Benefit-Cost Assessment of Different Homestead Vegetable Gardening on Improving Household Food and Nutrition Security in Rural Bangladesh

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ABSTRACT

Homestead vegetable gardening can play a significant role in improving food security for the resource poor rural households in developing country like Bangladesh. The present study quantifies costs/benefits of traditional and developed homestead vegetable production systems, and analyzes the underlying factors contributing to food security. The result suggests that developed gardening has better performances in terms of calorie intake and economic performances over traditional but the optimal calorie intake with least-cost technology could be a feasible livelihood strategy for resource poor people. The result also suggests that education, sex, and garden area have significant effect on food security. The occupation and family size are also positively associated with food security.

Introduction

Bangladesh is predominantly an agricultural country with the sector accounting for 23.5% of the country's GDP and employing around 62% of the total labor force (BBS 2006). In spite of recurrent natural calamities, the country has achieved impressive gains in food grain production in the last two decades and reached to near self-sufficiency at the national level by producing nearly 28 million metric tons of cereals, especially rice and wheat (BBS 2006). The food grain production in the country has increased from 11 million metric ton in the 1970s to more than 30 million metric ton in recent years (USDA 2010).

Despite these gains in total output, hunger and malnutrition remain a persistent problem in Bangladesh. According to a WFP (2008) report, 60 million people in Bangladesh still do not have sufficient food to eat and the country has the highest child underweight rate in South Asia and one of the highest in the world. Millions of children and women are suffering from one or more forms of malnutrition including low birth weight, stunting, underweight, vitamin A deficiency, iodine deficiencies disorder and anemia (UNICEF, 2009). About 25% of the population lives in extreme income poverty. The food security of this group of people worsens during the monsoon season.

One of the major constraints to achieving food security in Bangladesh is the scarcity of productive cultivable land. Of the 97.5 million rural households, nearly 30% are landless and do not have any cultivable land other than their homestead (BBS 1999). Of the land that is available for cultivation most of it is in small parcels, with nearly 50% of the population cultivating land less than 1 ha. The remaining 20% of the land is held by farmers owning land of size that is 1 ha or greater (BBS 1999). Moreover, due to industrialization and population pressure, cultivable land is decreasing at an alarming rate.

In spite of scarcity of land and the small size of land holding, the majority of rural households (including those considered functionally landless), usually have small plots of land next to their homesteads that can be used to grow essential commodities for their subsistence (Abedin and Quddus, 1990). These fragments of lands referred to as homestead gardens are usually smaller than 500 m^2 surrounding the homestead mainly with space for livestock, trees and vegetable beds (Brierley, 1985). Homestead based intervention like vegetable gardening has been playing an important role to alleviate poverty for resource poor people of developing country.

Amongst the type of homestead vegetable gardening practiced in Bangladesh, developed gardening has been favored over other types of gardening because of its ability to contribute towards food and nutrition security better than other type of gardens. However this assessment of homestead gardening is based primarily on per capita consumption of food (Mortuza et al., 2008; Talukder et al., 2010; and Khan et al., 2009) with very little emphasize on total calorie intake. The studies have examined the contribution of homestead gardens to food and nutrition security but the emphasis was only on whether the garden provided adequate amount of micronutrients such as vitamin A, iron. An accurate assessment of food and nutrition security requires that measurement of foods broken down into how calories and nutrients are being consumed. That is why per capita consumption does not reflect how much energy/calorie and nutrient is being consumed because different vegetables have different levels of calories.

In order to measure calorie and nutrient contents, some techniques such as dietary histories, 24-hour recall, actual weighing of food eaten, food frequencies questionnaires and chemical analysis to be taken place (Migotto et al., 2005). Specifically, food insecurity or "hard-core poverty" refers to a calorie intake of less than 1,805 kcal per capita per day, though there is an argument about correct energy requirement because it depends on person's age, body weight, sex, activity etc. In general, if a person able to meet minimum 18, 05 kcal per day meaning he is food secured. Again, the minimum level of vegetable intake is 200 gm per person/day recommended by Asian Vegetable Research and Development Center (AVRDC). The consumption of 200 gm may contain different amount of calorie and nutrient consumed by different vegetables. Therefore, it is useful to know for the policy maker/development practitioner and households that how much kcal might be produced and consumed to contribute on total kcal requirement to be food secured through homestead vegetable gardening.

