

**FACTORS INFLUENCING AGRICULTURAL MECHANIZATION
IN SOUTHWESTERN REGION OF BANGLADESH**

A Thesis

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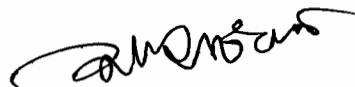
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Factors Influencing Agricultural Mechanization in Southwestern Region of Bangladesh

ABSTRACT

Mechanization, a multi-faceted concept, has made significant strides in the sector of agriculture in Bangladesh. It performs admirably in increasing crop productivity, income, time savings, labor efficiency, and cost-cutting, establishing itself as a dependable partner in agriculture. Assessing the extent of use of agricultural machinery as well as identifying the factors influencing mechanization in the southwestern region of Bangladesh remains less explored territory, necessitating further investigation. This study was conducted in Dumuria Upazila, Khulna, aimed to find out the status of use of agricultural machinery and to explore the factors influencing agricultural mechanization in the southwestern region of Bangladesh. Data were collected during December 2022 from 80 farmers using accidental random sampling method who had been exposed to mechanized cultivation. Nearly three-fifths (59%) of respondents reported moderate machinery use, predominantly in tillage, followed by pesticide application and irrigation. Conversely, lower mechanization rates were noted in crop harvesting and seed sowing, aligning with the Machinery Use Index (MUI) results. The majority of respondents (77.5%) were moderately influenced, and addressed scarcity and high wages of labor as the foremost factors influenced agricultural mechanization. Access to farm power closely followed in Agricultural Machinery Influence Index (AMII), while cattle ownership, proximity of the farm location, and irrigation access held subsequent positions. Crop lodging and land topography were less influential. Education, engagement with extension media, and cosmopolitanism were correlated positively with the extent of agricultural machinery use. Conversely, experience in mechanized cultivation displayed a negative correlation. Besides, age, farming experience, and mechanization experience were negatively correlated to the perceived influence. Conversely, education, organizational involvement, and media contact showed positive associations. However, the use of agricultural machinery revealed a focus on tillage, pesticide application, and irrigation stages. Respondents unanimously considered scarcity and high wage of labor as well as access to farm power as their foremost concerns.

Key word(s): *Agricultural Mechanization, Influencing Factors, Extent of use of machinery*

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The Author

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CHAPTER I

INTRODUCTION

1.1 General Background of the Study

Agriculture stands as the keystone of Bangladesh's economy, making a substantial contribution of approximately 11.20% to its Gross Domestic Product (BBS, 2022). Beyond its economic significance, agriculture serves as the lifeblood of employment generation, food security assurance, and export revenue generation, all of which are pivotal for the nation's overall wellbeing. This vital sector engages nearly half of Bangladesh's labor force and commands over 70% of the nation's arable land for crop cultivation (Kabir et al., 2017).

Recognizing the paramount importance of agricultural mechanization, the government has accorded it a position of utmost priority within the National Agricultural Policy, aimed at elevating productivity and crop yields (Hossen et al., 2020). Despite the daunting challenges posed by climate change and technological disparities, the government exhibits unwavering resolve in enhancing resilience, which encompasses measures such as subsidies, accessible credit facilities, and the promotion of sustainable agricultural practices (Ahmed et al., 2015). The agricultural sector is actively diversifying its crops, improving irrigation systems, and investing in research endeavors, all with a vision of a more adaptive and prosperous future. This dynamic approach not only fortifies food security but also contributes significantly to the alleviation of rural poverty and fuels broader economic growth (Pretty, 2018). The agricultural sector of Bangladesh indeed exemplifies resilience and adaptability, making enduring contributions to the nation's prosperity and development (Awal et al., 2013).

Undoubtedly, agricultural mechanization has emerged as a pivotal catalyst in shaping contemporary agriculture (Rahman et al., 2021). According to Arun et al. (2019), agricultural mechanization (AM) is a multifaceted concept encompassing a broad spectrum of elements, collectively propelling agricultural advancement. It is noteworthy that there exist substantial regional and national variations in the degree of mechanization, reflecting the intricate interplay of factors such as local agricultural practices, economic resources, and access to cutting-edge technology (Rasouli et al., 2009). In essence, AM transcends mere mechanical processes; it represents a dynamic and intricate approach to modernizing agriculture, influenced by a myriad of variables and the ever-evolving agricultural landscape (Baur and Iles, 2023).

The contemporary definition of agricultural mechanization encompasses the manufacturing, distribution, and utilization of various tools, machinery, and equipment designed to enhance agricultural land development, planting, harvesting, and primary processing (Emami et al., 2018). The profitability and competitiveness of agriculture hinge on mechanization, particularly as the labor force continues to dwindle. Moreover, the cultivation of multiple crops demands rapid land

preparation, planting, weeding, harvesting, and processing—tasks that are virtually impossible to accomplish efficiently without the intervention of machinery (Islam and Shirazul, 2009).

The reliability of mechanization lies in its capacity to amplify crop output and farm income while simultaneously curbing post-harvest losses, conserving precious time and labor, and reducing overall agricultural production expenses. As the world grapples with the imperative of sustainable food production, these empirical findings underscore the indispensable role of agricultural mechanization in achieving these objectives. It is a testament to the sector's adaptability and potential to drive agricultural progress, ensuring that farming remains both economically viable and environmentally sustainable in the years to come (Mehta et al., 2014).

In the contemporary landscape, the imperative to modernize agriculture remains universally crucial. An array of pressing challenges, including labor shortages, diminishing arable land, natural resource depletion, and escalating vulnerabilities associated with climate change, underscores the urgency of this endeavor (Rahman et al., 2021). Consequently, a comprehensive approach becomes imperative, one that encompasses advanced farming technologies, sustainable land management practices, and the cultivation of climate-resilient crop varieties. These measures are not only pivotal for enhancing food security but also for ensuring the long-term sustainability and resilience of agricultural sectors worldwide in response to evolving socio-economic and environmental dynamics (Srivastav et al., 2021).

Bangladesh, as a developing nation, grapples with multifaceted challenges, ranging from the imperative of feeding a burgeoning population to reducing poverty, conserving the environment, adapting to climate change, and combating malnutrition. Addressing these issues is paramount for ensuring food security, fostering economic growth, and maintaining political stability. The country pursues tailored solutions, recognizing the need for a holistic approach that encompasses agriculture, resource management, and social development to sustain progress (Emami et al., 2018).

Commencing in the early 1950s, the initiation of agricultural mechanization marked a significant turning point in the pursuit of enhanced agricultural productivity and food security in Bangladesh. Driven by the imperative to meet the burgeoning national food demands, this transformative journey pivoted upon the adoption of high-yielding crop varieties and green revolution technologies (Rahman et al., 2021). It is worth noting that the extent of mechanization within the agricultural sector exhibits notable variation across various operations (Singh and Singh, 2009).

Nonetheless, mechanization has gained substantial ground in Bangladesh, particularly in the realms of irrigation and field preparation, although its prevalence in other agricultural tasks such as planting and harvesting remains relatively limited. Recent efforts have been directed towards increasing farm productivity in Bangladesh through the deployment of various farm machines,

including seed planters, threshers, and harvesters (Rahman and Sujon, 2021). Given the predominantly small-scale nature of agriculture in the country, characterized by minute landholdings and persistent land fragmentation, the widespread adoption of mechanization remains contingent on the availability of small-scale machinery. Additionally, the prevalence of hiring services among farmers further complicates the estimation of agricultural machinery adoption, as ownership-based metrics tend to underestimate actual usage (Barman et al., 2019). Previous research has indicated that factors such as the level of education of the farmer and their spouse, farm size, and access to training significantly influence the adoption of agricultural mechanization (Rahman et al., 2021). Moreover, income levels, farming systems, knowledge, and government subsidies also exert substantial influence on the adoption of new agricultural technology (Arun et al., 2019). Perceptions of new technology, alongside a range of human-centric, economic, technological, and institutional factors, have been identified as key determinants of the adoption of innovative agricultural practices by smallholder farmers in developing countries (Barman et al., 2019).

1.2 Statement of the Problems

Mechanization is a multi-dimensional concept and is widely used in agriculture. There is, however, a major difference between the application of mechanization in developed and developing countries. The developing countries tend to design their own strategies in food security given the challenges they face in all aspects of their economy (Emami *et al.*, 2018).

To examine the major influential factors associated with agricultural mechanization from the perspective of farmers, the researcher performed the study " Factors Influencing Agricultural Mechanization in South-Western Region of Bangladesh." The following research questions were taken into account in order to oversee the study:

- a. What was the status of the use of agricultural machinery in south-western region of Bangladesh?
- b. Which factors had the major influence on agricultural mechanization in south-western region of Bangladesh?
- c. What were the selected characteristics of the farmers using agricultural machinery in south-western region of Bangladesh?
- d. Was there any relationship between the farmers' selected characteristics and their extent of the use of agricultural machinery?
- e. Was there any relationship between the farmer's selected characteristics and their perceived influence on the factors related to agricultural mechanization?

1.3 Specific Objectives of the Study

In an effort to address all the aforementioned concerns of agricultural mechanization, research in south-western Bangladesh should indeed be conducted. Addressing knowledge gaps for policymakers through the identification of factors influencing agricultural mechanization could serve Bangladesh to formulate future development policies more effectively (Rahman and Sujan, 2021). Thus, the specific objectives of this study were:

- a. To assess the extent of use agricultural machinery at various stages of farm operation in south-western Bangladesh
- b. To identify the factors that are most accountable for agricultural mechanization in south-western Bangladesh
- c. To examine selected characteristics of the farmers
- d. To explore the relationship between the farmer's selected characteristics and their extent of the use of agricultural machinery
- e. To ascertain the relationship between the farmer's selected characteristics and their perceived influence on the factors related to agricultural mechanization

1.4 Justification of the Study

The presence of specific farm machinery is a crucial factor that directly impacts the levels of mechanization. However, the landscape of agricultural mechanization (AM) is complex, influenced by a multitude of factors extending beyond mere machinery availability. These encompass challenges like a notable shortage of agricultural labor, the prevalence of contract farming arrangements, financial accessibility hurdles, the depth of equipment market penetration, and the relentless rise in global food demand, as underscored in the research by Arun et al. (2019). One crucial area that demands attention for the future transfer of technology (ToT) is the identification of the key drivers steering the wheels of agricultural mechanization. Unexpectedly, this essential matter remains relatively unexplored in the context of Bangladesh, particularly in its south-western region. Furthermore, past investigations into mechanization indicators predominantly depict a specific and common pattern of mechanization, primarily centered around crop-specific practices.

This research gap underscores the pressing need for more comprehensive and region-specific inquiries into the intricate dynamics of agricultural mechanization in Bangladesh. Such studies could serve as valuable roadmaps for policy formulation, resource allocation, and technology dissemination efforts in the quest for an agriculturally resilient and sustainable future.

