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EFFECTS OF URBANIZATION ON HOMESTEAD SIZE AND TREE SPECIES DIVERSITY AMONG FARMERS IN CUMILLA DISTRICT

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Abstract

Modernization plays a crucial role in socio-economic development globally and in Bangladesh. Agroforestry practices are increasingly adopted to support sustainable livelihoods. This study examines the impact of urbanization on homestead size and tree species diversity in Debidwar Upazila, Cumilla district. Data were collected through structured interviews with 90 randomly selected farmers from six villages between January and June 2018. Results indicate that most respondents in traditional and semi-modern areas were middle-aged with secondary education, while modern areas had more individuals with education beyond the secondary level. Family sizes were mostly medium (4–6 members), and income levels were moderate across all areas. Agriculture remained the primary occupation in traditional and semi-modern zones, whereas service sector jobs dominated in modern areas. Homestead sizes were generally medium in traditional and semi-modern areas but smaller in modern areas. Traditional agroforestry systems supported greater tree species diversity (18 species) compared to modern areas (11 species). Common tree species included mango (630), coconut (311), betel nut (240), and jackfruit (206). Key challenges such as transportation issues, unemployment, and economic difficulties were prevalent. Urbanization showed significant positive correlations with education, occupation, income, homestead size, tree species, and local problems, but no significant correlation with age or family size. The study concludes that urbanization has led to a notable reduction in homestead size and tree species diversity in the region.

Keywords: Agroforestry, Homestead size, Socio-economic development, Tree species diversity, Urbanization.

Introduction

Homesteads serve as small-scale farms, producing fruits, vegetables, and livestock, ensuring food security for rural households (Miah and Hussain 2010). Homestead is an age-old and traditional land use system with protection and production

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functions, contributing particularly to the food and nutrition security of smallholders (Vieira *et al.,* 2012). Trees grown in homesteads provide timber, bamboo, and firewood, fulfilling a large portion of the national demand. Homesteads also act as biodiversity hotspots, preserving native plant species and supporting ecological balance (Nath *et al*., 2014). Homesteads integrate multi-strata farming systems, combining trees, crops, and livestock to maximize land use (CGIAR, 2023). They support organic farming, reducing reliance on chemical fertilizers and pesticides.

Bangladesh is a densely populated agricultural-based country with about 68% of people living in rural areas (BBS, 2022). As of 2025, the population of Bangladesh is estimated to be 175.7 million with a population density of 1,350 people per square kilometer. Though the population is increasing every year, the population growth rate has been gradually declining over the years. Due to the rapid growth of population and the urbanization of rural areas, farm size has declined. Land fragmentation and declining farm size are critical problems that smallholder farmers are facing in maintaining traditional farming practices (Headey *et al.,* 2014).

In 2022, Bangladesh had approximately 32.07 million homesteads, covering roughly 0.27 million hectares of land (BBS, 2022). In Bangladesh, homesteads represent a well-established land use system where natural forests cover less than 10% of homestead gardens which are maintained by at least 20 million households, and represent one possible strategy for the conservation of biodiversity (Roy *et al*., 2012). Urbanization is defined as the demographic process whereby an increasing share of the national population lives within urban settlements (Potts, 2012).

Debidwar Upazila in the Cumila district is not the most urbanized. Rather, in the Cumilla district, Brahmanpara Upazila is recognized as one of the upazilas in the process of significant urbanization. Moreover, the environment of the upazila is at threat due to the establishment of a huge number of modern residential areas and different kinds of business structures such as garments, poultry, leather, shops, etc. The area of modern homesteads is becoming smaller to smaller day by day with no or little vegetation that affects livelihood as well as biodiversity (Ruba and Talucder, 2023). Homestead plays a vital role in the existence of rural people, providing them with food, fuel, fodder, timber, fish, and shelter. Homestead production is the most significant system of livelihood in rural areas. Its management affects the production, consumption, sale, and repurchase of field crops, livestock, fish, fruits, fuels, etc. The rural economy thus depends on the productivity of the natural resources, which is intimately linked with the biodiversity in the ecosystem (Khan *et al.,* 2020). Considering the situation mentioned above, the study was conducted to fulfill the following objectives to find out the change of homestead size due to urbanization and to assess the change of tree species due to urbanization.