A second issue that has been overlooked in the studies on homestead vegetable gardening is the precise cost of production under different gardening system. Among many other studies including Talukder et el, 2010; and Khan et al, 2009 have given much emphasis to increasing the volume of production in homestead gardening and how it improves food security. On the other hand, Mortuza et al., 2008 and Khan et al, 2009 have analyzed cost-benefit analysis (CBA) of homestead vegetable gardening in a given period that lacks detail cost analysis. More comprehensive cost-benefit analysis is required to assess profitability of homestead gardening model (Lannotti, Cunningam, and Ruel, 2009). Besides, it is generally observed that the cost of traditional gardening is less likely to establish and maintain relative to developed. This suggests that while developed gardening may offer benefits in terms of greater household food security, resource constraints may limit its adoption by poorer households.

A third issue is to examine the determinants that affects directly or indirectly to the individual or household food security. Usually small or functionally landless people are characterized by having no or small piece of cultivable land, low income, lack of inputs and lack of productive resources that further contribute to poverty as well as food insecurity. Furthermore, household characteristics such as type of housing, occupancy status, garden area, education, sex, family size, type of employment, and income also affect the household food security or living standard (Faridi and Wadood, 2010; Oni et al., 2010; BNHS, 1999).

The objectives of this study are

(i) to assess the calorie and nutrition intake performances between traditional and developed homestead vegetable gardening

(ii) to conduct cost-benefit analysis of traditional and developed vegetable gardening systems

(iii) to identify the underlying factors affecting household calorie intake by household demographic characteristics through homestead vegetable gardening.

Methods

The methods used for analysis are described in this section.

Profitability analysis of gardening

The economic analysis of homestead vegetable may garden provide a rational basis for making decision in allocating scarce resources among various options to achieve the goal. To measure the economic performances of traditional and developed gardening, the capital budgeting tools such as BCR, NPV, and IRR will be used. The formulae of those are explained below.

$$\mathrm{BCR} = \frac{\sum_{i=1}^{t} \frac{B_t}{(1+r)^t}}{\sum_{t=0}^{t} \frac{C_t}{(1+r)^t}} \qquad (1)$$

where,

B represents benefits of the project

C represents costs of the project

A BCR is greater than 1 indicates the project is profitable and a ratio is less than 1 indicates that it is unprofitable.

$$NPV = \sum_{t=0}^{T} \frac{R_t - C_t}{(1+r)^t} \qquad (2)$$

Where,

$t =$ time measured in years

$R_t =$ revenues in year t

$C_t =$ cost in year t

$r =$ discount rate

If NPV is >0, the system generates profits over the analysis horizon T. Conversely, where NPV<0, invested funds are lost because the cost of investment outweigh the benefits. If NPV=0, the investment would neither gain nor lose value for the homestead gardening. IRR is the rate (*r*) at which NPV=0

If $NPV = \sum_{t=0}^{T} \frac{R_t - C_t}{(1+r)^t} = 0$, then *r*=IRR (3)

The higher the IRR, the more desirable project becomes. This means that IRR is a parameter that can be used to compare traditional and developed homestead vegetable gardening system.