1.5 Scope of the Study

This study explores agricultural mechanization's diverse applications, aiming to enhance productivity. It assesses its current extent, key drivers, and offers insights for effective adoption

and problem-solving. The scope of this study is comprehensive, encompassing various facets of agricultural mechanization. From planting to harvesting, impact of mechanization on different stages of farming was thoroughly investigated. Additionally, the study assesses the current degree of mechanization employed by farmers, offering insights into its penetration and adoption levels in the agricultural landscape. Beyond that, it delves into the critical drivers behind the adoption of mechanization, shedding light on the factors influencing its integration. Ultimately, the research serves as a crucial resource for stakeholders, including farmers and policymakers, equipping them with the knowledge needed to navigate the challenges associated with mechanization in agriculture and ensure its successful implementation.

1.6 Limitations of the Study

Time and budget constraints, however, led to certain research limitations in this study. Despite the diversity of respondent characteristics within the study area, the research focused on only twelve variables as per the established protocol. Additionally, the primary source of information for the researchers relied on the responses gathered during interviews with selected participants. While the research team took careful measures to address these limitations effectively, it is important to note these constraints when interpreting the study's results and considering potential avenues for future research.

1.7 Assumptions of the Study

An assumption, as defined by Horwich (1982), was a belief or supposition considered true in the absence of concrete evidence or proof, relying on the available information or observations. Throughout the study, the researchers operated under the following assumptions:

- a. The respondents provided trustworthy and legitimate responses.
- b. The selected respondents possessed the understanding and skills necessary to offer adequate answers to the interview questions.
- c. The opinions and attitudes of the respondents were presumed to be consistent with those held by the majority of farmers in the study area.
- d. All data pertaining to the study variables had been normally and independently distributed.

1.8 Definition of Related Terms

The frequent terminologies that employed in this research paper are as follows:

Farmer: Within the context of this study, an individual who once presided over the stewardship of a farm was regarded as a farmer.

Respondent: The term 'respondents' was a reference to those farmers who found themselves entwined in the tapestry of mechanization, gracing the research sample with their presence.

Age (of the respondent): The number of years since the respondent's birth up to the time of the interview served as the basis for calculating their age. It served as a way to estimate how long they lived.

Education: In this scholarly exploration, 'education' emerged as the cultivation of coveted knowledge, skills, and a refined demeanor within the individual, forged through the arts of reading, writing, and kindred pursuits.

Family: In the context of this research, 'family' denoted a collective assembly of individuals (comprising the farmer, his or her spouse, children, and other dependent members) who resided beneath a single roof and typically congregated under one leadership.

Family Size: The family size of a household, as delineated in this study, was characterized as the numerical count of individuals constituting the family unit. This count encompassed the farmer, his or her spouse, children, and other dependent members who resided together and shared meals.

Farm: In the study, a rural farmer's 'farm' was characterized as a cohesive holding structured to generate one or more enterprises, all tailored to fulfill the goals of rural farmers. A farm could have either operated as a commercial venture or remained non-commercial.

Farm Size: 'Farm size' referred to the expanse of land owned by a farmer, upon which farming operations were executed. A respondent was acknowledged as having derived complete benefits from the cultivated area. The claim of farmers over land, whether leased or mortgaged from other sources, was deemed ownership when assessing the size of the farm.

Annual Income: 'Annual income' was heretofore defined as the collective earnings of the respondent and their familial cohort, stemming from agricultural activities and supplementary sources such as services, business endeavors, labor, and other avenues over the course of a year.

Farming Experience: 'Farming experience' had been defined as the historical engagement of farmers, spanning from their initial foray into agricultural activities to the time of the study.

Organizational Participation: The act of participating in group activities or engaging in an activity or event referred to as '(organizational) participation' during the course of the study.

Extension Contact: In the study, 'extension contact' was denoted as an individual's historical access to communication media, sources, or any extension teaching methods employed for the dissemination of novel technologies among farmers.

Training Exposure: 'Training Exposure' was referred to as the cumulative number that a farmer had attended various farming-related training courses throughout their life.

Cosmopolitanism: The moral stance known as 'cosmopolitanism' was characterized by its emphasis on the intrinsic value of all people, irrespective of their place of residence. It viewed the entire planet as its community, a perspective that placed it in contrast to the nation-state (Wahlström, 2014).

Agricultural Machinery: Agricultural machinery encompasses the use of technology and equipment, from simple hand tools to complex motorized devices like tractors, balers, combines, plows, and more. These tools aid in agricultural tasks, making them more efficient and less time-consuming (Hegazy et al., 2020).

Land Topography: In the study, 'land topography' was described as the measurement of elevation, where 'slope' represented the percentage change in elevation over a specified distance. To evaluate topography, the study utilized lines connecting locations with identical elevations, which were referred to as topographic contours (Erndwein et al., 2020).

Crop Lodging: 'Crop lodging' was defined as the permanent displacement of crop stems from their vertical position, resulting from stem buckling and/or root displacement (Erndwein et al., 2020).

CHAPTER II

REVIEW OF LITERATURE

Each research endeavor must address a distinctive and contemporary challenge that is directly relevant to current needs. This requirement applies throughout the paper, from the introductory background section to the main body where sources are discussed, and ultimately to the concluding or recommendation section that brings the paper together. Consequently, a thorough analysis of existing literature plays a crucial role in defining a unique research question and selecting the most appropriate theoretical framework and research approach. Essentially, the literature review's primary role is to position the current study within the broader context of relevant literature, providing essential context (Randolph, 2009). A literature review highlights the author's understanding of the research subject, as well as introduces researchers to key figures and groups in the field and can potentially transform into a publishable scientific paper with slight revisions (Taylor, 2013).

The researchers conducted an exhaustive examination of the literature pertinent to the research topic. The review was meticulously organized, with a clear focus on the primary objectives of the study. This chapter comprises eight distinct sections, which include:

1. Concept of agricultural mechanization
2. Development of agricultural mechanization
3. The state of agricultural mechanization at the present time
4. Issues related to agricultural mechanization that need to be addressed
5. The relationship between specific characteristics of the respondents and their use of agricultural machinery
6. Key factors influencing agricultural mechanization
7. Conceptual framework of the study

2.1 Concept of Agricultural Mechanization

The term "mechanization" refers to incorporating machinery and technology into agriculture to improve efficiency and productivity. It involves using tools, equipment, and machines to amplify labor and land output on farms, utilizing human effort, animal power, or mechanized technology. It spans from basic hand tools to advanced machinery, reducing labor, increasing crop yields, and improving farm management (Kienzle and Sims, 2014).

Agricultural mechanization enables precise tasks such as planting and harvesting, conserving resources, and reducing the environmental degradation. This modernization streamlines labor, addresses shortages, boosts productivity, and can mitigate climate-related challenges. It is vital for global food security, and minimizing strain on resources and labor (Negrete, 2018). Data shows that agricultural mechanization leads to a substantial 5.22% increase in crop intensity,

resulting in impressive yield improvements of 12% to 34%. Integrating seed and fertilizer drills saves 20% on seeds and 15-20% on fertilizers, increasing farmers' returns and gross income by an impressive 23.50% (Sombilla et al., 2013).

2.2 Development of Agricultural Mechanization

According to Rahman et al. (2021), agricultural mechanization in Bangladesh can be traced to the early 1950s, with the introduction of deep tube-well (DTW) irrigation. After independence in 1971, there was a significant shift in irrigation policy, promoting shallow tube wells (STWs) and low-lift pumps (LLPs). In 1988, the initiation of comprehensive mechanization coincided with the removal of import tariffs on two-wheeled tractors (2WTs).

During the 1990s, the import of 2WTs was completely duty-free, and private sector participation was actively encouraged. Furthermore, a consistent rise in the demand for agricultural machinery (Alam et al., 2017) prompted the emergence of local manufacturing workshops across the country (Islam, 2018). Many of these workshops gradually evolved into small-scale industries. The subsequent expansion of this sector was facilitated by the National Agricultural Policy of 1999, which provided tax relief and credit facilities. Consequently, Bangladesh emerged as one of the most mechanized agricultural economies in South Asia, as pointed out by Hossen (2019).

2.3 The State of Agricultural Mechanization at Present Time

According to Khan (2020), it was revealed that a substantial 66.97% of the respondents fell within the medium utilization category when it came to agricultural machinery. In contrast, 19.27% and 13.76% of farmers found themselves in the low and high utilization categories, respectively. In the research conducted by Rahman et al. (2021), a significant correlation emerged between farm power availability and the degree of mechanization in agriculture. Their study highlighted that, from a modest 0.3 kW/ha in 1960, it escalated to a noteworthy 1.82 kW/ha by 2015. This surge in mechanization significantly reduced reliance on animal power, displacing it by as much as 50 to 100%, albeit at the cost of reduced available time for farm work (Verma and Tripathi, 2015).

Tewari et al. (2012), in their investigation spanning 18 agricultural districts in West Bengal, India, noted a remarkable average cropping intensity of 182%. This figure exceeded the national average by a substantial 33.8%. They attributed this impressive agricultural performance to the advantages of farm mechanization, including the timely execution of operations, improved operation quality, and precision in input application.

Enviously, Rahman et al. (2021) unearthed the absence of a comprehensive census detailing the array of farm machinery employed in Bangladesh. Diesel engines emerged as the favored power source among farmers, primarily for running irrigation pumps. However, these versatile engines found application in various other agricultural tasks. Local transportation of agricultural produce heavily relied on small, locally crafted boats and trolleys powered by diesel engines. This

popularity is further bolstered by substantial government subsidies for diesel fuel. Gisselquist et al. (2002) delved into the effects of trade liberalization in 1988, revealing that the cost of agricultural machinery, especially power tillers and minor irrigation pumps, plummeted by an astonishing 50%. Consequently, this translated into a staggering increase of 400% in diesel engine sales and over 1000% in power tiller sales compared to the three years preceding liberalization. Furthermore, Rahman et al. (2021) underscored the significance of power tillers (2WTs) as complete implements, often propelled by diesel engines. 2WTs have gained widespread adoption compared to 4WTs. Currently, around 80% of the country's land is cultivated with 2WTs, with tractors covering the remaining 15% (Islam, 2018).

Rahman et al. (2021) also highlighted that a total of 1.57 million LLPs, STWs, and DTWs collectively irrigate nearly 95% of all cropland. The mechanization of pesticide and herbicide spraying in the country has reached an impressive 95%. However, despite these accomplishments, the adoption of other agricultural equipment, such as bedmakers, seeders, weeders, rice transplanters, and winnowers, has been progressing at a slower pace.

In his research, Rahman (2016) disclosed that land preparation in Pakistan has achieved near-complete mechanization, encompassing almost all crops. This includes a staggering 901 thousand chisel ploughs and 108 thousand moldboard ploughs in operation. Remarkably, the threshing operation for cereal crops is almost entirely mechanized, with an estimated 20,000–30,000 units sold annually.