Materials and Methods

Experimental site and Population sample

The study was conducted in three villages of Debidwar Upazila, Cumilla: Baniapara (Debidwar Sadar Union), Bankot-Padmokot (Dakshin Gunaighar Union), and Barashalghar-Choto Shalghar (Bara Shalghar Union), comprising a total of 350 farm

households. Within this Upazila, three samples Modern, Semi-modern, and Traditional were randomly selected under Sadar Upazila for data collection. A random sample of 90 households was selected, with an additional 15 households reserved as substitutes to ensure complete data collection. A detailed population structure and sample are presented in Table 1. Households were categorized into Modern, Semi-modern, and Traditional settlement types based on observable infrastructural, economic, and social characteristics, guided by local administrative insights and field observations.

Debidwar Upazila was purposively selected for this study due to its dynamic and transitional nature in terms of rural-urban transformation. Situated in the rapidly developing Cumilla District, Debidwar exhibits diverse settlement patterns and is undergoing notable infrastructural expansion and socio-economic change. This diversity makes it an ideal microcosm for examining urbanization trends in peri-urban and rural Bangladesh. The Upazila's mix of traditional villages, semi-modernizing communities, and emerging modern settlements provides a unique opportunity to study the continuum of urbanization and its implications on household livelihoods, land use, and service accessibility. Therefore, the area offers both representativeness and relevance for understanding broader patterns of rural transformation across similar regions in the country.

Table 1. Distribution of population and sample of the selected villages

Upazila	Union	Village	Population (Families)	Sample size	Reserved list
Debidwar	Debidwar Sador	Baniapara, Debidwar	132	30	5
	Dakshin gunaighar	Bankot, Padmokot	108	30	5
	Bara shalghar	Barashalghar, Choto Shalghar	110	30	5
Total			350	90	15

Variables and their measurement techniques

In a descriptive social study, variable selection and measurement are important. This study included both independent variables (e.g., age, education, family size, occupation, income from homestead, tree species, and problems caused by urbanization) and one dependent variable (effect of urbanization on homestead size). Independent variables are those presumed to influence or predict change, while the dependent variable reflects the observed outcome affected by variations in the independent variables.

Measurement of independent variables

Age: The respondents were classified into three categories: young (up to 35 yr), middle (36-50 yr), and old age (above 50 yr). Education: The education of respondents was classified under illiterate (0), sign only (0.5), Primary education (1-5), Secondary education (6-10), higher secondary (10-12), and above secondary (> 10). Family size: The family size

of the respondents was classified into three categories- small (up to 3), medium (4 to 6), and large family (> 6), respectively. Occupation: The occupation was classified as 1, 2, and 3 as agriculture, business, and service, respectively. Homestead farm size: Based on their farm size, the farmers were classified into three categories, followed as landless/marginal (up to 0.08), Small (0.09 - 0.14), Medium (0.15 - 0.20), and Large (>0.21), respectively. Income from homestead: Farmers were categorized into three groups based on their annual family income from homestead agroforestry: low income (up to 20,000 BDT), medium income (21,000 to 40,000 BDT), and high income (above 40,000 BDT). Tree species: Tree species were measured by counting the total species from each homestead, and total tree abundance was also measured from each homestead. Problems: Problems faced by the respondents from the scoring of some selected problems. Seven problems were selected, and scoring was given 2 marks for each problem, and the total was counted for each individual.

Measurement of the dependent variable

The dependent variable in this study was the effect of urbanization on homestead size.

Data collection and compilation

Primary data were collected by the researcher from January 15 to June 15, 2018, through face-to-face interviews conducted at respondents' homes and farms. Before each interview, the study's purpose was clearly explained to ensure accurate and honest responses. The relationship was established to reduce hesitation. The Sub-Assistant Agricultural Officer (SAAO) of DAE assisted in organizing respondent appointments. Collected data were coded, standardized, and transferred to a master sheet for tabulation and analysis in line with the study objectives. Although the data were collected seven years ago (January–June 2018), they remain relevant for the research objectives, which focus on assessing rural–urban transformation and associated socio-economic dynamics. Urbanization processes and rural livelihood transitions tend to evolve gradually, and the patterns observed during the study period still reflect key structural characteristics of the area. Thus, the 2018 dataset offers a credible and valuable empirical foundation for understanding ongoing developmental trajectories and informing policy discussions in similar rural and peri-urban contexts in Bangladesh.

Statistical analysis

The data collected were analyzed, coded, transferred from the interview schedule to a master sheet, summarized, categorized, and entered into a database using Microsoft Excel 2019. The data were analyzed using SPSS (Version 21.0) which was used to perform all statistical analyses. To explore the effect of urbanization on homestead size and tree species performed by the respondents and their selected characteristics, Pearson's Product-Moment Correlation Co-efficient (r) was used (Ray and Mondal, 2004).

