. Month wise production and intake percentage against RDA by farm household

Table 6. Nutrient contribution of fruits harvested from quick growing fruit trees

Tree	Amount harvested (kg)	Intake (kg)	RDA (360g/4p/day) need for 365 days (kg)	Percentage over RDA	
				Intake % over RDA	Production % over RDA
Guava	10	5	-	-	-
Litchi	50kg (2500 pc.)	1250 pc./25kg	-	-	-
Lemon	3	1.5	-	-	-
Mango	55	25	-	-	-
Jackfruit	100	55	-	-	-
Total (12 Months)	218	111.50 (51%)	164.25 kg	-32.12	32.72

**Family labour utilization and women empowerment**

Research results indicated that utilization of surplus family labour increased due to huge intervention of technologies in the homestead. Family labour was mostly used in home garden and was managed mostly by the idle family labour of male, female, and children. Male farmers participated more in vegetables bed preparation, planting, weeding, staling, fencing, crop protection and marketing while female members participated more in applying irrigation, mulching and harvesting of vegetables (Table 7). Children were also participated in all the works and helped their parents. Islam *et al.* (2003) reported that participation of male and female labour was almost equal while Khan *et al.* (2009) reported more participation of male compared to female. The higher participation of women in agricultural activities made positive impact on equity issues within the family and also in the community as well. Almost 50% of gardening works were managed by women and children and in fact, women were the main decision-makers regarding gardening practices. They used income to spent school fees, tiffin fees, buying pens and writing pads etc. for their children that were earned by selling garden produce (Fig. 6).

**Table 7. Involvement of family members (%) in different operation of vegetables and quick growing fruit trees**

Item of operations	Male labour (%)	Female labour (%)	Children (%)
Vegetables bed preparation	78	10	12
Planting	52	38	10
Weeding	48	36	16
Mulching	34	44	22
Irrigation	32	46	20
Stalking	46	42	12
Fencing	72	20	08
Crop/tree protection measures	53	36	11
Harvesting	24	59	17
Marketing	78	10	12
Mean	52	34	14

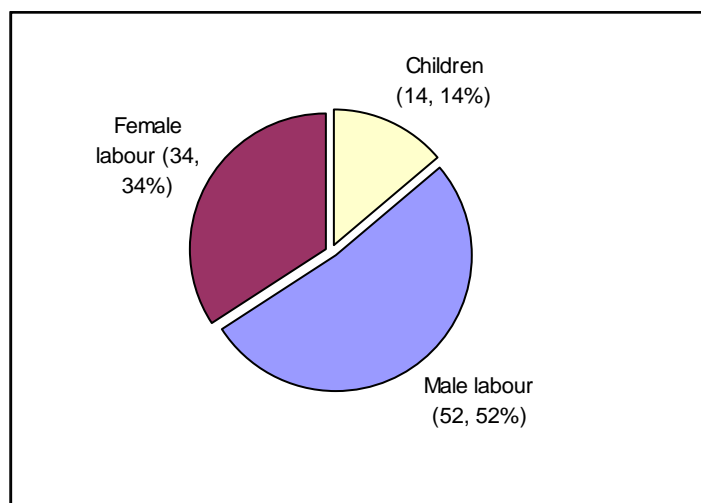


Fig. 6. Involvement of family members in the homestead production activities

## Impacts

The general impact was observed after intervention of technologies through holistic approach in integrated farming in the farmers homestead. The overall goal was to raise the farm productivity while relying on the existing resources and facilities available to farmer at the farm level. Timely sowing of recommended seed, application of fertilizer, plant protection measures and other intercultural operations in an integrated approach helped to boost up production of diversified vegetables and fruits. The same technology was rapidly disseminated to many farmers around the programme. The holistic farm approach directly and indirectly changed food habit, nutritional status, generated more income, health care, clothing and sanitation, saving pattern and borrowing of the participatory farmers. Thus, this ultimately improved the livelihood of farmer's family, food and nutrition security.

## Conclusion

The results of the study highlighted the importance of utilization of homestead by year round vegetable production and management of quick growing fruit trees in Bangladesh for small to medium farm holders. The farmers harvested diversified vegetables from different production units of their gardens and afterwards had sown new one in the empty beds. They got vegetables round the year, could meet their family needs, as well as distributed a portion of vegetables to relatives and neighbours, and also sold some surplus products to local markets. The activities in the homestead vegetable production and management of fruit trees provided a good source of nutrients for good health living and offered special opportunities for women and children to get involved in crop production. The "Golapgonj model" for homestead vegetable production was developed on the traditional practices, local conditions and cultural context and intervention of this could be a sustainable means to improve micronutrient intakes of high-risk groups and could improve household food & nutrition security. Homestead vegetable production and management of fruit trees programmes can be implemented successfully and cost-effectively on a national-scale using a collaborative model that fits local conditions. The findings of the study would definitely help the scientists, extension personnel, policy makers etc. to formulate livelihood improvement, food and nutrition security related sustainable agricultural programme at farm level.

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