



Research Article

Enhancing Sustainable Livelihoods and Empowering Women: A Study on Scavenging Duck Rearing in the Tanguar Haor Region of Bangladesh

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Abstract | Duck rearing in the haor areas is a common farming practice that helps small farmers to improve their livelihoods and reduce poverty in Bangladesh. The purpose of this study was to examine the socioeconomic effects of raising ducks on rural households, with a focus on the empowerment of women in intra-household decision-making, and to address the problems experienced by small-scale scavenging duck raisers. A total of 150 duck raising farmers from Tahirpur and Dharmapasha upazila of Tanguar haor were interviewed face-to-face using random sampling technique. To pinpoint the socio-economic status, statistical tools including frequency, percentage, and tabular representation were applied. Farmers' livelihood pattern was also presented in a Sustainable Livelihood Framework (SLF). The Women Empowerment Index (WEI) was developed to take into account the involvement of women in household decision-making, and the Problem Confrontation Index (PCI) was computed to determine the degree of difficulty faced by scavenging duck raisers. The research revealed that female (61.33%), middle-aged (46.67%) small-scale farmers (41.33%) were the predominant group engaged in duck-raising operations within the study locations. All types (human, social, natural, physical, and financial) of household capital increased to some extent after the adoption of the duck rearing, except for natural capital, which remained constant. Results showed that women empowerment has generated only in duck rearing related activities (1.08), while their family participation and mobility-related decisions were limited (average WEI score of 0.89). The study also identified some problems, such as disease outbreaks, high feed prices, and flash floods, which were the most significant in the study area. Future policies should focus on capacity-building programs, financial support, and risk reduction measures to ensure women's holistic empowerment and the sustainable development of duck farming in haor regions.

Received | August 14, 2024; **Accepted** | May 05, 2025; **Published** | October 09, 2025

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Citation | Islam, S., I.A. Begum, N. Sayadat, S. Rahman and B. Banik. 2025. Enhancing sustainable livelihoods and empowering women: A study on scavenging duck rearing in the Tanguar Haor Region of Bangladesh. *Sarhad Journal of Agriculture*, 41(4): 1507-1522.

DOI | <https://dx.doi.org/10.17582/journal.sja/2025/41.4.1553.1563>

Keywords | Haor, Problem confrontation, Scavenging duck, Sustainable livelihood, Women empowerment



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Introduction

Livelihood improvement and poverty reduction are central concerns in rural development strategies

worldwide, particularly in low-income countries like Bangladesh. The agricultural sector is the main driving force for the majority of rural families in Bangladesh contributing about 11.30% to the country's GDP

(BER, 2024), and employs 45.40% of the total labor force (BBS, 2023). Within this sector, livestock and poultry play a crucial role, accounting for approximately 1.84% of the national GDP and 15.79% of the agricultural GDP, highlighting their significance for food security and rural livelihoods (DLS, 2024). In Bangladesh, one of the most promising industries is the poultry industry, which produces animal protein for human consumption, generates revenue and adds to the GDP (Faruq, 2020). Ducks, pheasants, ostriches, geese, quails, guinea pigs, swans, turkeys, chickens, and other game birds are considered poultry. In rural areas in low-income nations, family poultry raising is a popular practice (Islam *et al.*, 2015). In this wetland-enriched country, duck farming can be a vital tool to improve small farmers status by enhancing food security and employment opportunities. In Asia, the majority of duck production is related with wetland rice cultivation, particularly in humid and subtropical zones, reflecting the appropriateness of haor regions. The duck population has been estimated at 63.845 million occupying the second position just after chicken, 375.645 million in the poultry sector in Bangladesh (DLS, 2021) where land ecology has a significant impact on duck production systems (Morduzzaman *et al.*, 2015). Ducks are an effective converter of agricultural by-products such as kitchen garbage, seeds, grains, garden leftovers, insects, green grasses, and any other human refuse that would otherwise be discarded. Smallholders commonly raise ducks in low-lying places using scavenging and semi-scavenging methods, with little or no feed supplementation (Rahman *et al.*, 2009). Duck rearing is also an effective climate change adaptation strategy practiced by the local farmers in the Haor region of Bangladesh (Kabir *et al.*, 2024). The practice of raising ducks is becoming more and more popular everywhere. Approximately 5.25% of local Tanguar Haor farmers are intensively dependent on only duck farming (Liza, 2024). The majority of the ducks in the nation are raised in rural areas using scavenging methods (Zahan *et al.*, 2016). Duck raising is regarded as an economic and lucrative livelihood alternative in Bangladesh (Hamid, 2019; Kabir *et al.*, 2020); it is low-cost, easy to manage, highly prolific, adaptive to adverse environmental circumstances, and comparably more resistant to common illnesses (Bhuiyan *et al.*, 2017). To combat poverty not just for this group of individuals, but also for troubled women, duck, which requires less land, cash, and talent, can be an effective strategy. Moreover, improving the position