Logit Regression Analysis

Logit regression analysis is a a technique which allows for estimating the probability that an event occurs or not, by predicting a binary dependent outcome from a set of independent variables. In this case, 200 gm vegetable consumption person/day is considered as threshold level of food security through homestead vegetable gardening. Based on nutrition content table (Appendix 1) has been used to estimate threshold calorie intake by consuming vegetables through traditional and developed gardening. On an average, 118 kcal has been estimated as food secured threshold level through only consuming 200 gm/person/day vegetable but to minimize the estimation error, threshold food security level was estimated as 125 kcal that is 5% more than 118 kcal. To examine the factors affecting food security, 89 households information in traditional and 17 household information in developed gardening have been combined as 106 sample size for logit analysis. Here, dependent variable is assumed as 1 (i.e., consuming 124 kcal> meaning food secured) or 0 (<125 kcal) in relation to certain amount of calorie intake, the linear probability model depicted it as:

$$P_i = E(Y = 1 | X_i) = \beta_1 + \beta_2 X_i \quad (4)$$

Where X_i is the calorie intake and Y=1 means that person is food secured

And an estimable linear form,

$$Log(\frac{P_i}{1 - P_i}) = X_i \beta \quad (5)$$

The ratio P_i/ (1-P_i) represent the odds-ratio in favour of observing the occurrence one event and not the other. In this case, P_i is the probability of >124 kcal in-taking the calorie and (1-P_i) is the probability of <125 kcal per person. The log of the odds ratio is not only linear in X but also linear in the parameters. In general, the latent variable, Y_i, which is correlated to the set of explanatory variables represented by X_i in equation (3), can be represented as follows for each person, i:

$$Y_i = \beta_o + \beta_1 LG\_Area + \beta_2 Edu\_G + \beta_3 Sex\_G + \beta_4 Occu\_HH + \beta_5 Fa\_Size + \varepsilon_i \quad (6)$$

The definition of the dependent and explanatory variables in equation (5) is given below:

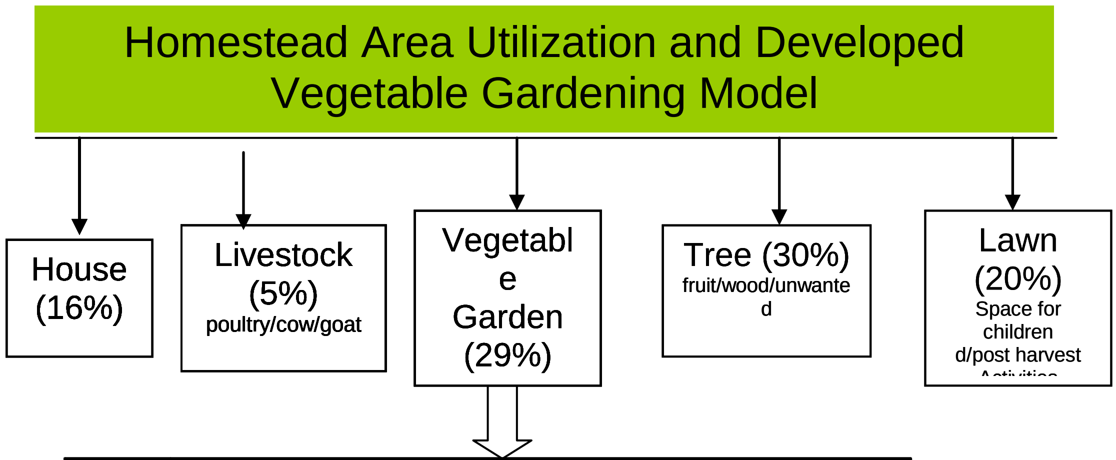
Y_i	= 1, if person will intake >124 kcal per day, zero otherwise
LG_Area	= The log of garden area (continuous variable)
Edu_G	= 1, if gardener is educated, zero otherwise
Sex_G	= 1, if female gardener, zero otherwise
$Occu\_HH$	= 1, if farming occupation, zero otherwise
Fa_Size	= 1, if small family size, zero otherwise

Household's demographic characteristics (i.e., education, sex, occupation and family size) and garden area are expected to influence food security because of those factors affects households calorie intake. The gardener's with education may produce and consume more vegetable than the gardener's without education. The large family size tends to be more food in-secured than the small family size. Garden area and gardener's sex can have also positive effect on food security. The STATA 10 software has been used to estimate the logistic regression model.