Results and Discussion

Age

The age of the respondents varied from 25 to 61 years, the average being 41.03 years with a standard deviation of 11.88 for the traditional areas by farmers. Again, for semi-modern area farmers, the age of the respondents varied from 24 to 60 years, the average being 40.47 years with a standard deviation of 9.66. In terms of modern area practices by farmers, the age of the respondents varied from 26 to 58 years, the average being 39.67 years with a standard deviation of 9.57 (Table 2). Young respondents (≤35 years) were more common in semi-modern and modern areas (36.67%) than in the traditional area (26.67%), with the lowest average age in the modern area (39.67 years). Middle-aged respondents (36–50 years) were the largest group, especially in the traditional area (53.33%). Older respondents (>50 years) were few, the highest in traditional (20.00%) and lowest in semi-modern areas (13.33%). Dutta *et al*., (2023) reported that age is an important factor regarding knowledge because age has a significant positive correlation with the cultivation of lemon production.

Education

The education level of the respondents ranged from 0-15 for each of the homestead categories (traditional, semi-modern, and modern) following the year of schooling. The average education score of the respondents was 5.93, 5.45, and 7.48 with a standard deviation of 4.20, 4.34, and 4.89 for the traditional, semi-modern, and modern areas, respectively (Table 2). Illiteracy is highest in the semi-modern area (13.33%) and absent in the traditional area. Average schooling years are lower in the semi-modern (5.45) than in the modern area (7.48). Signature-only respondents are more common in semi-modern (16.67%) and modern (10.00%) areas. Primary education is highest in the traditional area (26.67%), while secondary education dominates in traditional and semi-modern areas (40.00%). Higher education is most prevalent in the modern area (33.33%). Urbanization improves access to basic education for all. Expanding education systems in urban areas is easier and costs less than in rural areas. There is a positive relationship between urbanization and education school enrollment at both primary and secondary levels increases with urbanization (Arouri *et al.,* 2014).

Table 2. Distribution of the farmers according to their age (year), education (schooling), family size (members), and homestead size (ha)

Categories	Basis of category	Number of respondents											
		Traditional area (N=30)				Semi-modern area (N=30)				Modern area (N=30)			
Age (year)													
Categories	Basis of category	No.	%	Avg.	SD	No.	%	Avg.	SD	No.	%	Avg.	SD
Young	Up to 35	8	26.67			11	36.67			11	36.67		
Middle	36 - 50	16	53.33	41.03	11.88	15	50.00	40.47	9.66	14	46.67	39.67	9.57
Old	> 50	6	20.00			4	13.33			5	16.67		
Total		30	100			30	100			30	100		

Categories	Basis of category	Number of respondents											
		Traditional area (N=30)				Semi-modern area (N=30)				Modern area (N=30)			
Education (schooling)													
Categories	Basis of category	No.	%	Avg.	SD	No.	%	Avg.	SD	No.	%	Avg.	SD
Illiterate	0	3	10.00			4	13.33			3	10.00		
Can sign only	0.5	4	13.33			5	16.67			3	10.00		
Primary	1-5	8	26.67	5.93	4.2	7	23.33	5.45	4.34	6	20.00	7.48	4.89
Secondary	6-10	12	40.00			12	40.00			8	26.67		
Above secondary	> 10	3	10.00			2	6.67			10	33.33		
Total		30	100			30	100.00			30	100		
Family size (member)													
Categories	Basis of category	No.	%	Avg.	SD	No.	%	Avg.	SD	No.	%	Avg.	SD
Small	Up to 3	7	23.33			9	30.00			7	23.33		
Medium	4 to 6	18	60.00	5.13	2.06	15	50.00	5.10	2.26	16	53.33	5.33	2.08
Large	> 6	5	16.67			6	20.00			7	23.33		
Total		30	100			30	100			30	100		
Homestead size (ha)													
Categories	Basis of category	No.	%	Avg.	SD	No.	%	Avg.	SD	No.	%	Avg.	SD
Landless/ marginal	Up to 0.08	5	16.67			3	10.00			6	20.00		
Small	0.09 - 0.14	8	26.67	0.18	0.12	11	36.67	0.17	0.12	13	43.33	0.15	0.11
Medium	0.15 - 0.20	12	40.00			12	40.00			8	26.67		
Large	> 0.21	5	16.67			4	13.33			3	10.00		
Total		30	100			30	100			30	100		

