



ISSN Print: 2664-6064
 ISSN Online: 2664-6072
 NAAS Rating (2026): 4.69
 IJAN 2026; 8(8): 12-19
www.agriculturejournal.net
 Received: 08-05-2026
 Accepted: 12-06-2026

All authors' names and affiliations are listed below the references.

Bridging the Nutritional Gap through High Value Fruits: An Economic and Dietary Feasibility Analysis of Minimum Dietary Diversity (MDD) in Rural area of Sitakunda-Mirsarai Upazila, Chattogram, Bangladesh

Tapash Kumar Bhowmik, Minhajur Rahman, Md. Abul Kashem, Sayed Israt Hasan, Abu Al Alif, Md. Abir Hossain Nishat, Abdullah Al Kayes, Kamrul Islam and Md. Milon Hossain

DOI: <https://www.doi.org/10.33545/26646064.2026.v8.i8a.731>

Abstract

Background & Objective: Minimum Dietary Diversity (MDD) is a globally recognized proxy for micronutrient adequacy and overall nutritional security. This study investigates the current dietary patterns of the rural population in Sitakunda and Mirsarai upazillas of Chattogram, Bangladesh, while evaluating the economic and agronomic feasibility of High Value Fruits (HVF) as a sustainable intervention to bridge identified nutritional gaps.

Methodology: A comprehensive baseline survey was conducted involving 496 stakeholders, including micro-entrepreneurs, farmers and market actors. Data was collected on 10 standardized food groups to calculate overall MDD, alongside seasonal economic metrics for crop production and stakeholder constraints.

Results: The dietary analysis revealed severe deficiencies in critical micronutrient dense food groups. While grain consumption was nearly universal (99.8%), 52.8% of the population lacked access to Vitamin-A rich fruits and vegetables and 53.6% failed to consume nuts and seeds. Conversely, agricultural data indicated a high capacity for HVF cultivation, with prominent cultivation of Mango (37.8%) and Papaya (12.3%). Economic evaluations across three distinct seasons (March 2021-March 2022) proved HVF cultivation to be consistently profitable, yielding gross profits up to 27.63 thousand BDT per season. However, expansion is heavily hindered by post-harvest management (89.8%) and financial (84.2%) constraints.

Conclusion: Scaling up the cultivation of specific HVFs (e.g. Mango, Papaya, Dragon fruit) offers a highly viable dual solution: it directly mitigates the region's acute Vitamin A and micronutrient dietary deficiencies while simultaneously acting as a highly profitable economic engine for rural farmers.

Keywords: Agronomic feasibility, food groups, micro-entrepreneurs, micronutrient adequacy, minimum dietary diversity, nutritional gaps

1. Introduction

Global food security paradigms have increasingly shifted from mere caloric sufficiency to nutritional adequacy, emphasizing the importance of dietary quality in combating hidden hunger (Kennedy *et al.*, 2011; Pingali, 2015) ^[8,9]. Minimum Dietary Diversity (MDD) serves as a critical, validated indicator of population level nutrient adequacy, reflecting the consumption of multiple distinct food groups required to meet daily micronutrient profiles (FAO, 2021) ^[2]. In developing agrarian economies like Bangladesh, rural populations frequently suffer from monotonic diets heavily skewed toward starchy staples, leaving substantial deficits in vitamins and essential minerals (Jones, 2017; Hirvonen *et al.*, 2020) ^[7,5]. Addressing these micronutrient gaps requires sustainable, locally adaptable interventions. High-Value Fruits (HVF) such as dragon fruit, mango, papaya, cashew nuts and malta have emerged as a transformative agricultural sub-sector (Weinberger and Lumpkin, 2007) ^[7]. HVFs represent a dual leverage intervention: they are densely packed with deficient micronutrients (e.g. Vitamin A, Vitamin C, antioxidants) and command premium market

Corresponding Author:
Dr. Tapash Kumar Bhowmik
 Associate Professor, Plant
 Tissue Culture and
 Biotechnology Laboratory,
 Department of Botany,
 Faculty of Biological Sciences,
 University of Chittagong,
 Chattogram-4331, Bangladesh

prices, significantly outperforming traditional crops in economic yield per hectare (Cummings, 2007; Jones *et al.*, 2014; Sibhatu *et al.*, 2015) [1, 6, 10].