The data were obtained from World Vision Bangladesh (WVB), Agriculture sector (WVB) from the project named "Food Security Enhancement Initiative (FSEI)" funded by USAID. The FSEI project of WVB was being operated through the 36 Area Development Programs (ADPs) in 34 upazilas (sub-districts) across the country and five individual areas in Dhaka, Khulna and Chittagong cities (WVB, 2004). Out of 106 sample size, there are 89 households on traditional and 17 households on developed gardening.

Result and Discussion

In the study area, the average homestead area was 526.01 m^2 and was mainly utilized for tree, vegetable garden, lawn, house, and livestock by 30%, 29%, 20%, 16%, and 5% respectively. On average 2.5 types vegetables per household were grown out of twenty one species of vegetables cultivated traditionally. Amongst them, the bottle gourd and hyacinth bean were grown by more than 90% household under this gardening system. On the other hand, seventeen types of vegetables were produced per household under developed vegetable gardening with fixed plots/beds round the year (Table 2). Average garden area was used for traditional and developed gardening 110.85 m^2 and 156 m^2 respectively. The developed vegetable garden model is depicted (Figure 1) based on trial/demonstration vegetable garden information which will be used for food security analysis in this study. Next, food security performances between traditional and developed vegetable gardening are described, followed by profitability analysis of two gardening system. The underlying socio-demographic factors contributing towards food security are described thereafter. The last section summarizes the study.



Bed/Plots	Season		
	Rabi	**Kharif-1**	**Kharif-2**
1	Tomato	Red Amaranth	Indian Spinach
2	Red Amaranth+ Brinjal	Red Amaranth	Stem Amaranth
3	Spinach-Garlic/Red	Stem amaranth	Red amaranth
4	Radish-Onion	Stem Amaranth	Red amaranth
5	Carrot-Red	Stem Amaranth	Stem amaranth

Basic kalikapur Model

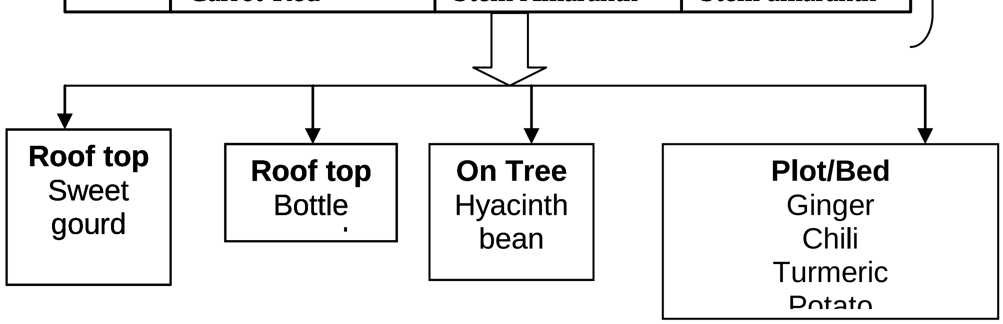


Figure 1: Developed Homestead Vegetable Garden for this study

Performances of traditional and developed gardening

Table 1 shows that developed garden provides significant amount of vegetable i.e., 364.56 gm/person/day that contain 179.83 kcal against the minimum requirement of 200 gm per person/day. On the other hand, the traditional garden provides only 42.87 gm that contain only 29.25 kcal per person. Based on threshold amount of 200 gm/person/day of vegetable by weight, also differ by consuming different vegetable by gardening system. It is 136.47 kcal in traditional and 98.66 in developed gardening.