Family Size

The average number of family members was 5.13, 5.10, and 5.33 for the traditional, semi-modern, and modern areas, respectively with standard deviations of 2.06, 2.26, and 2.08, respectively (Table 2). Small households (up to 3 members) comprise 23.33% of respondents in both traditional and modern areas, and 30.00% in semi-modern areas, with average household sizes around 5 members. Medium-sized households (4–6 members) are the most common, accounting for 60.00% in the traditional area, 50.00% in the semi-modern, and 53.33% in the modern area, with consistent average sizes across regions. Large households (>6 members) are more frequent in semi-modern (20.00%) and modern (23.33%) areas compared to traditional (16.67%), indicating a trend toward larger household sizes in more developed settings (Table 2). Average homestead sizes were traditional, semi-modern, and modern. Landless/marginal farmers were most common in the modern area (20.00%), while small landholders dominated there (43.33%), reflecting fragmentation. Medium landholders prevailed in traditional and semi-modern areas

(40.00%), and large landholders were highest in the traditional area (16.67%), declining with modernization. Plant communities respond sensitively to urban sprawl and are therefore considered indicators for human-induced changes in habitats and landscapes (Vakhlamova, 2015). Islam *et al.,* (2017) also found a significant reduction in tree species due to urbanization.

Occupation

The occupations of the farmers in the study area varied distinctly. Based on their occupation, they are classified as agriculture, business, and service which were calculated with given scores of 1, 2, and 3, respectively. Based on scoring, the average occupation score was 1.40, 1.63, and 1.73 with standard deviations of 0.62, 0.76, and 0.78, respectively in respect of the traditional, semi-modern, and modern areas, respectively (Table 3). Agricultural engagement is highest in the traditional area (66.67%) and lowest in the modern area (20.00%), showing reduced reliance on farming with modernization. Business involvement rises across areas, peaking in the modern area (33.33%). Service-based employment increases significantly, from 6.67% (traditional) to 46.67% (modern), indicating a shift toward non-agricultural livelihoods. Arouri *et al.,* (2014) similarly found that urbanization drives economic transformation in Africa, with industrial employment rising from 6.1% in less urbanized areas to 26.1% in highly urbanized regions.

Table 3. Distribution of farmers according to their occupation

Categories	Number of respondents											
	Traditional area (N=30)				Semi-modern area (N=30)				Modern area (N=30)			
	No.	%	Avg.	SD	No.	%	Avg.	SD	No.	%	Avg.	SD
Agriculture	20	66.67	1.40	0.62	16	53.33	1.63	0.76	6	20.00	1.73	0.78
Business	8	26.67			9	30.00			10	33.33		
Service	2	6.67			5	16.67			14	46.67		
Total	30	100			30	100			30	100		

Household annual income

The average household annual family income from the homestead of the respondents was 28.43, 27.37, and 32.63 thousand takas with standard deviations of 10.84, 11.72, and 13.84, respectively under traditional, semi-modern, and modern areas, respectively (Table 4). Medium-income households dominate across all areas, highest in traditional (63.33%) and semi-modern (60.00%), but decline in modern areas (50.00%). Average income peaks in modern areas (32,630 Tk.), with higher income variability. High-income respondents are most common in modern areas (33.33%), indicating rising income levels with urbanization. Low-income prevalence is highest in semi-modern areas (23.33%). Modern urbanization is driven by higher productivity from the industrial and service sectors. Pull factors such as better job and income opportunities attract people from rural to urban areas (Hossain, 2001).

Table 4. Distribution of farmers regarding annual family income from the

homestead

Category	Basis of category ('000' Tk.)	Number of respondents											
		Traditional area (N=30)				Semi-modern area (N=30)				Modern area (N=30)			
		No.	%	Avg.	SD	No.	%	Avg.	SD	No.	%	Avg.	SD
Low	Up to 20	5	16.67			7	23.33			5	16.67		
Medium	21-40	19	63.33	28.43	10.84	18	60.00	27.37	11.72	15	50.00	32.63	13.84
High	> 40	6	20.00			5	16.67			10	33.33		
Total		30	100			30	100			30	100		

Abundance and changes of tree species due to urbanization

Homesteads of selected study areas are composed of multiple tree species. A total of 18 plant species and 13 families were recorded from the set of 90 homesteads surveyed. The names of species with family, their abundance in homesteads, and their percentage of abundance were arranged (Table 5). Tree species diversity and abundance decline with modernization. Traditional areas recorded the highest diversity (18 species, avg. 12.07) and abundance (806 trees, avg. 26.87), followed by semi-modern (14 species, 686 trees) and modern areas (11 species, 547 trees). Urbanization leads to a notable reduction in both tree diversity and abundance. Plant communities are sensitive indicators of urban sprawl and human-induced habitat changes (Vakhlamova, 2015).