The Sitakunda and Mirsarai upazillas of Chattogram, characterized by their unique topography and active microenterprise ecosystems, present a fertile ground for HVF expansion. However, a localized, data driven synthesis of how HVF cultivation directly aligns with regional dietary deficiencies remains underexplored. This paper assesses the overall MDD of the region, identifies specific nutritional deficits and evaluates the economic and agronomic feasibility of integrating HVFs as a sustainable mechanism for comprehensive nutritional security.

2. Methodology

2.1 Study Area and Sampling

The study was conducted in Sitakunda and Mirsarai upazillas under the Chattogram district of Bangladesh. A systematic random sampling process was employed to select an extensive cohort of 496 respondents. The sample comprised 409 microenterprises (stratified by poverty levels: 10% ultra-poor, 19% transitional poor and 71% enterprising poor), 46 market channel actors (wholesalers, retailers, processors) and 41 institutional researchers and government officials.

2.2 Data Collection

An extensive field investigation was executed between September 27 2022 to October 1, 2022. Primary data was gathered using structured, pre-tested questionnaires. Key informants and focus groups included ultra-poor, transitional poor and enterprising poor farmers. The survey evaluated the overall baseline of Minimum Dietary Diversity (MDD) based on a 10-food-group framework to represent the general dietary habits and nutritional security of the population. Simultaneously, longitudinal agricultural economic data (costs, yields, sales) from March 2021 to March 2022 was extracted to measure production viability.

2.3 Data Analysis

Collected field data were processed and analyzed using Microsoft Excel and IBM SPSS (Statistical Product and Service Solutions). Descriptive statistics, including means, standard deviations (SD) and frequencies, were computed to map both the dietary baseline and the economic parameters of HVF farming.

3. Results

3.1 Overall Minimum Dietary Diversity (MDD) and Nutritional Gaps

To establish the regional nutritional baseline, the overall MDD was assessed based on the consumption patterns of 10 primary food groups over a standard recall period. The data reveals a heavy reliance on starchy staples alongside alarming deficits in micronutrient dense foods (Table 1).

According to the data, 53.6% of the population is not consuming nuts and seeds. Furthermore, the most critical micronutrient vulnerability lies in Vitamin A intake, where 52.80% of the surveyed population reported zero consumption of Vitamin-A rich fruits and vegetables. Overall, only 56% of the population achieves a minimum acceptable dietary diversity score, highlighting a substantial nutritional gap.

Table 1: Overall Minimum Dietary Diversity (MDD) Food Group Consumption Baseline

Food Groups	Positive Response (%)	Negative Response (%)
Grains	99.80%	0.20%
White roots and tubers	77.30%	22.70%
Plantains	80.70%	19.30%
Pulses (beans, peas, lentils)	58.30%	41.70%
Oils and fats	69.10%	30.90%
Nuts and seeds	46.40%	53.60%
Dark green leafy vegetables (DGLV)	69.10%	30.90%
Other Vitamin-A rich fruits and veg.	47.20%	52.80%
Other vegetables	83.50%	16.50%
Other fruits	56.00%	44.00%

3.2 Current HVF Cultivation Scenario

The region exhibits a promising baseline for fruit and tree cultivation, which serves as a foundation for scaling up HVFs. The survey of perennial crops across the four unions indicates that traditional high value fruits are already established within the local agricultural framework (Table 2). As illustrated in Table 2, Mango is the most widely cultivated fruit crop, occupying 37.80% of cultivated land, followed by Guava (27.00%), Jackfruit (16.00%) and Papaya (12.30%).

Table 2: Perennial fruits and tree cultivation (%)

Name	Frequency	Cultivated land (%)
Banana	52	12.80%
Guava	109	27.00%
Jackfruit	65	16.00%
Litchi	58	14.30%
Lemon	56	13.80%
Mango	153	37.80%
Papaya	50	12.30%
Pineapple	29	7.20%
Teak	77	19.00%
Blackberry	16	4.00%
Mahogany	18	4.40%
Akashmoni	19	4.70%

3.3 Economic Viability of Cultivation

To determine the commercial feasibility of scaling HVF to meet the nutritional gaps, seasonal economic data was analyzed across three consecutive cycles from March 2021 to March 2022 (Table 3-5).