Table 1: Per capita vegetable consumption of traditional and developed gardening

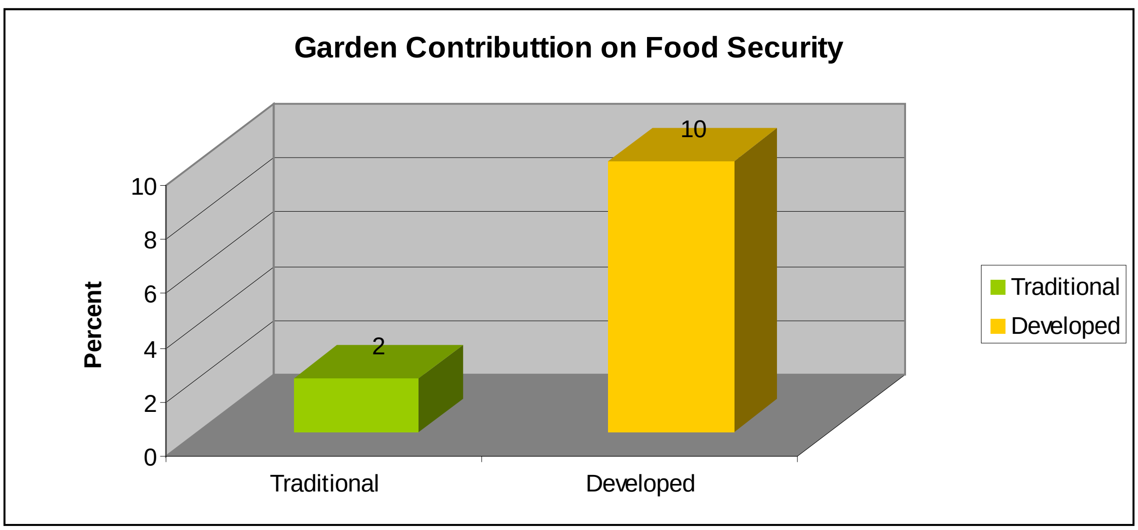
Gardening System	**Average per capita Consumption**			**Average kcal/200 gm**
	gm	**Kcal**	**kcal/200 gm**	
Traditional	42.87	29.25	136.47	118
Developed	364.56	179.83	98.66	

The developed gardening practice is more efficient in terms of land and capital use than the traditional gardening. In Appendix 3, bottle gourd ranks highest (1304 kcal) in terms of kcal/m^2 production and stem amaranth generates lowest (45 kcal) in traditional gardening. Per m^2 kcal consumption is highest (691.23 kcal) in case of bottle gourd and lowest (6.84 kcal) in coriander consumption. Overall, bottle gourd is the highest calorie providing vegetable and adopted by the maximum number of household (more than 90%) in traditional gardening in the study area.

Red amaranth ranks highest (69116 kcal) in producing kcal/ m^2 and spinach is the lowest kcal/m^2 (10378 kcal) producing vegetable in developed gardening. Red amaranth provides highest consumption (51271kcal/m^2) and lowest (6904 kcal/m^2) consumption generates from spinach. Bottle gourd ranks fourth (37479 kcal/m^2) in terms of production and ranks third (32961 kcal/m^2) in terms of consumption in developed gardening. Therefore, red amaranth is the number one crop in developed gardening in providing energy. On the other hand, bottle gourd plays a vital role providing energy in both gardening system.

The Figure 2 represents the per-capita gardening performances on the basis of minimum threshold of calorie intake (1805 kcal) per person/day in Bangladesh. The graph shows that developed garden contributes 10% to achieve threshold poverty level whereas traditional contributes only 2%.

Figure 2: Traditional and developed garden performance on overall food security



Profitability of traditional and developed gardening

In this section, performances of vegetable garden was discussed and developed garden found as a significant impact on food security but further analysis is required about how much cost incurred for this. Table 2 shows per household and m^2 cost under developed garden is significantly higher than traditional particularly when included labor cost. In reality, the labor cost was not paid by the household but it was recorded due to analyze the cost of production. According to Table 2, per hh and m^2 labor cost was Tk. 6509.58 and Tk. 709.38 respectively.