Table 5. An abundance of dominant tree species according to urbanization

Categories	Tree species and abundance									
	Traditional area (N=30)			Semi-modern area (N=30)			Modern area (N=30)			Total
	No.	% of total	Avg.	No.	% of total	Avg.	No.	% of total	Avg.	
Tree species	18	100.00	12.07	14	77.78	10.23	11	61.11	8.37	18
Total abundance	806	39.53	26.87	686	33.64	22.87	547	26.83	18.23	2039

Changes in homestead size due to urbanization

Under modern areas, 90% of the respondents agreed that changes occurred due to urbanization whereas 73.33% of respondents under semi-modern areas observed their changes due to urbanization (Table 6). Positive perceptions of urbanization increase with modernization, rising from 6.67% in traditional areas to 73.33% in semi-modern and 90.00% in modern areas. Conversely, negative responses decline from 93.33% to 26.67% and 10.00%, respectively, indicating greater acceptance of urbanization in more developed areas.

Table 6. Changes in homestead size due to urbanization

Categories	Number of respondents					
	Traditional area (N=30)		Semi-modern area (N=30)		Modern area (N=30)	
	Number	%	Number	%	Number	%
Yes	2	6.67	22	73.33	27	90.00
No	28	93.33	8	26.67	3	10.00
Total	30	100.00	30	100.00	30	100.00

Reduction of homestead tree species

In modern areas, all the respondents (100%) agreed that the reduction of homestead tree species in their homesteads occurred due to urbanization whereas 80% of respondents in semi-modern areas observed their tree species reduction due to urbanization (Table 7). Tree species reduction due to urbanization was not observed in traditional areas (0% Yes), but affirmative responses rose to 80% in semi-modern and 100% in modern areas. Negative responses dropped from 100% in traditional to 20% in semi-modern and 0% in modern areas, showing a clear shift toward acknowledging tree loss with modernization.

Table 7. Reduction of homestead tree species due to urbanization

Categories	Number of respondents					
	Traditional area (N=30)		Semi-modern area (N=30)		Modern area (N=30)	
	Number	%	Number	%	Number	%
Yes	0	0.00	24	80.00	30	100.00
No	30	100.00	6	20.00	0	0.00
Total	30	100.00	30	100.00	30	100.00

Problems faced by the respondents

Eight major urbanization-related problems were identified in the study: income decline (P1), household issues (P2), economic challenges (P3), overcrowding and pollution (P4), unemployment (P5), poor health and disease (P6), higher urban crime rates (P7), and transportation problems (P8) (Table 8). Results showed that unemployment was the most reported problem in traditional (83.33%) and modern areas (73.33%), while transportation issues dominated in semi-modern areas (53.33%). Overcrowding and pollution were the least reported in traditional areas (13.33%) but increased with modernization. Economic problems and perceived income decline decreased from traditional to modern areas, indicating improved stability. Poor health issues declined from 30% to 16.67%, whereas urban crime peaked in semi-modern areas (46.67%). Transportation problems dropped significantly from traditional (76.67%) to modern areas (26.67%). Overall, unemployment and transportation were the primary concerns across the study areas. This aligns with studies showing that unemployment often persists in transitioning rural communities due

to limited industrial diversification and skill mismatches (Mohammed and Hashim, 2024).

Table 8. Problems faced by the respondents due to urbanization

Categories	Number of respondents											
	Traditional area (N=30)				Semi-modern area (N=30)				Modern area (N=30)			
	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%
Income decreased (P_1)	18	60.00	12	40.00	11	36.67	19	63.33	9	30.00	21	70.00
Facing household problems (P_2)	16	53.33	14	46.67	10	33.33	20	66.67	11	36.67	19	63.33
Economic problems (P_3)	12	40.00	18	60.00	12	40.00	18	60.00	7	23.33	23	76.67
Overcrowding and pollution problems (P_4)	4	13.33	26	86.67	8	26.67	22	73.33	9	30.00	21	70.00
Unemployment problems (P_5)	25	83.33	5	16.67	8	26.67	22	73.33	22	73.33	8	26.67
Poor health and disease problems (P_6)	9	30.00	21	70.00	7	23.33	23	76.67	5	16.67	25	83.33
Urban crime more than traditional (P_7)	8	26.67	22	73.33	14	46.67	16	53.33	12	40.00	18	60.00
Transportation problems (P_8)	23	76.67	7	23.33	16	53.33	14	46.67	8	26.67	22	73.33

Changes in tree species due to urbanization

Table 9 shows that 100% of respondents in the modern area reported changes in tree species related to timber, fruits, and vegetables due to urbanization, while 83.33% and 73.33% noted changes in medicinal/ornamental plants and spices, respectively. In contrast, respondents in traditional areas reported no changes across all plant categories. Semi-modern areas exhibited intermediate responses, with most respondents observing changes. The presence of fuel and fodder trees, timber, fruits, and vegetables was confirmed by all modern-area respondents, whereas semi-modern areas showed moderate presence (26.67%), and traditional areas reported none. This indicates a marked increase in plant species diversity and utilization with urbanization and modernization.