Islam et al. (2016) explored the techno-economic performance of 4-row self-propelled mechanical rice transplanters in Bangladesh. They observed that manual planting demanded a labor-intensive effort of approximately 123–150 man-hours per hectare, whereas mechanical transplanting using four-row walking transplanters required a mere 9–11 man-hours per hectare. Rahman (2016), in his study, noted the labor-intensive nature of manual harvesting, which consumed up to 240 man-hours per hectare, leading to a severe labor shortage during harvest seasons. In contrast, the adoption of mechanized harvesting remained relatively low, below 5% (Rahman et al., 2021).

Remarkably, Rahman et al. (2021) discovered the presence of approximately 250,500 weeders in the country. Since 2016, the government has subsidized transplanting and harvesting machines to promote timely planting and harvesting of paddy and wheat before the onset of the monsoon season. This strategic move was prompted by a severe shortage of agricultural labor during peak transplanting and harvesting periods in rural areas. By mechanizing this crucial sector, the government aimed to ensure planting deadlines were met and crops harvested before the advent of the rainy season, addressing the challenges posed by climate change (Rahman et al., 2021).

In their study, Rahman et al. (2021) unveiled three distinct ownership models prevalent in Bangladesh—group ownership, cooperative ownership, and individual ownership. These models

facilitate the judicious use of farm machinery and broaden farmers' access to these valuable resources. Intriguingly, the charges for rental services often do not accurately reflect the true cost of ownership, including annual depreciation and interest, a practice prevalent among farmers and cooperatives investing their savings.

Islam and Shirazul (2009) observed that the majority of rural residents in Bangladesh face financial constraints and cannot afford costly machinery individually. While a select group of affluent farmers with extensive land holdings possess expensive equipment like tractors, power tillers, power tiller-operated seeders, and combiners, they often utilize these machines on their own farms and provide them on a rental basis to others. However, this privileged class remains relatively small in number.

Khan (2020) conducted a study revealing that a substantial 77.06% of farmers possessed a moderate number of agricultural implements. In contrast, 14.68% had low possession, while 9.26% enjoyed a high level of agricultural machinery ownership.

2.4 Issues Related to Agricultural Mechanization that Need to be Addressed

Khan (2020) found that 60.55% of respondents faced medium constraints, while 22.94% had lower constraints, and 16.51% dealt with high constraints. In 1980, the average farm size was 0.91 hectares, which declined to 0.68 hectares by 2000 (Roy and Singh, 2008). Many farmers now work on as little as 1.0 decimal of land, often fragmented across various plots dispersed across multiple locations. This fragmentation poses challenges to the optimal functioning of machinery (Majumder, 2013).

Alam et al. (2017) and Islam (2018) undertook research shedding light on the composition of rural households in Bangladesh, where a striking 84.39% fall into the category of small landholders, managing plots ranging from 50 to 249 decimals of land (BBS, 2018). However, even within this modest landholding, fragmentation reigns supreme, rendering the effective utilization of small and medium-sized power tillers, tractors, transplanters, reapers, mini-combine harvesters, and other machinery a daunting endeavor (Arko et al., 2020).

Islam and Shirazul (2009) astutely observed the presence of numerous small-scale workshops engaged in the production of substandard machinery, casting a pall over the farming landscape. These workshops tend to replicate machines without exacting attention to materials and specifications, resulting in the production of inferior-quality equipment. They also unraveled a paradox in the form of low tariffs on imported machinery and concurrently high tariffs imposed on spare parts and raw materials. This incongruity has dampened the spirits of local manufacturers and created skepticism among farmers regarding the use of imported machines. In a comprehensive review, Fuad and Flora (2019) illuminated the challenges posed by the exorbitant prices of imported agricultural machinery, placing them beyond the reach of impoverished

farmers. The prohibitive costs exacerbate the already challenging landscape of agricultural modernization. They unveiled another layer of complexity, portraying a scenario where the operators of agricultural machinery, comprising both farmers and custom-hire service providers, often grapple with a profound lack of awareness concerning the operation and maintenance schedules of their equipment. In addition, the manufacturing sub-sector is plagued by a dearth of skilled and experienced personnel, repair and maintenance roles.

Mechanized farming relies on farm machinery accessibility to crop fields, but a significant portion of rural Bangladesh faces inadequate farm road infrastructure. While off-road prime movers like tractors can navigate uneven crop fields, specialized machines like combine harvesters are hindered by inaccessible terrain (Lam et al., 2022).

In this manner, the intricate tapestry of challenges confronting agricultural mechanization in Bangladesh weaves a narrative rife with complexity, beckoning for innovative solutions and strategic interventions.

2.5 The Relationship between Specific Characteristics of the Respondents and Their Use of Agricultural Machinery

Researchers have undertaken no direct studies on the relationship between the respondents' selected characteristics and their problems associated with farm mechanization. However, some researchers have considered in case of problem confrontation of different crop sectors.

2.5.1 Age of the Respondent

Singh (2010) found that 60.0% of mango growers in southern Rajasthan were aged between 33 and 50. Mannan and Miah (2007) reported that most fruit farmers were middle-aged, followed by young and old farmers. Manabika et al. (2019) discovered that age had a significant influence on agricultural mechanization in Khulna, Bangladesh.

2.5.2. Educational qualification (Level of Education)

Singh (2010) conducted a study in Southern Rajasthan and found that majority of the farmers were illiterate. Mannan and Miah (2007) reported from their study that most cultivars possessed primary to secondary levels of education engaged in fruit cultivation. Karim (1996), in his study, found that the education of the farmers had a negative significant relationship with their influence level.

2.5.3 Family Size

Sultana *et al.* (2018) in a study, found that half of the respondents had a small-sized family. Mannan and Miah (2007) observed from their study that most of the cultivars had small to medium-sized families, followed by large families engaged in fruit cultivation.

2.5.4 Farm Size

Sultana *et al.* (2018) found that the highest proportion (48.89%) of the respondents had medium-sized farm while 31.69% of respondents had a small farm and 19.42% had large farm in the study

area. Rahman (1995) found that the farm size of the farmer had a significant negative influence on their use of machineries in cotton cultivation.

2.5.5 Annual Family Income

Sultana *et al.* (2018) found that the highest proportion (47.9%) of the respondents were in the medium income categories, followed by high income (22.7%) and very high income (18.9%), while only about 10.5% belongs to low-income categories. Karim (1996) found that annual income had a significant negative relationship with their influence level on mechanization.

2.5.6 Training Exposure

Hannan *et al.* (2020) conducted a study on "Socioeconomic condition and problem confrontation by the chicken farmers in the south western region in Bangladesh" and found that Training Exposure had a highly significant relationship with their problem confrontation.

2.5.7 Organizational Participation

Around 60% of Bangladeshi farmers actively participate in various organizations like agricultural cooperatives, farmers' associations, and self-help groups etc. (Barua, 2009). The country boasts more than 21,000 registered agricultural cooperative societies, benefiting approximately 8 million farmers through credit access, modern farming practices, and collective marketing (Salam *et al.*, 2005). Moreover, women farmers have formed self-help groups, comprising about 5 million members, primarily focusing on women's empowerment contributing significantly to rural development (Barua, 2009).

2.5.8 Extension Media Contact

Sultana *et al.* (2018) cited that most of the respondents (61.5%) had low extension media contact followed by 30.5% medium contact, and 8% high contact. Singh (2010) from their study, found that the majority (48.75%) of farmers had low extension contact followed by medium and high contact. Mannan and Miah (2007) cited from their study that most cultivars had low-level extension media contact engaged in fruit cultivation. Faroque, (1997) found a significant negative relationship with their problem confrontation in selected issues.

2.5.9 Cosmopolitanism

Cosmopolitanism is growing among Bangladesh's farmers due to factors like technology access. Over 18% of the population uses the internet, fostering global awareness. Climate change necessitates adaptation; agriculture contributes to 14.7% of the country's GDP. Education is vital; Bangladesh has a literacy rate of 73.9%, enabling cosmopolitan attitudes among the younger farming generation (Islam & Islam, 2020).

2.5.10 Farming Experience

Akter *et al.* (2019) conducted a study on "Present status and problem confrontation of Dyke vegetable production at freshwater *Ghers* of Bagerhat district in Bangladesh" and found that farming experience had a significant relationship with their problem confrontation.

2.5.11 Experience in Mechanized Cultivation

Bangladesh had witnessed a significant shift in agriculture, with nearly 80% of its agricultural land cultivated using two-wheel tractors (2WTs), while approximately 15% employed tractors. However, the farming experience remained complex due to challenges such as fragmented land holdings and the high cost of machinery (Baudron *et al.*, 2015).

2.6 Key Factors Influencing Agricultural Mechanization

Agricultural mechanization in Bangladesh is influenced by a complex interplay of factors. Small land holdings and fragmentation are significant challenges, discouraging extensive machinery investment due to limited space. Access to affordable credit and financial resources is vital for small-scale farmers to adopt mechanization. Education and training programs for farmers play a crucial role in promoting modern technologies (Rahman *et al.*, 2021). Infrastructure, including well-maintained roads, facilitates the movement of machinery and inputs. Government policies such as subsidies on machinery and input costs incentivize mechanization (Barua & Rahman, 2017). Crop diversity in Bangladesh, encompassing rice, jute, and various fruits, necessitates versatile machinery solutions, influenced by labor availability during peak agricultural seasons (Jalil, 2018). Balancing mechanization needs with sustainable farming is crucial to prevent environmental degradation and maintain soil health (Kirchmann & Thorvaldsson, 2000). However, Bangladesh is progressing in agricultural mechanization to boost productivity, reduce post-harvest losses, and enhance food security, emphasizing sustainability (Rahman *et al.*, 2021).

2.7 Conceptual Framework of the Study

In scientific research, the conceptual framework indicates selecting and measuring variables. This study was concerned with the factors influencing agricultural mechanization in south-western region of Bangladesh and the respondents of the study were from Dumuria Upazilla of Khulna District. Here, the factors associated with agricultural mechanization were the study's dependent variables. After consulting with the relevant experts and reviewing literature, eleven selected characteristics of the farmers were considered as the independent variables. To facilitate a structured and coherent discussion, the conceptual framework for this study has been devised as depicted in Figure 2.1.