Table 2: Per household and m^2 input and labor cost (expressed in Bangladesh currency)

	Input Cost (Tk.)		**Labor Cost (Tk.)**		**Total Cost (Tk.)**	
Gardening	per hh	per m^2	per hh	per m^2	per hh	per m^2
Traditional	323.65	409.15	343.14	465.98	681.7	894.51
Developed	1601.30	174.50	6509.58	709.38	8110.87	883.88

Therefore, it was felt that in order to get a comparative benefit analysis of gardening, with and without labor cost approach being used later to oversee the performances. The result describes the analysis of production and cost data to compare the profitability of two gardening system. For this, BCR, NPV and IRR have been estimated and discount rate has been considered as 5%. The present value of benefit (PVB) and present value of cost (PCB) without labor cost over a 10-year period from developed gardening are 32255.41 and 1005.65 respectively (Table 2). The present value of cost (with labor cost) is 5407.25 in developed gardening. On the basis of input cost, BCR is higher in developed (3.24) than traditional (2.63) but when labor cost was included in the analysis, traditional gardening was still feasible but developed garden was appeared as non-profitable (Table 3). Therefore, if there is no opportunity cost of household labor practicing developed gardening, the developed gardening is feasible for the farmer.

Table 3: Present values of benefit (PVB) and present values of cost (PCB), and benefit cost ratio (BCR) of traditional and developed gardening

Gardening Way	With only capital cost (Tk.)			With capital and labor cost (Tk.)		
	PVB	PCB	**BCR**	PVB	PCB	**BCR**
Traditional	567.52	215.77	2.63	562.52	454.47	1.25
Developed	3255.41	1005.65	3.24	3255.41	5407.25	0.60

Table 4 describes the net present value (NPV) when only capital cost included in traditional and developed as 3,054.76 and 23,448.70 respectively. When both labor and capital cost included, NPV was 981.79 in traditional and it was negative in developed gardening. IRR is 145% in traditional gardening when only capital cost included and 45% based on both costs. IRR is much higher as 370% in developed gardening and it was negative when both cost included in the analysis. Therefore, developed gardening is profitable compared to traditional when labor cost (that is not actually paid) is not considered as a cost of production.

Table 4: Net present value (NPV) and internal rate of return (IRR) of traditional and developed gardening

	NPV		**IRR**	
	With capital Cost (Tk.)	Total Cost (Tk.)	With capital Cost (Tk.)	Total Cost (Tk.)
Traditional	3,054.76	981.79	155%	45%
Developed	23,448.70	-6,561.37	370%	-

Factors contributing to Food Security

This section briefly explains that the household socio-demographic factors like household sex, education, occupation, family size, and garden area are associated with the food security.

Dependent Variable: 1 = Food security through consuming >124 kcal per person/day

0 = Otherwise

Table 5: Result of logit regression analysis

Independent Variables	**Coefficients**	**SE**	**$P>\vert z\vert$**	**LR chi ^{2}**	**Pseudo R^2**
LG_Area	2.616953	0.6804602	0.000		
Edu_G	4.393526	1.495452	0.003		
Sex_G	4.523204	1.267263	0.000	45.95 with p value 0.000	0.4979
OCCU_HH	1.239703	1.131769	0.273		
Fa_size	0.6573745	0.7894039	0.405		
Constant	-22.47318	5.317802	0.000		

Table 5 shows that the likelihood ratio (LR) chi-square of 45.95 with a p-value of 0.0000 tells that the model as a whole fits significantly better than an empty model (i.e., a model with no predictors). The garden area, education and sex of gardener's have significant impact on food security (Table 5). Every one unit change in garden area, the log odds of food security (versus food-insecurity) increases by 2.616. For a person being educated than person has no schooling, the log odds of being chances of food security increases by 4.39. Similarly, for the chance of being female gardener than the male, the log odds of food security chances increase by 4.52. The result also shows that household occupation and family are positively associated with the food security but the effect was insignificant.

Summary and Conclusion

The traditional gardening contributed only on average 29.25 kcal per person/day and developed gardening provided on average 179.83/person/day that is more than threshold level calorie intake through vegetable consumption. Bottle gourd plays an important role in traditional gardening whereas red amaranth has significant contribution under developed gardening. In both gardening system, bottle gourd is the most food security contributory vegetable in rural Bangladesh. Developed vegetable garden model (Figure 1) provides 10% kcal on overall food security in this study.