Table 9. Changes in tree species due to urbanization

Categories	Number of respondents											
	Traditional area (N=30)				Semi-modern area (N=30)				Modern area (N=30)			
	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%
Fuel and fodder tree	0	0	30	100	7	23.33	23	76.67	30	100.00	0	0.00
Timber	0	0	30	100	8	26.67	22	73.33	30	100.00	0	0.00
Fruits	0	0	30	100	8	26.67	22	73.33	30	100.00	0	0.00
Vegetables	0	0	30	100	9	30.00	21	70.00	30	100.00	0	0.00
Medicinal or ornamental	0	0	30	100	11	36.67	19	63.33	25	83.33	5	16.67
Spices	0	0	30	100	13	43.33	17	56.67	22	73.33	8	26.67

Relationship between the selected characteristics of the respondents and the effect of urbanization

Correlation coefficients (R-values) in this study (Table 10) were interpreted as follows: 0.00–0.19 indicated very low (negligible) correlation; 0.20–0.39 low (weak) correlation; 0.40–0.69 moderate correlation; 0.70–0.89 high (strong) correlation; and 0.90–1.00 very high (near-perfect) correlation. This classification provides a clear framework to evaluate the strength and direction of relationships between variables, facilitating informed analysis and interpretation of the data. Moderate to high correlations suggest meaningful associations that can guide further causal inference or prediction (Janse *et al*., 2021).

Table 10. The meaning of R-value

R-value	Meaning
0.00 to 0.19	A very low correlation
0.20 to 0.39	A low correlation
0.40 to 0.69	A moderate correlation
0.70 to 0.89	A high correlation
0.90 to 1.00	A very high correlation

Source: Cohen and Holliday (1982)

Pearson's Product-Moment Correlation Coefficient (r) was used to examine relationships between variables, with significance tested at the 5% and 1% levels (df = 88). Results (Table 11) revealed significant correlations between the effects of urbanization and variables such as education, homestead size, income from the homestead, tree species, and problems, some showing high to very high correlations. In contrast, age, family size, and occupation exhibited weak or non-significant correlations. These findings indicate that education, income, and homestead size significantly influence urbanization impacts, while demographic factors like age and family size have minimal effects.

Table 11. Co-efficient of correlation showing the relationship between selected characteristics of the respondents and the effect of urbanization

Dependent variable	Independent variable	Computed value of "r"	Tabulated value of "r" with 88 degrees of freedom	
			at 0.05 level	at 0.01 level
Effect of urbanization	Age	0.064^{NS}	0.205	0.267
	Education	0.405**		
	Family size	0.041^{NS}		
	Homestead size	-0.642**		
	Occupation	0.206*		
	Income from homestead	0.832**		

Dependent variable	Independent variable	Computed value of "r"	Tabulated value of "r" with 88 degrees of freedom	
			at 0.05 level	at 0.01 level
	Tree species	-0.713**		
	Problems	0.207*		

Note: NS=Correlation is not significant, *=Correlation is significant at the 0.05 level (2-tailed), **=Correlation is significant at the 0.01 level (2-tailed)

Relationship between the age of the respondents and the effect of urbanization

The correlation between respondents' age and the effect of urbanization was positive but very weak (r = 0.061), as shown in Table 11. Since this value was below the critical R-value (0.205) at the 5% significance level (df = 88), the relationship was not statistically significant. Thus, age had no meaningful influence on the perceived effects of urbanization.

Relationship between educational qualification and the effect of urbanization

A significant positive correlation was found between respondents' education and the effect of urbanization (r = 0.405), as shown in Table 11. This value exceeded the critical R-value (0.267) at the 1% significance level (df = 88), leading to the rejection of the null hypothesis. The result suggests that higher education is associated with greater awareness and better management of urbanization impacts, likely due to improved knowledge and experience. A significant positive relationship between education and urbanization (r = 0.405) highlights that better-educated individuals may possess greater awareness and adaptive capacity to manage urban impacts, consistent with findings by Chowdhury *et al*., (2022), who emphasized the role of education in enhancing rural livelihood strategies.