of women is a prerequisite for ensuring the balanced socioeconomic development of the nation. Only with greater involvement of women in development initiatives will this be possible (Barua *et al.*, 2021). Therefore, about 80% of rural women are involved in duck rearing in Bangladesh (Islam *et al.*, 2016). Small-scale scavenging duck raising is an essential part of improving resource livelihoods. By providing a balanced diet and helping in poverty alleviation in haor areas it is well accepted. The livelihood pattern will also improve by it. Earning from duck rearing has a potential impact on the total income of poor farmers and helps to make better choices. The literature currently available on duck farming in Bangladesh emphasizes its potential as an economical, climate-resilient, and effective agricultural method that supports rural livelihoods and reduces poverty (Hamid, 2019; Kabir *et al.*, 2020). Furthermore, earlier research has highlighted how raising ducks enhancing women's participation in economic activities (Islam *et al.*, 2016). However, most of these studies have been conducted in general rural areas without giving more focus on geographically unique and vulnerable ecosystems like the Tanguar haor regions, where a considerable number of farm households engage in duck rearing operations. This study bridges these gaps by focusing on the socio-economic features of the duck farming family in Tanguar Haor region, a critical and under-researched ecosystem in Bangladesh, utilizing the Sustainable Livelihood Framework (SLF) to assess the impacts of duck rearing on rural households, developing a Women Empowerment Index (WEI) to examine the women's empowerment status in intra-household decision-making processes by involving scavenging duck rearing activities, identifying and prioritizing challenges faced by scavenging duck raisers to suggest context-sensitive policy measures. It is expected that the study, can support the achievement of the United Nations Sustainable Development Goal, SDG: 2 (zero hunger) and SDG: 5 (gender equality) by providing a reliable source of nutritious food for people and can increase food security status by helping the policymakers to design better duck farming activities for improving the livelihood status of small duck raisers.

Materials and Methods

Study area selection and data collection

The study was carried out at the Tahirpur and Dharmapasha Upazila under the Sunamganj District

of the Tanguar haor which is a low-lying wetland that remains inundated for 7-8 months each year (Liza, 2024) and holds significant potential suitable for duck rearing due to its suitability for wetland ecosystems and the availability of natural resources like water bodies and aquatic vegetation. A purposive random sampling technique was used to collect information from 150 farmers who were involved with scavenging duck rearing through face-to-face direct interview techniques using a finalized semi structured interview schedule.

Analytical tools and techniques

For analyzing the data appropriate tabular techniques and statistical methods were intensively used. Simple statistical methods such as frequency, percentage, and tabular representation were used to categorize and display the socioeconomic data, as well as to describe the influence of scavenging duck farming on livelihood status by using sustainable livelihood framework (SLF), also known as asset pentagon considering five types of livelihood capitals (i.e., human, social, natural, physical and financial capitals) (DFID, 2000).

The Women Empowerment Index (WEI) was developed with women's participation in household decision-making in duck raising and other household activities in mind. In this context, 15 household decision-making actions were identified as indications of WEI. A three-point rating scale was used to evaluate household decision activities in the following ways:

The average score value of X_i (i.e., i^{th} indicator) for all decision indicators would equal the average of the value K_i represented by the following equation: $K_i = \text{Men made the decisions} \times 0 + \text{Decision is made by both} \times 1 + \text{Women made the decision} \times 2$.