Table 3: Cultivated Fruits (March 2021 to July 2021)

Variables	Mean (SD)	Median	Max-Min	IQR
Cultivated land (Decimal)	52.01 (46.06)	40	250 - 4	[75 - 16]
Total Cost of production (000 BDT)	115.03 (913.95)	10	10000 - 1.4	[19 - 5]
Total production (Mt)	1.84 (5.25)	1	100 - 0.13	(2 - 0.6)
Sales price (000 BDT)	26.72 (11.48)	25	85 - 0.4	[32 - 20]
Total Sales (Income) (000 BDT)	38.68 (36.77)	25	240.17 - 3.5	[48 - 15]
Gross profit (BDT) (000 BDT)	27.63 (55.57)	11.6	909 - 1	[30 - 8]

Table 4: Cultivated Fruits (July 2021 to November 2021)

Variables	Mean (SD)	Median	Max-Min	IQR
Cultivated land (Decimal)	51.34 (41.92)	40	300 - 5	[60 - 25]
Total Cost of production (000 BDT)	64.58 (595.85)	8	8500 - 1	[18 - 5]
Total production (Mt)	1.67 (1.76)	1.44	19 - 0.1	(2.1 - 0.76)
Sales price (000 BDT)	26.33 (13.35)	23.68	80.5 - 0.5	(34 - 15.5)
Total Sales (Income) (000 BDT)	37.14 (27.12)	33	161.19 - 0.95	[47 - 18]
Gross profit (BDT) (000 BDT)	23.65 (22.98)	17.32	155.92 - 1	[27 - 8]

Table 5: Cultivated Fruits (November 2021 to March 2022)

Variables	Mean (SD)	Median	Max-Min	IQR
Cultivated land (Decimal)	47.99 (44.65)	40	350 - 3	[56 - 20]
Total Cost of production (000 BDT)	10.97 (11.14)	7	120 - 1	[15 - 4]
Total production (Mt)	1.62 (2.59)	0.8	23 - 0.08	(1.8 - 0.5)
Sales price (000 BDT)	25.59 (11.97)	22.63	78 - 0.6	[30 - 19]
Total Sales (Income) (000 BDT)	37.14 (27.12)	33	161.19 - 0.95	[47 - 18]
Gross profit (BDT) (000 BDT)	20.71 (41.21)	11.2	654.15 - 0.5	[20 - 6]

The data unequivocally demonstrates that fruit cultivation maintains positive gross profit margins year round, ranging from a mean of 20.71 thousand BDT in the winter/spring season to 27.63 thousand BDT in the peak summer season.

3.4 Constraints and Opportunities in HVF Expansion

Despite the profitability, significant systemic barriers exist. We evaluated the constraints and opportunities associated with quality saplings, bio-pesticides, bio-fertilizers and farm technology.

Table 6: Constrains and opportunity of the quality sapling, bio-pesticides, bio-fertilizers, technology etc.

Variables	Constrain (Number)	Constrain (%)	Opportunity (Number)	Opportunity (%)
Land	32	7.90%	373	92.10%
Labour	351	86.70%	54	13.30%
Finance	340	84.20%	64	15.80%
Technology	350	86.60%	54	13.40%
Post-harvest management	362	89.80%	41	10.20%
Processing	361	89.10%	44	10.90%
Sales	23	5.70%	382	94.30%
Market price	60	14.90%	344	85.10%

As observed in Table 6, farmers overwhelmingly view Land (92.10%), Sales (94.30%) and Market Price (85.10%) as major opportunities. Conversely, critical vulnerabilities lie in Post-harvest management (89.80%), Processing (89.10%) and Finance (84.20%).

4. Discussion

4.1 Bridging the Micro-Nutrient Gap through Target Crops

The MDD baseline paints a stark reality of the regional dietary pattern. While staple grain requirements are met, 52.8% of the population suffers from a lack of Vitamin A-rich foods and 53.6% lack nuts and seeds. Prolonged Vitamin A deficiency is directly linked to weakened immunity and severe ocular morbidities in rural demographics (West, 2002; Stevens *et al.*, 2015) [13, 11].

High Value Fruits present an immediate, localized solution to this crisis. Local farmers are already predisposed to cultivating Mango (37.8%) and Papaya (12.3%). Both fruits are globally recognized as premier, bioavailable sources of beta-carotene (pro-vitamin A) and ascorbic acid (WHO, 2019) [14]. By actively transitioning these existing

agricultural baselines into intensive HVF models and introducing ultra-high-value variants like Dragon Fruit, Avocado and Malta the region can domesticate its nutritional supply chain. Furthermore, promoting the cultivation of Cashew Nuts, a highly suitable HVF for the Chittagong Hill Tracts topography, directly addresses the severe 53.6% deficit in nut/seed consumption, supplying essential healthy fats and proteins.

