Agricultural Credit and Its Impact on Agricultural Productivity: A Study on Rural Areas of Dhaka

A Dissertation Submitted to the Department of Banking and Insurance
and the Thesis Committee of University of Dhaka
In Partial Fulfillment of the Requirements
For the Degree of
Doctor of Philosophy (Ph.D.) in Banking and Economics

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Dedication

Dedicated to

Md. Delwar Hossain Patwary
(My respected father who motivated me a lot for my higher studies)

Kamun Nesa
(My respected mother who keeps me in her prayers always)

Sayeda Nusrat Jahan
(My beloved spouse who always takes care of me)

&

Aariyana Natasha
(My beloved daughter who always fill up my senses)

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Last but not least, I want to thank my beloved wife and daughter, who sacrificed greatly for me and inspired me to complete my task on time. The innumerable contributions made by my parents throughout my life could not be summed up by only expressing gratitude and appreciation to them.

Declaration

I, Md. Sazzad Hossain Patwary, hereby declare to submit the dissertation titled "Agricultural Credit and Its Impact on Agricultural Productivity: A Study on Rural Areas of Dhaka" to the Department of Banking and Insurance and the Thesis Committee of University of Dhaka in partial fulfillment of the requirements for the degree of Doctor of Philosophy (Ph.D.) in Banking and Economics.

I also do hereby solemnly declare that the work presented in this thesis paper has been carried out by me and has not been previously submitted to any other University/ College/ Organization for an Academic Qualification/ Certificate/ Diploma or Degree. The work I have presented does not breach any existing copyright, and no portion of this report is copied from any work done earlier for a degree or otherwise.

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Letter of Transmittal

4 January, 2024

To

Dr. Md. Shahidul Islam
Professor
Department of Banking and Insurance
Faculty of Business Studies
University of Dhaka.

Subject: Submission of Thesis titled "Agricultural Credit and Its Impact on Agricultural Productivity: A Study on Rural Areas of Dhaka."

Dear Sir,

At first accept my heartiest honor and respect. I have been doing my Ph.D. research under your kind supervision since November 2020. Following my proposal and pre-submission defense, you have assigned me to prepare the thesis for the requirement of my Ph.D. degree. I am now pleased to provide my thesis report on "Agricultural Credit and Its Impact on Agricultural Productivity: A Study on Rural Areas of Dhaka." Working on such an engaging and passionate topic was a privilege, and drafting the report under your constant direction was a rewarding experience for me.

Therefore, I pray and hope that you will graciously accept my thesis report. I have done my best to prepare the report, and I would be delighted to provide more clarification or elaboration on this report.

Sincerely Yours,

Md. Sazzad Hossain Patwary
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Supervisor's Certification

I, the undersigned, certify that I have read and hereby recommend for acceptance by the University of Dhaka, a dissertation titled, "Agricultural Credit and Its Impact on Agricultural Productivity: A Study on Rural Areas of Dhaka", in partial fulfillment of the requirements for the Degree of Doctor of Philosophy (Ph.D.) in Banking and Economics under University of Dhaka.

The thesis has been prepared by Md. Sazzad Hossain Patwary under my guidance and is a record of the bona fide work carried out successfully.

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Abstract

The agricultural sector has been regarded as the prime sector of the economy of Bangladesh since the industrial sector took its roots from this sector, and the service sector is also passively influenced by the agricultural sector. Besides its economic importance, this sector also has some social (i.e., food supply, nutrition demand fulfilment, rural employment) and environmental (i.e., influence on climate, biodiversity) contributions. In any developing country, economic and financial activities largely depend on smooth financial intermediation. Banks, as financial institutions, can play a vital role in this regard. Hence, Banks in Bangladesh can contribute to the economic development process through effective and efficient lending. In view of this sectoral importance, Bangladesh Bank has announced agricultural credit as a priority sector lending and mandatorily incorporated all scheduled banks to lend in this sector to increase agricultural productivity.

The purpose of this study is threefold: i) Detect the nature of the farmers' agricultural credit constraint status, explore the problems associated with access to banks' agricultural credit and find the intensity of banks' agricultural credit diversion to non-agricultural purposes. ii) Identify the determinants of constraint, access to credit and credit fungibility status. iii) Estimate the impact of constraint, access to credit and credit fungibility status on agricultural productivity.

A filed level survey was conducted over five sub-districts of Dhaka. Four hundred sampled farmer's data were collected through a structured, close-ended questionnaire. Collected data were further analyzed with STATA 14.2 software in both descriptive (i.e., cross-tabulation, ratio, mean and percentage) and analytical frameworks (i.e., probit regression model, propensity score matching model)

The outcome of descriptive statistics stated the condition of constraint status, access problems and extent of fund diversion. The probit regression model identifies marital status, gender, risk perception, cooperative membership, land ownership deed, total owned land and distance to bank variables that are found statistically significant to explain the constraint status of the farmers. While education, household size, household labor, krishi card, past access to bank credit, the purpose of farming and bank account variables are found statistically significant to predict access

to credit status. On the other hand, we have found that chronic diseases, delay in disbursement, old debt, non-fixed assets, and household size variables significantly influence credit fungibility status. Then paired t-test confirms several socio-economic differences exist between farmers' group, i.e., constraint and unconstraint, accessed and non-accessed, fungible and non-fungible. Results of the mean productivity confirm that unconstraint, accessed and non-fungible farmers' input use, production and income are significantly higher than the constraint, non-accessed and fungible farmers. Finally, PSM estimates revealed that the farmers' constraint and fungible status negatively impact input use, production and income. While the access status of the farmers positively affects input use, production and income.

Bangladesh Bank, the central monetary authority of Bangladesh, annually issues Agricultural and Rural Credit Policies and Programs for scheduled banks in Bangladesh. The empirical findings of this research can contribute to the modification of the agricultural credit policy of Bangladesh Bank. Moreover, other research findings, suggestions and recommendations can also incrementally contribute to taking policy measures by different relevant stakeholders.

The novelty of this study lies in using a very extensive, unique and newer data set to decompose the determinants of banks' agricultural credit constraints, access and diversion issues and their corresponding impacts on agricultural productivity. In Bangladesh, to the best of our knowledge, no work has been done on farmers' formal agricultural credit's different status determination and impact assessment issues based on micro-level data. Thus, we expect this evidence from Bangladesh can contribute incrementally to the existing literature.

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Abbreviations

ACC	Anti-Corruption Commission
ATE	Average Treatment Effect
ATET	Average Treatment Effect on the Treated
BB	Bangladesh Bank
BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi Taka
BKB	Bangladesh Krishi Bank
CDF	Cumulative Density Function
CIG	Common Interest Group
COVID	Coronavirus Disease
DEA	Direct Elicitation Approach
FCBs	Foreign Commercial Banks
FY	Financial Year
GDP	Gross Domestic Product
Ha	Hectare
IRDA	Insurance Regulatory and Development Authority
KM	Kilometer
MFIs	Micro Finance Institutions
NBFI	Non-bank Financial Institutions
NGOs	Non-Governmental Organizations
PCBs	Private Commercial Banks

PKSF	Palli Karma Sahayak Foundation
RAKUB	Rajshahi Krishi Unnayan Bank
SAAO	Sub Assistant Agricultural Officer
SD	Standard Deviation
SDBs	Specialized Banks
SOCBs	State-Owned Commercial Banks
Sq. km.	Square Kilometer
UAO	Upazila Agricultural Officer
USD	United States Dollar

Chapter 1
Introduction

1.1 Background of the Study

Agricultural credit acts as a vital catalyst in the agricultural production system and has a different role in different agricultural production cycles. It allows the farmers to meet their cash needs induced by the agriculture production process. The agricultural production process is characterized by a production cycle where inputs are converted into outputs within a time (Feder et al., 1990). Agricultural credit enables farmers to purchase inputs on demand and reach the optimum production output level. However, when farmers are under credit constraint due to credit market imperfection, the amount and combinations of inputs and investment used by a farmer deviate from the optimal levels and cause misallocation of resources, which creates sub-optimal use of inputs (Carter, 1989). The marginal contribution of agricultural credit allows input levels closer to the optimal levels and raises output and farm income (Feder et al., 1990). An adequate amount of credit and proper timing of credit disbursement shifted subsistence farming to large-scale farming (Sial and Carter, 1996). In addition to the adequacy and timing of credit disbursement, judicious use of credit is equally important in this regard. Thus, the adequate, timely disbursed, and properly used credit enables farmers to produce more products by adopting modernized and commercial farming. In the short run, agricultural credit helps farmers by increasing their purchasing power and financing their operating expenses, and in the long run, it can improve farmer investment opportunities (Conning and Udry, 2007). As mentioned by Feder et al. (1990), Carter and Olinto (2003), and Mukasa et al. (2017), access to agricultural credit by farmers has been considered an effective way to increase agricultural productivity, raise income and reduce poverty, thus improving the quality of life in rural areas of developing countries. In the short run, farmers can purchase their required production inputs, i.e., seeds, fertilizer, pesticides, and maintain their operating costs, i.e., irrigation and labor costs, by short-term credit. Production machinery and equipment, i.e., tractor, power tiller, deep tube well, and harvester, can be acquired by long-term agricultural financing.

Bangladesh is one of the world's most densely populated countries; with 1141 people per square KM. Industrial expansion and unplanned housing reduce the cropping areas day by day. The growing population's increasing food and nutrition demand fulfilment through gradually reducing cropped areas has become a significant challenge. This demand fulfilment requires improved inputs and modern agricultural equipment and machinery to harvest more from a given resource. Unfortunately, a large portion of the farming households in Bangladesh are small-scale, and due to their low-income level, they cannot apply those desired improved inputs and modern equipment and machinery. Moreover, agricultural production functions have become both labor and capital-intensive nowadays. Bank credit in this regard can play a vital role in meeting farmers' liquidity and investment needs for their farming activities, i.e., modernization and expansion.

As a developing nation, Bangladesh is heavily dependents on the agriculture sector for all aspects of economic activities. Specifically, in a densely populated country like Bangladesh, ensuring food and nutrition security necessitates a focus on augmenting output. The acceleration of agricultural production is contingent upon the modernization and commercialization of farming activities, necessitating a sufficient influx of funds. In response to the growing need for agricultural funding, Bangladesh Bank has designated agricultural credit as a priority sector for lending. Hence, it is imperative to examine the accessibility of agricultural credit provided by banks, together with the constraints and concerns regarding its diversion. Furthermore, it is crucial to address the impact evaluation of access, constraints, and credit diversion on agricultural productivity. Considering this crucial component of agricultural financing, our current work has been designed to identify factors influencing bank's agricultural credit access, constraints and fungibility as well as their corresponding effect on productivity.

1.2 Statement of the Problem

Like other developing countries in our country, formal credit market imperfections make it challenging to allocate adequate financial resources to the farmers on time. Thus, the farmers become credit constraints, restraining access to agricultural credit. Existing credit market imperfections and credit constraints lead to a misallocation of resources and sub-optimal use of

inputs in farm production. Some previous empirical studies[1] in different parts of the world found that this misallocation and sub-optimal use of inputs negatively influences agricultural productivity resulting in lower income for credit-constraint farmers than unconstraint farmers. Credit constraints and lack of access to credit also affect rural development by shifting farming households to non-agricultural activities, misusing the farmer's farming ability and experience (Ellis, 2000).

Despite the significant role played by the agricultural sector in Bangladesh's economy, this sector received only 1.77% of the bank's total domestic credit in FY 2021 (Bangladesh Bank Annual Report, 2021). This poor amount of agricultural credit is mainly due to the dominance of the rural economy in Bangladesh, with minimal financial services and products by the banks for the farmers. The risky nature of the agricultural production process, price uncertainty, long harvesting time, poor infrastructure, and the distant marketplace instigate the challenges for the farmers to access formal credit. For this instance, formal credit intermediaries like banks are reluctant to finance in the agricultural sector due to the said risk and less profit orientation. Access to credit by the farmers hampers mainly in two ways. The farmers are forced to restrain themselves from credit access due to the high cost of borrowing, huge formalities, rigid collateral requirements, unfriendly repayment schedules, etc., imposed by the banks. At the same time, the bank is reluctant to finance farming activities due to the high systematic risk arising from natural hazards, high operating costs, and poor infrastructure in rural areas. In addition to the problems discussed earlier, if the farmers get access to the credit, they suffer from inadequacy of credit, improper timing of credit disbursement, and high cost of credit. Another challenge of disbursed agricultural credit is to ensure its proper use. Due to the low-income levels of the farmers, delay in disbursement and insufficiency of credit, and lack of credit supervision by bank officials, some farmers diverted agricultural credit to non-agricultural activities hence misallocated resources. Thus, this credit fungibility should be kept as low as possible to ensure proper flow to the agricultural production process.

Farmers in developing countries often experience low productivity due to credit constraints, lack of access to credit, and for credit diversion. So, it is necessary to identify the nature of constraint status, problems associated with credit access, and the intensity of credit fungibility. Besides

[1] Jappelli (1990), Petrick (2004), Ali and Duponchel (2014), Mukasa et al. (2017)

that, determining factors that affect credit constraint, access, and fungibility status should also be studied. The impact of credit constraint, access, and fungibility status may influence productivity levels differently. Therefore, we have to measure this effect and ensure the significance of this productivity difference. Hence, the determinant factors of credit constraint, access, fungibility status, and their corresponding influence on farm productivity need to be assessed.

1.3 Research Questions

The existing literature on agricultural credit constraint focuses on identifying the determinants of credit constraint status of the farming households. For instances Omodara et al. (2021), Balana et al. (2020), Kofarmata & Danlami (2019), and Chandio & Jiang (2018) investigated the determinant factors of credit constraint status. An increasing number of recent empirical researches indicate that credit constraint negatively impact agricultural productivity in rural areas of developing nations. For reference Balana & Oyeyemi (2022), Lakhan et al. (2020), Amanullah et al. (2019), Kinuthia (2018) and Mukasa et al. (2017) found adverse effect of credit constraint on farm productivity. The above-mentioned empirical works evident that a plethora of researches have been carried out at different region of the world. As far as we are aware, In Bangladesh no studies have been done to estimate the determinant factors of bank's agricultural credit constraint status and its corresponding effect on agricultural productivity. Therefore, the following research questions arise in the researcher's attention and need to be answered in this study:

i. Which factors determine bank's agricultural credit constraint status of the farmers in Bangladesh?
ii. How do banks' agricultural credit constraint status impact farm's input use, production, and income?

The influencing factors to get access in agricultural credit and the impact of access to agricultural credit on agricultural productivity has also long been discussed. For example Taremwa et al. (2022), Zulfiqar et al. (2021), Isaga (2018) and Temesgen et al. (2018) identified the factors which influence access to agricultural credit. While positive and significant effect of access to credit on farm productivity has been confirmed by Abdallah et al. (2019), Chandio et al. (2018), Bichi (2017) and Akudugu (2016). However, to the best of our knowledge, in Bangladesh identification of the factors behind access to bank's agricultural credit and the relationship between access to bank's credit and farm productivity yet to discovered. Hence, the researcher

has identified the following research questions, which require investigation in this research.

iii. What are the determinant factors to get access to banks' agricultural credit by the farming households in Bangladesh?
iv. Is there any connection between banks' agricultural credit access with farmers' input use, production and income level?

Investigation of the influencing factors behind agricultural credit fungibility has been conducted by Ankrah Twumasi et al. (2022), Darfor et al. (2021), Chandio et al. (2018), Saqib et al. (2017) and Hussain & Thapa (2016). On the other hand, negative impact of credit fungibility on farm production has been discussed in conceptual level by Saqib et al. (2017), Oboh & Ekpebu (2011), Nosiru (2010) and in the earlier time Odedokun (1996), Meyer (1990), Feder et al. (1989) stated only the fungibility conditions of the study area. Thus, recent empirical evidence regarding determinants of bank's credit fungibility and its corresponding effect on farm productivity has obtained researcher's attention and arises the following research questions:

v. What factors determine banks' agricultural credit fungibility status of the farmers in Bangladesh?
vi. How does banks' agricultural credit fungibility effect farm income, production, and input uses of the farmers?

1.4 Research Objectives

The main purpose of the study is to identify the determinants of banks' agricultural credit constraint, access, and fungibility status of the farmers and to estimate their corresponding impact on agricultural productivity. However, the following specific research objectives are furnished below.

i. To identify the determining factors of banks' agricultural credit constraint status of the farmers.
ii. To examine the impact of banks' agricultural credit constraint status of the farmers on farm production, income, and inputs uses.
iii. To determine the factors which influence access to banks' agricultural credit.
iv. To evaluate the influence of access to banks' agricultural credit on farming households' production, income, and input investment.

v. To identify the factors that causes banks' agricultural credit fungibility status.
vi. To measure the effect of banks' agricultural credit fungibility on farmers' inputs usage, production, and income level.

1.5 Research Hypothesis

1.5.1 Determinants of agricultural credit constraint status

Freeman et al. (1998) found a negative association between age of the farmers and constraint status. The higher the age, better the life and farming experience; thus, aged farmers are hypothesized less likely to be constraint. According to Musaka et al. (2017), female-headed families are less likely to ask for loans because they fear of losing collateral and become risk constraint. Awunyo et al. (2014), Omonona et al. (2010) found gender as significant determinants of constraint status. Married farmers are less likely to be constraint as they have their spouse's support from other agricultural activities and or as a guarantor for taking credit. Musaka et al. (2017) posit that farmers with a higher level of education would have more financial literacy, enabling them to comprehend complex loan conditions and increase their chances of obtaining loans. Findings of Komicha & Ohlmer (2007), Ali and Deininger (2012) also supports this inverse relation between educational qualification and constraint status. Experienced farmers are well prepared for their farming activities and have efficiency in resource allocation; thus, we assumed that farming experience influence credit constraint conditions of the farmers. The household size increases the family expenditure, which stresses the economic resources. Freeman et al. (1998) found that farming households with more family members are prone to credit constraints. Risk perception is a self-attributed feature of the farmers view towards the riskiness of obtaining bank credit. Therefore, it has been hypothesized that risk perception has positive influence on credit constraint. Farmers can obtain liquidity support from cooperative as an active and participatory member. Consequently, being a part of that cooperative, farmers are getting financial benefits; hence we expected cooperative membership status to be negatively associated with the constraint position of the farmers. Petrick (2004) found that previously defaulted and rescheduled loans led to becoming the farmers' constraint status. Previous default may lower the confidence level of the farmer, and the banks are usually reluctant to lend to the defaulter. Feder et al. (1990) found a positive association between past defaults to present constraint conditions. Banks always seek land property as collateral for lending, and they prefer all land documents in order. Fletschner et

al. (2010) posits the title of land increase the collateral value of land and improve credit availability. Carter and Olinto (2003) discovered that land titles reduce farmers' supply-side credit constraint status. Additional owned land indicates added creditworthiness of the borrower and ensures sufficient collateral submission leads to obtaining an adequate amount of credit. Musaka et al. (2017) mentioned that distances between commercial banks and farmers' residences significantly impact transaction costs-constraint. Feder et al. (1990) in China considered the total number of dependents to explain the constraint status and found a positive association. Lemessa & Gemechu (2016) mentioned that large farms could use more capital, labor and other farm inputs, increasing the demand for credit and, as demand rises, the likelihood of obtaining credit. Based on above-discussed empirical findings and the theoretical concepts, the following research hypothesis has been developed:

H_1: Other things held constant, age, gender, marital status, education, experience, household size, risk perception, cooperative membership, previous default, land ownership deed, total owned land, dependency ratio, distance to bank, and type of farm determines banks' agricultural credit constraint status of the farmers.

1.5.2 Impact of agricultural credit constraint status on farm productivity

Carter (1989) posits that lower productivity levels are influenced by several factors, including lower investment and a misallocation of variable inputs. Agricultural credit constraint leads misallocation of inputs uses and investment and cause lower productivity. According to Foltz (2004) unconstraint farmers can separate consumption decisions from farm production decisions. So, the unconstraint farmers can conveniently choose the combination of production inputs optimally for their production process. Feder et al. (1990) and Guirkinger &Boucher (2008) founds significant differences in inputs use and income between constraint and unconstraint farmers. Production level differences were also identified by Omonona et al. (2010), and Oyedele et al. (2009). A plenty of studies have been conducted to estimate the effects of credit constraints on income and production and found significant negative effect. For instance, Balana & Oyeyemi (2022), Lakhan et al. (2020), Amanullah et al. (2019), Kinuthia (2018), Mukasa et al. (2017), Dong et al. (2010) found adverse effect of credit constraint on farm productivity. Considering previous empirical arguments and findings of the related literature the following research hypothesis has been developed:

H_2: Banks' agricultural credit constraint status significantly affects farmers' input use, production, and income; ceteris paribus.