Individual women's empowerment indexes, such as the Women Empowerment Index of Duck Raising Related (WEIdi), Women Empowerment Index of Family Matters (WEIfi), and Women Empowerment Index of Mobility (WEImi) (Bose et al., 2009).

$$\text{WEIdi} = \sum \frac{X_i}{4}; \text{WEIfi} = \sum \frac{X_i}{5}; \text{WEImi} = \sum \frac{X_i}{6}$$

$$\text{Therefore, the overall WEI} = \frac{\text{WEIdi} + \text{WEIfi} + \text{WEImi}}{3}$$

Decision: If $\text{WEI} > 1$ Empowered; and $\text{WEI} \leq 1$ Not

empowered.

The Problem Confrontation Index (PCI) was used to assess the severity of challenges faced by scavenging duck raisers. For each of the eighteen selected challenges, respondents were given four possible replies ("high =3", "medium =2", "low =1", and "not at all =0"). Problem Confrontation Index (PCI) = $Ph \times 3 + Pm \times 2 + Pl \times 1 + Pn \times 0$ (Islam et al., 2023). Where, Ph = the total number of respondents who expressed the problem as "high"; Pm = the total number of respondents who expressed the problem as "medium"; Pl = the total number of respondents who expressed the problem as "low"; and Pn = the total number of respondents who expressed the problem as "not at all".

Results and Discussions

Socioeconomic status of scavenging duck farmers

Farmers everyday lives are impacted by their socioeconomic traits, including gender, age, educational qualification, farm size, annual income etc. Assessing the socioeconomic attributes of poultry raisers is crucial for analyzing how family poultry farming affects the enhancement of livelihoods (Kabir et al., 2015). Major socioeconomic attributes of scavenging duck raisers in the study area are presented in Table 1.

Most of the female was actively involved in the duck raising activities that was 61.33% in the study area. This result provides compelling evidence of women's engagement in livelihood-generating activities in environmentally unique region like Tanguar Haor. The farmers were divided into three age groups: Young (18-35), middle-aged (36-50), and old (>50) (Table 1). The average age of duck farmers was between 36 and 50 years. The majority (46.67%) of scavenging duck raisers were middle-aged that agreed with the finding of Parvez et al. (2020). Level of education is a crucial criterion for duck farming. Direct interviews with the respondent farmers in the research region were used to determine the level of education. Many studies found that the state of education is very disappointing in Haor areas (NIPORT, 2005). In the study areas, the majority (38%) of scavenging duck raisers had only primary education while 26% farmers had no formal education, and only 6% farmers had higher secondary or above level of education. This study was in close agreement with the observation of Pervin et al. (2013)

Table 1: *Socioeconomic status of scavenging duck raisers.*

Characteristics	Scoring method	Categories	Frequency	Percentage (%)
Gender		Male	58	38.67
		Female	92	61.33
Age	Years	Young aged (18-35)	49	32.67
		Middle aged (36-50)	70	46.67
		Old aged (>50)	31	20.67
Educational status	Years of schooling	Illiterate (0)	39	26.00
		Primary (1-5)	57	38.00
		Secondary (6-10)	45	30.00
		Higher secondary and above (>11)	9	6.00
Farm size	Acres	Landless farmers (<0.05)	22	14.67
		Marginal farmers (0.05-0.49)	54	36.00
		Small farmers (0.5-2.49)	62	41.33
		Medium farmers (2.5-7.49)	10	6.67
		Large farmers (>7.5)	2	1.33
Annual income	000 Bangladeshi Taka	Low (<150)	59	39.33
		Medium (150-258)	65	43.33
		High (>258)	26	17.33
Training received	Times	Not received (0)	81	54.00
		Low (1-2)	44	29.33
		Medium (3-4)	21	14.00
		High (>4)	4	2.67
Extension media contact	Times	No contact (0)	66	44.00
		Low (<5)	55	36.67
		Medium (5-10)	19	12.67
		High (>10)	10	6.67