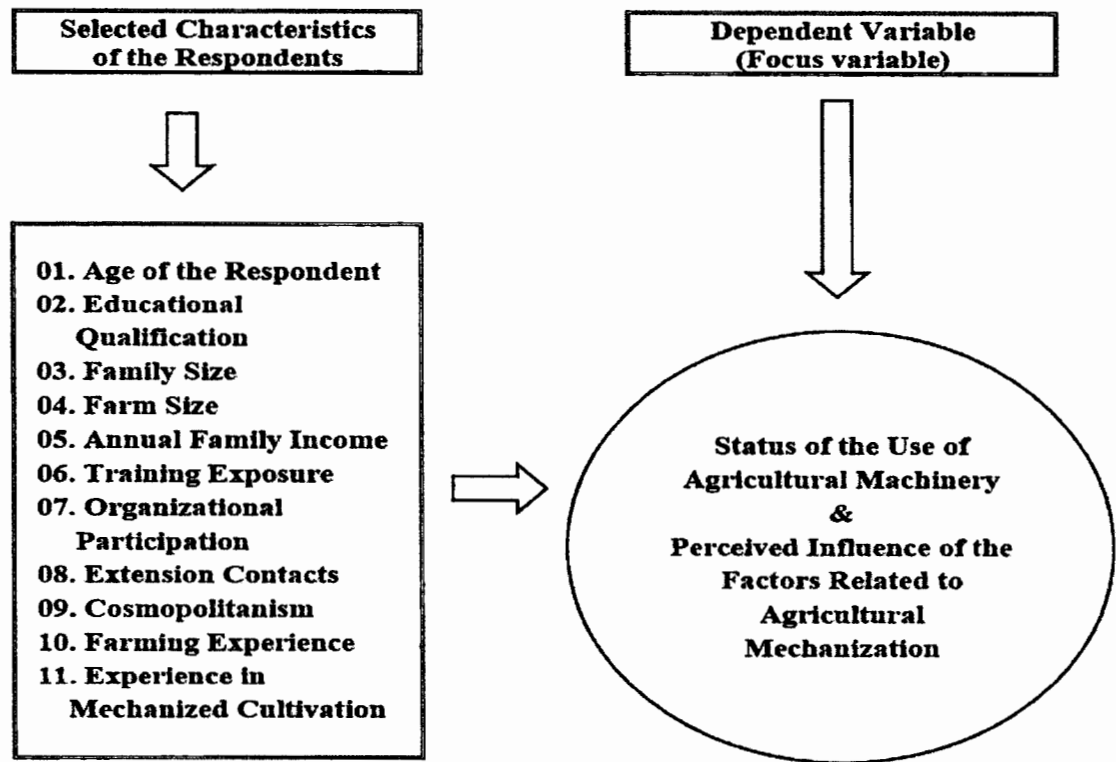


Figure 2.1: Conceptual model showing the relationship between the selected characteristics of the farmers (Independent Variables) and the status of the use of agricultural machinery & the factors influencing agricultural mechanization in south-western region of Bangladesh

CHAPTER III

METHODOLOGY

Methodology is essential for collecting accurate data, ensuring reliability, and forming credible conclusions in research (Kothari, 2004). It guides the systematic process of data collection and analysis, enhancing the overall research quality and supporting informed decision-making (Castleberry and Nolen, 2018).

The research was conducted to examine the factors influencing agricultural mechanization in the southwestern region of Bangladesh. Precise approaches were utilized in this research to discover, select, process, and evaluate information about the issue, driven by well-defined research objectives that guided the research endeavor, including data collection, analysis, and conclusion. In this chapter, a brief description of the materials and methods employed in the research is provided, outlining the procedures and approaches followed.

3.1 Design of the Study

The research objectives were met, and biases were minimized through the utilization of the Descript and Diagnostic design (Kothari, 2004). Data collection employed a census sampling approach, encompassing the entire population of interest to ensure comprehensive representation. Semi-structured interviews were conducted with respondents, facilitating an in-depth exploration of the study's subject matter and leading to a deeper understanding of participant perspectives and experiences. The combination of census sampling and semi-structured interviews bolstered the study's validity and reliability, yielding robust, widely applicable findings. The interview schedule, featuring both open-ended and predetermined questions, allowed for profound probing while maintaining consistency.

3.2 Locale of the Study

The research took place in Dumuria Upazila, located in the Khulna district (Figure 3.1) between 88° 49' and 88° 59' east longitude and 22° 59' and 23° 08' north latitude. We selected these study areas due to time and resource constraints, ensuring feasible data collection and analysis. These locations were considered representative of the broader context, offering valuable insights within our limitations.

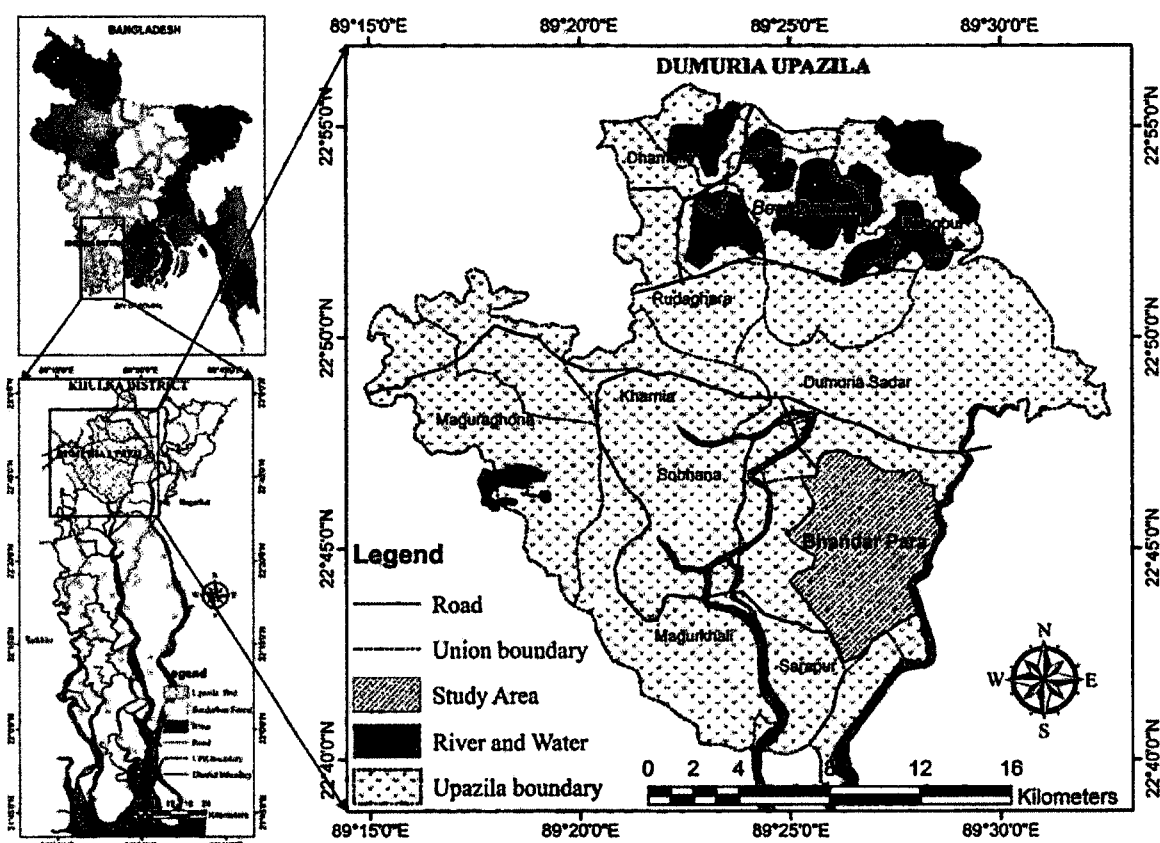


Figure 3.1: Map of Dumuria Upazila of Khulna District showing the study area
https://www.researchgate.net/figure/Location-of-the-study-area-Dumuria-Upazila-in-Khulna-district_fig1_342153734

3.3 Population and Sampling

The study centered on farmers engaged in mechanized cultivation. A sample of 80 farmers from Dumuria, Khulna, was selected through an accidental random sampling method, guaranteeing equal chances of inclusion. This approach increased the representativeness of the sample and the potential for findings to be generalized (Kothari, 2004).

3.4 Data Collection

3.4.1 Preparation of interview schedule:

A systematically designed interview schedule (considering specific objectives) was used to gather relevant data from respondents. It incorporated a combination of open and closed questions, direct queries, and measurement scales. The schedule underwent pretesting and revisions based on feedback from five farmers and is provided in Appendix A.

3.4.2 Method and time of data collection:

The researcher conducted personal interviews to ensure validity and accuracy. Multiple visits were made, including meetings with the Upazila Agriculture Officer (UAO) and Sub-Assistant Agriculture Officer (SAAO). Careful planning and clear explanations fostered respondent comfort, facilitating smooth data collection with excellent cooperation and coordination. All the data were collected during December, 2022.

3.5 Data Tabulation

Post-field survey interview schedules were used for data tabulation. The collected data underwent meticulous summarization and inspection. A master sheet was created to align individual variables with study objectives, aiding comprehensive analysis.

3.6 Data Processing

During data processing, qualitative data were quantified using suitable scoring techniques. Local measurements were converted to standard units. Indices and scales aided in efficient data reduction and analysis. Personal characteristics were categorized and presented in concise tables for interpretation. Statistical descriptors included number, frequency, percentage, range, mean, standard deviation and rank order. Pearson's Product Correlation Coefficient (r) was used to determine the relationship among the variables.

3.7 Measurement of Selected Characteristics of the Respondents

Eleven personal characteristics were selected as independent variables, and their measurement procedure is described below.

3.7.1 Age

The respondent's age was measured in terms of actual years from his/her birth to the time of interview based on their response. It was expressed in terms of whole years. Based on age, the respondents were classified into different categories, as shown in Table 3.1

Table 3.1 Categories of the respondents according to their age

Categories	Age Limits (Year)
Young Farmer	≤ 35
Middle-aged Farmer	36 - 50
Old Farmer	> 50

3.7.2 Level of education (Schooling year)

Respondents' education levels were quantified by counting years of schooling, assigning a score of one (01) per year, including those who could only sign, and categorized accordingly, as shown in Table 3.2.

Table 3.2 Categories of the respondents according to their level of education

Categories	Score (Year of Schooling)
Illiterate	0
Primary level	1 - 5
Secondary level	6 - 10
Higher secondary level	11 - 12
Above Higher Secondary Level	13 - 17

3.7.3 Family size

The family size of a respondent was measured by the total number of his/her family members, including the farmer, his/her spouse, children and other dependents who were eating and staying together. The respondents were classified into different categories based on family size, as shown in Table 3.3.

Table 3.3 Categories of the respondents according to family size

Categories	No. of Family Members
Small-sized family	≤ 4
Medium-sized family	5 - 6
Large-sized family	> 6

3.7.4 Farm size

Farm size was measured as the size of the respondents' farm on which farmers continued his/her farming operations during the study period. It included the area of homestead, land cultivation under his/her family cultivation, land given to others on lease etc. The area was measured in terms of a hectare (Ha). The farm size of a respondent was measured by using the following formula:

$$\text{Farm Size: FS} = A + B + 1/2 (C + D) + E + O$$

Where, A = Homestead

B = Land under own cultivation

C = Land under share crops in

D = Land under share crops out

E = Land under leased in

O = Others (including backyard pond etc.)

The actual size of the farm was considered as the score of the farm size. For example, if a respondent had 0.05 Ha of land, then his/her score was 0.05. The data were first recorded in a local unit and then converted to the hectare (Ha). The respondents were classified into five categories based on farm size, as shown in Table 3.4.