1.5.3 Determinants of access to agricultural credit

Sekyi et al. (2016) argued that educated farmers can collect credit information conveniently and have better understanding about lending terms and conditions. Ozowa (1995) mentioned that literate farmers are more likely to recognize the advantages of credit use and have better knowledge about credit sources. Therefore, educational qualification of the farmers impacts access to credit positively. According to Madafu (2015), farmers with higher experience have sufficient financial past records that the banks may require to process the loan. This assumption is also supported by Gamage (2011). Isaga (2018) mentioned that a higher income level from agricultural activities implied the enhanced ability of farming household to repay the loan timely. Hence, the farm income postulates positive association with access to credit. Awotide et al. (2015) mentioned younger farmers lean towards more risk takers than older farmers, thus expected to have more access than their counterparts. Temesgen et al. (2018) argued that female households are comparatively more occupied with childcare and house chores in addition to their farming activities, leading to less interaction with extraneous matter. Hence, this assumption suggests male farmers are more likely to get access in credit. Banks prefer to disburse credit on cash flow generating capacity. Commercial farmers can make cash flow by selling their products, therefore increase their repayment capacity. Thus, it can be assumed that the purpose of farming is positively associated with banks' access to credit. Larger households spend more, which reduces savings and creditworthiness. Thus, household size and credit access anticipated to be negatively correlated. This assumption also aligns with Oyedele et al. (2009) and Owusu's (2017) findings. Chandio et al. (2018) claimed that formal financial institutions prefer owned land for credit risk management. Thus, we hypothesized that greater land ownership would enhance farmers' access to banks' agricultural financing. This assumption also corresponds with Zulfiqar et al. (2021) findings. Abdallah et al. (2019) argued that full-time farming involvement by family labor leads to more hours spent on farming activities and decreases the time spent on loan processing. Thus, on this ground, we can assume a negative relation between household labor and access to credit. Banks must provide agricultural credit to actual farmers, thus krishi

card helps lenders to identify them. Therefore, it has been assumed holding krishi card connects with access to credit. Morris & Meyer (1993) and Dzadze et al. (2012) mentioned saving habits influence farmers' access to credit since it provide banks a financial history for lending decisions. Byerlee et al. (2014) found that off-farm income helps farmers repay loans on schedule. Thus, non-agricultural income and credit access should be positively correlated. Yehuala (2008) mentioned past access to bank credit as an experienced dealing with credit use and bank formalities. Thus, historical bank credit access is thought to be positively related with bank loan access. Farmers having bank accounts are in touch with bank officials therefore informed about credit schemes. Additionally, funds in those accounts reassure bankers about repayment capacity. Farmers with bank accounts are twice as likely to access agricultural finance, according to Taremwa et al. (2022). Thus, having bank accounts are thought to increase agricultural financing access.

From the above discussion, our next hypothesis has been developed as follows:

> H_3: Access to banks' agricultural credit is determined by education, experience, firm income, age, gender, purpose of farming, household size, land holding, household labor, krishi card, savings, non-farm income, past access to credit, and bank account; ceteris paribus.

1.5.4 Impact of access to credit status on farm productivity

Feder et al. (1990) asserted that access to credit empowers farmers to purchase additional agricultural inputs, hence enhancing production. Carter (1988) suggested credit can boost agricultural production and income in three ways. First, it lets farmers buy and use high-yielding inputs over conventional ones. Second, credit facilitates buying innovative technology over traditional equipment and machinery. Third, access to credit improves fixed input, family labour, and farming skill use. Therefore, access to credit help farmers to increase production and earn more. Sial & Carter (1996) argued that enhanced access to finance can lead to higher agricultural productivity and increased income for farmers. Carter & Olinto (2003) also discuss a comparable concept. Awotide et al. (2015) and Kinuthia (2018) discovered that farmers who had access to credit utilized a greater amount of inputs compared to farmers who did not have access to credit. According to Yazdani & Gunjal (1998) and Baffoe et al. (2014), farmers who have access to agricultural finance from banks have higher levels of production than the farmers who do not

have access to such credit. Carter (1988) and Reyes & Lensink (2011) also discovered substantial differences in agricultural income between farmers who had access and those who did not have access in agricultural credit. Numerous studies have also been undertaken to assess the impact of agricultural credit access on income and productivity, and have consistently revealed a considerable positive effect. For reference, Abdallah et al. (2019), Chandio et al. (2018), Bichi (2017), Akudugu (2016), and Duy (2015) explored a significant positive relationship between access to credit and agricultural output.

The above literature review and previous discussion guided us to develop the next hypothesis:

> H_4: Access to banks' agricultural credit status significantly impacts farm's input use, production, and income level; ceteris paribus.

1.5.5 Determinants of agricultural credit fungibility status

Male farmers have greater mobility, physical activity, and knowledge compared to female farmers, therefore making them potentially more inclined to utilize agricultural funds for non-agricultural purpose. This assumption aligns Darfor et al. (2021), who found a positive association between male farmers and credit fungibility. Social capital like education may help farmers to use agricultural loans in better way. Kuwornu et al. (2012) claimed that educated farmers distribute agricultural finance more efficiently, therefore become less fungible. According to Hussain & Thapa (2016), owners of non-fixed assets could sell them to pay for immediate family needs like food or emergency medical care. With such assets, they could use credit more for agriculture. Thus, we assumed non-fixed assets reduce fungibility. Farming households borrowed money from various sources. Most farmers tend to repay loans with another loan. Thus, we assumed that farmers with old debt would use banks agricultural credit to repay their previous loans. Thus, old debt assumed to impact on fungibility status. According to Kuwornu et al. (2012), inadequate agricultural credit, which is insufficient for any meaningful farm operation, is typically redirected to non-agricultural activities. Thus, we hypothesized that farmers with adequate agricultural credit are less likely to become fungible. Oboh & Ekpebu (2011) found that bank officials' visits increases credit allocation to farming activities. Hence, it can be assumed bank loan monitoring reduces tendency of credit fungibility. Kuwornu et al. (2012) noted that delayed loan disbursement encourages farmers to misuse the funds. The agricultural production process is time-sensitive, so delayed credit disbursement may leads credit

fungibility. Hussain & Thapa (2016) cited that the usage of agricultural credit for non-farm activities decreases as the landholding size increases. Greater landholding size increases the likelihood of higher agricultural revenue by expanding farm operations, lowering credit fungibility. Darfor et al. (2021) noted that farming households with more chronically ill family members may be forced to redirect agricultural credit to treat chronic diseases, making them more likely to be fungibility. Proper assessment and monitoring tendency regarding agricultural loan remains poor among the Govt. bank officials. Therefore, it has been assumed that the farmers who obtained credit from Govt. banks are more likely to divert agricultural credit than their counterparts. Ijioma & Osondu (2015) said that larger household size might result in loan diversions due to rising consumption costs. Based on this perspective, we hypothesize that the size of a household has a positive influence on its credit fungibility status. Taking into account the aforementioned points, we construct the following hypothesis:

H_5: Credit fungibility status is explained by gender, education, non-fixed asset, old debt, adequacy, monitoring, delay in disbursement, owned land, no. of family members in chronic diseases, source of bank credit, and household size; ceteris paribus.

1.5.6 Impact of agricultural credit fungibility status on farm productivity

Pischke and Adams (1980) argued that loans have a negative effect on the economic well-being of rural households because they divert credit away from intended uses. The negative correlation between agricultural credit and farm productivity can also be attributed to farmers' behavior regarding the fungibility of agricultural loans. Oboh & Ekpebu (2011) mentioned that increasing agricultural productivity necessitates the efficient and judicious use of credit in framing activities. Agricultural credit fungibility reduces productivity by diverting funds to unproductive uses. Thus, production inputs are deviated from optimal level and suboptimal input and equipment use lower the production level. Saqib et al. (2017) mentioned low farm production, which in turn leads to low farm income, occurs when agricultural credits are utilized for purposes other than farming. When credit for agriculture inputs like seeds, fertilizers, and equipment is diverted to non-agriculture uses like consumption, loan repayment, and home repair, interrupts agriculture production, resulting in low farming returns. However, the adverse effect of credit

fungibility on farm production has also been mentioned by Twumasi et al. (2022), Ijioma & Osondu (2015), Nosiru (2010) and Hussain & Thapa (2016) among others.

Considering previous arguments and empirical evidence the following research hypothesis has been developed:

H_6: Banks' agricultural credit fungibility status significantly affects farmers' input use, production and income level; ceteris paribus.

1.6 Rationale of the Study

The agriculture sector contributes 13.47% to the national GDP of Bangladesh in the financial year 2020-21 (Bangladesh Economic Review, 2021). 40.36 % of the total labor force is directly involved in this sector (Labor Force Survey, 2017). In 2020-21, export earnings stood at 1505.51 Million USD (Export Promotion Bureau Yearly Statement, FY20-21). Besides the economic importance, this sector notably contributes to social aspects, i.e., food security and nutrition, rural employment, poverty alleviation, enhancing the standard of living etc. From an environmental perspective, its effect on land, water, air quality, biodiversity, and coping with climate change manifests another dimension of this sector's importance. The agricultural sector is regarded as the prime sector of the economy of Bangladesh. The development of the economy of Bangladesh, directly and indirectly, depends on the development of agriculture. Hence, agricultural development is very crucial for a developing country like Bangladesh. Considering the enormous importance of this sector, Bangladesh Bank has announced agricultural credit as the priority sector lending since 2008 and mandatorily incorporates all the scheduled banks to finance in this sector. Increasing productivity, maximizing crop diversification, making agriculture profitable through modernization, nutritionally safe crop production and marketing systems, and ensuring the nutrition and food security of the public, agricultural credit is decisive. Service sectors like wholesale and retail business, hotels, restaurants, transportation etc., have been passively boosted by the upliftment of the agricultural sector. The growth and progress of the industrial sector also depend on the development of the agricultural sector since it took its root from the agricultural sector. Worldwide, agriculture is the primary source of income among poor rural people. Agricultural growth can reduce rural poverty rates faster and more effectively than other sectors. Therefore, in view of the enormous prospects and contribution of the

agricultural sector, this study has been motivated and designed to understand the condition of banks' agricultural credit and its impact on micro-level farm productivity.

1.7 Significance of the Study

Output from the farming household at the micro level stimulates macro-level national agricultural production, agricultural growth as well as the overall growth of the economy (Madafu, 2015). As we mentioned earlier, most of the farmers in Bangladesh are small-scale in nature. Due to their small scale of farming operation based on traditional farming techniques, they face low productivity, which leads to low income and savings. With low savings and limited access to external finance, they are forced to use traditional inputs and obsolete technologies, ultimately decreasing productivity (Feder et al., 1989). To overcome this low productivity level, tiny farmers need credit in the soft term and at a concessional rate. In Bangladesh, as a priority sector lending and regulatory requirement, banks are now providing credit to the farmers. However, due to some problems discussed earlier, we have spot credit constraints, access problems, and fungibility issues of banks' agricultural credit. If those problems are correctly identified and rectified accordingly, we hope the farmers can overcome the low productivity level, their farming productivity will be maximized, and the overall economy will be boosted. This practical implication guided the study to identify the determinants of the farmers' credit constraint, access and fungibility status, and their respective impact on productivity. We expect these empirical findings will provide some recommendations imperative in forming policies and best practices to improve farmers' constraint condition, accessibility to credit, and fungibility of credit.

1.8 Conceptual Framework

A conceptual framework is a general idea inferred from specific conditions. It symbolizes several interrelated ideas (Smyth, 2004). Figure-1.1 shows the conceptual framework of this study derived from literature and presents the research's conceptual basis. The conceptual framework aims to show the circumstantial effect of credit constraint, access to bank credit, and credit fungibility of the farmers, and it also explains the ultimate impact on the performance of farmers.

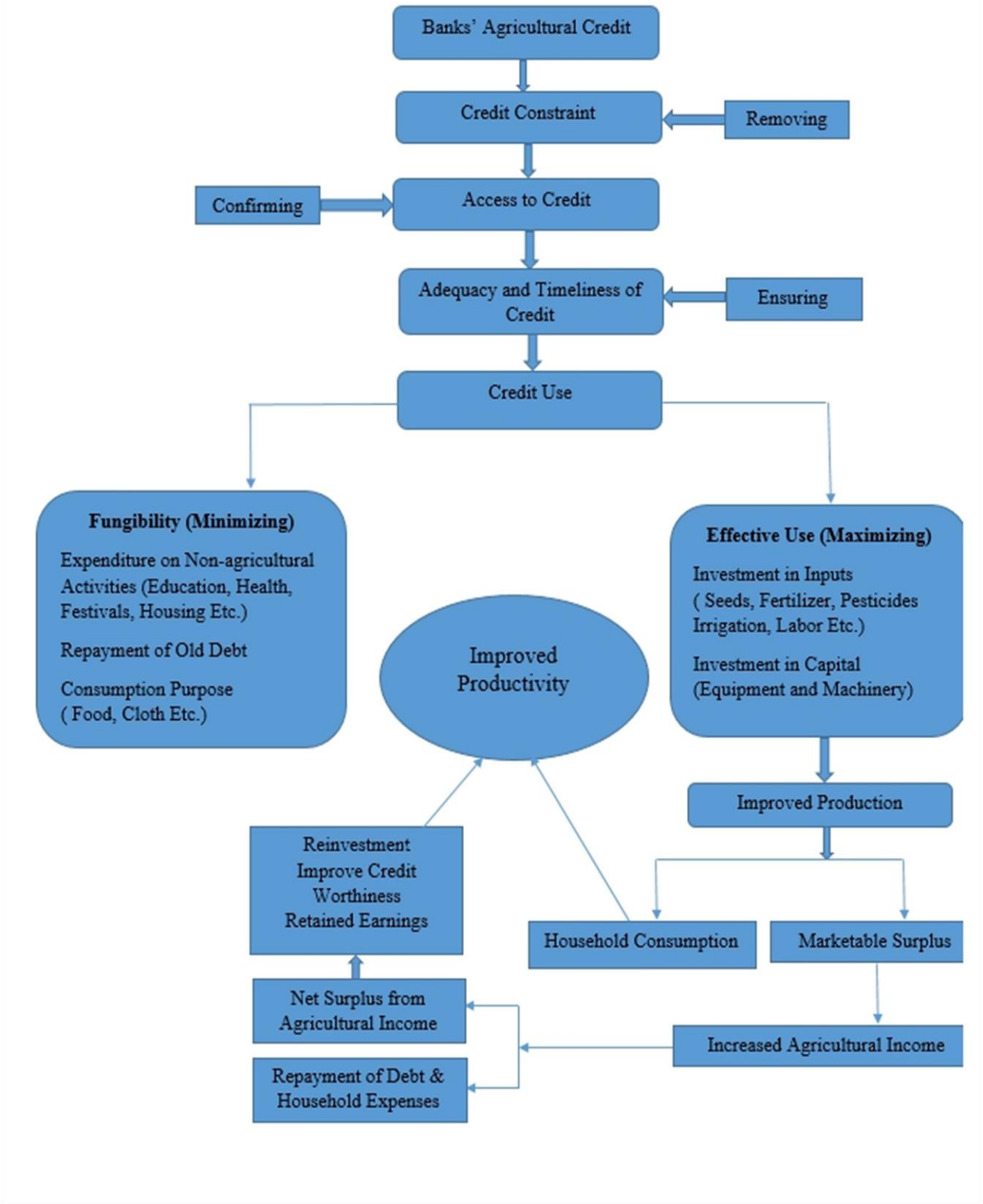


Figure 1.1: Conceptual Framework

Given the importance of the agricultural sector, Bangladesh Bank has formulated agricultural credit policy and program yearly and instructed all the scheduled banks to provide agricultural credit at a concessional rate and in easy terms and conditions. However, farmers are under credit constraints due to supply and demand side factors (Fletschner et al., 2010). In this study, we will try to identify the factors behind farmers' credit constraint condition and measure the impact of credit constraint on farm productivity. From the credit constraint condition findings, policymakers can take steps and remove credit constraints.

In this study, we will also find the credit access problems and the determining factors of access to credit. Considering those issues, we expect more inclusion of the farmers in access to bank credit. Hence, only the inclusion of the farmers in banks' agricultural credit net is not sufficient to have impact on farm production. Adequacy of credit and timing of credit disbursement also have to be ensured. Kuwornu et al. (2012) mentioned inadequate agricultural credit is typically redirected to non-agricultural activities, hence sufficient credit allocation is required for meaningful farming activities. Siddiqi et al. (2009) argued that effective use of agricultural credit require timely loan disbursement at the grass root level. Credit can be effectively used by investing in working capital and fixed capital. Inefficient credit use can occur by diverting agricultural credit to non-agricultural activities. Therefore, to ensure the intended purpose of credit, fungibility should be minimized, and effective use of credit should be maximized. According to Saqib et al. (2017) low farm production, which in turn leads to low farm income, occurs when agricultural credits are utilized for purposes other than farming. Oboh & Ekpebu (2011) stated that enhancing agricultural productivity requires the effective and prudent utilization of credit in agricultural operations. From the said reference, we can conceptualize that the maximization of the effective use of credit brings improved production at the household level. According to Hussain (2012) improved production increases households' consumption of agricultural commodities and ensure food safety. After fulfilling the household's requirement, the surplus can be sold at the market, generating additional income. Therefore, increased agricultural income can meet other household expenses and facilitate repayment of bank loans, and then the net surplus remains. Net surplus leads to retained earnings and enhance the credit worthiness of the farmers. Hence, the retained earnings and required additional bank credit can create extensive reinvestment opportunities for modernize and extensive farming, ultimately bringing improved agricultural productivity.

1.9 Scopes and Limitations of the Study

1.9.1 Scopes of the Study

This microeconomic analysis is based on data obtained from farming households in rural areas of the Dhaka district of Bangladesh. In a strict sense, the findings of this study are relevant mainly to the study areas but may also be extended to other areas with similar economic, infrastructure, agroecological, demographic, and socioeconomic characteristics. On this ground, the study's findings will allow to development of comprehensive policy recommendations.

The analysis of this study is based on the new dataset collected from the field-level survey. The data collection was done in the year 2022. Hence, the findings of this research are evident in the most recent conditions of the sampled farmers in the study area.

Existing studies of banks' agricultural credit and farm productivity in Bangladesh encompass only the aggregated macroeconomic analysis. Study based on microeconomic analysis is minimal. Hence, this study will address this avenue of research and bring the findings of agricultural credit and productivity from farming household-level data.

Policymakers require data-based empirical evidence to formulate policies and guidelines. Bangladesh Bank, the central bank of Bangladesh, yearly issues agricultural credit policies and programs. The outcome of this study can be considered for policy and guidelines modification regarding agricultural credit policy and program.

1.9.2 Limitations of the Study

This study does not consider panel and longitudinal datasets from different districts and different time periods due to time and budget constraints. Hence, this study covers rural areas of Dhaka district only.

Only crop farmers have been taken into account as the sampling unit. In order to ensure homogeneity among the selected farmers and facilitate analysis, this study excludes farmers who engage in cattle and fish farming.

Farmers obtained agricultural credit from different sources, i.e., formal, informal, and semi-formal sectors. Although various sources of agricultural credit are available, this study only focused on banks' agricultural credit.

Even though all the scientific approach has been applied in the field-level data collection, any inaccurate response and information given by the respondents would make imprecise results.

1.10 Organization of the Study

This study is organized into seven chapters. Chapter one is the introductory chapter which encompasses the background of the study, research problems, research questions, the purpose of the research, research hypothesis, rationale of the study, significance, conceptual framework, scope, and limitation of the study.

In chapter two, the definition of some key concepts is discussed. Afterward, a brief overview of the agricultural credit market in Bangladesh was presented. A narrative review of the previous empirical literature is presented later. Finally, the literature gap is addressed at the end of this chapter.

Chapter three describes the methodology of the entire study, including types of data, nature of the study, description of the study area, population and sampling design, data collection methods, data analysis techniques, specification of variables considered in the study, and some descriptive statistics of the sampled farmers.

Chapter four presents the nature and conditions of the credit constraint status of the farmers. Following the determinants of agricultural credit constraint status, the impact of constraint status on productivity has been furnished. In chapter five, problems associated with access to credit have been discussed, and factors behind credit access and its impact on productivity have also been presented. Chapter six includes the study of the intensity of credit fungibility and the use of credit. Later causes of fungibility and the effect of fungibility on farm output have been measured. In these three chapters, descriptive and inferential statistics are used to present the finding of the analysis.

Finally, chapter seven summarizes the study's findings, and then some suggestions and recommendations are presented as policy implications. After concluding remarks, the scope for future research has been addressed at the end of the conclusion chapter.

Chapter 2

Literature Review

2.1 Definition of Key Concepts

Agricultural Credit

Agricultural credit refers to financing in agriculture-related activities, from production to marketing. It encompasses short, medium, and long-term loans ranging the entire agricultural value chain - input supply, production, processing, and marketing (Mwihaki, 2015). Agricultural credit is a contract through which a sum of money or commodities is given to the farming household for agricultural activities by an institution or person on condition of repayment under specific terms and conditions. The institutional credit provider consists of formal institutions, such as nationalized banks, specialized banks, private commercial banks, and semi-formal entities, such as non-governmental organizations, cooperative societies, and input suppliers. Non-institutional credit providers include friends, family members, mahajan[2], dadon[3] businesspeople, moneylenders, etc. Ex-Ante agricultural credit refers to credit requirements for supplies, equipment purchase and land preparation prior to production. Ex-Post agriculture credit signifies the necessity for post-production credit for marketing, packing, transportation, and storing.