who reported that 32.5% received primary education and only one percent of respondents had a higher level of education. According to [Islam et al. \(2023\)](#), farm sizes of scavenging duck farmers were classified into five different categories; these are landless farmers (<0.05 acres), marginal farmers (0.05-0.49 acres), small farmers (0.5-2.49 acres), medium farmers (2.5-7.49 acres) and large farmers (>7.5 acres). In the study area, most of the farmers were small farmers having 0.5-2.49 acres of farm size. It was found that only 1.33% of farmers in the research region were large farmers, while 6.67% were medium farmers. This underscores the critical role of scavenging duck rearing as a livelihood strategy for small-scale farmers who have limited land resources. For these smallholders, duck rearing serves as an efficient and sustainable means of income generation and food security, particularly in a resource-constrained environment. Respondents were classified into three income groups, i.e., low (<150000 Bangladeshi Taka), medium (150000-258000 Bangladeshi Taka)

and high (>258000 Bangladeshi Taka) based on the annual family income ([Fidah et al., 2024](#)). A large group of farmers about 43.33% had an annual income of 150000-258000 Bangladeshi Taka. This finding highlights the poor economic condition of duck raisers in the Tanguar Haor region, particularly in resource-constrained settings where such activities provide a sustainable livelihood option. [Table 1](#) reveals that 29.33% received one or twice training followed by 14% received training three to four times on duck rearing. The highest portion (54%) of duck raisers received no training on duck raising activities that is similar to the finding of [Jha et al. \(2015\)](#). Extension media contact is an important criterion for making the duck farming more successful ([Sheheli et al., 2023](#)). [Table 1](#) depict that a large number (44%) of scavenging duck farmers kept no contact while only 36.67% had low contact (5-10 times in the whole farming life) with extension media. That indicates many farmers still follow traditional methods with limited knowledge about modern duck farming

practices. Extension media can raise awareness about government programs, vaccination campaigns, and marketing opportunities, offering great potential to make duck farming in the haor region more profitable and sustainable.

Livelihood status after adopting scavenging duck practices
Livelihood is the collection of skills, possessions, and pursuits that give them access to the resources necessary to meet their fundamental needs and maintain their well-being. The construction of livelihoods is a reflection and an attempt to meet both material and experiential demands (Kabir *et al.*, 2015). The sustainable livelihoods framework (SLF) enhances comprehension of the economic conditions of the impoverished. It organizes the factors that limit or augment livelihood opportunities and illustrates their interrelations (Serrat, 2017). The livelihood framework is presented together in Table 2 with the pattern of livelihood for farmers, which includes components for human, social, natural, physical, and financial well-being. The transformation and enhancement of the respondent's quality of life are explored in relation to changes in these capitals. In

terms of access to human capital for scavenging duck raisers, health status increased by 81%, education by 92%, training by 65%, and knowledge or skills increased by 58%.

The social capital of rural communities showed increases in collaboration of 51%, political power or influence in the village, and social group engagement of 34% and 59%, respectively. There is a wide variation in the resources that make up natural capital such as access to forest area by the duck raisers, which was mostly unchanged (55%) meanwhile the Cultivable land increased only by 45% and highest increase in Greenland and pastures by 63%. The changing state of physical capital confirmed that the housing structure, mobile phone and furniture were the same as before but access of using tube wells, boats and sanitation increased by 61%, 52%, and 53% respectively in the study areas. The access to financial capital for scavenging duck raisers was also increased. Though the cash in hand and savings increased by 79%, and 68% respectively, donations and access to bank accounts were mostly constant for the scavenging duck farmers.

Table 2: Sustainable livelihood framework (percentage of change in farmers livelihood capital).