Table 3.4 Categories of the respondents according to their farm size

Categories	Score (ha)
Landless	< 0.02
Marginal farmers	0.02 - 0.20
Small farmers	0.21 - 1.00
Medium farmers	1.01 - 3.00
Large farmers	> 3.00

3.7.5 Annual family income

Annual family income is operationally defined as the total income of the respondents from farming and other sources, including the incomes of other family members for one year (2022). The response was obtained by asking the respondent the income he/she earned during the last year. A score of one (1) was arranged for '1000' BDT. The categories of income of the respondents are represented in Table 3.5.

Table 3.5 Categories of the respondents according to their annual family income

Categories	Income (1000= 1BDT)
Low income	≤ 150
Medium income	151 - 300
High income	> 300

3.7.6 Training exposure

Farmers' Training Exposure score was determined by the number of Training Exposure he/she received without considering the duration of training exposure. The respondents were classified into the following categories based on the Training Exposure score, as shown in Table 3.6.

Table 3.6 Categories of the respondents according to their training exposure

Categories	Score (No. of Training Exposure)
No Training Exposure	0
Low Training Exposure	1
Medium Training Exposure	2
High Training Exposure	≥ 3

3.7.7 Organizational participation

It refers to the respondent's active engagement and involvement within an organization, which includes any member or stakeholder's willingness and effort to contribute to the organization's objectives, activities, decision-making processes, and overall success. The degree of organizational participation of the respondent was assessed in consideration of his/her active involvement as either general member, executive member or executive officer without considering the duration of participation. The respondents were classified into the following categories based on their organizational participation score, as shown in Table 3.7.

Table 3.7 Categories of the respondents according to their organizational participation

Categories	Score (Organizational Participation)
No Participation	0
Low Participation	1 - 6
Medium Participation	7 - 12
High Participation	13 - 18

3.7.8 Extension media contact

It refers to the extent of exposure by the respondents to different extension methods during the last year. The respondents were asked to indicate their exposure as regularly, sometimes, seldom, and never—the scores assigned as 3, 2, 1 and 0, as shown in the scales, respectively. The maximum and minimum scores could be 30 and 0, respectively. The extension contact score was determined by adding all the scores obtained by a respondent against extension media. Based on the extension contact score, the respondents were classified into different categories, as shown in Table 3.8.

Table 3.8 Categories of the respondents according to their extension contact

Categories	Score
No extension contacts	0
Low extension contacts	1 - 10
Medium extension contacts	11 - 20
High extension contacts	21 - 30

**3.7.9 Cosmopolitanism**

Farmers can be identified by their cosmopolitanism among as well as outside their local communities. People that exhibit cosmopolitan characteristics frequently have a background of cross-cultural encounters and a passion for cutting-edge research. Having roots in many cultures, cosmopolitan farmers have a global viewpoint and a willingness to learn from and incorporate new ideas into their farming methods. The respondents were classified into the following categories based on their cosmopolitanism score, as shown in Table 3.9.

Table 3.9 Categories of the respondents based on their cosmopolitanism

Categories	Score
No Cosmopolitanism	0
Low Cosmopolitanism	1 - 6
Medium Cosmopolitanism	7 - 12
High Cosmopolitanism	13 - 18

3.7.10 Farming experience

The farming experience of a respondent was measured based on his/her involvement in farming. It has been expressed in terms of years. For example, if a respondent was involved in farming for one year, his/her experience of farming experience was one (01). Based on the farming experience scores, the respondents were grouped into the following categories, as shown in Table 3.10.

Table 3.10 Categories of the respondents based on farming experience

Categories	Score (Year of experience)
Low experience	1 - 15
Medium experience	16 - 30
High experience	≥ 30

3.7.11 Experience in mechanized cultivation

Experience in mechanized cultivation of a respondent was measured based on his/her involvement in mechanized farming. It was also expressed in terms of years. For example, if a respondent was involved in mechanized cultivation for one year, his/her experience score was one (01). Based on experience in mechanized cultivation scores, the respondents were grouped into the following categories, as shown in Table 3.11.

Table 3.11 Categories of the respondents based on experience in farm mechanization

Categories	Score (Year of experience)
Low experience	1 - 10
Medium experience	11 - 20
High experience	> 20

3.8 Determining the Status of the Extent of Use of Agricultural Machinery in Different Farm Stages

The status of the extent of use of agricultural machinery in different farm stages was determined in terms of machineries used by the farmers in different farm stages. The respondents were directly asked to mention the extent of machinery uses in different stages of their farm operation.

The machinery use intensity was determined by calculating the Machinery Use Index (MUI) which was determined by using the following formula.

$$\text{MUI (\%)} = \frac{\text{Observed MUI Score}}{\text{Highest Possible MUI Score}} \times 100$$

Besides, the Machinery Use Index MUI Score was calculated by using the following formula:

$$\text{MUIS} = (\text{N}_{\text{RE}} \times 3) + (\text{N}_{\text{SO}} \times 2) + (\text{N}_{\text{SE}} \times 1) + (\text{N}_{\text{NE}} \times 0)$$

Where, MUIS = Machinery Use Index Score

N_{RE} = No. of the respondent used machinery regularly

N_{SO} = No. of the respondent sometimes used machinery

N_{SE} = No. of the respondent seldom used machinery

N_{NE} = No. of the respondent not at all used machinery
The respondents were grouped into the following categories based on their Machinery Use Index (MUI) Score, as shown in Table 3.12.

Table 3.12 Categories of the respondents according to their Machinery Use Index (MUI) Score

Categories	Score
Low Use	1 - 8
Medium Use	9 - 16
High Use	17 - 24

3.9 Identification of the Factors Influencing Agricultural Mechanization (AM) in South-Western Region of Bangladesh:

In the study, twelve (12) factors that were considered to have probable influence on agricultural mechanization (AM) were: proximity of the farm location, cattle ownership and number, access to electricity, access to irrigation, scarcity and high wage of labor, access to credit, government subsidy for mechanization, availability of machineries on hire basis, farming/cropping system, land topography, crop lodging in field and access to mass media. The factors influencing agricultural mechanization (AM) most, were identified based on Agricultural Machinery Influence Index (AMII). Each of the respondents was asked to indicate the factors which influenced him/her to adopt agricultural mechanization (AM). A four points Likert scale such as highly influenced (3), moderately influenced (2), less influenced (1), and not at all (0) was employed against each of the factors influencing AM. The Agricultural Machinery Influence (AMI) score was determined by adding all the scores obtained by a respondent against 12-scheduled factors. For any of the respondents, the Agricultural Machinery Influence (AMI) score could range from a score of 1 to 36 where 1 indicated less influence and 36 indicated highest influence. Besides, an Agricultural Machinery Influence Index (AMII) was calculated to find out the most influential factors using the following formula:

$$\% \text{ AMII} = \frac{\text{Obtained AMII Score}}{\text{Highest Possible AMII Score}} \times 100$$

Where, AMII = Agricultural Machinery Influence Index

The AMII score was determined using the following formula:

$$\text{Obtained AMII Score} = N_{hi} \times 3 + N_{mi} \times 2 + N_{li} \times 1 + N_{ni} \times 0$$

Where, N_{hi} = Number of the respondents influenced highly

N_{mi} = Number of the respondents influenced moderately

N_{li} = Number of the respondents less influenced

N_{ni} = Number of respondents not at all influenced

The respondents were grouped into the following categories based on their Agricultural Machinery Influence (AMI) score, as shown in Table 3.13.

Table 3.13 Categories of the respondents according to their Agricultural Machinery Influence (AMI) score

Categories	Score
Less Influenced	1 - 12
Moderately Influenced	13 - 24
Highly Influenced	25 - 36

3.10 Compilation of Data

Following the field survey, interview schedule data was compiled, converting local units to standard units, applying coding and scoring techniques to quantify qualitative data, and transferring responses to a master sheet for computer entry. Subsequently, the data were analyzed in alignment with the study's objectives.

3.11 Statistical Analysis

Data analysis was aligned with the study's objectives, employing statistical measures (e.g., number, range, mean, standard deviation, minimum, maximum, rank order, percentage). Tables were utilized for data presentation. Pearson's Product Moment correlation coefficient was computed to investigate relationships between respondents' characteristics and the factors influencing agricultural mechanization. Statistical Package for Social Science (SPSS 22) software was utilized for data analysis.

CHAPTER IV

RESULTS AND DISCUSSION

The data were collected from the respondents (farmers) and carefully accomplished, coded, computed, tabulated, and analyzed in alignment with the study's objectives. Subsequently, this chapter has been written with great care. Consequently, the study's findings and reasoned interpretations of the results have been presented and discussed within this chapter.

4.1 Status of the Extent of Use of Agricultural Machinery in Different Farm Stages

The present status of agricultural mechanization was determined in terms of machineries used by the farmers in different farm stages.

4.1.1 Uses of machinery by the farmers in different stages of farm operations

In the study area, farmers used a wide array of agricultural machinery, from small to heavy equipment, across different cultivation stages, including post-harvest activities. In accordance with the statement of the farmers (Table 4.1), mechanization was most prevalent in tillage (100%), followed by pesticide application (96.3%) and irrigation (93.8%). However, lower rate of mechanization was observed in case of crop harvesting (28.7%) and seed sowing (27.5%). Fertilizer application (55%), post-harvest management (45.0%), and intercultural operations (38.8%) exhibited varied adoption levels.

Considering the Machinery Use Index (MUI), the study revealed consistent results. Remarkably, the tillage stage secured the top position, translating to a commanding 91.7% rating. The pesticide application stage secured the 2nd position with a rating of 73.3%, while the irrigation stage closely followed in the 3rd position with a rating of 72.1%. The lower positions were held by crop harvesting (12.9%) and seed sowing (11.7%), which ranked 7th and 8th, respectively.

The position of crop harvesting was 7th based on both citation and MUIS respectively. This might be due to that the price of machinery for harvesting like combine harvester was very high. Again, the mechanization was lowest in case of seed sowing/planting/ transplanting based on both citation and MUIS respectively. This might be due to that the machinery for these operations was not easily available to the farmers.

Targeted interventions are needed to boost mechanization in specific stages, potentially improving agricultural efficiency and addressing challenges in harvesting and sowing phases.

Table 4.1. Relative position of the use of machinery in different farm stages

Sl. No.	Cropping Stages	Total Users		Rank	MUI		Rank
		Citation	%		MUIS	%	
01	Tillage	80	100	1 st	220	91.7	1 st
02	Seed Sowing/ Planting/ Transplanting	22	27.5	8 th	28	11.7	8 th
03	Irrigation/ Watering	75	93.8	3 rd	173	72.1	3 rd
04	Fertilizer Application	44	55.0	4 th	75	31.2	5 th
05	Pesticide Application	77	96.3	2 nd	177	73.7	2 nd
06	Other Intercultural Operations	31	38.8	6 th	43	17.9	6 th
07	Crop Harvesting	23	28.7	7 th	31	12.9	7 th
08	At Post-harvest Period	36	45.0	5 th	82	34.2	4 th

MUI (Machinery Use Index); MUIS (Machinery Use Index Score)

4.1.2 Distribution of farmers according to their extent of use of agricultural machinery

In Table 4.2, farm machinery usage scores of the respondents were categorized as ranging from 4 to 18, with a mean of 10.36 and a standard deviation of 3.633. The data revealed that almost three-fifth of respondents (58.8%) reported medium machinery usage, while 28.7% indicated high usage and 12.5% reported low usage. This distribution suggests that a significant majority (87.5%) of respondents fall within the medium to high farm machinery usage category. This was a good sign for farm mechanization compared with others' farming.