Credit Constraint

Credit constraint refers to a situation where an individual or firm is unable to borrow funds or experiencing difficulties in obtaining credit from financial institutions. Agricultural credit constraint is the condition in which farmers or agricultural enterprises encounter challenges in acquiring the essential financial resources or credit required to invest in their farming activities. According to Guirkinger & Boucher (2008), credit constrained individuals are those who would normally participate in the credit market in an ideal scenario but choose to withdraw due to asymmetric information. The four primary dimensions of credit constraints are price, quantity,

[2] Local merchant who also involved with the money lending business.
[3] Is a system of advancing funds to the farmers in the condition of selling goods at a predetermined price to the moneylenders.

risk, and transaction cost constraints. Price constraint occurs when an individual decides not to participate in the credit market due to high interest rates. Quantity constraint refers the situation when credit demand is not fully met. While, transaction cost constraint states the presence of high non-interest monetary expenses and time involvement that restraint a farmer from borrowing. Risk constraint encompasses the voluntary withdrawal of the farmers from credit market due to their self-attributed risk perception.

Credit Fungibility

Cohen (1968) defines credit fungibility as the diversion of credit from its original purpose to other uses. Agricultural credit fungibility refers to the act of diverting agricultural credit towards non-farm activities, such as living expenses, medical expenditures, education cost, and house repairs, instead of using it wisely for purchasing inputs and making investments for agricultural activities. Credit fungibility can be categorized into two forms: financial substitution and expenditure substitution. Hussain & Thapa (2016) defined financial substitution as the practice of farmers combining agricultural and other credit into a common fund for a specific purpose. Conversely, expenditure substitution refers to the situation where farmers utilize agricultural financing for other purposes.

Agricultural Productivity

The concept of productivity is a relative term, often measured as the overall efficiency of productive units or simply as a ratio of output to the corresponding inputs (Mwihaki, 2015). Productivity can also be defined as someone's ability to produce more economically and efficiently from a given resource (Mohammad, 1992). In this study, agricultural productivity is defined as a ratio of output, i.e., the market value of produced agricultural commodities, and net agricultural income to input, i.e., total cultivated land employed in agricultural production.

Agricultural Income

Agricultural income commonly denotes the revenue generated from agricultural activities. The revenue encompasses income derived from diverse agricultural sources, including farming, crop cultivation, livestock, dairy, poultry, and other related agricultural activities. The actual earnings a farmer realizes from their farming operations, accounting for both revenue and various costs associated with agricultural production, is termed as net agricultural income.

Agricultural Farm Household

A group of persons living together and taking meals from the same kitchen is termed a household. A household that depends on agriculture is called an agricultural farm household. A household cultivating at least 0.05 acres of land is defined as an agricultural farm household (Preliminary Report of Agriculture Census, 2019). A farming household cultivates 0.05 to 2.49 acres of land is called a small farm. 2.50 to 7.49 acres indicates a medium farm and 7.50 acres above is a large farm (Agriculture Census, 2008).

Rural Areas

Generally, rural areas indicate dependency on agricultural activities, less industrial base, less population density, and poor infrastructure. Specifically, the whole country, excluding city corporations, municipalities, sub-district headquarters, other urban areas, and growth centers, were treated as rural areas (Rural Credit Survey, 2014).

2.2 Agricultural Credit Market in Bangladesh

Like other developing countries, the agricultural credit markets of Bangladesh consist of formal, semi-formal, and informal markets. This credit market segmentation has been formed based on the degree of regulations. Key features are discussed as under:

2.2.1 Formal Agricultural Credit Market

The formal agricultural credit market of Bangladesh comprises all scheduled banks of Bangladesh. 55 of 61 scheduled banks participate in Bangladesh's formal agricultural credit market (Agricultural & Rural Credit Policy and Program, 2021-2022). Due to high operating expenses, i.e., costs related to screening, visitation, monitoring, prosecution, and interest ceilings fixed by the government, banks have a low scope of profitability from agricultural credit. Moreover, substantial financial risk arises from moral hazard, few assets as security, and variability of the client's income due to dependency on natural forces makes agricultural credit risky. This risk and less profit orientation lead lack of financing in this sector by formal financial institutions (Khandker and Faruqee, 2003). Another salient feature of Govt. financed formal agricultural credit is its subsidy. There has always been debate about subsidized credit. Nevertheless, the Govt. must know how much and how long these credits should be subsidized,

who receives the subsidy, and whether it helps the borrowers (Khandker and Faruqee, 2003). In Bangladesh, BKB, RAKUB, and SOCBs fail to administer agricultural credit due to corruption, poor management, massive default rate, and Govt. subsidized recapitalization.

2.2.2 Semi-Formal Agricultural Credit Market

NGOs, Govt. Institutions, i.e., PKSF, Ministry of Employment, Ministry of Woman; Non-scheduled banks, i.e., Grameen Bank, Karmashangosthan Bank; cooperatives, input suppliers, and micro-finance institutions are the supplier of semi-formal agricultural credit in Bangladesh. Credit suppliers are relatively free from strict regulations in a semi-formal agricultural credit market. Interest ceilings by those intuitions are not as strict as by the banks. In addition, due to substantial operating expenses, the interest rate is relatively high for the semi-formal source of agricultural credit. With an extended branch networking, semi-formal agricultural credit suppliers ensure proximity to the farming household. Hence, no collateral is required for credit from semi-formal sources. Close monitoring and frequent visitation thus ensure a high recovery rate. Another feature of semi-formal agricultural credit is instant access. Efficient management and a skilled workforce can manage fast loan processing time, timeliness, and adequacy of credit.

2.2.3 Informal Agricultural Credit Market

Relatives, friends, neighbors, colleagues, money lenders, mahajans, dadon business people are the major suppliers of informal agricultural credit to the farmers in Bangladesh. Since most of these suppliers, i.e., relatives, friends, and neighbors, provide credit to the farmers on the ground of interpersonal relationships, there is no or low cost of accessing a loan, and no collateral is required. Other groups, i.e., moneylenders, mahajans, dadon business people, imposed very high-interest rates and collateral submission. Though informal credit has various limitations, it is familiar to some farmers for its flexibility, instant access, timely delivery, and low transaction cost. In addition, some informal lenders also perform an essential role by facilitating the marketing of products or providing inputs. Another aspect of informal credit is that it goes mostly for consumption rather than agricultural production activities and does not meet farmers' capital needs. In a nutshell, informal agricultural credit is expensive, short-term, and used for consumption rather than investment.

2.3 Key Features and Statistics of Banks Agricultural Credit in Bangladesh

2.3.1 Sources of Banks' Agricultural Credit

As we mentioned earlier, sixty-one scheduled banks in Bangladesh operate under the complete control and supervision of Bangladesh Bank. Fifty-five scheduled banks are presently providing agricultural credit to the farmers. Earlier former agricultural credit market consisted of two Specialized Banks (SDBs), i.e., BKB (Bangladesh Krishi Bank) and RAKUB (Rajshahi Krishi Unnayan Bank). These banks are also exclusively owned by the Government of Bangladesh and established for agricultural development. Then the State-Owned Commercial Banks (SOCBs), which are entirely or majorly owned by the government of Bangladesh, started to provide agricultural credit. There are now 6 SOCBs that are providing agricultural credit. Since 2008 as a policy modification of agricultural credit by Bangladesh Bank, all Private Commercial Banks (PCBs) and Foreign Commercial Banks (FCBs) are mandatorily delivering agricultural credit to the farming household. Present participators in the formal agricultural lending market are 43 private commercial banks that are owned by individuals and private companies. Thirty-three traditional PCBs out of 43 execute banking operations on interest-based and provide cash-based agricultural loans. While 10 Islamic Shariah-based PCBs, executing their banking activities according to Islamic Shariah-based principles, deliver agricultural credit in kind. Out of 43 PCBs, 39 banks are delivering agricultural credit at present. Nine Foreign Commercial Banks (FCBs) operate in Bangladesh as the branches of the banks incorporated abroad. They also provide agricultural credit through NGOs-MFIs linkage since they have limited branch expansion in rural areas. Out of 9 FCBs, eight banks are providing agricultural credit now.

2.3.2 Products of Banks' Agricultural Credit

The product design of banks' agricultural credit in Bangladesh encompasses two bases, i.e., term-wise and purpose-wise. Term-wise credit is given based on the tenure of loan repayment time. Term-wise credit is mainly three types, i.e., short-term, medium-term, and long-term. Short-term loans are given for a maximum of 18 months. This loan is given for crop production, agricultural products processing, fisheries, soil remediation, marketing, seed production, salt farming etc. Medium-term loans are to be repaid within 18 months to a maximum of 5 years. Cattle farms, fruits and flower farms, and purchasing equipment, machinery, and vehicle are the

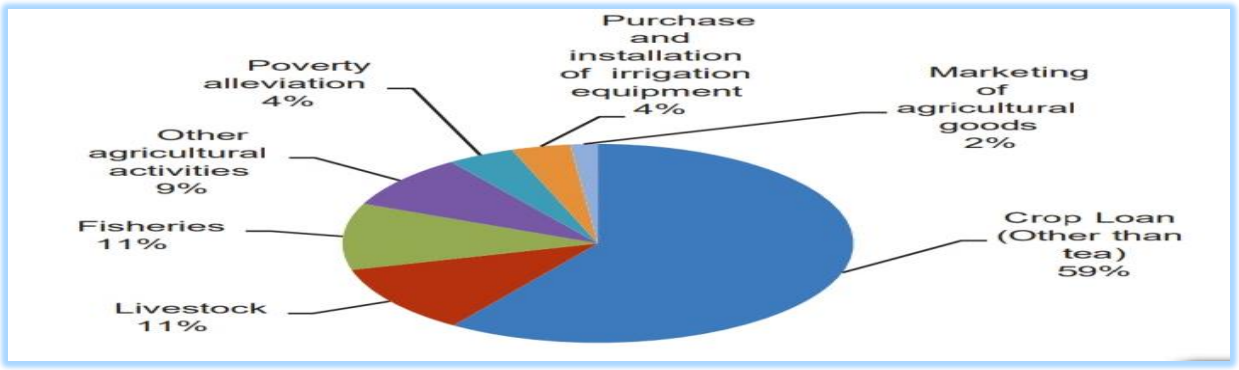
primary purpose for providing the medium-term loan. Long-term loans mainly consist of horticulture development, the establishment of the agricultural industry, export-oriented agricultural product processing, tea plantation, and rubber cultivation. The tenure of this loan is five years and above, usually set according to the project's gestation period and income generation. Purpose-wise agricultural credit comprises crop loans, dairy loans, poultry loans, fisheries loans, and credit for equipment purchase. Crop loan is given for cultivation of cereal crops, i.e., rice, wheat, maize, potato etc.; rabi[4] and kharip[5] vegetables, spices, i.e., onion, garlic, ginger, cumin etc.; pulse crops, i.e., mugh bean, lentil, khesari etc.; oil crops, i.e., mustard, sunflower, soybean, flax seed etc.; cash crops, i.e., cotton, jute, sugar cane and for fruits and flowers farming. Dairy loan encompasses purchasing cattle, i.e., bull, ox, cow, goat, sheep etc.; for meat production and processing; milk production. Fisheries loan includes the production of all kinds of fish, crab, mussels, turtles etc.; production of dry fish; purchasing fishing vehicles, i.e., trawlers and boats; fish and shrimp hatchery, fish feed production for own; construction of small cold storage, purchase of nets, i.e., trawls net, purse-seine, grill nets etc. Poultry loan contains broiler and layer poultry farms, hatchery units, poultry feed producer for their self-production, and duck rearing. Credit for equipment purchase embraces the purchase of agricultural production equipment, i.e. threshers, power tillers, deep tube-well, shallow tube-well, hand-driven tube-well, water pumps, treadle pumps, insecticides sprayers, plough, cultivators, drills, rotavators, diggers, planter, reaper etc.; transport financing, i.e., purchase of tractors, refrigeration vans, farm cooling tanks, motorcycles for milkmen, small pickups, mini trucks, chiller carriers, etc.; other equipment, i.e., installation of the turbine, sprinkle irrigation system, water management, solar energy plants etc.

2.3.3 Performance of Banks' Agricultural Credit

Figure-2.1 presents the sub-sector-wise targeted disbursement of banks' agricultural credit for FY 2021, and Figure-2.2 shows the sub-sector-wise actual disbursement of banks' agricultural credit for FY 2021.

[4] The winter harvesting season, which runs from October/November until March/April.
[5] Summer harvesting season, which runs from June/July until September/October.

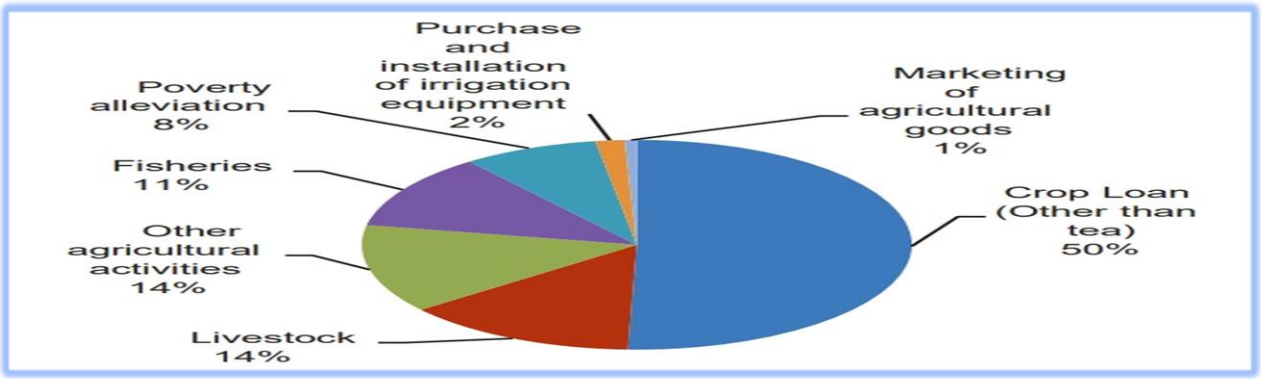
Figure 2.1: Target for Banks' Agricultural Credit Disbursement in FY 2021



Source: Annual Report 2021, Bangladesh Bank

The comparison revealed that the highest target for crop loans was 59%, but actual disbursement was 50% of the total disbursed credit. According to the agricultural credit policy and program guidelines, at least 60% of the credit should be disbursed to the crop sector. Hence, we found a significant shortfall of credit disbursement in the crop sector. Targeted credit disbursement for livestock and fisheries was 11% each, and actual credit disbursement stood at 11% for fisheries and 14% for the livestock sub-sector, indicating more than 100% target achievement. On the other hand, credit for marketing agricultural goods and irrigation equipment purchase and installation fails to achieve the target. While credit for other agricultural activities and poverty alleviation successfully achieve targeted disbursement.

Figure 2.2: Actual Disbursement of Banks' Agricultural Credit in FY 2021



Source: Annual Report 2021, Bangladesh Bank

Table-2.1 represents a comparative statement of target, disbursement, and recovery of banks' agricultural credit for the last three years. In 2019, actual disbursement was more than hundred

percent of the targeted disbursement. In 2020 and 2021, it was less than a hundred percent. The leading cause of that shortfall is the frequent interruption in banking activities due to the COVID situation. For the same reason, a negative 3.68% growth rate of actual disbursement was found in 2020. However, in 2021 we have seen positive growth of 12.13%. For the last three years, on average, 85% of credit was disbursed in the short-term, and the remaining 15% went for long-term credit. The credit recovery rate from the due for recovery was only 69.76% in the year 2020, and in 2021 this rate was accelerated to 96.93%, which was satisfactory. Overdue as a percentage of outstanding was 15.6%, 13.3%, and 12.8% for the last three years and showed a declining trend which is relatively satisfactory in the case of overdue management.

Table 2.1: Comparative Statement of Banks' Agricultural Credit

(Billion BDT)

Indicators	FY 2019	FY2020	FY2021
Disbursement Target	218.80	241.40	262.90
Actual Disbursement	236.20	227.50	255.10
Target Achievement in %	107.95%	94.24%	97.03%
Disbursement Growth Rate in %	-	-3.68%	12.13%
Disbursed in Short-term Credit	199.30	191.50	220.70
	(84.38%)	(84.18%)	(86.52%)
Disbursed in Long term Credit	36.90	36.00	34.40
	(15.62%)	(15.82%)	(13.48%)
Recovery	237.30	212.50	271.20
Due for Recovery	304.60	279.80	336.60
Recovery Rate in %	-	69.76%	96.93%
Total Outstanding Loan	429.70	455.90	459.40
Overdue	66.90	60.60	58.70
Overdue as Percentage of Outstanding	15.6%	13.3%	12.8%

Source: Annual Report 2021, Bangladesh Bank

In Table-2.2, the performance of agricultural credit by different lenders is furnished. FCBs and SDBs achieved more than a hundred percent of targeted disbursement. SCBs achieved only

84.19% of targeted disbursement, which is very poor and the lowest among the lender's group. This poor performance is also remaining for SCBs in the case of overdue as a percentage of outstanding which is 19.12%, indicating the lowest recovery rate of overdue. A 13.35% overdue rate is found for SDBs which is also above the average industry rate of 12.76%. The extraordinary performance of FCBs has been noticed since they have zero percent overdue and 120.83% of target achievement. The overdue rate of 5.68% for PCBs is pretty satisfactory, but 93.15% of the disbursement target achievement is not.

Table-2.2: Performance of Agricultural Credit by Bank Category in FY 2021

(Billion BDT)

Indicators	SCBs	SDBs*	PCBs	FCBs	Total
Disbursement Target	31.95	78.50	145.46	7.01	262.92
Actual Disbursement	26.90	87.25	135.49	8.47	255.11
Target Achievement in %	84.19%	111.15%	93.15%	120.83%	97.03%
Recovery	24.61	89.42	147.12	10.09	271.24
Overdue	22.22	29.86	6.57	0.00	58.65
Outstanding	116.19	223.73	115.67	3.81	459.40
Overdue as Percentage of Outstanding	19.12%	13.35%	5.68%	0.00%	12.76%

Source: Annual Report 2021, Bangladesh Bank * BKB and RAKUB Only

2.4 Related Literature on Agricultural Credit Constraints

2.4.1 Related literature on factors affecting agricultural credit constraint status and condition of constraint status

In their study in Madagascar, Zeller et al. (1994) found the farmers' wealth, debt-to-equity ratio, creditworthiness, age, gender, educational qualification, and collateral requirements as the key determinants of the credit constraint status of the farmers. Following, Lapar (1994), in his doctoral dissertation, identified total assets value, financial assets value, education, and sex as statistically significant factors to explain the constraint status of the rural farm enterprise in

Philippines. Freeman et al. (1998) hypothesized older farmers have better life and working experience, hence that constraint status negatively associated with age. The authors empirically found a negative association between age and constraint status in Kenya. Then Omonona et al. (2010) identified age, sex, farm size, education, marital status, contact with extension agent, land acquisition, income, membership of local institutions, saving, outstanding debt, and dependency ratio as the key determinants of the credit constraint status of the farmers in Nigeria. Subsequently, Kuwornu et al. (2012) found that gender, household size of farmers, annual income of farmers and farm size significantly impact credit constraint conditions of the farmers in Ghana. According to Musaka et al. (2017), educated farmers are more financially literate and can understand complex loan terms, increasing their chances of getting loans and less likely to be constraint. Freeman et al. (1998), Komicha & Ohlmer (2007), and Ali and Deininger (2012) all found similar evidence of the impact of educational attainment on constraint status.

In recent study of Kofarmata and Danlami (2019) revealed several statistically significant indicators that explain the credit constraint status of farmers, including experience in farming business, farm size, administrative involvement, and political affiliation. Findings of Omodara et al. (2021) indicated that credit rationing is influenced by factors such as affiliation with cooperative associations, level of experience, educational attainment and frequency of loan applications. Presently, Balana & Oyeyemi (2022) founds experience, land title, value of assets, savings and non-farm income as statistically significant influencing factors to explain credit constrain status of the farmers.

Based on the prior research findings discussed in the previous section, we have found that the constraint status of farmers is determined by considering their demographic and socio-economic characteristics, as well as farm-specific and institutional aspects, both separately and collectively. However, only a small number of researches have taken into account the combined influence of farm, farmer, and institution-specific characteristics to determine constraint status. Thus, in order to fill this vacuum in research, we propose that it is necessary to examine the constraint status by considering the combined impact of certain features related to the farm, farmer, and institution.

The subsequent section provides a concise overview of prior empirical research findings about the nature and extension of credit constraint status of farming households.