Livelihood capitals	Indicators	Increased	Decreased	Constant
Human capital	Health status	81	2	17
	Education	92	0	8
	Training	65	5	30
	Knowledge and skills	58	12	30
Social capital	Cooperation among rural communities	51	6	43
	Influence or political power in the village	34	3	63
	Involvement in social group	59	10	31
Natural capital	Cultivable land	45	23	32
	Grasslands and pastures	63	14	23
	Forest area	21	24	55
	Open water bodies	55	18	27
Physical capital	Housing structure	35	5	60
	Tube well	61	0	39
	Boat	52	4	44
	Radio/ TV	45	0	55
	Mobile phone	39	7	54
	Sanitation	53	11	36
	Furniture	39	5	56
	Cash in hand	79	2	19
Financial capital	Savings	68	0	32
	Donation	38	18	44
	Access to bank account	41	0	59

Table 3: Women's empowerment in intra-household decision-making processes after participating in scavenging duck raising.

Dimensions	Statements	Decisions taken by men	Decisions taken by both men and women	Decisions taken by women	WEI	Average WEI
Duck rearing related	Purchasing duck	38	67	45	1.05	1.08
	Rearing Duck	30	54	66	1.24	
	Duck treatment	45	55	50	1.03	
	Selling eggs/duck	55	40	55	1.00	
Family matters related	Children's education	56	55	39	0.89	0.87
	Household assets	52	58	40	0.92	
	Savings	60	49	41	0.87	
	Coping mechanisms	51	58	41	0.93	
	Marriage of children	59	70	21	0.75	
Mobility Related	Different training program	78	54	18	0.60	0.73
	Market	68	57	25	0.71	
	Health Centre or hospital	38	83	29	0.94	
	Social or political meeting	101	42	7	0.37	
	Vote center	67	62	21	0.69	
	Attending Social festival	37	64	49	1.08	
Average indicator of decision making (a+b+c)/3						0.89

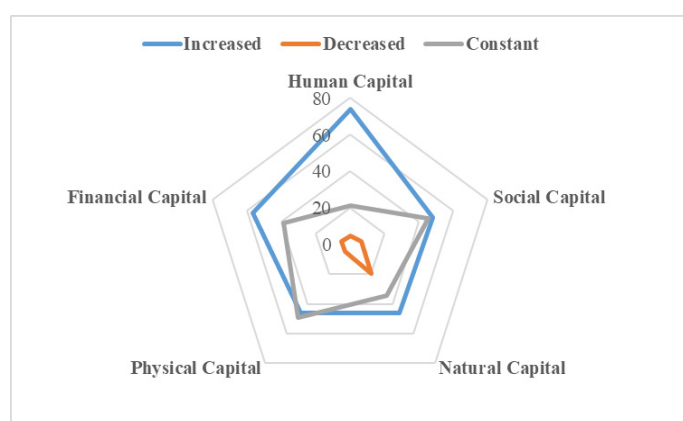


Figure 1: Overall change in farmers' livelihood capitals after scavenging duck raising.

The asset pentagon of the sustainable livelihood framework was employed to enable the visual presentation of likely information about farmers' assets, highlighting significant interrelationships between the various assets. Figure 1 depicts the forms of pentagons. Similar to these findings, were discovered by Uddin *et al.* (2023) in green grass production in Bangladesh offers opportunities for job creation, revenue generation, and, to a lesser extent, poverty alleviation. This study demonstrated the extraordinary increase in farmers livelihoods after using scavenging duck raising. It is shown that all five types of household capital increased after the adoption of the duck raisers, except for natural capital, which remained constant. Kabir *et al.* (2015) and Islam *et al.* (2015) also found that scavenging family poultry

production can improve the financial and physical assets and also the health and sanitation system of the smallholder farmers.

Women's empowerment in the intra-household decision making process

Women's participation in intra-household decision-making processes displays the democratic rights of family members, and their economic contribution to family income is an important feature in their intra-family decision-making process (Khanum and Mahadi, 2015). The haor duck farmers were asked about whether men or women, or both, made decisions regarding each of the activities as shown in Table 3 to gauge the degree of engagement across 15 variables. It was observed that men and women nearly always made shared decisions about duck purchases, household assets, kid marriage, and health center or hospital choices. However, it has been observed that a few women were the sole decision-makers in circumstances involving family issues and mobility-related decisions. From Table 3 it is observed that only 7 women can only decide to attend social or political gatherings. Again only 18 women decided whether to attend in different training programs. Finally, the Women Empowerment Index (WEI) was constructed to determine the total empowerment level of haor women in duck parenting, family concerns, and mobility-related decisions.