Per household and m^2 cost under developed garden is significantly higher than traditional, when self labor included as a cost. Per household and m^2 labor cost was Tk. 6509.58 and Tk. 709.38 respectively; and it was Tk. 323.14 and Tk. 465.98 respectively in traditional gardening. When only input cost was included, BCR was higher in developed (3.24) than traditional (2.63). When labor cost was included in the analysis, though traditional gardening was feasible (BCR>1) but developed garden was appeared as non-profitable (BCR<1). NPV of traditional and developed gardening was as 10,554.22 and 40,788.35 respectively. NPV was 4,960.88 in traditional but it was negative in developed gardening when labor cost included in the analysis. Therefore, developed gardening practice for achieving food security, labor cost issue to be critically considered.

The logit regression result shows that the garden area, education and sex of gardener’s have significant impact on food security. Meaning that educated household tends to be food secured than who has no schooling. Similarly, increasing garden area has economics of scale effect on food security. The result also shows that household occupation and family have the positive effect on food security, though the effect was insignificant.

For improving food security, integrated approach alongside homestead vegetable garden based on agro-ecological condition and cultural issues to be considered. Small scale poultry could be an important intervention into developed gardening system to increase contribution on overall food security but again cost of production in particular self labor has to be utilized in rational way.

In conclusion, some of the constraint stated above is clearly linked to the specific policy areas. The rationale policy intervention to support homestead gardening as follows:

i. The main food security component, availability and accessibility could be achieved in some extent through practicing developed homestead vegetable gardening along with potential interventions into the vegetable gardening system throughout the year.
ii. Self employment for the idle household members or lack of work availability particularly women and children, homestead developed vegetable gardening is a wonderful weapon to combat food security.

iii. Safe and fresh food could be available through practicing integrated pest management in the vegetable gardening that is easier to apply by the household members.

iv. Utilization of homestead for multiple interventions can play a role as household livelihood objectives resulting connect gardening household with government extension and research departments, private companies, micro finance organizations/banks, family members, neighbors, and local markets.

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Appendix 1. Nutrient contents in vegetables grown in traditional and developed garden

Vegetables	Nutrient contents per 100 gm								
	Energy, kcal	**Protein, gm**	**Fat, gm**	**Carbohydrate, gm**	**Calcium, gm**	**Iron, gm**	**Carotene, gm**	**Vitamin B_1, mg**	**Vitamin B_2, mg**	**Vitamin C, mg**
Red	43	5.3	0.1	5	374	0	11940	0.1	0.13	43
Stem	19	0.9	0.1	3.5	260	1.8	255	0.01	0.18	10
Indian	27	2.2	0.2	4.2	164	10	12750	0.02	0.36	64
Spinach	30	3.3	0.1	4	98	10	8470	0.03	0.09	97
Radish	28	1.3	0.1	5.4	10	0.5	0	0.43	0.03	34
Tomato	23	1.9	0.1	3.6	20	1.8	192	0.07	0.01	31
Brinjal	42	1.8	2.9	2.2	28	0.9	850	0.12	0.08	5
Garlic	145	6.3	0.1	29.8	30	1.3	0	0.06	0.23	13
Onion	50	1.2	0.1	11.1	47	0.7	0	0.08	0.01	11
Carrot	57	1.2	0.2	12.7	27	2.2	10520	0.04	0.05	6
Bottle gourd	66	1.1	0.01	15.1	26	0.7	0	0.01	0.02	4
Hyacinth	48	3.8	0.7	6.7	210	1.9	187	0.1	0.05	9
Sweet gourd	30	1.4	0.5	4.5	48	0.7	7200	0.07	0.06	26
String bean	31	1.8	0.1	7	37	0	35	0	0	16
Chili	103	1.6	0.1	23.7	11	1.2	2340	0.17	0.16	125
Turmeric	349	6.3	5.1	69.4	150	18.6	30	0.03	0	0
Ginger	390	2.3	0.9	12.3	20	2.6	40	0.06	0.03	6
Coriander	30	2	0	4	0	0	337	0	0	27
Bitter gourd	19	0.84	0.18	4.32	9	0.38	6	0.05	0.05	33
Cucumber	16	0.65	0.11	3.63	16	0.28	0	0.02	0.03	2.8
Potato	97	1.6	0.6	22.6	11	0.7	0	0.03	0.03	10