Barham et al. (1996) explored that non-price credit constraint status is common among lower-wealth households in Guatemala. Among the 201 sampled small-scale farmers, one-third are constrained in formal loans, and two-thirds are unconstraint. In their research, Guirkinger & Boucher (2008) disclosed the extension of different credit constraint statuses of the farmers and found risk constraint and transaction cost constraint farmers account for 26% of the overall sample and 52% of the constraint sample. Fletschner et al. (2010) explored one-fourth of the sampled farmers are found risk rationed, while almost half of the sampled farmers are credit constraint. Then, Ali et al. (2014) in Rwanda found that seventy-one percent farmers are credit constraints; including 32 percent of sampled farmers who are quantity rationed, and 10 percent are transaction cost constraints. Recently, Mukasa et al. (2017) in Ethiopia investigate the status and extent of constraints status of the farmers. Analyzed data showed that around 66.6% of the sampled farmers were credit constraints, among them 71.9% are risk constraints, and 14.33% are transaction cost constraints. The authors suggested that enhancing farmers' access to financial information, expanding the number of branches of banks and microfinance institutions in the country, especially in rural areas, and lowering financial transaction costs might remove farmers' credit constraints condition. Kinuthia (2018), in his working paper, founds that twenty percent of farming households are unconstraint; 36% of the farmers are transaction cost constraints, while 34% and 8% are risk and price constraints, respectively. Recently in their study, Balana et al. (2020) discovered that 14.0 percent of the sampled agricultural households in Ethiopia experienced credit constraints, while this figure was determined as 45.4 percent in Tanzania. Study further revealed that households that are constrained by supply-side factors account for 6.7 percent and 10.2 percent of the farmers surveyed in Ethiopia and Tanzania, respectively. Whereas demand-side constrained households made up 9.5 percent and 42 percent correspondingly in Ethiopia and Tanzania.

Based on the preceding discussion, it is clear that much research has been conducted in various regions of the world to identify the nature of credit constraints faced by farmers. As far as we know, there is no empirical evidence has been found regarding identification of the type and extent of bank's agricultural credit constraint in the context of Bangladesh. As a result, we inspired to fill this research need in the current study that we are conducting.

2.4.2 Related literature on impact of agricultural credit constraint status on agricultural productivity

Feder et al. (1990) identified the productivity difference between credit constraint and unconstraint farm households in China. They estimated the effect of credit constraint status on the farm productivity of 200 sampled farmers. They discovered that if each credit-rationed farming household received an additional credit of 17.82 yuan, the total production of those families would increase by 201.08 yuan or around 0.04% of the total output. Freeman et al. (1998) presented cross-country evidence of the productivity difference between constraint and unconstraint farmers. Findings revealed that a one percent increase in credit leads to a 0.6% increase in productivity for credit-rationed farms and a 0.4% increase for credit-non-rationed farms in Ethiopia. In Kenya, a one percent increase in credit leads to a 1.6% increase in productivity on credit constraint farms and a 0.9% increase on credit unconstraint farms.

Foltz (2004) argued that due to government intervention, the moral hazard of borrowers, high transaction expenses, and the monopoly power of informal lenders lead to agricultural credit market imperfection, which in turn influences the credit constraint status of the farmers of Tunisia. He found the elasticity of profits to loans is 0.20 for rationed farmers and 0.04 for non-rationed farmers, according to analyzed data from a sample of 142 farmers. Then, Komicha (2007), in his doctoral thesis, discovered that credit constraint status negatively affected the technical efficiency of farm households, and there was a gap of 12% in technical efficiency between credit constraint and unconstraint farm households in Ethiopia. In their research, Guirkinger & Boucher (2008) disclosed 57% of output loss associated with the credit constraint status of the farmer and estimated on average that output would rise by $482 per hectare if all sorts of credit constraints were entirely removed. Overall, the value of farm output was reduced by 26% in Peru due to credit constrained condition of the farmers. Similarly, Fletschner et al. (2010) explored that twenty-seven percent profits of the farmers are reduced due to credit constraint status compared to those who are not. Then Dong et al. (2010), in their research conducted in China, explored 31.6% of agricultural productivity and 23.2% of rural household income has been improved with the removal of credit constraints. The study also suggests that production inputs, farmers' capabilities, and educational levels cannot be fully utilized under credit constraint status. In an another study of Dong et al. (2012) conducted in Heilongjiang

province, Northeast China, revealing that the average agricultural output was estimated to be increased by 75 percent by removing credit constraints. The study also confirms that under the credit constraint status of the farmers, labor inputs and education may not be entirely working because of the inappropriate combination of inputs. The statistically significant negative coefficient between productivity and constraint status validates the hypothesis that credit unconstraint farmers have higher yields and vice versa. In their study in China and India, Kumar et al. (2013) experienced 74% of Chinese farming households and 78% of Indian farming households indicating that credit constraint would reduce input use and lower agricultural productivity. Then, Ali et al. (2014) in Rwanda found that 17 percent of farm output could be increased by eliminating all types of credit rationing in the semi-formal sector. They also found a significant productivity level gap between constraint and unconstraint farming households, with the latter group reporting higher input use and production levels.

Recent times Mukasa et al. (2017) in Ethiopia investigate the impact of credit constraints on the farm output of smallholder farmer and found the productivity gain model reveals that alleviating all sorts of credit constraints would generate 60% productivity gains in the study area of Ethiopia. Afterwards, Kinuthia (2018) discovered significant differences in net revenue per hectare of land in between constraint and unconstraint farmers. He founds net revenue per hectare of land is USD 41.18 for constraint farmers and 118.24 for unconstraint farmers. Subsequently, Amanullah et al. (2019) conducted a study in rural Sindh, Pakistan to estimate farm level impacts of credit constraints on agricultural investment and income. The findings suggest that removing credit constraint might lead to a substantial rise in agricultural investment and income, with potential growth rates of up to 7.3% and 5.1% respectively. The study conducted by Lakhan et al. (2020), the findings indicate that farmers facing constraints, cultivate a larger area of land, specifically 2.8-4.1% more, compared to farmers without constraints. However, credit-constrained farmers experienced a decrease in both spending and income per capita, with reductions of 18.9% and 13.8% respectively, in comparison to unconstrained farmers.

The previous section has acknowledged the adverse effects of credit constraints on farm productivity. However, we have recognized that there is a dearth of research on the assessment of the credit constraints effects on the usage of inputs, production, and income levels distinctly.

Hence, the existence of this study gap has been acknowledged and serves as a driving force for the researcher to determine the magnitude of credit constraint impact on farming household's input investment, production and income level separately.

2.5 Related Literature on Access to Agricultural Credit

2.5.1 Related literature on factors affecting access to agricultural credit and condition of credit access

Sarap (1990) explored that the smaller landholdings, the informal and oral nature of tenancy contracts, illiteracy and lower caste status negatively impact peasants' access to formal credit in India. Mohieldin and Write (2000) discovered that gender, educational level, family labor, and farm size had a positive impact on the likelihood of individuals being able to get formal loans. Yehuala (2008), in his doctoral dissertation, discovered extension programs, experience in credit use, total cultivated land size, number of livestock, and collateral or group formation as the key determinant factors behind access to formal credit. Then Kosgey (2013), in his study in Kenya, found that farmers' age, education level, household size, and repayment period were extremely vital factors that influence access to agricultural credit. Awotide et al. (2015) posits that younger farmers lean towards more risk than older farmers, thus expected to have more access than their counterparts. Therefore the authors hypothesized a negative association of age on credit access. Madafu (2015) states that experienced farmers possess enough financial records that banks may demand for loan processing. Gamage (2011) also supports this premise, contending that novice farmers lack sufficient records about past financial performance, hence posing challenges for lenders in assessing loan requests. Sekyi et al. (2017) identified age, literacy, farm equipment, and group membership as the variables which significantly affect farmers' access to credit in their study area of Ghana. They suggested a well-functioning farmer-based group organization for reducing credit constraints and increasing access to credit and productivity.

In recent studies of Isaga (2018), demonstrates that the assets allocated to farming operations, education, and gender play a substantial role in determining access to bank financing by the smallholders farmers in the Mvomero District of Morogoro, Tanzania. Meanwhile Temesgen et al. (2018) revealed that education level, the frequency of extension contact had positive and family size and distance from microfinance institutions had a negative and significant effect on

households' credit participation in the study area in Ethiopia. In their research paper, Abdallah et al. (2019) found farm size, labor use, sex, age, education as the significant determining factors for both access to credit and productivity in the study area of Ghana. Later on Zulfiqar et al. (2021) identified several critical factors that influence access to bank credit among farmers in the Southern Punjab of Pakistan, including the age, education, farm income, off-farm income, and land ownership of the farmers. Then Taremwa et al. (2022) mentioned opening a savings account at a commercial bank improves the chances of obtaining credit by reducing the imbalance of information between the farmer and the bank. The findings also revealed that access to agricultural financing among farmers in the eastern and western provinces of Rwanda is influenced by both individual and institutional factors.

We observed that, individual, farm related, and institutional factors influence farmers' access to credit status, based on previous research. However, few studies have included individual, farm related, and institutional factors altogether to evaluate access to credit status. To fill this study gap, we propose examining the access status by assessing the combined impact of individual, farm related, and institutional aspects.

The following section presents a brief summary of previous empirical study findings on the condition of access to credit status of farming households.

Sarap (1990) explored that small and marginal farmers had less access to formal credit than medium and large farmers in the survey area of India. Khandker & Faruqee (2003) also found massive discrimination in access to institutional loans. They found that the large households who are only 4.1% of total households that receive 41.6% of formal agricultural credit, and subsistence households, who constitute more than 69% of total households, receive only 23% of institutional loans. Hussain & Thapa (2012) mentioned that lower-small farmers have less access to formal credit than other farmers. They obtain only 9% of the total formal credit and 28% of the total informal credit. This access amount satisfies only 6% of the total credit demand by lower-small farmers. The authors concluded as a result of that, the lower-small farmers are forced to depend on informal credit in Pakistan. Then Kosgey (2013), in his study in Kenya, found. Only 36.8 % of the sampled farmers have access to agricultural credit. However, the remaining 63.2% did not have access to credit. According to the findings of Zulfiqar et al. (2021), 44.6 percent of the total agricultural credit disbursed to subsistence farm holdings. In

contrast, the proportion of economic farm holdings and above economic farm holding is found as 17.8 and 37.6 percent, respectively.

It is evident from the preceding discourse that a substantial amount of research has been devoted to determining the access status of various categories of farmers. However it is necessary to identify different condition of accessed credit (e.g., adequacy, timeliness, cost of borrowing, tenure) in between public and private sector banks. Therefore, we concentrated on bridging this research gap in order to produce novel insights concerning different conditions of accessed credit by the farming households.

2.5.2 Related literature on impact of access to agricultural credit on agricultural productivity

Carter (1988), in his study in Nicaragua, founds that credit receivers are 16% more technically efficient with credit, and a randomly selected credit receiver would use 46% more inputs than he or she would have otherwise. A positive association between credit and input use and farm productivity is also identified in this study. Diagne (1998), in his working paper, stated that enabling households to lessen their borrowing from informal sources can accelerate access to formal credit, bringing a marginally beneficial impact on annual household income in Malawi. The study also suggested improving infrastructure in rural areas to facilitate formal institutional credit expansion. Then Spio (2002), in his doctoral thesis, concluded that access to agricultural credit increased a randomly selected farmer's output by 21% on average, and a productivity gap exists between the borrower and non-borrower farming households in South Africa. Khandker & Faruqee (2003) found a positive effect of agricultural credit access on the net value of agricultural output in Pakistan. Data analysis confirms that a 10% increase in borrowing from a formal source increases agricultural output by almost 1%. Olagunju (2007) argued that farming households who are out of agricultural credit are inefficient in resource utilization compared to farmers with credit. Credit non-participant farmers are underutilizing labor, capital investment, fertilizer, and equipment devoted to production. Afterwards, Nosiru (2010) identified that the credit beneficiaries had higher average farming efficiency than the non-beneficiaries of credit in his study conducted in Nigeria. Access to microcredit facilities was observed to be important in improving farm production, but it is found in the study area not to have a justifiable utilization of the credit; otherwise, productivity would have been more productive.

Reyes & Lensink (2011) found a significant difference in gross income and net income between the borrower and non-borrower farmers in their working paper conducted in Chile. While the study also revealed that short-term credit does not significantly affect farm productivity. Subsequently, Rahman et al. (2014) stated that the amount of credit, household size, income, education level of the farmer, short-term loans, and long-term loans significantly and positively affect agricultural productivity in Pakistan. Then Baffoe et al. (2014) concluded that the average profit of borrowed households is higher and statistically different from that of non-borrowed households in Ghana. The study recommends judicious use of credit, leading to proper input acquisition and, thus, increased productivity. Duy (2015), in his study conducted in Vietnam, found that access to formal credit is likely to increase farmers' production and technical efficiency. The author recommends credit plus services for better credit utilization among the farmers.

Akudugu (2016) explored a significant positive relationship between access to credit and agricultural output. He argued that informal credit is more productive than formal credit. Specifically, access to formal and informal credit raises farm household agricultural output by about 0.1 and 0.45, respectively. Afterwards, Bichi (2017) in Nigeria conducted his research and explored agricultural credit's relationship with farm productivity, which is significant at a five percent level with a positive coefficient of 0.04. The findings suggest that those who get an additional one percent of agricultural credit will increase their production by 0.04 percent compared to those who did not get access to agricultural credit, keeping other factors constant. In recent times, Chandio et al. (2018) reaffirmed that agricultural credit has a favorable and highly significant impact on wheat production. Additionally, it has found that short-term loans have a more pronounced effect on wheat productivity compared to long-term loans. In their research paper, Abdallah et al. (2019) revealed that credit access accelerates farming households' agricultural income, and a significant productivity gap exists between accessed and non-accessed farmers in both study area zones in Ghana.

The empirical evidence presented in the prior section concerning the effect of credit access on agricultural output is ample and found different regions of the world. To the best of our knowledge, there is a dearth of empirical research examining the effects of banks' agricultural credit access on agricultural productivity in Bangladesh. Consequently, this research need motivated us to undertake the present study.

2.6 Related Literature on Agricultural Credit Fungibility

2.6.1 Related literature on factors affecting agricultural credit fungibility and condition of credit fungibility

Meyer (1990) argued that the lower interest rates of formal loans relative to other sources lead higher rate of fungibility. Thus, low-interest rates trigger the excess demand of the larger, more powerful, and politically involved farmers intended to practice their influence to get a more significant share of the concessional loan for other purposes. Siddiqi et al. (2009) argued that to ensure proper use of agricultural credit and avoid fungibility, agricultural credit policy should address timely and adequate loan disbursement at the grass root level, simultaneously judging proper loan requirements and identifying needy farmers. Then Nosiru (2010) concludes expansion of commercial banks' operation through proper monitoring of loans and frequent visitation by bank officials can reduce the tendency of agricultural credit fungibility among farmers. Afterwards, Oboh & Ekpebu (2011) founds age, education, farm size, household size, length of loan delay and visitation by bank officials as the key variables to explain credit allocation to the farming sector in Nigeria. Kuwornu et al. (2012) asserted that a farmer with a higher level of education has the ability to allocate agricultural loans in a more effective manner. Therefore, it is anticipated that farmers with higher levels of formal education would allocate a greater amount of credit to the agricultural sector and exhibit reduced fungibility. The authors mentioned that delayed disbursement of agricultural loans tends to entice farmers to use the funds for inappropriate purposes. They also mentioned inadequate agricultural credit, which is insufficient for any meaningful farm operation, is typically redirected to non-agricultural activities and induce credit fungibility. Hussain (2012), in his doctoral thesis, stated that agricultural credit is diverted from formal sources to the repayment of informal sources and vice versa. Even credit is given in kind (Inputs) despite being sold to other farmers at the time for immediate medical expenses. He founds non-fixed assets; non-farm income, landholding size, household size, and credit source are the significant factors that influence the credit fungibility rate of the farmers. Then Hussain & Thapa (2012) mentioned as a result of insufficient revenue and capital, a significant number of farmers engage in the misappropriation of agriculture credit.

According to Ijioma & Osondu (2015) a larger household size may result in loan diversions due to an increase in consumption expenses. The authors also mentioned low income, meeting

household's both food and non-food expenses as major cause of credit fungibility. Then Hussain & Thapa (2016) cited that the usage of agricultural credit for non-farm activities decreases as the landholding size increases. They also posits holding non-fixed assets can fulfill immediate family needs, thus reduce fungibility tendency of the farmers. Chandio et al. (2018) stated inadequacy of funds and delay in disbursement are the main reasons behind agricultural credit fungibility. Recently in their study in Ghana, Darfor et al. (2021) found illiteracy, household size, gender, and no. of family members suffering from chronic diseases positively influence the agricultural credit fungibility status of the farmers. Whereas agricultural credit fungibility is negatively associated with off-farm income and farm size. Ankrah Twumasi et al. (2022) mentioned engagement in non-agricultural employment of a household reduced the tendency of agricultural credit fungibility. They also found the reduction of agriculture credit fungibility is more significant when females are employed in off-farm activities, compared to males.

The preceding section outlines different categories of factors that can impact the fungibility status of the farming households. Furthermore, the prior discussion has also carried empirical evidence from many regions of the world regarding the determinants of fungibility status. However, there has not yet been any empirical study conducted in Bangladesh to comprehensively understand the influencing variables of fungibility status. Thus, we acknowledge that scarcity of research in our current study.

The following section presented the nature of fungibility status, uses of fungible funds as well as condition and intensity of fungibility in between different regions and source of credit. .

Von Pischke and Adams (1980) conducted their study in Latin American countries and found that agricultural credit fungibility exists at the national, financial intermediary, and farm levels. Donor agencies' sector-specific funds are sometimes diverted to other sectors by the central monetary authority. Financial institutions further diverted sector-oriented loans to other purposes for additional profit making, and finally, farmers also misuse the loans for non-agricultural purposes. In a study in Bolivia, Ladman & Tinnermeier (1981) provide a theoretical framework for the misuse of agricultural credit at the state level as a political-economic instrument. Concessionary interest rates and permissive repetitive default is employed in this context. Therefore, they suggest that pressure from foreign donors and agencies could help minimize this agricultural credit fungibility and maximize resource allocation and income distribution. Then

Feder et al. (1989) found in the Gongzhuling state of China, 81.9% of total agricultural loans have come from formal sources. This rate is 69.3% and 48.3% for Tai and Jurong states. The fungibility of formal agricultural credit is only about 3% in Gongzhuling state. The corresponding rate is 9% and 42% for China's Tai and Jurong states. Following that in another study, Feder et al. (1990) identified intensity of fungibility in between formal and informal sources and recognized the purposes of credit diversion (e.g., house construction, social expenditure, and household consumptions). The study also revealed that 75% of the total loan borrowed by sampled farmers comes from formal sources, and the remaining belongs to informal sources. Only 3.4% of total formal agricultural loans are diverted into non-farming activities. In contrast, 86.3% of informal loans are misused in non-farming activities. Mahajan & Ramola (1996) explored fifty to seventy-five percent of the agricultural credit from banks gets diverted to other non-productive purposes (e.g., household expenses, emergencies such as sickness, social expenditures and repayment of the moneylender's old debt). In addition several studies, including Saddik (1995) in Egypt, Akram (2008) and Siddiqi et al. (2009) in Pakistan, Cole (2009) in India, and Muhumuza (1997) in Uganda, also have indicated that a significant proportion of agricultural funding is allocated towards non-agricultural activities, such as the purchase of consumer goods, the observance of festivals, and the construction and maintenance of houses.

Khandker & Faruqee (2003) explored that in their study area of Pakistan, formal agricultural loan's fungibility rate is only 12.5%, while this rate is alarming for informal loans, which is 73.1%. Menaria & Bhandari (2013) explored farmers' motives, insufficiency of loans, and delay in disbursement, ranked as the first, second, and third reasons behind agricultural credit fungibility. While household consumption, social expenses, and repayment of old borrowing ranked in the same fashion for the areas of misused funds. Then Ijioma & Osondu (2015), in a study in Nigeria, discovered that 37.78% of the farmers diverted the agricultural credit, and 53.33% of them did not involve in fungibility, whereas 8.89% of the respondents did not reply whether they diverted accessed credit or not. Saqib et al. (2016) found a significant difference among the farmers' groups regarding credit fungibility in Pakistan. Lower subsistence farmers' agricultural credit fungibility is 85.7%. This ratio is 70.6% for medium subsistence farmers and 58.3% for upper subsistence farmers. Another study of Saqib et al. (2017) explored that 49% of

total agricultural credit is used for non-agricultural purposes by small farmers, whereas this tendency of fungibility is found at 39.5% for medium and large farmers. Subsequently Chandio et al. (2018) found that the agricultural credit fungibility rate is 48.47% and 43.49% for small-scale, medium and large-scale farmers. They also found that average investment in agricultural production inputs is higher for medium and large-scale farmers as they are less likely to divert funds to non-agricultural purposes and vice versa.

