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Research paper

Development of home garden model for year round production and consumption for improving resource-poor household food security in Bangladesh

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ABSTRACT

The government of Bangladesh has long been striving to increase food security and to reduce poverty and malnutrition. In this regard, home gardens can play an important role in providing enhanced food supply and increased diversity of food to some extent. Studies on niche/ecosystem based homestead gardening were carried out at Lahirirhat Farming Systems Research and Development site, Rangpur under the On-Farm Research Division of Bangladesh Agricultural Research Institute during 2008–2009, resulting in the development of a year round production model, known as the Rangpur (Syedpur) model, for Tista Meander Floodplain agro-ecological region of Bangladesh. The objective of the study was to utilize the homestead resources in scientific ways for producing fresh vegetables and fruits over space and time and to enhance the nutritional supplies for the family throughout the year. A total of 12 households were selected from landless (no cultivable land), marginal (0.2–0.6 ha) and small (0.61–1.0 ha) farmer groups and seven production niches were intervened for round the year production following the Rangpur model. The niches were open sunny place, roof top, trellis, fence, boundary, marshy land and partially shady place. After the intervention, the highest amount of vegetables was produced by the small farmer groups (511 kg/year) followed by marginal (499 kg/year) and landless (422 kg/year) farmers. The yearly vegetable requirements of farmers were largely met by the homestead garden with a supply between 55 and 79 kg/head/year compared with the bench mark level of 21–30 kg/head/year before the intervention. The highest total income (BDT 5030/year) and net income (BDT 4290/year) were obtained from homestead at small farmers followed by marginal and landless farmers. From this study it is evident that the target farmers were able to fulfill their daily requirement of vegetables in most parts of the year by following the Rangpur model. This suggests an increase in food security and a reduction in malnutrition of farm families in the target households of Rangpur region in Bangladesh. The upscaling of the production model based on niche/ecosystem in different poverty stricken regions of Bangladesh is recommended to achieve food security and malnutrition reduction.

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1. Introduction

Bangladesh is a developing country of about 156.4 million people [1] inhabiting in its 147,570 km² area and is primarily an

agriculture-based economy. About 40% people in Bangladesh live below the food consumption-based poverty line and they could not afford sufficient food to meet a daily diet of 2122 kcal/day/person [2]. Malnutrition, especially micronutrient malnutrition in the form of deficiencies in vitamin A, iron and iodine, is a serious public health problem in Bangladesh [3]. Vitamin A deficiency adversely affects nearly 20% preschool aged children and about 25% of women of reproductive age [4,5]. Similarly, many women are suffering from

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anemia due to iron deficiency. It has been reported that 93% family in Bangladesh is suffering from vitamin C deficiency, 85% in riboflavin, 81% in vitamin A and calcium, 60% in protein and 59% in calorie requirement [6]. From human growth and development standpoint, micronutrient deficiency can result in different types of diseases, hamper physical growth, retard child growth, increase the duration and severity of illness, reduce work output, as well as slow social and cognitive development [7].

Over 80% of the country's 14.7 million agriculture farm households are smallholders who occupy less than a quarter of a hectare of cultivated area and typically practice intensive subsistence agriculture [8]. They intensively cultivate a wide variety of plant species (vegetables, fruits, medicinal plants and trees), and maintain livestock and poultry sheds, as well as fishponds around the household or within a walking distance from the family home, known as home gardens [9,10]. Home gardens are defined as small areas of cultivated land immediately surrounding the home or homestead [11]. These home gardens can play a vital role in the production of vegetables and fruits throughout the country and can promote household food self-sufficiency. An increase in the production and productivity of homegardens may be a viable alternative for providing food and nutritional security in poor households of Bangladesh. The important benefits of home gardens include improved food security, increased availability of food and better nutrition through food diversity, income and enhanced rural employment, decreased risk through diversification, as well as environmental benefits through recycling water and waste nutrients [10,12,13]. Their potential contributions to food security, income and rural employment have widely been reported by the Food and Agriculture Organization of the United Nations [14], in Asia, for example, in Bangladesh [2,3], Sri Lanka [10], India [15,16], Indonesia [17] and the Philippines [18], as well as beyond Asia [11,19].

Home gardens play an important role in household food security of Bangladesh and have thus become an integral part of rural households [9,20]. Home gardens are operational farm units, especially in tropical and subtropical countries, which mainly engage women family labor and sustain high agricultural production. However, production is still considered as supplemental rather than a main source of family consumption and income [9,10,21]. Homestead area is more effective and common production unit for fulfilling various household basic needs such as food, fuel, timber and others including employment of female and aged household members [9,18].