Source: INFS (1992), Hossain et al (1994), BBS (2004), Kabir (2004), and Wikipedia

Appendix 2. List of vegetables grown in traditional and developed garden

SI #	Traditional		Developed	
	English Name	**Scientific Name**	**English Name**	**Scientific Name**
1	Red amaranth	***Amaranthus gangeticas***	Red amaranth	***Amaranthus gangeticas***
2	Stem Amaranth	***Amaranthus lividus***	Stem Amaranth	***Amaranthus lividus***
3	Indian Spinach	***Basellalba***	Indian Spinach	***Basellalba***
4	Spinach	***Spinacia Oleracea***	Spinach	***Spinacia Oleracea***
5	Radish	***Raphanus Sativus***	Radish	***Raphanus Sativus***
6	Tomato	***Lycopersicon esculentum***	Tomato	***Lycopersicon esculentum***
7	Brinjal	***Solanum melongena***	Brinjal	***Solanum melongena***
8	Garlic	***A sativum L***	Garlic	***A sativum L***
9	Onion	***Allium cepa L***	Onion	***Allium cepa L***
10	Carrot	***Daucus carota***	Carrot	***Daucus carota***
11	Bottle gourd	***Lageneria siceraria***	Bottle gourd	***Lageneria siceraria***
12	Hyacinth bean	***Lablab niger***	Hyacinth bean	***Lablab niger***
13	Sweet gourd	***Cucurbita moschata***	Sweet gourd	***Cucurbita moschata***
14	String bean	***Lagenararia siceraria***	-	-
15	Chili	***C frutescens L***	Chili	***C frutescens L***
16	Turmeric	***Curcuma long L***	Turmeric	***Curcuma long L***
17	Ginger	***Zingiber officinale L***	Ginger	***Zingiber officinale L***
18	Coriander	***Coriandrum sativum***	-	-
19	Bitter gourd	***Momordica charantia***	-	-
20	Cucumber	***Cucumis sativus***	-	-
21	Potato	*Solanum tuberosum*	Potato	*Solanum tuberosum*

Appendix 3. Energy performances between traditional and developed gardening

Sl #	Vegetables	Traditional		Developed	
		Kcal produced/m^2	kcal consumed/m^2	kcal produced/m2	kcal consumed/m2
1	Red Amaranth	135.33	72.67	69116.05	51270.51
2	Stem Amaranth	2.05	35.78	35162.59	24241.15
3	Indian Spinach	603.50	472.62	26243.33	15978.94
4	Spinach	276.92	276.92	10378.50	6904.13
5	Radish	345.35	109.02	24103.45	15838.90
6	Tomato	422.71	172.72	15767.08	10962.66
7	Brinjal	571.66	140.75	26864.25	20465.03
8	Garlic	749.25	489.40	32229.88	26683.63
9	Onion	397.44	269.23	16192.50	12686.25
10	Carrot	596.08	260.78	39450.41	23292.34
11	Bottle Gourd	1304.42	691.23	37478.93	32960.81
12	Hyacinth Bean	325.67	172.14	12088.80	7744.40
13	Sweet Gourd	316.67	188.10	13547.63	11739.94
14	Chilli	422.21	84.44	20878.10	14171.51
15	Turmeric	837.47	536.42	34551.00	27920.00
16	Ginger	906.30	409.30	29986.13	24082.50
17	Potato	699.06	416.96	41706.36	36533.84
18	String bean	141.67	141.67	0.00	0.00
19	Coriander	45.13	6.84	0.00	0.00
20	Cucumber	109.04	28.69	0.00	0.00
21	Bitter gourd	102.62	102.62	0.00	0.00