Table 4: Problems faced by the scavenging duck raisers.

Dimensions	Problem statement	Extent of problems				PCI	Rank order
		Not at all	Low	Moderate	High		
Economic problem	Lack of capital	43	35	48	24	203	10
	High price of feed	19	22	51	58	298	2
	High price of the vaccine	29	26	35	60	276	4
	Lack of credit facilities	37	53	38	22	195	11
Social and natural problem	Theft	37	46	35	32	212	9
	Outbreak of disease	15	21	54	60	309	1
	Environmental pollution	78	43	20	9	110	18
	Predatory animals	25	29	45	51	272	5
	Flash flood	20	27	48	55	288	3
	Farmers conflict if ducks move to other fields	51	46	35	18	170	12
Marketing problem	Price fluctuation of eggs, ducklings and ducks	41	39	31	39	218	8
	Lack of competitive market	55	53	21	21	158	13
	High intervention of middlemen	58	48	28	16	152	14
Technical problem	Lower quality of duckling	63	51	26	10	133	17
	Inadequate veterinary services	30	59	23	38	219	7
	Lack of training facilities	59	53	20	18	147	16
	Housing Problem	23	39	40	48	263	6
	Inadequate parent stock	62	49	18	21	148	15

In the study, the findings showed that the average WEI for duck-rearing-related decisions was 1.08 that means haor women are empowered through duck-rearing-related activities. However, they are not empowered in family matters and mobility-related decisions as the average WEI was less than one in the study areas. The average WEI of the decision indicator was 0.89 in Table 3 highlighting a consistently low empowerment index for women, suggesting limited opportunities for them to contribute their ideas for implementation in the study area. Bose *et al.* (2009) also found a similar type of low value of the empowerment index for women.

The contrasting levels of empowerment in different decision areas indicate that while duck rearing offers a space for economic engagement and partial decision-making authority, broader social and mobility-related decisions remain male-dominated. These results suggest a need for targeted interventions aimed at enhancing women's decision-making power in all aspects of life. Strategies to improve women's access to training, information, and resources could play a crucial role in strengthening their roles in both economic and social decision-making processes. This could help in promoting a more inclusive decision-making environment that allows women to fully

exercise their democratic rights and contribute effectively to family and community welfare.

Problems faced by the scavenging duck farmers

The present study identified various technical, marketing, social, natural, and economic challenges faced by farmers engaged in scavenging duck rearing in the Tanguar Haor region of Bangladesh.

The challenges identified, particularly disease outbreaks, high feed price, high vaccine price, lack of training, and high intervention by middlemen, highlight significant barriers to sustainable livelihoods and women's empowerment (Hasan, 2023). The computed problem confrontation index (PCI) of the identified major 18 problems have been arranged in rank order according to their severity.

The most pressing problem identified is the 'outbreak of disease' considered as the 1st ranked problem (PCI= 309), which threatens the health of ducks and directly affects production. This result agrees with the finding of Afrin *et al.* (2016) and Sheheli *et al.* (2023). A study by Churchil and Jalaludeen (2022) found that duck farmers suffer significant losses due to various disease outbreaks such as duck plague, duck cholera, and avian influenza. 'High prices of feed' considered as the

2nd ranked problem (PCI =298), leading to increased production costs. Zannat *et al.* (2018) also found this problem as severe in their study.

Flash floods was identified as 3rd most severe problems (PCI= 288) in the study location which caused for infrastructure damage.