Table 4.2 Distribution of the respondents according to their machinery usage score

Categories	Score	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
Low	1-8	10	12.5	4	18	10.36 ± 3.633
Medium	9-16	47	58.8			
High	17-24	23	28.7			
Total		80	100	Range (possible): (1-24)		

4.2 Factors Influencing Agricultural Mechanization in South-Western Region of Bangladesh

4.2.1 Factors influencing agricultural mechanization as perceived by the farmers

In the context of the study, the influence of various factors on agricultural mechanization was thoroughly examined. A comprehensive overview of the hierarchical significance assigned to these factors by the respondents has been provided in Table 4.3.

According to the respondents, scarcity and high wage of labor was found the most dominant factor influencing agricultural mechanization. This paramount concern, unanimously acknowledged by

all of the respondents (100%), firmly secured the first position in the ranking of influential factors. Following closely behind, access to farm power was found, with a substantial recognition rate of 97.5%. The third position was occupied by proximity of the farm location, with its importance being attributed to 96.3%. Subsequently, the fourth and fifth positions were occupied by cattle ownership and its number (92.2%) and access to irrigation (91.3%), respectively.

In contrast, the ranking also reveals factors that were comparatively less recognized among respondents. government subsidy stands as a less influential factor, as it was deemed significant by only 66.3% of respondents. Similarly, land topography and crop lodging in field find themselves sharing the lower rungs of influence, with both factors receiving a recognition rate of 68.8%.

According to the Agricultural Machinery Influence Index (AMII) as the metric, a hierarchical structure of factors influencing agricultural mechanization can also be discerned. While some factors command unanimous acclaim, others occupy a more nuanced and less acknowledged role in this crucial domain. This nuanced evaluation unveils the complex web of factors impacting agricultural mechanization, providing valuable insights for policymakers and stakeholders aiming to optimize farming practices based on the perspectives of respondents.

Topping this hierarchy was the concern of scarcity and high wage of labor, registering at 85.8%. Remarkably, access to farm power claimed the second position with a very close rating of 85.4%, underscoring its significance. In pursuit, it was found that cattle ownership and number was at 64.2%, securing the third spot, followed by proximity of the farm location at 62.9% and access to irrigation at 60.4%, occupying the fourth and fifth positions, respectively.

In contrast, crop lodging in the field (31.3%) and land topography (32.9%) emerged as comparatively less influential factors. Diving further into the ranking, access to credit claimed the sixth position at 57.5%, trailed by availability of machinery on hire basis at 50.4%. Farming and Cropping System followed at 45.8%, with access to mass media at 43.7% and government subsidy at 41.6%, completing the list at the 7th, 8th, 9th and 10th positions, respectively.

Table 4.3 Relative position of the factors influencing agricultural mechanization

Sl. No.	Statement of Factor	Respondent		Rank	AMII		Rank
		Citation	%		AMIIS	%	
01	Proximity of the Farm Location	77	96.3	3 rd	151	62.9	4 th
02	Cattle Ownership and Its Number	74	92.5	4 th	154	64.2	3 rd
03	Access to Farm Power	78	97.5	2 nd	205	85.4	2 nd
04	Access to Irrigation	73	91.3	5 th	145	60.4	5 th
05	Scarcity and High Wage of Labor	80	100	1 st	206	85.8	1 st
06	Access to Credit	64	86.3	8 th	138	57.5	6 th
07	Government Subsidy	53	66.3	11 th	100	41.6	10 th
08	Availability of Machineries on Hire Basis	71	88.8	7 th	121	50.4	7 th
09	Farming and Cropping System	72	90.0	6 th	110	45.8	8 th
10	Land Topography	55	68.8	10 th	79	32.9	11 th
11	Crop Lodging in Field	55	68.8	10 th	75	31.3	12 th
12	Access to Mass Media	62	77.5	9 th	105	43.7	9 th

AMII = Agricultural Machinery Influence Index; AMIIS = Agricultural Machinery Influence Index Score

The analysis based on the Agricultural Machinery Influence Index (AMII) revealed key insights into the factors impacting agricultural mechanization. Notably, the scarcity of labor and high wages took the top spot, with access to farm power closely following. Cattle ownership and its number, farm location, and access to irrigation also emerged as significant influencers. Conversely, factors such as crop lodging and land topography appeared less critical in this context. Access to credit and the availability of machinery on a hire basis highlighted the importance of financial support. Additionally, systemic factors like farming practices, access to mass media, and government subsidies also played integral roles.

4.2.2 Distribution of the farmers according to their level of influence by the factors related to agricultural mechanization

The distribution of respondents concerning the factors influencing mechanization have been presented in Table 4.4. The influence levels among respondents spanned from 11 to 35, with a mean score of 19.86 and a standard deviation of 4.478.

The data in Table 4.15 reveal that a substantial majority, comprising 77.5% of the respondents, fell into the moderately influenced category. Conversely, one-fifth of the respondents (20.0%) exhibited a high level of influence, while a smaller proportion (2.5%) reported a lower level of influence of the factors related to agricultural mechanization.

Table 4.4 Distribution of respondents influenced by the factors related to agricultural mechanization

Categories	Score	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
Less Influenced	1-12	2	2.5	11	35	19.86 ± 4.474
Moderately Influenced	13-24	62	77.5			
Highly Influenced	25-36	16	20.0			
Total		80	100	Range (possible): (1-36)		

4.3 Selected Characteristics of the Respondents

This section covers the details concerning the eleven selected characteristics of the farmers.

4.3.1 Age

Table 4.5 outlines the age distribution of the respondents, spanning from 18 to 75 years, with an average age of 45.87 years and a standard deviation of 13.00. Of the 80 respondents, the highest proportion of the respondents (41.3%) were middle-aged, while 26.2% were young-aged, and 32.5% were old-aged. The prevalence of middle-aged respondents hint at their pivotal role in shaping farming practices and contributing to agriculture. The increasing participation of the younger generation signifies a demographic shift, while the presence of experienced elders underscores their invaluable wisdom within the farming community.

Table 4.5 Distribution of the respondents according to their age

Categories	Score (Year)	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
Young	≤ 35	21	26.2	18	75	45.87 ± 13.00
Middle	36 - 50	33	41.3			
Old	> 50	26	32.5			
Total		80	100	Range (possible): 0-Unknown		

4.3.2 Level of education

Table 4.6 illustrates the educational distribution among farmers. Educational scores ranged from 0 to 17, with an average score of 6.00 and a standard deviation of 5.229. The maximum of the respondents (47.5%) held primary education, followed by secondary (28.7%), higher secondary (10.0%), above higher secondary (8.8%), and illiterate (5.0%) categories. Notably, most (95%) of respondents possessed some level of education, with only one twentieth (5%) being illiterate. These findings are consistent with the research conducted by Mannan and Miah (2007), which reported a similar prevalence of respondents with secondary education.

Table 4.6 Distribution of the respondents according to their level of education

Categories	Score (Year)	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
Illiterate	0	4	5.0	0	17	6.00 ± 5.229
Primary	1-5	38	47.5			
Secondary	6-10	23	28.7			
Higher Secondary	11-12	8	10.0			
Above Higher secondary	13-17	7	8.8			
Total		80	100	Range (possible): (0-17)		

4.3.3 Family size

Table 4.7 presents the distribution of respondents in accordance with their family sizes. Utilizing family size scores, respondents' households were categorized into three groups: small, medium, and large. Family sizes ranged from 2 to 10, with an average of 4.70 and a standard deviation of 1.382. Notably, the average family size (4.7) among respondents exceeds the national average of 4.50 (BBS, 2016). It means that the farmers of the study area were less aware about population growth and planned family.

The data in Table 4.7 reveals that the maximum proportion (46.2%) of respondents belonged to small families, while 45.0% and 8.8% fell into the categories of medium-sized and large-sized families, respectively. These findings align with those of Manabika et al. (2019), who reported that majority (55.0%) of respondents had small-sized families. However, it was noteworthy that a significant majority (91.2%) of respondents had small to medium-sized families, with only 8.8% having large families.

Table 4.7 Distribution of the respondents according to their family size

Categories	Score (Number)	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
Small	≤ 4	37	46.2	2	10	4.70 ± 1.382
Medium	5-6	36	45.0			
Large	> 6	7	8.8			
Total		80	100	Range (possible): 0-Unknown		

4.3.4 Farm size

Table 4.8 provides an insightful view of the distribution of respondents based on their farm sizes. The observed farm size scores among the respondents displayed a range from 0.02 hectares to

5.32 hectares, with an average farm size of 0.988 hectares and a standard deviation of 0.991. This data underscores the wide variation in farm sizes within the study group.

A notable finding was that a substantial majority (52.5%) of the farmers were categorized as possessing small farms. This indicates that over half of the respondents were operating on limited agricultural land. In contrast, about one-third (30%) of farmers were classified as having medium-sized farms, which suggested a significant segment of respondents operating on moderately sized land. Furthermore, one-tenth (10%) of the respondents were considered as marginal farmers, while a few (6.3%) had large farms and a very poor (1.3%) were landless. These distinctions in farm sizes provide valuable insights into the diversity of agricultural practices within the study area.

It was particularly noteworthy that the average farm size in the study area, at 0.988 hectares, surpassed the national average of 0.048 hectares (BBS, 2016). This divergence highlights the regional variation in landholding patterns and underscores the importance of considering local contexts when formulating agricultural policies and strategies.

Table 4.8 Distribution of the respondents according to their farm size

Categories	Score (Ha)	Number = 80		Range		Mean±SD ($\bar{X} \pm \delta$)
		Number	(%)	Min.	Max.	
Landless	< 0.02	1	1.3	0.02	5.32	0.988 ± 0.991
Marginal	0.02-0.2	8	10.0			
Small	0.21-1.0	42	52.5			
Medium	1.01-3	24	30.0			
Large	> 3	5	6.3			
Total		80	100	Range (possible): 0-Unknown		

4.3.5 Annual income

The data in Table 4.9 offers insights into the distribution of respondents based on their annual family income. The income range, from 80 to 800 (with 1000 BDT = 1), showed considerable variability, reflecting diverse economic backgrounds within the surveyed population. The average annual income was 239.16, with a standard deviation of 130.547. Notably, a substantial proportion (45.0%) of respondents fell into the medium-income category, indicating a sizable middle-income group. Meanwhile, 28.7% and 26.3% of respondents were categorized as having low and high income, respectively.