Relationship between the family size of the respondents and the effect of urbanization

As shown in Table 11, a very weak positive correlation was observed between family size and the effect of urbanization (r = 0.041), which was below the critical value (0.205) at the 5% significance level (df = 88). The relationship was not statistically significant, indicating that family size had no meaningful influence on the perceived effects of urbanization.

Relationship between the homestead size of the respondents and the effect of urbanization

Table 11 shows a significant negative correlation between the variables (r = -0.642), exceeding the critical value (0.267) at the 1% significance level (df = 88). The null hypothesis was rejected, indicating a strong inverse relationship between the variables.

Relationship between the occupation of the respondents and the effect of urbanization

As shown in Table 11, a positive correlation was found between respondents' occupation and the effect of urbanization (r = 0.206), slightly exceeding the critical value

(0.205) at the 5% significance level (df = 88). The null hypothesis was rejected, indicating a statistically significant relationship between occupation and urbanization effects.

Relationship between income from the homestead of the respondents and the effect of urbanization

Table 11 reveals a strong positive correlation between homestead income and the effect of urbanization (r = 0.832), surpassing the critical value (0.267) at the 1% significance level (df = 88). The null hypothesis was rejected, indicating a highly significant relationship suggesting that higher homestead income is strongly associated with greater urbanization impact.

Relationship between the tree species of the respondents and the effect of urbanization

Table 11 shows a significant negative correlation between tree species and the effect of urbanization (r = -0.713), exceeding the critical value (0.267) at the 1% significance level (df = 88). The null hypothesis was rejected, indicating that tree species significantly declined with increasing urbanization. Tree species and homestead size revealed strong negative correlations with urbanization (r = -0.713 and -0.642, respectively), indicating a decline in vegetation and land availability due to urban encroachment. This supports previous findings by Chen, (2020), who documented biodiversity loss in rapidly urbanizing regions of Bangladesh.

Relationship between problems of the respondents and the effect of urbanization

As presented in Table 11, a positive correlation was found between respondents' problems and the effect of urbanization (r = 0.207), slightly exceeding the critical value (0.205) at the 5% significance level (df = 88). The null hypothesis was rejected, indicating a statistically significant relationship—urbanization was associated with increased problems faced by respondents. The positive correlation between respondents' reported problems and urbanization (r = 0.207) suggests increased socio-environmental stress, consistent with James, (2024), who linked urban sprawl to heightened livelihood challenges.

Conclusion

The study concludes that urbanization has a significant impact on reducing homestead size and tree abundance in the selected areas. Key socio-economic factors such as education, occupation, income, and perceived challenges showed strong correlations with these changes, while age, family size, and number of tree species had no significant influence. Traditional and semi-modern areas were largely dependent on agriculture, whereas modern areas exhibited a shift toward employment in the service sector. Across all settlement types, unemployment and inadequate transportation emerged as major challenges in the study areas.

Author’s contributions

SUBM was responsible for data collection and preparation of the initial draft of

the manuscript. NN and MGJH contributed to the enhancement of the analysis and interpretation of the results and discussion. LM improved the reference of this manuscript. MRA and MSAT contributed significantly to the overall improvement and refinement of the manuscript. AUK provided substantial input in revising and improving the draft manuscript. All authors reviewed and approved the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this manuscript.

References

Arouri, M. H., Youssef, A. B., Nguyen-Viet, C., and Soucat, A. 2014. Effects of urbanization on economic growth and human capital formation in Africa. *HAL*. halshs-01068271. https://shs.hal.science/halshs-01068271.

BBS (Bangladesh Bureau of Statistics). 2022. Statistical Yearbook of Bangladesh 2022. Statistics and Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh. Dhaka, Bangladesh.

CGIAR. 2023. https://www.cgiar.org/initiative-result/empowering-villages-in-Bangladesh-through-homestead-vegetable-production.

Chen, B. 2020. Urbanization and Decline of Old Growth Windbreak Trees on Private Homesteads: A Case Study in Ryukyu Island Villages, Japan. *Forests*. *11*(9):990. https://doi.org/10.3390/f11090990.

Chowdhury, M. A., Hasan, M. K., and Islam, S. L. U. 2022. Climate change adaptation in Bangladesh: Current practices, challenges and the way forward. *J. Clim. Change Health*. *6*:100108. https://doi.org/10.1016/j.joclim.2021.100108.