Most of the farmers at the Farming Systems Research and Development (FSRD) site, Lahirirhat, Rangpur, Bangladesh are having poor resources. Cultivable land in this region is a scarce resource and is mostly utilized for growing major field crops including rice (*Oryza sativa*), wheat (*Triticum aestivum*), potato (*Solanum tuberosum*) and jute (*Corchorus* spp.). Crop yields are relatively lower largely due to poor management practices and low quality seeds. Even though most of the farmers have homestead area, but utilized only for growing small amount of vegetables for their own consumption, not for higher production and income generation. Moreover, the productivity of the homestead garden is again low due to insufficient scientific knowledge of crop production and unavailability of good quality seeds and saplings when needed. These improperly managed homesteads would be effective to bring under year round production for improving the family nutrition and income generation of smallholders [22]. On an average, Bangladeshi people consume a total of 126 g of vegetables and fruit from an average national per capita per day consumption of 23 g of leafy vegetables, 89 g of non-leafy vegetables and 14 g of fruit. This intake is far below the minimum recommended daily consumption of 400 g of vegetables and fruit [23].

To address the problems of household food insecurity and malnutrition, the On-Farm Research Division (OFRD) of the Bangladesh

Agricultural Research Institute (BARI) initiated a homestead vegetable production model known as the "Kalikapur model" in 1984. The model was subsequently modified based on the existing ecosystems (niches) of each homestead, where different fruits were also included along with vegetables [24]. By following the modified model, the productivity and nutrition supplying capacity of each homestead increased by 3–4 times than the previous one [6]. Subsequently, 6–10 niches/ecosystems based homestead vegetable production models were developed in different agro-ecological regions of the country and henceforth recommended for scaling-up. Many international and local non-governmental organizations as well as the BARI have promoted home gardens in Bangladesh [3,4]. The impact of home gardens on improving nutrition and increasing household income and the quantity of the households' food production has been widely studied in Bangladesh [3,25,26]. However, scientific evidence for the development of a year round production model and the utilization of this model for producing fresh vegetables and fruits to enhance the nutritional supplies for the family throughout the year is still limited in Bangladesh. Therefore, the objective of the study was to test the Rangpur (Syedpur) model for designing cropping pattern for year round production systems in Rangpur, Bangladesh and its impact on family nutrition and income generation throughout the year. The present study did not evaluate the crop nutritional values; however, the developed model would be useful for explaining the combination of production (agronomic yield) and consumption (crop utilization) in predicting food security value of crops in small-scale farming systems.

2. Materials and methods

The study was initiated at Lahirirhat FSRD site, Rangpur, Bangladesh during 2008–2009 cropping seasons in the homestead of 12 selected farmers. Small unreplicated trials on farmers' fields, known as "dispersed experiments", were established under local farm conditions [27]. Only landless, marginal and small farmers were the target group; therefore, five landless, four marginal and three small farmers were selected resulting in a total of 12 households. The landless farmer did not possess any cultivable land whereas the marginal and the small farmer had between 0.2 and 0.6 ha, and between 0.61 and 1.0 ha cultivable land, respectively. The study area is located at 21°24' N latitude and 88°23' E longitude with 31 m above mean sea level. The area mostly falls under high and medium high land areas of the Tista Meander Floodplain with an extent of 946,803 ha [26]. The soils of this region are moderately acidic (pH of 4.6–6.5), low in organic matter content on the higher land (<1%), but moderate in the lower parts (~2%). Overall, the fertility level is low to medium, but the status of K and CEC is medium in most of the places. Soils in general have good water holding capacity [28]. The area receives an annual rainfall of around 2160 mm with relatively early onset and late cessation.

The homestead resources, needs and choice assessments were performed with the active participation of the family members of the selected households. At each homestead, seven production niches were identified and brought under cultivation following the Rangpur (Syedpur) model. The niches were open sunny place, roof top, trellis, fence, boundary, marshy land and partially shady place (Table 1). Group meeting of farmers was organized to orient them on the utilization pattern and production practices of the homestead vegetables and fruit following the Rangpur model. The activities of the program were prioritized based on farmer's needs, problems, nutritional requirement and income. A work plan was then developed with the participation of the farmers'. An open sunny area of 30 m² was used for implementing pattern based vegetable cultivation. Each area was divided into five beds; thus, the area of each bed was 5 m × 6 m. A total of 14 vegetables

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