4.2 Economic Viability as a Catalyst for Nutritional Security

Nutritional interventions in impoverished areas fail if they do not make economic sense for the producers (Gillespie *et al.*, 2019) [3]. Seasonal data prove that fruit cultivation is inherently lucrative across the calendar year. Even in the lowest yield cycle (Nov 2021 to Mar 2022), farmers achieved a mean gross profit of 20.71 thousand BDT.

This profitability is the economic engine that can drive nutritional security. As farmers generate higher incomes from HVF, household purchasing power increases, historically correlating with improved household dietary diversity scores (Headey and Alderman, 2019) [4]. Furthermore, the overwhelming perception of Sales (94.3%) and Market Price (85.1%) as high opportunity vectors indicates robust, unmet consumer demand.

4.3 Navigating Constraints for Sustainable Implementation

To realize the potential of HVF, systemic constraints must be dismantled. Post-harvest management (89.8%) and processing (89.1%) as the most severe bottlenecks. Because HVFs (like Papaya and Malta) are highly perishable, the absence of cold storage infrastructure and rapid transport systems leads to massive spoilage, keeping the nutritional benefits from reaching local consumers. Additionally, Financial constraints (84.2%) prevent ultra-poor and transitional-poor farmers from accessing the initial capital required for high quality tissue cultured saplings, bio-pesticides and bio-fertilizers.

5. Conclusion and Recommendations

The dietary architecture of Sitakunda and Mirsarai is heavily deficient in essential micronutrients, particularly Vitamin-A rich foods and nutrient-dense nuts/seeds. Expanding the cultivation of High Value Fruits (HVF) offers a scientifically and economically validated dual intervention.

Crops like Mango, Papaya and Cashew nut directly target the identified MDD deficits while providing farmers with highly profitable gross margins across all seasons. However, the success of this transition is hindered by severe post-harvest and financial bottlenecks.

To bridge this nutritional and economic gap, the following policy-level recommendations are proposed:

1. **Targeted Crop Financing:** Microcredit institutions (NGOs) and state agricultural banks must design loan products specifically tailored to the gestation periods of HVEs to alleviate the 84.2% financial constraint.
2. **Post-Harvest Infrastructure:** Establish localized, cooperative owned cold storage facilities and processing units (e.g. for jams, jellies and dried fruits) to combat the 89.8% post-harvest management barrier.
3. **Nutritional Value Chain Integration:** Foster direct linkages between HVE producers and regional markets/super-shops, minimizing middle man interference and ensuring that nutrient dense fruits remain affordable for local consumers, thereby directly lifting the region's overall MDD score.
4. **Technology Transfer:** Promote the dissemination of tissue culture raised saplings, bio-fertilizers and bio-pesticides through collaborative efforts between BARI, BFRI and local government agricultural extensions.

6. Authors Declaration

Acknowledgment

The authors express their sincere gratitude and profound indebtedness to Md. Arifur Rahman, Chief Executive; Md. Manzur Murshed Chowdhuri, Director, Economic Development; Md. Newaz Mahmud, Program Manager; and Mr. Suman Deb Nath, Project Manager, YPSA, Chattogram, for their invaluable guidance, constructive advice, continuous inspiration, financial support, and generous assistance in successfully completing the baseline survey.

The authors are deeply grateful to Akond Md. Rafiqul Islam, Senior General Manager, PKSF, Dhaka, Bangladesh, for his valuable support, constructive guidance, and encouragement during the field investigation and data collection.

Heartfelt appreciation is extended to all the participants from Sitakunda and Mirsarai upazilas of Chattogram for their valuable cooperation and for providing authentic information throughout the study.

The authors also sincerely thank the young and energetic students, namely Pratik Mazumder, Meheeb Hossain, Tahmina Jahin, Shrabonti Mozumder, Md. Ismail, Khairul Anam Evan, Shreya Chakma, Umaiya Binte Farhad, Anika Sultana, Fahmida Haque, Anjuman Ara Mim, and Md. Abdul Alim, Department of Botany, University of Chittagong, for their dedicated participation in field data collection and data entry.

Special thanks are also extended to the enthusiastic students, Abu Taim and S. M. Tanvir Akash, Department of Botany, University of Chittagong, for their untiring efforts and dedicated assistance in data entry.

Finally, the authors gratefully acknowledge the Plant Tissue Culture and Biotechnology Laboratory, Department of Botany, Faculty of Biological Sciences, University of Chittagong, Chattogram-4331, Bangladesh, for providing the laboratory facilities and workspace required to successfully complete this research.