Cohen, L., and Holliday, M. 1982. Statistics for social scientists: An introductory text. London: Harper and Row. pp. 1-382.

Dutta, S., Amin, M. R., Alam, F., and Khan, A. U. 2023. Impact of climate change on lemon (*Citrus limon* L.) production in eastern Bangladesh. *Bangladesh J. Agri. 47*(2):64-77. https://doi.org/10.3329/bjagri.v47i2.63327.

Headey, D., Dereje, M., and Taffesse, A. S. 2014. Land constraints and agricultural intensification in Ethiopia: A village-level analysis of high-potential areas. *Food Policy*. *48*:129-141.

Hossain, M. Z. 2001. Rural-urban Migration in Bangladesh: A Micro-Level Study. Paper for presentation in the Session on Internal Migration at the Brazil IUSSP Conference in 2001. pp. 125-150.

Islam, M. R., Baten, M. A., Hossain, S. M. A., Afroz, S. M., and Naher, K. 2017. Changes in homestead biodiversity with modernization in the rural areas of Bangladesh. *Int. J. Agri. Res. Innov. Tec. 7*(1): 32-37.

James, N. 2024. Urbanization and Its Impact on Environmental Sustainability. *J. Appl. Geo. Studies*. *3*(1):54-66. https://doi.org/10.47941/jags.1624.

Janse, R. J., Hoekstra, T., Jager, K. J., Zoccali, C., Tripepi, G., and Dekker, F. W. 2021. Conducting correlation analysis: Important limitations and pitfalls. *Clin Kidney J. 14*(11):2332. https://doi.org/10.1093/ckj/sfab085.

Khan, A. U., Choudhury, M. A. R., Tarapder, S. A., and Ema, I. J. 2020. Status of Mango Fruit

Infestation at Home Garden in Mymensingh, Bangladesh. *CRAF*. *1*(4):35-42. Doi: http://dx.doi.org/10.18782/2582-7146.119.

Miah, M. G., and Hussain, M. J. 2010. Homestead Agroforestry: A Potential Resource in Bangladesh. In: Lichtfouse, E. (eds) Sociology, Organic Farming, Climate Change and Soil Science. Sustainable Agriculture Reviews. *Springer*. *3*. https://doi.org/10.1007/978-90-481-3333-8_16.

Mohammed, S. F., and Hashim, S. H. 2024. A critical review on rural youth unemployment in Ethiopia. *Int. J. Adolesc. Youth*. *29*(1). https://doi.org/10.1080/02673843.2024.2322564.

Nath, T. K., Aziz, N., and Inoue, M. 2014. Contribution of Homestead Forests to Rural Economy and Climate Change Mitigation: A Study from the Ecologically Critical Area of Cox's Bazar—Teknaf Peninsula, Bangladesh. *Small-scale For*. *14*:1-18. https://doi.org/10.1007/s11842-014-9270-x.

Potts, D. 2012. Challenging the myths of urban dynamics in Sub-Saharan Africa: The evidence from Nigeria. *World Dev*. *40*(7):1382-1393.

Rahman, M. M., Atiqullah, M., and Miah, M. G. 2009. Homestead Plant Biodiversity in the South-Western Coastal Zone of Bangladesh: Way Forward to Identification, Utilization and Conservation. National Food Policy Capacity Strengthening Programme (NFPCSP), Food and Agriculture Organization of the United Nations (FAO), Dhaka, Bangladesh, pp. 1-25.

Ray, G. L., and Mondal, S. 2004. Research Methods in Social Sciences and Extension Education (2nd ed.). Kalyani Publishers, Ludhiana, India.

Roy, B., Rahman, M. H., and Fardusi, M. J. 2012. Status, Diversity, and Traditional Uses of Homestead Gardens in Northern Bangladesh: A Means of Sustainable Biodiversity Conservation. *Int. Sch. Res. Notices*. *2013*(1):124103. https://doi.org/10.1155/2013/124103.

Ruba, U. B., and Talucder, M. S. A. 2023. Potentiality of homestead agroforestry for achieving sustainable development goals: Bangladesh perspectives. *Heliyon*. *9*(3). https://doi.org/10.1016/j.heliyon.2023.e14541.

Vakhlamova, T. 2015. *Consequences of rapid urbanization on plant diversity in a Western Siberian city*. Philosophisch-Naturwissenschaftlichen Fakultät der Universität Basel.

Vieira, T. A., Rosa, L. D. S., and Santos, M. D. L. 2012. Agrobiodiversity of home gardens in Bonito, State of Para, Brazil. *Rev. Ciênc. Agrár*. *55*(3):159-166.