The average per capita income (2,160 USD) in the study area was lower than the national per capita income of 2,688 USD (BBS, 2022). It highlights the economic disparities and challenges of the respondents as well as the need for targeted economic interventions and policies to uplift the living standards of the agricultural community, especially those with lower incomes.

Table 4.9 Distribution of the respondents according to their annual income

Categories	Score (01= 1000 BDT)	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
Low	<150	23	28.7	80	800	239.86 ± 130.547
Medium	150-300	36	45.0			
High	>300	21	26.3			
Total		80	100	Range (possible): 0-Unknown		

4.1.6 Training exposure

Table 4.10 displays the distribution of respondents based on their training exposure scores, ranging from 0 to 3, with a mean of 0.86 and a standard deviation of 0.791. More than half of the respondents (51.2%) had low training exposure, while one-tenth (10.0%) had medium exposure and very few (5.0%) had high exposure. Notably, one-third (33.8%) of them had no training exposure, suggesting room for potential capacity-building initiatives.

Table 4.10 Distribution of the respondents according to their training exposure

Categories	Score (Number)	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
No	0	27	33.8	0	3	0.86 ± 0.791
Low	1	41	51.2			
Medium	2	8	10.0			
High	≥ 3	4	5.0			
Total		80	100	Range (possible): 0-Unknown		

4.3.7 Organizational participation

Table 4.11 illustrates the distribution of the respondents according to their organizational participation scores, ranging from 0 to 4. The mean score was 1.44, with a standard deviation of 1.029. Strikingly, vast majority (78.8%) of respondents exhibited low organizational participation, with no organizational participation by 21.3%, indicating potential gaps in engagement with organizations. Equally noteworthy was that none of the respondents fell within the medium-to-high organizational participation range, emphasizing room for enhancing organizational involvement among the surveyed farmers. This suggests a need for strategies to promote greater engagement and collaboration between farmers and relevant institutions.

Table 4.11 Distribution of the respondents according to their organizational participation

Categories	Score	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
No	0	17	21.3	0	4	1.44 ± 1.029
Low	1-6	63	78.8			
Medium	7-12	0	0.0			
High	13-18	0	0.0			
Total		80	100	Range (possible): (0-18)		

4.3.8 Extension contact

Table 4.12 reveals the distribution of respondents based on their extension contact scores, ranging from 1 to 21, with an average of 6.45 and a standard deviation of 3.917. Strikingly, a substantial majority (86.2%) of respondents exhibited low extension contact, potentially indicating a gap in accessing valuable agricultural extension services. Notably, 11.3% had medium and 2.5% had high extension contact, indicating room for improvement in connecting farmers with extension resources. Nevertheless, the fact that all respondents had some level of extension contact highlights the pervasive nature of these services within the surveyed population, suggesting potential for targeted enhancements.

Table 4.12 Distribution of the respondents according to their extension contact

Categories	Score	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
No	0	0	0.0	1	21	6.45 ± 3.917
Low	1-10	69	86.2			
Medium	11-20	9	11.3			
High	21-30	2	2.5			
Total		80	100	Range (possible): (0-30)		

4.3.9 Cosmopolitanism

Table 4.13 shows the respondent distribution by cosmopolitanism scores, ranging from 2 to 13, with an average of 7.60 and a standard deviation of 2.661. The maximum proportion (68.8%) of the respondents displayed medium cosmopolitanism, indicating moderate exposure to external influences. 30.0% displayed medium cosmopolitanism, and 1.2% exhibited high cosmopolitanism, reflecting a baseline awareness of global factors influencing their agriculture.

Table 4.13 Distribution of the respondents according to their cosmopolitanism

Categories	Score	Number = 80		Range		Mean±SD ($\bar{X} \pm \delta$)
		Number	(%)	Min.	Max.	
No	0	0	0.0	2	13	7.60 ± 2.661
Low	1-6	24	30.0			
Medium	7-12	55	68.8			
High	13-18	1	1.2			
Total		80	100	Range (possible): (0-18)		

4.3.10 Farming experience

Table 4.14 provides a comprehensive overview of the farming experience of the respondents, ranging from 2 to 55 years, with an average of 22.79 and a standard deviation of 12.86. Notably, the highest proportion (42.5%) of the farmers fell into the medium experience category, indicating a balanced mix of experienced and less experienced farmers within the sample. Meanwhile, 31.3% and 26.2% of respondents were classified as having low and high experience, respectively.

This distribution aligns with expectations, as farming experience often corresponds with age, as noted. The presence of both highly experienced and less experienced individuals suggests a dynamic mix of traditional wisdom and potential for innovative practices, which could contribute to a diverse and resilient agricultural landscape.

Table 4.14 Distribution of the respondents according to their farming experience

Categories	Score (Year)	Number = 80		Range		Mean±SD ($\bar{X} \pm \delta$)
		Number	(%)	Min.	Max.	
Low	1-15	25	31.3	2	55	22.79 ± 12.860
Medium	16-30	34	42.5			
High	>30	21	26.2			
Total		80	100	Range (possible): 1-Unknown		

4.3.11 Experience in mechanized cultivation

In Table 4.15, experience in mechanized cultivation of the respondents ranged from 2 to 27 years, with an average of 12.10 and a standard deviation of 2.618. Notably, about half of the respondents (47.5%) exhibited low experience, indicating limited exposure to mechanization. Conversely, 41.3% had medium experience, and 11.3% had high experience. The predominance of low mechanization experience underscores the scope for promoting modern agricultural technologies among the surveyed farmers, potentially enhancing efficiency and productivity in the agricultural sector.

Table 4.15 Distribution of the respondents according to their experience in mechanized cultivation

Categories	Score (Year)	Number = 80		Range		Mean±SD ($\bar{X}\pm\delta$)
		Number	(%)	Min.	Max.	
Low	1-10	38	47.5	2	27	12.10 ± 2.618
Medium	11-20	33	41.3			
High	>20	9	11.3			
Total		80	100	Range (possible): 1-Unknown		

Long-standing farming practices might breed resistance to change, even among those experienced in mechanized cultivation. This reluctance with age might hinder the adoption of new, potentially productivity-boosting agricultural technologies. and the influence level of the farmers in mechanized agriculture

4.4 Relationship between the Farmer's Selected Characteristics and the Extent of Use of Agricultural Machinery & Their Perceived Influence Level on Factors Related to Agricultural Mechanization

4.4.1 Relationship between the farmer's selected characteristics and their extent of use of agricultural machinery

The investigation into the relationship between the selected characteristics of the respondents and their extent of the use of agricultural machinery involved the computation of the coefficient of correlation. Within this section, descriptions have been provided concerning the relationships between the eleven selected characteristics of the respondents (considered independent variables) and the extent of the use of agricultural machinery (treated as the dependent variable). Pearson's Product Moment Coefficient of Correlation (r) was employed, with significance levels set at both five percent and one percent. The outcomes of the coefficient of correlation are comprehensively presented in Table 4.16.

Education, extension media contact and cosmopolitanism showed positive significant relationship with the extent of the use of agricultural machinery. It means the higher are the education, extension media contact and cosmopolitanism, the higher is the extent of the use of agricultural machinery by farmers. On the other hand, experience in mechanized cultivation had a negative significant relationship with the extent of the use of agricultural machinery. It means the higher is the experience in mechanized cultivation, the lower is the extent of the use of agricultural machinery. The positive significant relationship between education, media exposure, cosmopolitanism, and agricultural machinery usage might stem from increased knowledge and exposure to modern techniques. Conversely, negative relationship of the farmers, experienced in

mechanized cultivation, with machinery usage might arise from their reliance on established, non-mechanized methods. These individuals might possess deeply ingrained practices, perceiving machinery as less effective or costly due to prior challenges. Their expertise might bias them toward manual techniques, despite the potential benefits machinery offers. This dynamic reflected a tug-of-war between modern knowledge dissemination and entrenched, traditional farming methods, illuminating the multifaceted influences shaping farmers' choices in adopting agricultural machinery.

Table 4.16 Relationship between the farmer's selected characteristics and their extent of the use of agricultural machinery

The extent of the Use of Agricultural Machinery	Farmer's Selected Characteristics	Correlation Coefficient	Significance Level
	Age	0.009	NS
	Education	0.361	**
	Family Size	-0.089	NS
	Farm Size	0.074	NS
	Annual Family Income	0.177	NS
	Training Exposure	0.172	NS
	Organizational Participation	0.143	NS
	Extension Media contacts	0.435	**
	Cosmopolitanism	0.297	**
	Farming Experience	-0.165	NS
	Experience in Mechanized Cultivation	-0.230	*

*NS= Non-significant, **Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed), PPCC = Pearson's Product Moment co-efficient of correlation.*

4.4.2 Relationship between the farmer's selected characteristics and their perceived influence level on factors related to agricultural mechanization

The investigation into the relationship between the selected characteristics of the respondents and the factors influencing agricultural mechanization involved the computation of the coefficient of correlation. Within this section, descriptions have been provided concerning the relationships between the eleven selected characteristics of the respondents (considered independent variables) and the factors influencing agricultural mechanization (treated as the dependent variable). Pearson's Product Moment Coefficient of Correlation (r) was employed, with significance levels set at both five percent and one percent. The outcomes of the coefficient of correlation are comprehensively presented in Table 4.17.

Age, however, negatively correlates (5%) with mechanization influence, indicating older farmers are less influenced. Besides, education (5%), organizational participation, and extension media contacts (1%) positively relate to higher mechanization influence. Conversely, farming and mechanized cultivation experience (5%) show negative significance.

Table 4.17 Relationship between the farmer's selected characteristics and the influence level of the farmers in mechanized agriculture

Factors Influencing Agricultural Mechanization	Farmer's Selected Characteristics	Correlation Coefficient	Significance Level
	Age	-0.277	*
	Education	0.244	*
	Family Size	-0.065	NS
	Farm Size	0.144	NS
	Annual Family Income	0.065	NS
	Training Exposure	0.217	NS
	Organizational Participation	0.415	**
	Extension Media contacts	0.380	**
	Cosmopolitanism	0.008	NS
	Farming Experience	-0.247	*
	Experience in Mechanized Cultivation	-0.301	**

*NS= Non-significant, **Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed), PPCC = Pearson's Product Moment co-efficient of correlation.*

Thus, increased education, active involvement in organizations, and greater engagement with extension media contacts contributed positively to the influence level of mechanization. On the other hand, age had a reverse effect on influence. Experience in farming and mechanized cultivation both displayed negative significance under the influence of factors. Age, experience in farming and experience in mechanized cultivation showed negative significant relationship with the perceived influence. It means that the higher are the age, experience in farming and experience in mechanized cultivation, the lower is the influence of the farmers. Education, organizational participation and extension media contact showed a positive significant relationship with perceived influence of the farmers. It means that the higher are the education, organizational participation and extension media contact, the higher is the influence level of the farmers to mechanized agriculture.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The study was conducted with a view to determine the present status and the factors influencing agricultural mechanization in south-western region of Bangladesh. For the study, data were collected from 80 respondents of Dumuria Upazila of Khulna using an interview schedule through face-to-face interview. The findings of the study are summarized below.