Conflict of Interest

The authors declare that there are no conflicts of interest.

Funding Statement

This baseline assessment was conducted with financial and technical support from the Rural Microenterprise Transformation Project (RMTP), implemented in collaboration with YPSA, Chattogram.

Data Availability Statement

The raw data, statistical outputs and socioeconomic datasets generated and analyzed during the current study are not publicly available because they contain confidential information that could compromise the privacy of the rural microenterprise respondents. However, the datasets are available from the corresponding author upon reasonable request for legitimate academic or research purposes, subject to applicable ethical approval and confidentiality requirements.

References

1. Cummings RW. Agricultural diversification and smallholders in South Asia. New Delhi: Academic Foundation; 2007.
2. Food and Agriculture Organization of the United Nations. Minimum dietary diversity for women: an updated guide to measurement from collection to action. Rome: FAO; 2021. doi:10.4060/cb3434en.
3. Gillespie S, Harris J, Kadiyala S. The agriculture-nutrition disconnect in India: what do we know? IFPRI Discussion Paper. Washington (DC): International Food Policy Research Institute; 2019. p. 1-45.
4. Headey D, Alderman H. The relative caloric prices of healthy and unhealthy foods differ systematically across income levels and continents. *Journal of Nutrition*. 2019;149^[11]:2020-2033.
5. Hirvonen K, Bai Y, Headey D, Masters WA. Affordability of the EAT-Lancet reference diet: a global analysis. *Lancet Glob Health*. 2020;8^[1]:59-66.
6. Jones AD, Shrinivas A, Bezner Kerr R. Farm production diversity is associated with greater household dietary diversity in Malawi. *Food Policy*. 2014;46:1-12.
7. Jones AD. Critical review of the emerging research evidence on agricultural biodiversity, diet diversity and nutritional status in low- and middle-income countries. *Nutrition Reviews*. 2017;75^[10]:769-782.
8. Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity. Rome: Food and Agriculture Organization of the United Nations; 2011.
9. Pingali P. Agricultural policy and nutrition outcomes: getting beyond the preoccupation with calories. *Food Security*. 2015;7^[3]:583-591.
10. Sibhatu KT, Krishna VV, Qaim M. Production diversity and dietary diversity in smallholder farm households. *Proceedings of the National Academy of Sciences of the United States of America*. 2015;112^[34]:10657-10662.
11. Stevens GA, Bennett JE, Hennocq Q, Lu Y, De-Regil LM, Rogers L, *et al*. Trends and mortality effects of vitamin A deficiency in children in 138 low-income and middle-income countries between 1991 and 2013: a

- pooled analysis of population-based surveys. *Lancet Glob Health*. 2015;3^[9]:528-536.
12. Weinberger K, Lumpkin TA. Diversification into horticulture and poverty reduction: a research agenda. *World Development*. 2007;35^[8]:1464-1480.
13. West KP Jr. Extent of vitamin A deficiency among preschool children and women of reproductive age. *Journal of Nutrition*. 2002;132^[9]:2857S-2866S.
14. World Health Organization. Increasing fruit and vegetable consumption to reduce the risk of non-communicable diseases. Geneva: World Health Organization; 2019.

Authors' Names and Affiliations

Tapash Kumar Bhowmik

Associate Professor, Plant Tissue Culture and Biotechnology Laboratory, Department of Botany, Faculty of Biological Sciences, University of Chittagong, Chattogram-4331, Bangladesh

Minhajur Rahman

Associate Professor, Ecology and Phytochemistry Laboratory, Department of Botany, Faculty of Biological Sciences, University of Chittagong, Chattogram-4331, Bangladesh

Md. Abul Kashem

Assistant Professor, Plant Tissue Culture and Biotechnology Laboratory, Department of Botany, Faculty of Biological Sciences, University of Chittagong, Chattogram-4331, Bangladesh

Sayed Israt Hasan

Department of Botany, University of Chittagong, Chattogram-4331, Bangladesh

Abu Al Alif

Department of Botany, University of Chittagong, Chattogram-4331, Bangladesh

Md. Abir Hossain Nishat

Department of Botany, University of Chittagong, Chattogram-4331, Bangladesh

Abdullah Al Kayes

Department of Botany, University of Chittagong, Chattogram-4331, Bangladesh

Kamrul Islam

Department of Botany, University of Chittagong, Chattogram-4331, Bangladesh

Md. Milon Hossain

Department of Botany, University of Chittagong, Chattogram-4331, Bangladesh