The above empirical findings reveal the purposes of fungible fund uses; fungibility rate in between types of farmer, areas and sources of fund. However, fungibility rate based on loan size, intensity of fungibility on the basis of fungibility ratio not yet identified. Moreover, comparison between public and private sector banks regarding fungibility ratio and credit margin of investment yet to explore. Hence, we acknowledge this research gap and deemed it worthy of future investigation.

2.6.2 Related literature on impact of credit fungibility on agricultural productivity

Von Pischke and Adams (1980) argued that the detrimental effect of loans on the lives of rural households is linked to the misuse of funds resulting from a lack of financial literacy. Odedokun (1996) addressed two types of agricultural credit fungibility, i.e., financial substitution and expenditure substitution and posits each of these adversely affects the use of credit for agricultural production. The diversion of agricultural financing to non-productive activities significantly hampers agricultural productivity. Consequently, the utilization of production inputs deviates from the ideal level, resulting in suboptimal usage of inputs and equipment, which can reduce production output relative to the available resources. Then Nosiru (2010) explored that the amount of credit obtained by the farmers is not positively contributed to farm productivity level due to non-judicious utilization and diversion of agricultural credit. Similarly Oboh & Ekpebu (2011) stated that enhancing agricultural output requires the effective and prudent utilizations of loans in agricultural operations. The authors also mentioned that it is essential to provide farmers who benefit from loans with fundamental training on effective loan management to reduce the prevalence of loan diversion.

Hussain & Thapa (2016) argued that when agricultural credits are utilized for nonfarm activities, it leads to diminished and substandard agricultural output, hence impacting farm revenue. Saqib

et al. (2017) posit that low farm production, which affects low farm income, happens when agricultural credits are used for purposes other than farming. According to Ankrah Twumasi et al. (2022) the adverse correlation between agricultural loans and farm productivity can also be ascribed to the adoption of agriculture credit fungibility by the farmers.

Summarizing the above discussion, we have found that the adverse effect of credit fungibility on farm productivity has been discussed at the conceptual level by the scholars. Furthermore, the limited number of studies on the theoretical framework of the effects of agricultural loan fungibility on production suggests a lack of focus from researchers. In addition to that, as far as we concern, there is no data based inspection has been done to scrutiny the impact of banks' agricultural credit fungibility on productivity. Therefore, to address this research gap, we conducted empirical research to provide data on the impact of banks' agricultural credit fungibility on farm productivity.

2.7 Related Literature on Impact of Agricultural Credit on Agricultural Productivity in Context of Bangladesh

Bidisha et al. (2015) presents empirical evidence supporting the beneficial impact of engaging in a semi-formal sectors credit scheme on agricultural productivity. The authors mentioned that credit played a substantial role in enhancing household crop production, as opposed to a similar household that did not have access to credit. Then Jimi et al. (2016) analyzed survey data from a field experimental investigation and demonstrate that loosening the credit constraint has a substantial and beneficial effect on both agricultural output and efficiency. Afterwards, Afrin (2016) investigates the influence of seasonal loans from NGO on crop production in the Badarganj Upazila in Rangpur district and found the recipients of seasonal loans in the study area exhibited higher productivity compared to those who did not receive such loans. Hossain et al. (2019) subsequently suggest that the presence of semi-formal credit has a moderately positive influence, although the precise impact is not well defined. The microcredit program enhances the income generated by crop farming, but it does not have a substantial impact on overall income.

The empirical evidence shown above suggests that the impact assessment of credit on agricultural productivity in Bangladesh has been done based on survey conducted at the field level, only includes the credit offered by semi-formal institution such as NGOs. Thus, there is a

requirement to assess the impact of formal financial institution's (e.g., banks) credit on agricultural output in Bangladesh. In view of this the following section investigated the impact of banks' agricultural credit on farm productivity.

The results of Islam's study (2020), based on secondary data, reveal the existence of both short-term and long-term connections between banks agricultural credit and agricultural productivity in Bangladesh. The author mentioned in addition to bank credit, the productivity of the agricultural sector is also influenced by other dynamic factors such as inflation, interest rate, and government expenditure on agriculture. Following that Mehdee & Rahman (2021) utilized time series analysis to examine the influence of bank credit and subsidy on the growth of agricultural production, using data obtained from secondary sources. The authors found there is a long-term relation between agricultural production and agricultural credit in Bangladesh. Subsequently, Islam & Yu (2022) in their study in Bangladesh developed a multiple regression model to analyze the secondary data, and found there is a substantial positive relationship between bank loans to the agricultural output in the country. Most recently, Patwary et al. (2023) in their study in Bangladesh affirms that bank agricultural loan, pesticide consumption, and utilization of cultivated lands are significantly related to agricultural production in the long term. The VECM model has been applied in a series data obtained from different published sources. The authors propose implementing policy changes at Bangladesh Bank to enact new legislation, programs, products, funding rules, and expanding rural banking networks for increased disbursement of credit.

The empirical evidence presented above from Bangladesh demonstrates a positive and long term association between banks' agricultural credit and agricultural productivity at macro level based on secondary data. However, to the best of our knowledge, a microeconomic analysis based on field survey that examines the influence of agricultural credit provided by banks on productivity, specifically in Bangladesh, has not been conducted yet. Thereby this lack of research motivate us to conduct a micro-economic field-level study to explore the impact of banks agricultural credit on farm productivity in our current study.

2.8 Literature Gap

Based on the discussion of prior empirical research, it is evident that from the standpoint of Bangladesh, an investigation into the factors that influence the access, fungibility, and constraint of banks' agricultural credit, as well as the subsequent impact on farm productivity, has yet to be conducted using field-level data. Limited research has been undertaken in Bangladesh concerning the credit accessibility of semi-formal sector and its impact on productivity, utilizing primary data. In contrast, some studies regarding impact of banks' agricultural credit on productivity in context of Bangladesh were done on aggregated level secondary data. In this regard, a microeconomic analysis based on field survey that examines the influencing factors of bank's agricultural credit constraint, access, fungibility status and their corresponding effect on farm productivity need to be addressed. Therefore, we expect by addressing this significant research gap in our present study; will bring some insights to the existing literature.

From a global standpoint, the early portions of the literature review address how certain studies focus solely on demographic and socio-economic aspects specific to farmers when determining the constraint, access, and fungibility status. Conversely, numerous studies take into account elements that are specific to farms and factors that are specific to farmers. Furthermore, numerous researches also take into account institutional variables in this regard. However, only a small number of researches have taken into account the combined effects of farm, farmer, and institution-specific characteristics. Therefore, to address this study gap, we suggest that it is imperative to investigate the constraint, access and fungibility status by taking into account the collective influence of specific characteristics associated with the farm, farmer, and institution.

The preceding literature review section has also recognized data based impact of credit constraints and accessibility on agricultural production. Nevertheless, we acknowledge the lack of research on the evaluation of the impact of credit constraint and access on the usage of inputs, production, and income levels in a separate manner. Therefore, the researcher recognizes the presence of this vacuum in information and is motivated to investigate the extent to which credit constraints and access to credit affect the investment in inputs, production, and income of farming households. On the other hand, adverse effect of credit fungibility on farm productivity has been discussed at the conceptual level by the scholars. There is no data based inspection has been done to scrutiny the impact of banks' agricultural credit fungibility on productivity. Hence,

to fill this research gap, we conducted empirical study on banks' agricultural credit fungibility and farm productivity.

Furthermore, this study addressed private and public sector banks' comparison regarding the nature of constraint status, condition of accessed credit (e.g., adequacy, timeliness, cost of borrowing, tenure) intensity of fungibility (e.g., fungibility ratio and credit margin of investment).

Based on the previous studies carried out throughout the world, we have applied empirically valid techniques and tools in our recent field-level data collected in 2022. Thus, we expect our findings will incrementally contribute to the existing literature by addressing the gap in the literature mentioned above.

Chapter 3
Methodology

3.1 Nature of the Study

This study is mainly analytical research. Analytical research analyses collected facts and information to discover the cause and effect and critically evaluate the material (Kothari, 2004). In this study, our main concern is to evaluate factors behind bank's agricultural credit constraint, access to credit and fungibility status. In addition to that, we also investigate the effect of credit constraint, access to credit and fungibility status on different productivity indicators. Besides that, nature, extensions, conditions of credit constraint, access to credit and fungibility status are also studied in this study by stating the affairs as it exists at present. Hence, to some extent, this research is descriptive as well. This study is empirical since it is based on empirical data, and its measurement is based on established techniques and tools used by previous empirical works.

According to Kothari (2004), applied research aims to identify the solution to the present problem faced by a society or community. Most of the farmers in our country are under agricultural credit constraints. They also have been facing a lack of access to bank credit and some problems associated with credit access. Moreover, agricultural credit diversion tendency is also existing among the farmers. In addition to that low level of agricultural productivity also remain. Our study aims to address these practical problems; hence, this research falls under applied research criteria. Both quantitative and qualitative approach is used in this study. We applied the qualitative approach to investigating the reasons behind farmers' behaviors, i.e., how they think and do certain things. On the other hand, the quantitative approach refers to the phenomena that can be measured in quantity or amount. The quantitative approach is used in this study to measure the magnitude of the cause and effect of some factors on each other.

3.2 Types and Sources of Data

We have taken into account both primary and secondary sources of information. The majority of the data analysis has been done using first-hand information. Secondary data has also been collected and examined on a small scale to provide more statistics

3.2.1 Primary Data

Primary data states the data collected for the first time and thus happens to be original and fresh (Kothari, 2004). In this study, a field-level survey was carried out through a well-structured pretested questionnaire. The face-to-face interview method is followed to collect the data from the farmers. The questionnaire is designed as close-ended and pre-coded. Despite this, the questionnaire also noted farmers' willful thoughts and ideas in the form of informal discussions. The interviews are mainly taken in the farming field, farmers' houses, tea stalls and shops for seeds, fertilizer and insecticides.

3.2.2 Secondary Data

According to the definition by Kothari (2004), secondary data can be termed as already published and available data collected earlier and analyzed by someone else. In addition to this study's extensive use of primary data, few secondary data were collected for other analyses and information. The primary sources of secondary data are furnished below.

Banks' Reports

Banks reports and documents include Bangladesh Bank Annual Report 2020-21, Agricultural & Rural Credit Policy and Program for the FY 2021-2022 published by Bangladesh Bank, Annual reports of different scheduled banks, and information from respective banks' websites.

Government Censuses, Surveys and Other Reports

This category comprises Preliminary Report on Agricultural Census 2019, Agriculture and Rural Statistics 2018, Labor Force Survey 2017, Rural Credit Survey 2014, Agricultural Census 2008 published by Bangladesh Bureau of Statistics; Bangladesh Economic Review 2021, 8^{th} Five Year Plan published by Ministry of Finance; Yearly Statement for FY 2020-21 published by Export Promotion Bureau of Bangladesh.

District-Level Information and Reports

It includes Dhaka District Statistics 2011, published by Bangladesh Bureau of Statistics; Govt. websites of Dhaka district, Keraniganj, Nawabganj, Dhamrai, Savar and Dohar sub-districts; published by Bangladesh National Portal.

3.3 The Study Area

The study was conducted in the rural areas of Dhaka district. As per Rural Credit Survey (2014) conducted by BBS, the whole country, excluding city corporations, municipalities, sub-district headquarters, other urban areas, and growth centers, were treated as rural areas. Considering the time and budget constraints and for the researcher's convenience, rural areas of Dhaka have been selected as the study area. For reference Temesgen et al. (2018) purposively selected Toke-Kutaye district of Ethiopia while studying factors affecting credit access. However, there are five sub-districts under Dhaka district: Keraniganj, Nawabganj, Dhamrai, Savar and Dohar. All the sub-districts are covered in the study. From Keraniganj sub-district Kalatia, Ruhitpur, Konda; from Nawabganj sub-district Jantrail, Sholla, Barrah; from Dhamrai sub-district Dhamrai Sadar, Shambhag, Kulla; from Savar sub-district Shimulia, Banagram, Tetujhora, and from Dohar sub-district Nayabari and Bilaspur union council area has been chosen randomly for field level data collection from the farming household.

Geographic Position and Administration

Dhaka district is fenced by Gazipur and Tangail districts on the north, on the east by Narayanganj district, on the south by Munshinganj and Faridpur districts and on the west by Manikganj district. It lies between 23º53' and 24º06' north latitudes and between 90º01' and 90º37' east longitudes. The district's total area is 1463.60 sq. km. (565.00 sq. miles). Dhaka district was established in 1772. The district comprises five sub-districts, including 63 union councils, 974 mauzas[6] and 1999 villages.

Economic Situation

The economy of the rural areas of Dhaka is mainly agriculture-based, and the urban area is industry based. The main crops of our study area include paddy, wheat, jute, corn, mustard, potato, onion, vegetables, spices, pulses etc. Jackfruit, kath lichee, blackberry, palm betel-nut, banana etc. are the main fruits of the rural areas of Dhaka. Besides crops, livestock, poultry, and fishing are the subsidiary source of household income in the study area.

[6] Mauza is the smallest unit-area for revenue collection and different from the term village. Some villages may form a mauza or a village comprise some mauza.

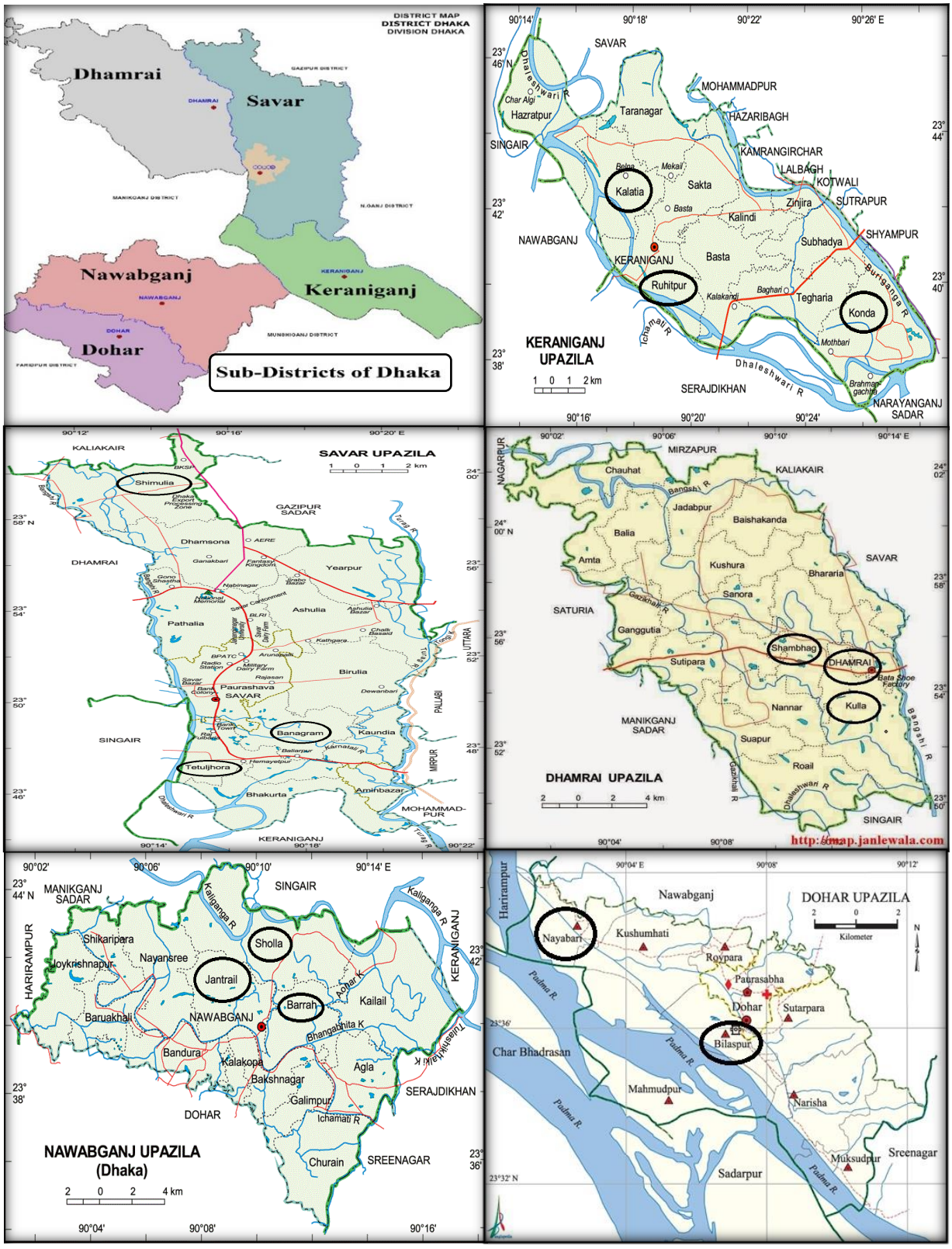


Figure 3.1: Maps of Study Area

Figure 3.1 presents the maps of the study area. At the upper left corner of the figure, all sub-districts of Dhaka have been shown. Then the union council areas under each sub-district have been marked where the data collection has been conducted. In the following Table, sub-district-wise, some key features of the study area have been presented.

Table 3.1: Description of Study Area

Features	Keraniganj	Nawabganj	Dhamrai	Savar	Dohar
Area (In Sq. km.)	166.87	244.80	307.41	280.11	161.49
Number of Union	12	14	16	13	8
Population	794,360	318,811	412,418	1385,910	226,439
Literacy Rate in %	58.50	57.80	50.80	68.00	57.50
Major Crops	Potato, Paddy, Vegetables	Paddy, Vegetables, Jute,	Paddy, Corn, Mustard	Vegetables, Paddy, Corn	Paddy, Spices, Mustard
Net Cropped Area in Ha	10,257	17,784	22,550	17,580	16,500
No. of Banks Branch	43	32	23	36	20
Length of Road in KM	1,123	963	646	1,147	722

Source: Dhaka District Statistics 2011 and Website of Bangladesh National Portal

3.4 Population and Sampling Design

Population

The population is the total elements from which the researcher desires to make inferences (Cooper and Schindler, 2007). This study's target population is the farming households of Dhaka's rural areas. According to the Preliminary Report of the Agricultural Census (2019) published by BBS, the total number of agriculture farm households in Dhaka district is 341216. Among them, 145782 households belong to the urban area, and the remaining 195434 households are farming in rural areas. As our study is conducted in a rural part of Dhaka district, the population size of our study is 195434.

Sample Unit

The farming household head is the sampling unit in our study, who has dominant control and makes planning and decisions for agricultural works of the said household. Agriculture work specifies all activities regarding managing and operating a farm holding. It comprises land preparation, sowing, weeding, harvesting, supervising laborer, maintaining farm accounts, preparing agriculture products for sale, repairing machinery and equipment, constructing farm sheds and fences, and engaging in other related agricultural activities.

Sample Size Determination

According to Adam and Kamzora (2008), mathematicians usually define a sample size as a population subset from which some inference can be drawn. This study's sample size has been determined using the following Yamane's formula (Yamane, 1967).

Here,			We have,
n	=	$N/(1+Ne^2)$	N= 195434 as Total Farming Household
n	=	Sample Size	e = 0.05 as 5 percent
N	=	Population	$n= 195434/ (1+195434*0.05^2)$
e	=	Precision value	$n=399.18 \approx 400$

Finally, after calculating, we found the sample size as 400.

Sampling Technique

In this investigation, a multi-stage sampling strategy was utilized. Initially, we deliberately chose the rural parts of Dhaka instead of other potential districts, taking into account the researcher's ease of travel, as well as time and budget constraints. For the second phase, a total of 14 union council areas have been selected randomly from the 81 union council areas in rural Dhaka. Ultimately, a total of 400 agricultural households have been selected from 14 union council areas using the simple random sampling technique. Sampling techniques are based on two fundamental concepts, i.e., probability and non-probability. Probability sampling is based on random selection (Kothari, 2004). As per this study, the population size is finite, and there is no restriction for sample selection. Hence, the simple random sampling technique has been chosen where every unit of analysis in the population has an equal chance of being included as a sample.

For reference Chandio & Jiang (2018) and Lakhan et al. (2020) in Pakistan applied multi-stage simple random sampling technique to assess the determinants and influence of credit constraint status on productivity of the farming households.

3.5 Data Collection Method

As discussed earlier, this research is mainly based on collecting and analyzing primary data. Through a well-structured pretested questionnaire, data have been collected from field-level surveys through face-to-face personal interviews. The tools and procedure of the questionnaire development process have been discussed below.

Questionnaire

A questionnaire is a tool used for data collection from a sample through a prespecified set of questions constructed by the researcher to collect information needed to answer the study questions (Kombo and Tromp, 2006). The questionnaire used for data collection has been presented in Appendix B. Considering the literacy level of the farming household head, a Bangla version of the questionnaire is also developed, presented in Appendix C. All scientific tools and procedures are followed carefully to develop the questionnaire. Based on the characteristics of the sampling unit, face to face interviewing method is selected. Then the individual content of the question, length and wording, is kept as simple as possible for a clear understanding of the farmers and overcoming their inability to answer. According to Malhotra and Dash (2015), the structured questionnaire prespecified the set of response alternatives and response format. We have used the structured questionnaire where fill-in responses and tabular response options are used for collecting continuous variables' information. The dichotomous response option provided information about binary variables, and the MCQ response option collected information about the categorical variables. Though all responses are prespecified and pre-coded despite an open option named others is also kept in the questionnaire. According to the objectives of our study, firstly, we specify the information needed, then structure the questions and finally arrange the order of the questions. Identification and demographic information are presented first, then household-related information, agricultural credit exposure-related information, and institutional information are furnished. Finally, farm production, income, expenditure and other financial information are presented at the end. Then form and layout of the questionnaire were finalized.