5.1.1 Status of the Extent of Use of Agricultural Machinery by Farmers

The study in the given area highlighted diverse agricultural machinery usage. The highest mechanization was observed during tillage (91.7%), followed closely by pesticide application (73.3%) and irrigation (72.1%). Conversely, crop harvesting (28.7%) and seed sowing (27.5%) showed lower mechanization rates. Employing the Machinery Use Index (MUI), tillage scored the highest at 220, while crop harvesting and seed sowing had the lowest ratings at 12.9% and 11.7%, respectively. These findings underscore significant variations in mechanization adoption across different farming stages, with a pronounced focus on mechanization during soil preparation and pesticide application. However, most respondents (58.8%) reported medium machinery usage, with 28.7% indicating high usage and 12.5% reporting low usage.

5.1.2 Factors Influencing Agricultural Mechanization as Perceived by the Farmers

Notably, the top-ranking concern, unanimously acknowledged by all respondents (100%), was the scarcity and high wage of labor. Access to farm power closely followed by a recognition rate of 97.5%, emphasizing its significance. Proximity of the farm location secured the third position, acknowledged by 96.3% of respondents. Cattle ownership and number (92.2%) and access to irrigation (91.3%) occupied the fourth and fifth positions, respectively. Conversely, some factors garnered less recognition, such as government subsidy (66.3%), land topography (68.8%), and crop lodging in the field (68.8%). These findings reveal the intricate web of influences on agricultural mechanization. Utilizing the Agricultural Machinery Influence Index (AMII), scarcity and high labor costs topped the hierarchy at 85.8%, closely followed by access to electricity at 85.4%. Cattle ownership (64.2%), proximity to the farm location (62.9%), and access to irrigation (60.4%) held the subsequent positions. Factors like crop lodging, land topography, access to credit, machinery availability on hire, farming and cropping systems, access to mass media, and government subsidies exhibited varying levels of influence, contributing to a nuanced understanding of agricultural mechanization dynamics. However, 77.5% of respondents had moderate influence, 20.0% had high influence, and 2.5% had low influence in agricultural mechanization.

5.1.3 Selected Characteristics of the Farmers

In a study involving 80 respondents from Dumuria Upazila in Khulna, several key findings emerged. Demographically, the majority fell into the middle-aged category (41.3%), with significant representation from both young-aged (26.2%) and old-aged (32.5%) groups. Educational attainment was notably high, with only 5% of respondents being illiterate. Family sizes varied, with 46.2% belonging to small families, 45.0% to medium-sized ones, and 8.8% to large-sized families. The average family size was slightly above the national average at 4.70. Farming was a common occupation, and over half (52.5%) of the respondents operated on small farms, reflecting limited agricultural land access.

Income distribution showed a substantial middle-income group (45.0%), while 28.7% had low income and 26.3% had high income. However, the study also revealed that more than half of the respondents (51.2%) had low training exposure, and 78.8% exhibited low organizational participation, indicating potential gaps in engagement. Furthermore, there was limited access to agricultural extension services, as 86.2% had low extension contact. Cosmopolitanism levels were primarily moderate (68.8%), indicating moderate exposure to external influences. Regarding experience with mechanization, 47.5% had low experience, while 41.3% had medium experience, highlighting variations in exposure to mechanized farming practices within the sample. These findings offer valuable insights into the demographics, family dynamics, income levels, and agricultural experiences of the respondents in Dumuria Upazila.

5.1.4 Relationship between the Farmer's Selected Characteristics and Their Extent of the Use of Agricultural Machinery & Their Perceived Influence on Factors Related to Agricultural Mechanization

The use of agricultural machinery positively links with education, media exposure, and openness to new ideas, but inversely with experience in mechanized farming. Education, media contact, and cosmopolitanism encourage machinery adoption, while experienced farmers tend to stick to traditional methods due to perceived inefficiencies or costliness of machinery despite its potential benefits. This highlights a clash between modern knowledge and entrenched practices, influencing farmers' decisions regarding machinery adoption.

The study explores relationships between respondents' characteristics and agricultural mechanization influences. Older age negatively correlates (5%) with mechanization influence, while education (5%), organizational participation, and extension media contacts (1%) have positive associations. Experience in farming and mechanized cultivation (5%) negatively affects influence. Education, active participation in organizations, and engagement with extension media positively contribute to mechanization influence.

5.2 Conclusion

In the study involving 80 respondents in Dumuria Upazila, Khulna, the research uncovered a multifaceted landscape. Demographically, a middle-aged population with substantial educational achievements prevailed. Disparities emerged in family sizes, income, training exposure, organizational engagement, and access to agricultural extension services. Notably, the mechanization spectrum revealed a focus on tillage, pesticide application, and irrigation. Furthermore, respondents unanimously regarded labor scarcity and high wages as their foremost concerns, highlighting the pivotal role of labor dynamics. Access to farm power and farm location proximity were also deemed influential factors. While cattle ownership, irrigation access, and other elements held varying degrees of sway, government subsidies, land topography, and crop lodging received lesser recognition. The study illuminated the intricate interplay of factors influencing agricultural mechanization. It underscored the importance of tailored approaches to foster modern farming techniques, particularly in soil preparation and pesticide application. The majority of respondents reported a moderate level of influence on agricultural mechanization, unveiling the nuanced complexity of these practices. Modern knowledge encourages machinery use, as seen among educated, cosmopolite farmers. Conversely, experienced farmers favor traditional methods due to perceived machinery drawbacks, showcasing a clash between innovation and entrenched practices in agriculture. This study's findings not only offer insights into Dumuria Upazila's farming dynamics but also inform strategies to optimize agricultural practices and mechanization, emphasizing the significance of factors like education and organizational engagement while addressing challenges such as labor scarcity and access to farm power.

5.3. Recommendations

5.3.1 Recommendations for Policy Implication

Based on the findings of the study_

- * It may be recommended that training programs be tailored for all age groups, with a focus on modern farming techniques.
- * Emphasis should be placed on enhancing technical skills through demonstration.
- * Active participation in agricultural organizations should be promoted, and access to extension services should be improved, with particular attention given to those with limited exposure.
- * Labor scarcity should be addressed through the implementation of solutions regarding mechanization, and infrastructure development should be prioritized.
- * The accessibility and effectiveness of government subsidies should be enhanced to benefit local farmers.

5.3.2 Recommendations for Further Research

- * The study was limited to the selected villages of Dumuri Upazila of Khulna district. Therefore, the study does not represent the whole picture of Bangladesh, so it is recommended to conduct similar studies in other parts of Bangladesh.
- * Moreover, contributions of eleven characteristics of farmers with their use of agricultural machinery have been investigated in this study. However, further research should be conducted to find out the contribution of the other personal characteristics of the farmers with their other problems.
- * However, further studies can be conducted using an exploratory research design.



CHAPTER VI

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APPENDIX A

AGROTECHNOLOGY DISCIPLINE KHULNA UNIVERSITY, KHULNA-9208

Interview Schedule (English version)

Title: Factors Influencing Agricultural Mechanization in South-Western Region of Bangladesh
(Confidentiality will be maintained and all information will be used only for study purpose)

Sample No.: _____ Date: _____

Part-A

Name of the Respondent: _____

Contact No.: _____

Village: _____

Union: _____

Thana/Upazila: _____

District: _____

Part-B (Please answer the following questions. Give tick (✓) marks in appropriate place)

01. Age of the Respondent (Year): _____

02. Educational qualification (Schooling Year): _____

☐ a. Cannot read or write ☐ b. Can sign only ☐ c. Passed class:

03. Family Size (Number): _____

(Please, mention the name of your family members, their education and occupations.)

S/N	Name of the Family Member	Education (Year)	Occupation
01			
02			
03			
04			

04. Farm Size (Ha): _____

(Please, furnish information about your lands according to use.)

S/N	Use of land	Area of land	
		Local unit	Hectare
A ₁	Homestead		
A ₂	Own land under own cultivation		
A ₃	Land taken from others on barga		
A ₄	Land given to others on barga		
A ₅	Fallow Land		
Total: Farm Size = A ₁ + A ₂ + ½ (A ₃ + A ₄) + A ₅			

05. Annual family income (BDT): _____

(Please mention your family income from each of the following sources in 2022.)

Source of income	Amount (BDT)
Agriculture	
Business	
Service	
Day laborer	
Others	
Total	

06. Training (Number): _____

Did you receive any training on agricultural machinery uses?

Yes: ☐

No: ☐

If yes, mention the following:

S/N	Name of training	Duration (Day)	Organized by
01			
02			

07. Organizational Participation (Score):

S/N	Name of the organization	Nature of Participation with Duration				
		Not at all (0)	General Member (1)	Executive Member (2)	Executive officer (3)	Duration
01	Local Farmer club					
02	DAE Farmer Group					
03	Farmer Field School					
04	NGO association					
05	Mosque/Mandir/Pagoda/Church					
06	School/Madrasa/Others					

08. Extension Contacts (Score):

S/N	Media	Extension contacts			
		Never (0)	Seldom (1)	Sometimes (2)	Regularly (3)
01	UAO/ UAAO	Not at all/ month ()	1 time / month ()	2-3 times/ month ()	> 3 times/ month ()
02	AEO	Not at all/ month ()	1-2 times/ month ()	3-5 times/ month ()	> 5 times/ month ()
03	SAAO	Not at all/ month ()	1-4 times/ month ()	5-8 times/ month ()	> 8 times/ month ()
04	Field Day	Not at all/ Crop cycle ()	1 time/ Crop cycle ()	2-3 times/ Crop cycle ()	> 3 times/ Crop cycle ()
05	Friends, Neighbors & Relatives (FNR)	Not at all/ month ()	1-4 times/ month ()	5-8 times/ month ()	> 8 times/ month ()
06	NGO Worker(s)	Not at all/ month ()	1-3 times/ month ()	4-6 times/ month ()	> 6 times/ month ()
07	Input Diller(s)	Not at all/ Crop season ()	1-2 time/ Crop season ()	3-4 times/ Crop season ()	> 4 times/ Crop season ()
08	Printed Media (Newspaper, Leaflet, poster)	Not at all / week ()	1-2 times/ week ()	3-5 times/ week ()	> 5 times / week ()
09	Radio	Not at all / week ()	1-2 times/ week ()	3-5 times/ week ()	> 5 times / week ()
10	Television	Not at all / week ()	1-2 times/ week ()	3-5 times/ week ()	> 5 times / week ()

09. Cosmopolitanism

(Please state your frequency of visits outside your locality.)

S/N	Place of visit	Frequency of visit			
		Never (0)	Seldom (1)	Sometimes (2)	Regularly (3)
01	Other villages				
02	Other unions				
03	Other Upazila Sadar				
04	Own District Sadar/ Khulna City				
05	Other District Sadar				
06	Other Cities (Dhaka, Barisal...)				

10. Farming experience (year):**11. Experience in mechanized cultivation (year):**