The 4th ranked problem was 'high prices of vaccines (PCI= 276) and predatory animals (PCI= 272) was identified as 5th ranked problem pose significant threats to duck health and safety. Ahmed *et al.*, 2021 found that insufficient vaccines and its high price was a severe problem in their research area. Other notable issues include housing problems (PCI= 263), inadequate veterinary services (PCI= 219), and price fluctuations of eggs, ducklings, and ducks (PCI= 218), which disrupt the production, market stability and income generation. Sheheli *et al.* (2023) also identified these problems in the haor areas.

Begum *et al.* (2020) identified the low market price of duck eggs and meat as the second major constraint in their study. Theft (PCI= 212) and lack of capital (rank 10) undermine financial security, while lack of credit institutions (PCI= 195) limits access to necessary resources. Farmers' conflicts over duck movement (PCI= 170), lack of competitive markets (PCI= 158), and high intervention of middlemen (PCI= 152) add to the logistical challenges. Inadequate parent stock (PCI= 148), lack of training facilities (PCI= 147), and lower quality of ducklings (PCI= 133) affect the productivity and quality of duck rearing. Finally, environmental pollution (PCI= 110) exacerbates the already difficult conditions for duck raisers by contaminating the water and reducing the overall habitat quality. This problem was confronted least by the scavenging duck raisers in the study area.

Women, who play a dominant role in this livelihood activity, require targeted support to overcome these barriers. Training programs, financial assistance, and access to competitive markets could empower women and improve household incomes by dsuck raising in sustainable way. These interventions, combined with policies aimed at empowering women, such as microcredit access and entrepreneurship training, can transform scavenging duck rearing into a resilient and empowering livelihood activity for women in the Tanguar Haor region.

Conclusions and Recommendations

The study concludes that scavenging duck raising in Tanguar haor region of Bangladesh has an enormous opportunities and potentials to boost up the production revenue creation, self-employment, poverty eradication, women's empowerment, and small farmer livelihood improvement. Overall, the study found females actively participate in duck-raising operations in the Sunamganj District of Bangladesh, with middle-aged adults dominating this sector. Education levels among duck raisers vary, with a significant portion having only primary education. Most duck raisers are small-scale farmers with limited land holdings. The sustainable livelihood framework (SLF) uses an asset pentagon to visually represent the farmers assets, highlighting how they changed after adopting scavenging duck rearing. It is noted that all five types of household capital increased after adopting this livelihood strategy, except for natural capital, especially in forest areas. This suggests that scavenging duck raising had a positive impact on the livelihoods of these farmers, enhancing their well-being across various dimensions of capital. Women Empowerment Index (WEI) indicates that haor women appear empowered in duck rearing but less so in family matters and mobility-related decisions. Outbreaks of disease, the high price of feed, flash floods, the high price of the vaccine, and predatory animals were the most common problems faced by scavenging duck raisers in the study areas. Based on the findings of this study, duck rearing can be a viable livelihood option for farmers, especially in developing countries. So, there is a need to address the challenges faced by scavenging duck raisers and the government and other stakeholders can provide support to them through access to credit, and vaccination services. Further research is needed to develop sustainable duck rearing practices.

Acknowledgments

The People's Republic of Bangladesh's Ministry of Science and Technology is still acknowledged by the authors for providing the funding necessary to see the study through to completion.

Novelty Statement

This study uniquely explores the socioeconomic impact of scavenging duck rearing in Bangladesh's

haor re-gions, with a specific focus on women's empowerment in household decision-making. By integrating tools such as the Women Empowerment Index (WEI), Sustainable Livelihood Framework (SLF), and Problem Con-frontation Index (PCI), the research provides a comprehensive analysis of how duck farming contributes to livelihood improvement, while highlighting gender-specific challenges and outcomes—an area previously under-represented in rural development literature.

Autor's Contribution

Santa Islam: Conceptualization, data curation, formal analysis, investigation, methodology, software, writing original draft.

Ismat Ara Begum: Conceptualization, funding acquisition, investigation, resources, supervision.

Nazmus Sayadat: Data curation, formal analysis, software.

Saifur Rahman: Visualization, writing review and editing.

Bristy Banik: Visualization, writing review and editing.

Conflict of interest

The authors have declared no conflict of interest.

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