After that, the questionnaire went through a pretesting. Presetting refers to checking the questionnaire on a small sample to improve the questionnaire by identifying and eliminating potential problems (Malhotra and Dash, 2015). After pretesting and rectifying the questionnaire, desk checking has been done, and thereby the researcher finalizes the questionnaire for final data collection.

3.6 Data Analysis Techniques

Table 3.2: Description of Data Analysis and Used Techniques

Description of Data Analysis	Techniques Used
Identifying Banks' Agricultural Credit Constraint Category	▪ Direct Elicitation Approach (DEA)
Extension of Credit Constraint, Condition of Access to Credit and Intensity of Credit	▪ Percentage, Ratio ▪ Chi-square test, Pie Chart
Determining factors affecting Credit Constraint Status, Access to Credit and Credit Fungibility	▪ Mean, Standard Deviation ▪ Probit Regression
Post-estimation of Probit Model for Credit Constraint, Access to Credit and Credit	▪ Classification Test ▪ Correlation Matrix
Mean Difference of Socio-economic Factors by Credit Constraint, Credit Access and Credit Fungibility Status	▪ Paired T-test
Relationship of Credit Constraint, Credit Access and Credit Fungibility Status with Agricultural Production	▪ Chi-square test
Mean Difference of Input Use, Production and Income between Credit Constraint, Credit Accessed and Credit Fungible Farmers	▪ Paired T-test
Impact Assessment of Credit Constraint, Credit Access and Credit Fungibility Status on Input Use, Production and Income of the Farmers	▪ Propensity Score Matching (PSM) Model

Given the study's objectives, some descriptive and inferential statistics are measured through STATA 14.2 software. The summary of used techniques is furnished in Table-3.2. Particular techniques are explained according to the description of data analysis for the understanding of the readers and to maintain the linkage between objectives with the findings.

3.7 Variables and Model Specification

From previous empirical studies which have been discussed in the previous chapter, we have identified several factors influences agricultural credit constraint, access and fungibility status of the farmers. Specifically the previous literature gap suggested some studies only examine the demographic and socio-economic factors in order to determine constraints, access, and fungibility status. In contrast, other research considers farm-specific features and farmer-specific aspects. Few studies consider institutional elements in relation to this matter. Nevertheless, only a limited number of studies have considered the collective impacts of farm, farmer, and institution-specific attributes. To fill in this research gap, we already propose it is important to look into the state of constraint, access, and fungibility status by considering the farm, farmer, and institutional factors collectively. Therefore, we include famer and farming household specific factors (e.g., age of the farmer, gender, marital status, educational qualification, farming experience, household size, risk perception, dependency ratio); farm specific factors (e.g., type of farm, cooperative membership, previous default, landownership deed, total owned land) and institutional factor (e.g., distance to bank) to explain constraint status. Similarly, to identify the access status, famer and farming household specific factors (e.g., age, gender, education, experience, household size, household labor, non-agricultural income, savings); farm specific factors (e.g., purpose of farming, total owned land, agricultural income, krishi card) and institutional factors (e.g., past access in bank credit, bank account) has been considered. Then to determine fungibility status, famer and farming household specific factors (e.g., gender, education, household size, chronic diseases, non-fixed assets); farm specific factors (e.g., total owned land, old debt) and institutional factors (e.g., bank loan type, delay in disbursement, loan monitoring, adequacy ratio) has been included.

On the other hand, to identify the impact of constraint, access and fungibility status on farm productivity, three productivity variables (e.g., input use, production and net agricultural income) has also been considered on the basis of previous empirical works and literature gap.

In the following part of this section, some tables are organized to present the models and variables considered for the entire study. Variables type and the expected effect of independent and treatment variable on the outcome variable is also presented in the table.

Table 3.3: Description of Variables for Determining Factors Affecting Credit Constraint

Model Used	**Binary Probit Regression Model**		
Notation	**Dependent Variable**	**Variable Type**	**Expected Effect**
cons	Constraint Status	Binary	-
Notation	**Independent Variable**	**Variable Type**	**Expected Effect**
age	Age of the Farmer	Continuous	Positive/Negative
gen	Gender of the Farmer	Binary	Negative
marry	Marital Status	Binary	Negative
edu	Educational Qualification	Continuous	Negative
exp	Farming Experience	Continuous	Negative
hhsz	Household Size	Continuous	Positive
risk	Risk Perception	Binary	Positive
coope	Cooperative Membership	Binary	Negative
olddft	Previous Default	Binary	Positive
deed	Landownership Deed	Binary	Negative
totaol	Total Owned Land	Continuous	Negative
dbnk	Distance to Bank	Continuous	Positive
depen	Dependency Ratio	Continuous	Positive
tfarm	Type of Farm	Binary	Negative

Table 3.4: Description of Variables for Determining Factors Affecting Access to Credit

Model Used	**Binary Probit Regression Model**		
Notation	Dependent Variable	Variable Type	Expected Effect
access	Access to Bank Credit	Binary	-
Notation	Independent Variable	Variable Type	Expected Effect
age	Age of the Farmer	Continuous	Positive/Negative
gen	Gender of the Farmer	Binary	Positive
edu	Educational Qualification	Continuous	Positive
exp	Farming Experience	Continuous	Positive
hhsz	Household Size	Continuous	Negative
hhl	Household Labor	Continuous	Positive/Negative
kcard	Krishi Card	Binary	Positive
naginco	Non-Agricultural Income	Continuous	Positive
sav	Savings	Continuous	Positive
aginco	Agricultural Income	Continuous	Positive
totaol	Total Owned Land	Continuous	Positive
pfarm	Purpose of farming	Binary	Positive
paccs	Past Access in Bank Credit	Binary	Positive
bnkacc	Bank Account	Binary	Positive

Table 3.5: Description of Variables for Determining Factors Affecting Credit Fungibility

Model Used	**Binary Probit Regression Model**		
Notation	Dependent Variable	Variable Type	Expected Effect
fungis	Fungibility Status	Binary	-
Notation	Independent Variable	Variable Type	Expected Effect
gen	Gender of the Farmer	Binary	Positive
edu	Educational Qualification	Continuous	Negative
chro	Chronic Diseases	Continuous	Positive
bltyp	Bank Loan Type	Binary	Positive
delay	Delay in Disbursement	Continuous	Positive
olddbt	Old Debt.	Binary	Positive
nonfix	Non-fixed Assets	Continuous	Negative
bnkmon	Loan Monitoring	Binary	Negative
hhsz	Household Size	Continuous	Positive
totaol	Total Owned Land	Continuous	Negative
adequ	Adequacy Ratio	Continuous	Negative

Table 3.6: Expected Impact of Credit Constraint, Access and Fungibility Status on Input Use, Production and Income

Model Used	**Propensity Score Matching (PSM)**		
	Impact on Outcome Variable		
Treatment Variable	Model 1 (Input)	Model 2 (Production)	Model 3 (Income)
Credit Constraint	Negative	Negative	Negative
Access to Credit	Positive	Positive	Positive
Credit Fungibility	Negative	Negative	Negative

3.8 Research Design

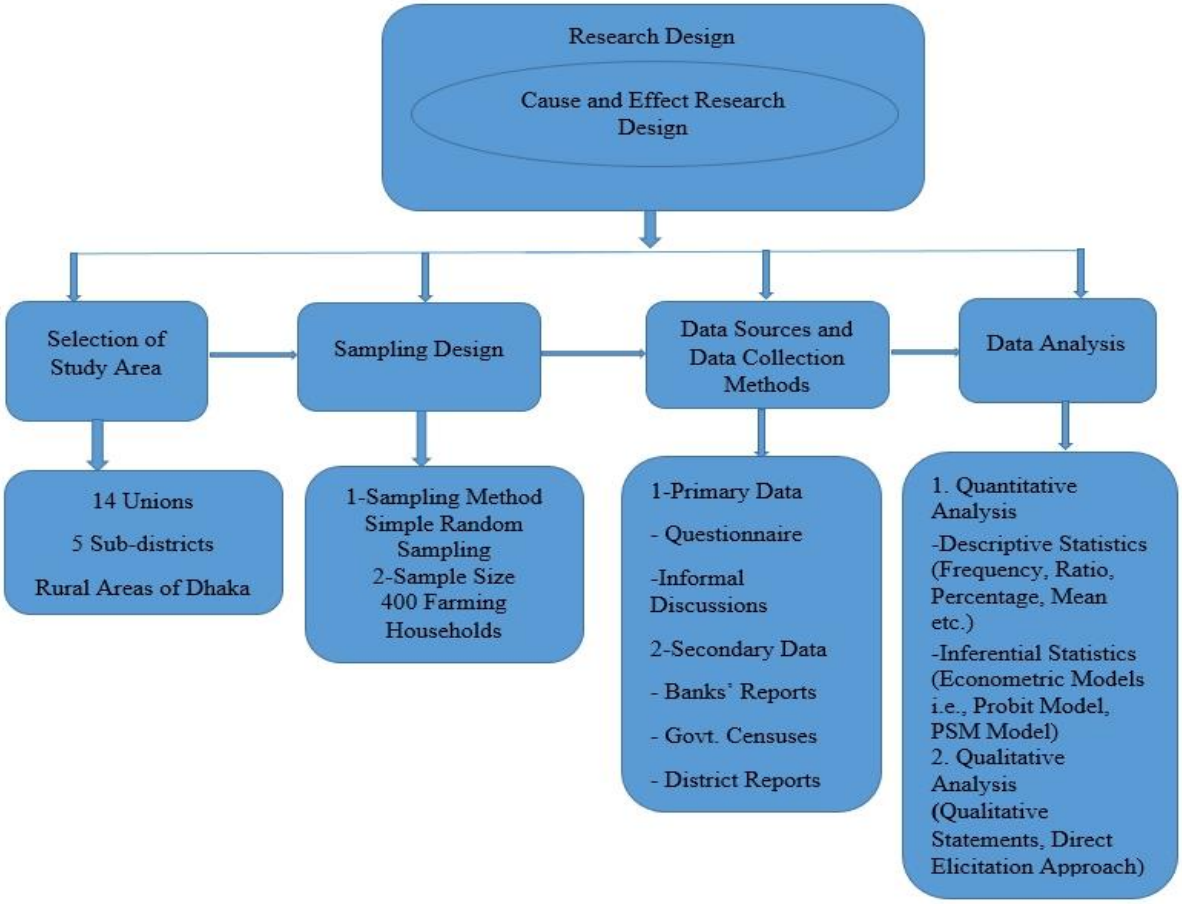


Figure 3.2: Research Design

3.9 Descriptive Statistics of the Respondents

In this section, some descriptive statistics of the sampled farmers are presented. Our sample size is 400 according to the sample size determination formula discussed earlier. A total of 404 respondents' data was collected. Out of 404, 400 observations data have been used for data analysis.

Table- 3.7 presents the sampling distribution. From the Keraniganj sub-district total of 80 respondents' data were collected, which is 20% of the sampled farmers. 28, 21 and 31 farmers were interviewed from Kalatia, Ruhitpur and Konda unions, respectively, under the Keraniganj sub-district. A total of 91 farmers data which is 22.75% of the total sampled farmers belong to the

Table 3.7: Sampling Distribution

Code	Area	Frequency	Percent
1	Keraniganj	80	20.00
2	Nawabganj	91	22.75
3	Dhamrai	88	22.00
4	Savar	76	19.00
5	Dohar	65	16.25
Total		400	100.00

Source: Field Survey 2022

Nawabganj sub-district: Jantrail, Sholla and Barrah union cover 30, 33 and 28 respondent's information. We have 88 respondents from the Dhamrai sub-district, which contains 22% of the total sample, and Dhamrai Sadar, Shambhag, and Kulla union contain 33, 26 and 29 farmers. From the Savar sub-district, Shimulia, Banagram, and Tetujhora union includes 28, 21 and 27 respondents, in total 76, which is 19% of the entire sample. Finally, from Dohar, 65 farmers' data were obtained, which is 16.25% of the whole sample; 36 and 29 respondents belong to Nayabari and Bilaspur unions.

Table 3.8: Age Group of the Respondents

Code	Age Range	Frequency	Percent
1	18 Years and Below	0	0.00
2	19-35 Years	44	11.00
3	36-50 Years	161	40.25
4	51-64 Yeas	129	32.25
5	65 Years and Above	66	16.50
Total		400	100.00

Source: Field Survey 2022

Table-3.8 shows the age group of the farmers. Here we have 161 respondents within the middle-aged group (36-50 Years), which indicates 40.25% of the total sample. Then 32.25% of the total sampled farmers belong to the 51-64 years group. Senior citizen farmers are found as 16.50%. On the other hand, the young farmers' group represents 11% of the total sampled respondents.

Table 3.9: Educational Qualification of the Respondents

Code	Educational Level	Frequency	Percent
1	Illiterate	100	25.00
2	Primary Level	127	31.75
3	Secondary Level	130	32.50
4	Higher Secondary Level	34	8.50
5	Graduation and Above	9	2.25
Total		400	100.00

Source: Field Survey 2022

Table-3.9 shows 100 illiterate farmers, one-fourth of the total sample. The primary level covers 1 to 5 years completed years in formal education and founds that 31.75% of the sampled farmers' educational level belongs to the primary level. Most of them reported that they did not get access to secondary level due to poverty and lack of educational institutions. Whilst 32.50% of farmers prevailed between class six to SSC level education and said that their family orientation was to be involved in farming activities so that they did not carry for higher secondary level education. Meanwhile, we have found that 8.50% and 2.25% of the respondents have completed HSC and graduation levels, respectively.

Table-3.10 represents the farming experience of the respondents. Here, full-time farming experience is considered. 24% of farmers replied that they have above 40 years of active farming experience. The same portion is also found for 21 to 30 years of experienced farmers. Then 22.25% and 19% of sampled farmers' experience level is 11 to 20 years and 31 to 40 years, respectively. Only 10.75% of the sampled farmers' experience is relatively low, which is 10.75%.

Table 3.10: Farming Experience of the Respondents

Code	Experience Range	Frequency	Percent
1	1-10 Years	43	10.75
2	11-20 Years	89	22.25
3	21-30 Years	96	24.00
4	31-40 Years	76	19.00
5	41 Years and Above	96	24.00
Total		400	100.00

Source: Field Survey 2022

Table 3.11: Gender of the Respondents

Code	Gender	Frequency	Percent
0	Female	34	8.50
1	Male	366	91.50
Total		400	100.00

Source: Field Survey 2022

From Table-3.11, we have seen the dominance of male farmers in the study area. A total of 366 farmers are male and contain 91.50% of the total sample. Our study considers crop farmers and practically crop farming is relatively more challenging than other farming activities. Thus, we have only 8.50% of female farmers. Parda protha[7] is found as another reason for not exposing to crop farming by female farmers. Besides that, dominance by the male gender in economic activities remains in rural areas still now. We have found that most female farmers are doing agricultural activities due to the demise and illness of their spouses. Some female farmers are divorced, some one's husband is living abroad, and a few female farmers' life partners are doing other business and involved in other professions.

[7] A religious practice by Muslim women not to exposing to the outside people.

Table 3.12: Marital Status of the Respondents

Code	Marital Status	Frequency	Percent
0	Unmarried	8	2.00
1	Married	392	98.00
Total		400	100.00

Source: Field Survey 2022

Table-3.12 displays the marital status of the farmers. Only eight farmers are found unmarried, and only two percent of the sampled farmers. On the other hand, 392 respondents who are 98% of the entire sample, are found married.

Table 3.13: Household Size of the Respondents

Code	No. of Family Member	Frequency	Percent
1	1-3 Persons	73	18.25
2	4-6 Persons	238	59.50
3	7-9 Persons	62	15.50
4	10 Persons and Above	27	6.75
Total		400	100.00

Source: Field Survey 2022

Table-3.13 exhibited the category of household size. Seventy-three respondents belong to a small household with members between one to three, 18.25 percent of the sample size. On the other hand, most of the respondents (59.50%) encompass medium households with 4 to 6 members. Seven to nine persons comprise large household that contains 15.50% of the total respondents. Finally, we have only 27 farmers who, are only 6.75% of the sampled farmers, belong to an extended household containing ten persons and above. This low rate also indicated Bangladesh's gradually declining joint family culture, even in rural areas.

Table-3.14 demonstrates the farm type of the sampled farmers. According to BBS's Agriculture Census (2008), the small farm comprises a cultivated land area between 0.05 to 2.49 acres. Here, 303 farmers are doing small farming activities, 75.75% of the sampled farmers. This finding is

quite similar to the Agriculture Census (2008) finding, where small farm holding was found as 84.27% of total farm holding. The median and large farm holdings are 18.75% and 5.50% among the respondents.

Table 3.14: Farm Type of the Respondents

Code	Farm Type	Farming Area in Acres	Frequency	Percent
1	Small Farm	0.05-2.49	303	75.75
2	Medium Farm	2.50-7.49	75	18.75
3	Large Farm	7.50 and Above	22	5.50
Total			400	100.00

Source: Field Survey 2022

Table 3.15: Purpose of Farming of the Respondents

Code	Purpose	Frequency	Percent
0	Subsistence	52	13.00
1	Commercial	348	87.00
Total		400	100.00

Source: Field Survey 2022

Table-3.15 shows the purpose of farming of the respondents. Subsistence farming is farming activities to maintain a household's demand. More specifically, subsistence farmers consume most of their produced goods and sell small or no portion of their agricultural commodities. Only 13 percent of the farmers replied that they were doing subsistence farming. At the same time, 348 farmers, 87% of the entire sample, reported doing commercial farming. When most products are sold, and a small portion is consumed, it is defined as commercial farming.

Table-3.16 indicates the nature of agricultural activities among the farmers. Here agriculture only refers to doing only crop farming. Among the farmers' community in Bangladesh, two different local terms of farming activities exist, i.e., krishi[8] and khamari[9]. Hence, the category agriculture

[8] Local term which specifies crop farming only
[9] Local term which specifies dairy, poultry and fish farming

only comprises crop farming alone, that is krishi. On the other hand, agriculture and others refer mainly to crop farming and khamari as secondary farming activities. In the study area, we have found many farmers doing other non-agricultural activities, i.e., working as a carpenter, tailor, driver, cook, land broker, storekeeper etc., besides their main crop farming activities. They are also included in agriculture and other categories. Results showed that only 48 farmers, 12% of the total sampled farmers, are doing agriculture only. Whilst 352 respondents reported doing khamari and other non-agricultural activities to maintain their livelihood. They also said that only crop farming is insufficient for family expenditure maintenance and even sometimes not profitable. Hence, 88% of the sampled farmers are involved in agriculture and other activities.

Table-3.16: Nature of Farming of the Respondents

Code	Nature of Farming	Frequency	Percent
0	Agriculture and Others	352	88.00
1	Agriculture Only	48	12.00
Total		400	100.00

Source: Field Survey 2022

Chapter 4
Agricultural Credit Constraints

4.1 Preface

Due to substantial operating costs, time involvement, the risky nature of farming activities, and less profit orientation from agricultural lending, commercial banks are reluctant to finance in the agricultural sector. Govt. and specialized banks are suffering from corruption and poor management in credit administration. Besides, huge transaction costs and collateral requirements restrain farmers from agricultural credit facilities. In view of this agricultural credit constraint issue, Bangladesh Bank is trying to modify the credit policy and regularity requirements continuously. Hence, understanding the nature of credit constraint status, the determinants of credit constraint, and its possible effect on farm productivity needs to be addressed for farmers' welfare, agricultural development, and economic development of a country as a whole. In this chapter, we develop econometric models to estimate the determining factors of credit constraint status and measure the effect of credit constraint status on farm inputs use, production, and income based on relevant theory and empirical works.

4.2 Theoretical Background

Conceptually, the influence of credit market imperfections and credit rationing in emerging nations has long been acknowledged.[10] In developing countries credit market works incompetently due to some factors of market imperfections, i.e., fixation of interest rate by the government, informal lender's monopoly power, huge transaction costs incurred by debtors in the loan application process, moral hazard problems arise from the borrowers (Foltz, 2004). In most cases, some of these imperfections combine and create constraint status for the farmers and restrain them from the agricultural credit market. In some previous empirical studies, farmers are classified as agricultural credit constraints when they have an excess demand for credit. This situation is termed quantity constraint status and the most common constraint status of the farmers in a developing country and which affects farm productivity due to a shortage of input use and investment.

[10] For reference Stiglitz and Weiss (1981); Eswaran and Kotwal (1986); Carter (1988); Kochar (1997).

Meanwhile, there are three ways the farmers' have fallen into agricultural credit constraint situation. Firstly, banks usually pass the transaction costs like application screening, loan monitoring, and contract enforcing expenses to the borrowers. These costs sometimes restrict borrowers from the credit market, thus falling them into the transaction cost constraint group. Secondly, to lessen the moral hazard that arises from the debtors, lenders require borrowers to bear default risk in the form of collateral submission. Fear of losing collateral creates a risk constraint condition for the farmers. Additionally, the agricultural insurance markets are inefficient in developing countries, so the farmers will not prefer to borrow considering the risk involved, even though the credit would increase productivity and income. Lastly, the interest rate imposed by the lender may restrict some farmers from the credit market as this fixed financial expense cannot be bearable for them and raise the farmers' financial risk. Though Govt. intervention through subsidized interest rates may relax this situation. However, in real scenarios, commercial banks cannot consistently maintain the interest rate ceiling with the excuse of the enormous operating costs of the loan and risk premium. Meanwhile, in Bangladesh, foreign and local commercial banks are now disbursing agricultural credit as a regularity requirement imposed by Bangladesh Bank. Nevertheless, having a minimal branch network in the rural areas of those banks, they rely on the network of NGOs and MFIs to disburse the loan, which ultimately increases the loan's interest, and therefore, the farmers become price constraint. However, like a quantity-constraint farmer, a farmer's resource allocation and productivity are adversely affected by transaction cost, risk, and price constraints. So, price, quantity, risk, and transaction cost constraints should be considered as agricultural credit constraints in a broader sense (Guirkinger & Boucher, 2008).

This section will discuss the detailed aspects of credit constraint status. Previous literature stated that a farmer has become quantity constraint when credit demand is not fully met. Empirical literature theoretically demonstrates that the moral hazard and adverse selection problems lead to the quantity rationing of the farmers. Quantity constraint mainly results from a farmer’s inability to submit the quantity or quality of collateral the lender requires. Due to a lack of an organized property rights system and insufficient assets holding due to poverty in a developing country, many farming households cannot submit adequate collateral to the banks. From the banks' point of view, addressing moral hazard and mitigating the bank’s credit risk, the bank requires collateral. Quantity constraint farmers are thus unwillingly restricted in access to credit and

hence lose the opportunity of liquidity fulfilment. A quantity constraint farmer is thus involuntarily restricted from their demanded amount of credit and, hence, cannot use the profit-maximizing level of inputs (Fletschner et al., 2010). Therefore, quantity constraint is regarded as a supply-side credit constraint. Transaction cost constraint arises from the ex-ante screening of borrowers, and ex-post monitoring of borrowers encompasses high monetary and time costs. Collateral verification costs include vetting assets, whether the assets are free from any encumbrance, having a registered title, or not. All of these expenses are borne by the borrowers, increasing their cost of borrowing and ultimately turning them voluntarily out of the credit market and becoming a transaction cost constraint. No knowledge about the loan application procedure and no or limited lender supplier are also influential factors to create transaction cost constraint status. Therefore, a farmer has become transaction cost constraint when non-interest monetary expenses and time involvement prevent a farmer from borrowing. Due to the farmers' lack of access to agricultural insurance, uncertainty prevails in their income level. Thus, banks are imposing a collateral requirement for their financial risk mitigation. From the farmers' point of view, some farmers may not be keen to take the risk of submitting their asset in the form of collateral as they fear of losing it. Some farmers do not like to be indebted because of the fear of loan non-payment and default risk. The perception that the loan would be rejected is another factor behind becoming a risk constraint borrower. Price constraint is another type of constraint status of the farmer who chooses not to participate in the credit market due to the high-interest rate of the loan. Due to the high-interest rate, they fear their expected income will be adversely affected. Supply-side constraints arise from the bank. In contrast, demand-side constraint status arises from the farming households. Due to transaction cost and risk involved in borrowing, the farmers voluntarily withdrawal themselves from the formal agricultural credit market, which creates demand-side constraint status for the farmers. (Fletschner et al., 2010).

4.3 Identifying Nature and Extension of Credit Constraint Status

In the literature, three broad ways are used to determine a household's credit constraint status[11]. The field survey allows us to use Direct Elicitation Approach (DEA). This method has developed based on the combination of practical outcomes and qualitative questions to identify credit

[11] Detection through direct elicitation approach by Feder et al. (1990), Jappelli (1990), Guirkinger &Boucher (2008); Violation of the life-cycle hypothesis by Gersovitz (1988), Besley (1995), Browning & Lusardi (1996); and Credit limit approach by Diagne et al. (2000); Diagne & Zeller (2001).

constraints status to categorize farmers as constraint or unconstraint in banks' agricultural credit. DEA was applied in near past studies by Fletschner et al. (2010) in Peru, Reyes & Lensink (2011) in Chile, Kumar et al. (2013) in India and China, and Ali et al. (2014) in Rwanda. This method has also been applied in recent research works of Mukasa et al. (2017) in Ethiopia and Kinuthia (2018) in Uganda & Tanzania. When constraint status is found, this method will further identify whether the constraint status arises from quantity, transaction cost, risk, or price rationing. The first separation of farmers is done based on applicant versus non-applicant of banks' agricultural credit. Applicant farmers are then further categorized according to the following outcomes, i.e., rejected applicants, partially received applicants, and those in the pending situation are categorized as quantity constraint; on the other hand, whose demand was fully met are denoted as unconstraint farmers. The categorization of non-applicant farmers requires more information for further classification. Those who replied that they do not need banks' agricultural credit as they have sufficient resources are classified as unconstrained among the non-applicant farmers. The farmers who are not applied due to the high rate of interest as they perceive denoted as price constraint. Those who reported that due to the lengthy loan processing time, massive documentation and paperwork, costly fees of the loan application, extra payment for getting a loan, frequent travelling, complex application procedure, not having enough collateral security, and lack of knowledge about application procedure as the leading causes for not applying for banks' agricultural credit are categorized as transaction cost constraint. While those who mentioned fear of losing their assets, legal issues, non-repayment risk, and those who reported that they do not like to be indebted and believe that the loan would be rejected are classified as risk constraint farmers.

Table 4.1: Application Status for Banks' Agricultural Credit

Code	Application Status	Frequency	Percent
0	Not Applied	308	77.00
1	Applied	92	23.00
Total		400	100.00

Source: Field Survey 2022

Table-4.1 presents the application status for banks' agricultural credit by the farmers. As we discussed in the previous section, to identify the credit constraint status, we asked a series of questions to the farmers regarding their exposure to banks' agricultural credit. The first question to identify constraint status through DEA was whether they applied for banks' agricultural credit for the last twelve months or not (Appendix-B, Question No. 18). In response to that question, 308 farmers replied that they did not apply for banks' agricultural credit which is 77% of the total respondents. On the other hand, 92 respondents, only 23% of the sampled farmers, said they had applied for banks' agricultural credit.

After segregating the farmers' application status, we asked the applicant farmers whether they received a sufficient loan (Appendix-B, Question No. 19). This response is displayed in Table-4.2. Out of the 92 farmers who applied for the loan, 39 received sufficient credit as they demanded, which is 42.39% of the applied farmers. According to the classification guidelines of DEA, these 39 farmers are a portion of unconstraint farmers. While 53 farmers replied who is 57.61% of the applied farmers, they did not receive sufficient credit as required. These 53 farmers are termed quantity constraint farmers and a part of total constraint farmers.

Table 4.2: Applicant-Based Sufficiency of Banks' Agricultural Credit

Code	Sufficiency Level	Frequency	Percent
0	Not Get Sufficient Credit	53	57.61
1	Get Sufficient Credit	39	42.39
Total		92	100.00

Source: Field Survey 2022

Meanwhile, we try to investigate the reason behind the insufficiency of credit. The outcome is furnished in Table-4.3. Here we asked the farmers the main reason for not getting sufficient credit. In response to that question, 32.08% of farmers who have not received the required credit said that bank officials are not cooperative in sanctioning credit. They are not interested in providing loans as farmers require. Most farmers reported that the bank official usually provides agricultural credit in a flat portion that is provides a loan in a flat portion of twenty thousand or fifty thousand. While 33.96% of farmers said they tried to convince the bank officials about their need for credit according to their cultivable land but failed to convince them, the bank official

said they have no more budget to provide agricultural credit anymore. Then 20.75% of farmers reported that they did not get enough credit as they failed to submit the required collateral as the bank official required. The sufferer farmers also reported that the bank officials impose a very high amount of collateral submission compared to the bank loan amount. Then 5.66% of farmers reported that they did not obtain the desired amount of credit due to incompleteness in required documents. The same portion of the farmers said they did not receive the required credit as they gave insufficient tips or speed money to the bank officials. The reasons mentioned above are also the reasons for the quantity constraint status of the farmers. Finally, we have found that being unable to convince the bank officials, lack of interest in agricultural credit disbursement by bank officials, and lack of collateral submission as required by the bank officials are the first, second, and third leading causes of the quantity constraint condition of the farmers.

Table 4.3: Main Reason for Not Getting Sufficient Banks' Agricultural Credit

Code	Main Cause	Frequency	Percent
1	Lack of Interest by the Bank Officials	17	32.08
2	Failed to Present Need Required	18	33.96
3	Required Documents Incomplete	3	5.66
4	Lack of Collateral	11	20.75
5	Did Not Give Required Bribe	3	5.66
6	Others	1	1.89
Total		53	100.00

Source: Field Survey 2022

The following Table-4.4 demonstrates the frequency distribution of the leading cause of not applying for banks' agricultural credit. As we have found, 308 farmers reported their non-application status. In this situation, the researcher tried to investigate the leading cause for not applying for banks' agricultural credit and found a total of 100 farmers, which is 32.47% of the non-applicant group, replied that they do not need banks' credit as they have enough liquidity to run their agricultural production. These 100 farmers are another portion of unconstraint farmers according to DEA procedure. Only five farmers, who are only 1.62% thought that the interest

rate was too high for them; therefore, they restrained themselves from credit access; thus, they were termed as price constraint farmers. 11.36% of farmers reacted that due to the extra payment involved in loan processing in the form of bribe, broker, and lobbying payment, as they perceived and observed from the experience of others, they did not apply. 5.52% of farmers responded that bank loan processing involved frequent travel to the bank office, which wastes their working time; hence they restrained from bank borrowing.

Table 4.4: Main Reason for Not Applying for Banks' Agricultural Credit

Code	Main Cause	Frequency	Percent
1	No Need	100	32.47
2	High-Interest Rate	5	1.62
3	Extra Payment for Bribe, Broker, Lobbing	35	11.36
4	Frequent Travel	17	5.52
5	Huge Paper Work Involved	27	8.77
6	Complex Application Procedure	42	13.64
7	Long Processing Time	6	1.95
8	Not Having Collateral Security	9	2.92
9	Don't Know Where & How to Apply	19	6.17
10	Don't Like to be Indebted	5	1.62
11	Believe Would be Rejected	10	3.25
12	Fear of Non-Payment	16	5.19
13	Fear of Losing Collateral	4	1.30
14	Fear of Legal Issues	7	2.27
15	Others	6	1.95
Total		308	100.00

Source: Field Survey 2022

Different papers and documents are required to process bank loans as a part of the bank's compliance. However, some farmers, who are 8.77% of the non-applicant group, said that due to this extensive paperwork involvement, they voluntarily withdraw from bank credit. 13.64% of

farmers believed the application process for a bank loan is complex according to their educational level; therefore, they do not seek bank credit on this ground. Then 1.95%, 2.92%, and 6.17% of the farmers reported the long processing time of bank loans, not having collateral security, and lack of knowledge about where and how to apply for banks' agricultural credit, respectively, as their main reason for not exposing in bank credit. In the study area, we have found some farmers facing liquidity crises despite not trying for bank credit as they do not like to be indebted for any loan. Only 1.62% of the non-applicant farmers have that thought. 3.25% of the non-applicant farmers believed their loan would be rejected; therefore, they did not apply. Some farmers, who are 5.19% of the non-applicant group, feared they would be unable to make repayments on time as they have been facing inconsistent returns from agricultural activities. 1.30% of the non-applicant farmers fear collateral submission as most of them are illiterate; they fear the bank may take over their property title. A total of seven farmers, who are 2.27% of the non-applicant group, fear the legal issues regarding bank credit default and hence did not apply. Finally, 1.95% of farmers reported some other reasons, i.e., inadequacy, and improper timing of credit, as their primary cause for not applying for agricultural credit. In a nutshell, we can conclude that the complex application procedure, the existence of extra cost in the form of bribes, broker and lobbying payment, and extensive documentation and paperwork as the first, second, and third main reasons behind not exposing to banks' agricultural credit by the farmers in our study area.

Table-4.5 presents the category of credit constraint status, their frequency distribution on the total sample, and their relative frequency on constraint farmers. As we found earlier, a total of 100 farmers reported that they did not apply for a loan because they have enough resources and are denoted as a portion of unconstraint farmers. In addition to this portion, we have found 39 farmers who have applied for bank credit, received their demanded credit, and are unconstraint farmers. Hence, we have a total of 139 farmers who are unconstraint in banks' agricultural credit, and their portion is 34.75% of the sample size. Previously we have also identified that 53 farmers are not getting their required credit; therefore, they are classified as quantity constraint farmers. Quantity constraint farmers are found as 13.25% of the entire sample. A similar result of 13% quantity constraint farmer is found by Fletschner et al. (2010) in Peru, and Guirkinger &Boucher (2008) founds 10% quantity constraint farmers while using the dataset of 2003 in Peru. Reyes & Lensink (2011) found that 10.7% of the farmers as quantity constraints in Chile.

Table 4.5: Banks' Agricultural Credit Constraint Category

Code	Constraint Category	Frequency	Percent in Total Sample	Percent in Constrain Farmers
1	Unconstraint	139	34.75	-
2	Quantity Constraint	53	13.25	20.31
3	Price Constraint	5	1.25	1.92
4	Transaction Cost Constraint	159	39.75	60.92
5	Risk Constraint	42	10.50	16.09
6	Others	2	0.50	0.76
Total		400	100.00	100.00

Source: Field Survey 2022

However, we found the relative portion of quantity constraint farmers as 20.31% of the total constraint farmers. Farmers who did not apply for bank credit for high-interest rates are labelled as price-constraint farmers. Here we have 1.25% of the total sampled farmers belonging to the price constraint category and 1.92% of the total constraint farmers are price constraint. Based on the classification criteria of DEA, we have a total of 159 farmers who are transaction cost constraints and comprise 39.75% of the whole sample, and the result is quite similar to the findings of Kinuthia (2018) in Uganda & Tanzania, where the author founds 36% of the farmers are transaction cost constraints. In our present study, the relative frequency of transaction cost constraint is 60.92% of the total constraint farmers. Risk constraint farmers are found as 42, 10.50% of the total sample size. This finding is almost similar to the findings of Guirkinger &Boucher (2008) in Peru for the data set of 1997, where they found 9% of the total farmers as risk constraints. While in our study, the relative frequency of risk constraint farmers is found as 16.09% among the constraint farmers. Finally, we have found that only two farmers are fallen into other categories. Other forms of constraint status have not been found empirically. However, in our study, we have found two farmers who did not apply for bank loans due to the involvement of interest, which is strictly prohibited in Islam. However, they need agricultural loans for farm operation and expansion but cannot get access due to the interest-based banking system. In that case, we argued that some Islamic Sharia-based banks provide agricultural credit.

In response to this question, those farmers expressed their doubt about that so-called Islamic banking procedure as they said. Hence, though we have found no empirical findings before, we have addressed this type of constraint status in other forms of constraint status. This other constraint category comprises only 0.50% of the sample and 0.76% of the total constraint farmers.

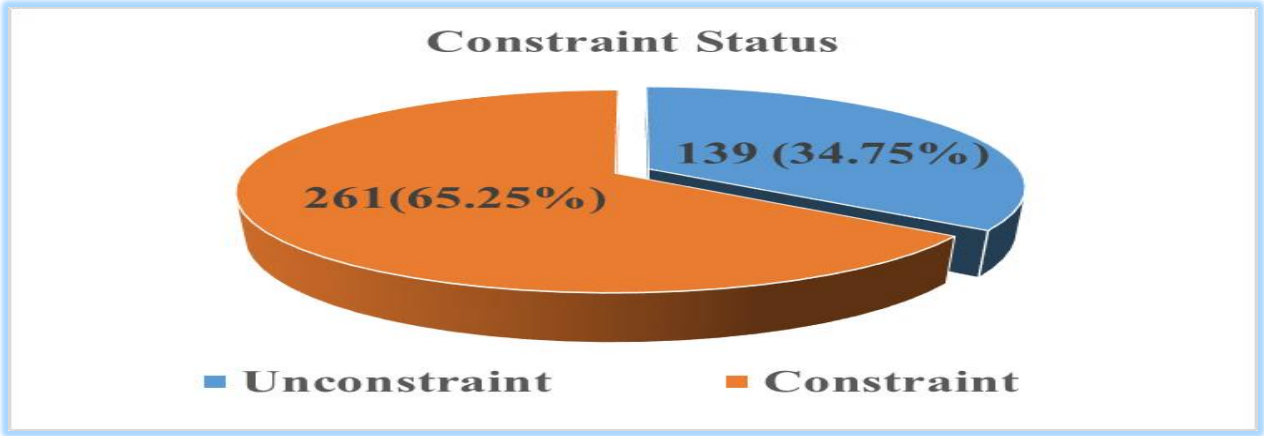
Table-4.6 demonstrates the demand side and supply side constraint categories of the farmers. The demand side includes transaction cost, risk, price, and other constraint categories, as this constraint arises from the demand side that comes from farmers' thoughts and perceptions. Here we have 79.69% of the sampled farmers voluntarily withdraw themselves from access to agricultural credit and forming demand-side constraints. In comparison, the supply side constraint is 20.31%, arising from the supply side, that is, from the banks' side through insufficient credit disbursement to the farmers.

Table 4.6: Demand Side and Supplied Side Constraint Category

Code	Constraint Category	Frequency	Percent
0	Demand Side	208	79.69
1	Supplied Side	53	20.31
Total		261	100.00

Source: Field Survey 2022

Figure 4.1: Banks' Agricultural Credit Constraint Status



Source: Field Survey 2022

Figure-4.1 shows the constraint category as a whole. We have 139 unconstraint farmers, 34.75% of the total sampled farmers. In contrast, constraint farmers are found as 261 by summing all constraint categories. The relative portion of the constraint framers is 65.25% of the entire sample. More specifically, this finding revealed that for every three farmers in the study area, two are constrained, and one is unconstrained. This result is quite similar to the finding of Musaka et al. (2017) in Ethiopia. The authors found that 33.36% of the farmers are unconstrained and 66.64% constrained.

Table-4.7 exhibited an extension of the credit constraint status of the respondents based on borrowing conditions. Out of 139 unconstraint farmers, 100 farmers are not borrowing from banks which is 71.94% of the unconstraint farmers, and 39 farmers borrowed from the bank, constituting 28.06% of total unconstraint farmers. On the other hand, out of 261 constraint farmers, 80.08% are non-borrowers, and the remaining 19.92% are borrowers. This difference is statistically significant at the ten percent level since the chi-square value is 3.4146 with a corresponding probability of 0.065.

Table 4.7: Constraint Status Based on Borrowing Category

Condition	Non-Borrower	Borrower	Total
Unconstraint	100	39	139
	(71.94)	(28.06)	(100.00)
Constraint	209	52	261
	(80.08)	(19.92)	(100.00)
Total	309	91	400
	(77.25)	(22.75)	(100.00)

Source: Field Survey 2022 Pearson chi2(1) = 3.4146 (Pr = 0.065)
Note: Figures in brackets are respective percentages.

Table-4.8 states the sub-district-wise constraint status. As mentioned earlier, we have conducted our study in five sub-districts of Dhaka. Eighty respondents belong to the Keraniganj sub-district; out of them, 60 farmers are constraint, 20 farmers are unconstraint, indicating 75% of the farmers from Keraniganj sub-district are credit constraint, and 25% are unconstraint. For

Nawabganj, 49.45% of farmers are constraint, and the remaining 50.55% are unconstraint. The Constraint situation is relatively low in this area compared to other areas. In Dhamrai, out of 88 farmers, 56 farmers who are 63.64% of the farmers from Dhamrai, are constraint, and 36.36% of respondents are unconstraint. This situation is quite similar to the results of our entire sample. In Savar, constraint and unconstraint rates are 69.74% and 30.26%, respectively. In Dohar, 72.31% of farmers are constraint, and the remaining 27.69% are unconstraint. This difference is statistically significant at the one percent level since the chi-square value is 15.5760 with a corresponding probability of 0.004. Here we can conclude that the Keraniganj area is in the worst position, having the top constraint rate, and the Nawabganj area is ranked first with the relatively highest portion of unconstraint farmers.

Table 4.8: Constraint Status Based on Area

Area	Unconstraint	Constraint	Total
Keraniganj	20	60	80
	(25.00)	(75.00)	(100.00)
Nawabganj	46	45	91
	(50.55)	(49.45)	(100.00)
Dhamrai	32	56	88
	(36.36)	(63.64)	(100.00)
Savar	23	53	76
	(30.26)	(69.74)	(100.00)
Dohar	18	47	65
	(27.69)	(72.31)	(100.00)
Total	139	261	400
	(34.75)	(65.25)	(100.00)

Source: Field Survey 2022 Pearson chi2(4) = 15.5760 (Pr = 0.004)
Note: Figures in brackets are respective percentages.

4.4 Factors Influencing Credit Constrain Status

This section belongs to the investigation of factors behind the credit constraint status of the farmer. In this process, empirical factors which explain credit constraint status are described, and then an econometric model is developed to estimate the influence of the explanatory variables on the outcome variable. Afterwards, the results of the model have been furnished, and finally some post-estimation has been carried out to check the robustness of the model outcome.

4.4.1 Description of the Variables Used in the Study of Credit Constraint Status

A review of conceptual literature on factors influencing farmers' credit constraint status, previous empirical research findings, and the authors' knowledge were used to specify the factors behind farmers' credit constraint status. In other words, among several factors associated with credit constraint status, the following demographic, socio-economic, farm-specific, and institutional factors are considered to explain constraint status.

4.4.1(a) Dependent Variable

The dependent variable for this study is dichotomous and represents farmers' constraint status. Constraint status is denoted as 'cons' and takes the value of 1 if the farmer is constraint and 0 for unconstraint farmers. This denomination is to distinguish between the constraint and unconstraint conditions of the farmers. From the qualitative responses of the farmers and using DEA, we have already identified farmer's constraint condition, which is discussed in detail in the earlier section. Credit constraint status of the farmers as the binary dependent variable to explain constraint status has been used by Foltz (2004), Ali et al. (2014), and Mukasa et al. (2017).

4.4.1(b) Independent Variables

i. Age of the Farmer (age)

Age is defined as the farming household head's actual age at the interview time and measured in completed years. This age is a continuous variable. The higher the age better the life and farming experience; thus, higher age is hypothesized to have a negative association with constraint status. Freeman et al. (1998) found a negative association in Kenya. While higher age also indicates obsolete conception and fear about bank lending. Older farmers may have lack of information

about bank lending procedures. Thus, age may positively associate with constraint status. Hence, we expect age may have both positive and negative impacts on constraint status.

ii. Gender of the Farmer (gen)

This binary variable takes the value of 1 for male and 0 for female farmers. In any developing country, especially in rural areas male household head has greater control over economic activities and more exposure to information and outside activities. Omonona et al. (2010) in Nigeria and Awunyo et al. (2014) in Ghana mentioned that male farmers have more access to formal loans than female farmers. According to Musaka et al. (2017), female-headed families are less likely to ask for loans because they believe that the interest rates charged by lenders are excessively high, and they fear losing their collateral if they cannot repay the loan. Therefore, we expected male-gender farmers are less likely to be credit constraint.

iii. Marital Status (marry)

Here, if the farming household is married, it takes the value of 1, and for unmarried, it is 0; hence it is a dummy variable. We assumed married farmers are less likely to be constraint as they have a spouse's support from other agricultural activities and as a guarantor for taking credit.

iv. Educational Qualification (edu)

This continuous variable is defined as no. of completed years in formal education. Farmers with higher educational levels are expected to have more accumulated knowledge, greater exposure to the external environment, and a better understanding of bank formalities. Musaka et al. (2017) posit that farmers with a higher level of education would have more financial literacy, enabling them to comprehend complex loan conditions and increase their chances of obtaining loans. This qualification may increase their confidence in their ability to apply for credit and their capacity to repay it. From the lender's perspective, education indicates that prospective borrowers are financially responsible, creditworthy, and able to manage credit more effectively. Freeman et al. (1998), Komicha & Ohlmer (2007), Ali and Deininger (2012) all obtained comparable negative influence of educational qualification on constraint status. Therefore, we hypothesized that educational qualification is negatively associated with constraint status.

v. Farming Experience (exp)

Total no. of active farming experience in years counts farming experience. Hence, this is a continuous variable. Experienced farmers are well prepared for their farming activities and have efficiency in resource allocation; thus, we assumed that farming experience negatively impacts constraint conditions. In other words, the higher the experience of the farmer, is less likely to be constrained in banks' agricultural credit.

vi. Household Size (hhsz)

This variable is continuous and counts the no. of family members living together and taking a meal from the same kitchen. The household size increases the family expenditure, which stresses the economic resources. Freeman et al. (1998) found that farming households with more family members are prone to credit constraints. Therefore, we expected a positive relationship between household size and the constrained situation of the farmers.

vii. Risk Perception (risk)

This variable is measured by the responses to a qualitative question: whether the farmers think taking bank loans is risky or not. Those who replied that taking a bank loan is risky coded as 1 and 0 for those who thought taking a bank loan is not risky. Therefore, this is a binary variable. Some farmers thought borrowing from the bank is risky as they kept collateral and took legal action in case of loan default. While some farmers replied that if loans are obtained in time and adequate manner and used correctly, then the repayment of the loan is possible; hence, they do not think obtaining a bank loan is risky. So, we assumed that risk perception positively influences constraint status.

viii. Cooperative Membership (coope)

This variable is dummy in nature and takes value 1 if the farmer is presently involved with an active cooperative as a member and 0 for otherwise. Farmers can obtain liquidity from that organization as an active and participatory member of a cooperative. Additionally, through some projects, Govt. provides subsidies for machinery and equipment to the functioning cooperatives. Therefore, being a part of that cooperative, farmers are getting financial benefits; hence we

expected cooperative membership status to be negatively associated with the constraint position of the farmers.

ix. Previous Default (olddft)

Previous default is defined based on the farmers' previous default status of bank credit. It is a dichotomous variable. One is coded if the farmers had defaulted bank credit previously and 0 for otherwise. Due to unavoidable circumstances, agricultural credit may become default as farming activities depend on nature. Feder et al. (1990) found a positive association between past default to present constraint conditions. Petrick (2004) in Poland found that previously defaulted and rescheduled loans led to becoming the farmers' constraint status. Whatever, this default may lower the confidence level of the farmer, and the banks are usually reluctant to lend to the defaulter. Therefore, we hypothesized that the previous default status positively impacts constraint status.

x. Landownership Deed (deed)

In developing countries, property rights and transfer of property are mostly oral, especially in rural areas. This variable landownership deed is the proxy of the title of lands and is binary in form and takes the value one if the farmer has most of his/her land documents in order and takes 0 for otherwise. Banks always seek land property as collateral for lending, and they prefer all land documents in order. According to Fletschner et al. (2010), the title of land denotes ownership of a registered property title, which ought to increase the collateral value of land and improve credit availability and financial efficiency. In Paraguay, Carter and Olinto (2003) discovered that land titles reduce farmers' supply-side credit constraint. So, we assumed that landownership deed is negatively associated with constraint status.

xi. Total Owned Land (totaol)

This variable is continuous and counts the total owned farming area and homeland. More owned land indicates additional borrower creditworthiness and ensures repayment capacity. Moreover, more owned land ensures sufficient collateral submission leads to obtaining an adequate amount of credit. Thus, we postulate that total owned land negatively impacts constraint status.

xii. Distance to Bank (dbnk)

It indicates the proximity of the nearest scheduled bank branch to the farmers' residence. It is a continuous variable and is measured as the distance in KM. Location proximity can make easy contact with the lenders and access more information about bank loan facilities. Additionally, proximity can reduce transportation costs and save time for the farmers. Musaka et al. (2017) mentioned that distances between commercial banks and farmers' residences significantly impact transaction costs-constraint. This finding suggests that the greater the distance between a farmer and potential lenders, the greater the possibility that the farmer will not apply for a loan due to the high transportation expense. These distances also hinder farmers' access to adequate information regarding the financial services banks offer. Therefore, we assumed higher the distance; the farmers are more likely to be constrained in banks' agricultural credit.

xiii. Dependency Ratio (depen)

This is a ratio of non-working to working members of the farming household. The non-working group is proxied by the no. of family members below 15 years and above 65 years and above. At the same time, the working group is proxied by the 15-64 years age range of family members. This dependency ratio is a continuous variable and indicates the family burden level. Feder et al. (1990) in China considered the total number of dependents to explain the constraint status and found a positive association. Thus, we hypothesized a positive association between the dependency ratio and constraint status.

xiv. Type of Farm (tfarm)

This dummy variable is coded as 1 for large farmers cultivating above 7.50 acres of land and 0 for otherwise. The large-scale farming operation generally indicates higher output and income. Hence, we assumed large farmers are less likely to be constrained as they have enough resources and better creditworthiness. Lemessa & Gemechu (2016) mentioned that a farmer who cultivates a more extensive area of land could use more capital, labor and other farm inputs, increasing the demand for credit and, as demand rises, the likelihood of obtaining credit. Thus, we expected large farmers are less likely to be constrained in banks' agricultural credit.

4.4.2 Econometric Modeling

As already noted, the dependent variable for this study is constraint status which is a dummy variable. There are several models to analyze the data involving binary outcomes, i.e., linear probability, logit, tobit, and probit models. The probit model has several advantages over other models for binary outcomes, such as the logistic regression model. One advantage is that the probit model allows for more flexible distributions of errors, assuming a normal distribution of errors, whereas the logistic regression assumes a logistic distribution. Another advantage is that the probit model can be interpreted in terms of standard deviations, which can help understand the magnitude and direction of the effects of predictor variables. The probit model is a statistical model used to analyze binary outcomes, that is, outcomes that can only take two possible values (e.g., success/failure, yes/no, etc.). It is a type of regression analysis that estimates the probability of the binary outcome based on a set of predictor variables. However, our study has continuous and dummy variables as independent variables. In this study, using a variety of observable and theoretically feasible socio-economic and credit factors, a probit model is used to predict the determinants of credit constraint status among the farmers. In this analysis, we applied the binary probit model to determine the influence of the explanatory variables on the explained variable. The Probit model was used in past studies,[12] in the near past by Oyedele et al. (2009) in Nigeria and recently by Mukasa et al. (2017) in Ethiopia; Chandio et al. (2018) in Pakistan.

The linear probability model estimates the probability of y=1 as a linear function of the independent variables and is expressed in equation 4.1. Where P(y=1) is the probability of a binary dependent variable taking the value 1, given a set of k predictor variables x1, x2, ..., xk and β0, β1, β2, ..., βk are the coefficients of the independent variables that need to be estimated from the data, while μ is the error term that accounts for unobserved variation in the response variable.

$$P(y=1) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots + \beta_k x_{k+} \mu = x\beta + \mu \qquad \text{Equation 4.1}$$

However, the main limitation of the linear probability model is that it cannot be strict with the value of y between 0 and 1. Since our outcome variable is a dummy variable which takes the

[12] For reference Lapar (1994) in Philippines, Feder et al. (1990) in China, Zeller (1994) in Madagascar; Freeman et al. (1998) in Kenya; Kedir (2003) in Ethiopia, Petrick (2004) in Poland.

value of 0 and 1. Therefore we estimate the probit model, which takes the probability value of y=1 as a non-linear function G of the independent variables and can be expressed in equation 4.2.

$$P(y=1) = G(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots + \beta_k x_k) + \mu = G(x\beta) + \mu \qquad \text{Equation 4.2}$$

The probit model used the cumulative density function (CDF) of the normal distribution of Φ as stated in equation 4.2. In this equation, G is the cumulative distribution function (CDF) of the standard normal distribution, transforming the linear combination of predictor variables (xβ) into a probability value between 0 and 1.

$$P(y = 1) = \theta(x\beta) = \int_{-\infty}^{x\beta} \theta(z)dz \qquad \text{Equation 4.3}$$

Equation 4.3 provides an expression that, as a function of the linear predictor xβ, gives a chance that the binary result y=1 will occur. In this equation, x is a vector of predictor variables, β is a vector of coefficients that tie x to the outcome probability, and θ(z) is the CDF of a standard normal distribution evaluated at z. The linear predictor x is considered to be normally distributed and represents the linear combination of the predictor variables and coefficients.

Hence, we can express our dependent variable constraint status y as the function of independent variables in the following equation 4.4. Here β_0 is the constant, and μ is the error term. Respective β_i is the coefficient for the corresponding independent variables.

$$P(cons=1) = \Phi(\beta_0 + \beta_1\, age + \beta_2\, gen + \beta_3\, marry + \beta_4\, edu + \beta_5\, exp + \beta_6\, hhsz + \beta_7\, risk + \beta_8\, coope + \beta_9\, olddft + \beta_{10}\, deed + \beta_{11}\, totaol + \beta_{12}\, dbnk + \beta_{13}\, depen + \beta_{14}\, tfarm + \mu)$$

Equation 4.4

The coefficients in the probit model are obtained by maximizing the log-likelihood function, and the functional form of the log-likelihood function is presented in equation 4.5.

$$lnL = \sum w_j \ln \Phi(x_j\beta) + \sum wj \ln\{1-\Phi(x_j\beta)\} \qquad \text{Equation 4.5}$$

In this equation, the terms wj represent the weights or frequencies of the observations, xj represents the jth row of the design matrix, β is the vector of parameters to be estimated, and Φ is

the cumulative density function of normal distribution. The log-likelihood function for the probit model is used to estimate the parameters β that maximize the probability of observing the data given the model. The function is derived from the assumption that the binary outcome y is explained with the probability function of xjβ, where xjβ is the CDF of a standard normal distribution evaluated at xjβ, and it is expressed as the sum of the logarithms of the probabilities of observing the data. The log-likelihood function can then be expressed as the sum of the logarithms of the probabilities of observing the data, given by Φ(xjβ) for y=1 and 1-Φ(xjβ) for y=0.

4.4.3 Determinants of Credit Constraint Status

Table 4.9 presents the summary statistics of the variables for studying credit constraint status. The mean value of constraint status showed 0.6525, which indicates that 65.25% of farmers are constrained. The average age is found as 50.8025 years. This finding is quite similar to the results of Kumar et al. (2013) in India, where the respondents' mean age was 47.5 years. Male gender and married farmers are 91.5% and 98%, respectively. The mean value of educational qualification and farming experience is 5.295 and 30.7875 years, correspondingly. The average household size of the sampled farmers is found as 5.2375 members, which corresponds with the mean value of sampled households of 5.4 by Fletschner et al. (2010) in Peru. Then 0.625 mean value of risk perception revealed that 62.50% of farmers reported that taking bank credit is risky. The average value of cooperative membership is 0.2675, indicating that only 26.75% of the sampled farmers are active cooperative society members in the study area. Sekyi et al. (2017) in Ghana found that 32% of the sampled farmers were members of cooperatives. Only two percent of farmers informed that they have defaulted on previous bank credit as we have a mean value of 0.02. The average value of land ownership deed found as 0.535 stated that 53.50% of farmers have most of their land documents in order. Then we have 110.57 decimal of land as the average total owned land by the respondents. The mean value of distance to the bank is found as 2.04 KM. The dependency ratio is 0.5938, indicating that on average for every working person, 0.5938 non-working persons belong to the household. Finally, the farm type variable’s mean value of 0.055 shows that only 5.50% of farmers belong to large farms.

Table 4.9: Summary Statistics (Credit Constraint Model)

Notation	Short Description	Observation	Mean	Standard Deviation
cons	Constraint Status (1= Constraint, 0= Unconstraint)	400	0.6525	0.4767
age	Age of the Farmers in Years	400	50.8025	12.3703
gen	Gender of the Farmer (1=Male,0=Female)	400	0.9150	0.2792
marry	Marital Status of the Farmer (1=Married, 0=Unmarried)	400	0.9800	0.1401
edu	No. of Completed Years in Formal Education	400	5.2950	4.1685
exp	Full-Time Farming Experience in Years	400	30.7875	15.6473
hhsz	Household Size (No. of Family Members)	400	5.2375	2.3107
risk	Risk Perception (1= Feel Risky, 0= Otherwise)	400	0.6250	0.4847
coope	Cooperative Membership (1=Member,0=Otherwise)	400	0.2675	0.4432
olddft	Previous Default (1=Previous Default,0=Otherwise)	400	0.0200	0.1401
deed	Landownership Deed (1=Deed Ownership,0=Otherwise)	400	0.5350	0.4993
totaol	Total Owned Land in Decimal	400	110.5732	137.2050
dbnk	Distance to Bank in Kilometers	400	2.0404	1.4246
depen	Dependency Ratio (Ratio of Non-working to Working)	400	0.5938	0.5092
tfarm	Type of Farm (1=Large, 0=Medium and Small)	400	0.0550	0.2282

Source: Computed by STATA 14.2 using Field survey data 2022

Table 4.10: Outcome of Probit Model for Credit Constraint Status

Probit Regression		LR chi2(14)	= 288.96		
Number of observations = 400		Prob > chi2	= 0.0000		
Log likelihood	= -113.87435	Pseudo R^2	= 0.5592		
Notation	**Variable Name**	**Coefficient**	**Standard Error**	**z-value**	**P>|z|**
age	Age of the Farmer	-.0066914	0.0121	-0.55	0.580
gen	Gender of the Farmer	-.8402534	0.4191	-2.00	0.045**
marry	Marital Status	-1.098289	0.6610	-1.66	0.097*
edu	Educational Qualification	.0303307	0.0280	1.08	0.279
exp	Farming Experience	.0026906	0.0098	0.27	0.785
hhsz	Household Size	.0094757	0.0445	0.21	0.831
risk	Risk Perception	1.915873	0.2056	9.32	0.000***
coope	Cooperative Membership	-1.095011	0.2352	-4.65	0.000***
olddft	Previous Default	-.4144926	0.5646	-0.73	0.463
deed	Landownership Deed	-.996239	0.2097	-4.75	0.000***
totaol	Total Owned Land	-.0018384	0.0008	-2.27	0.023**
dbnk	Distance to Bank	.3981727	0.0845	4.71	0.000***
depen	Dependency Ratio	-.1271304	0.2058	-0.62	0.537
tfarm	Type of Farm	1.315947	0.5222	2.52	0.012**
_cons		1.665458	0.8683	1.92	0.055*

Source: Computed by STATA 14.2 using Field survey data 2022
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-4.10 demonstrates the results of the probit regression model. STATA 14.2 software was used, and the following command was applied to generate the outcome of the probit model.

probit cons age gen marry edu exp hhsz risk coope olddft deed totaol dbnk depen tfarm

Results showed that the LR chi2 value is 288.96 with a probability value of 0.0000, which indicates the overall model is significant at a one percent level. Log-likelihood value is found as -113.87435, which is negative. If the log-likelihood value is found as zero, then it indicates an entirely perfect model, which is impractical. On the other hand, the log-likelihood value of one stated worst possible model. The desirable outcome of the log-likelihood value is to be negative, and our results showed a negative log-likelihood value which is satisfactory. Then we have the Pseudo R^2 value as 0.5592. Mentionable that in the probit model's Pseudo R^2 does not quantify the variation of the dependent variable by the independent variables like other linear models. It only indicates how well the model predicts the dependent variable. Generally, 0.40 and above Pseudo R^2 value is acceptable, and a higher value is preferable. Since we have Pseudo R^2 as 0.5592, above 0.40, it indicates a good fit for the model.

Table 4.10 also shows the independent variables' coefficient, standard error, and corresponding probability value. Here we have found age, education, and experience, which are not statistically significant and according to their expected sign. Household size is found according to our expected sign but found statistically insignificant. Marital status and gender are found according to our hypothesized relation and found statistically significant at 10 and 5 percent levels, respectively. Risk perception and cooperative membership are found statistically significant at one percent level and as per our expected sign. We hypothesized the positive impact of previous default and dependency ratio on constraint status. However, the results showed a negative impact though found insignificant. The land ownership deed and distance to bank variable are found statistically significant at a one percent level and found according to our assumed direction. Total owned land found significant at 5 percent level having the expected sign. Finally, the type of farm was found to be significant at 5 percent level but not as per our expected sign.

From Table-4.10 we have obtained the direction of independent variables' impact on dependent variables and their corresponding probability value. Though we have coefficient value, we cannot explain it because those coefficient value does not measure the magnitude of the independent variables to explain the dependent variable. To know the magnitude, we have to estimate the marginal effect. In Table 4.11, we have furnished the outcome of marginal effect estimation. In this regard, margins, dydx (*) command is used. Here we have the marginal effect of gender is -.1336 revealed that if the farmer is male, he is 13.36% less likely to be constrained

than his counterpart. The marginal effect of marital status showed that being married a farmer is 17.46% less likely to be constraint than an unmarried farmer, and found as per our hypothesized negative relation.

Table 4.11: Estimation of Marginal Effects (Credit Constraint Model)

Notation	Variable Name	Marginal Effect	Standard Error	z-value	P>|z|
age	Age of the Farmer	-.001064	0.0019	-0.55	0.580
gen	Gender of the Farmer	-.1336114	0.0661	-2.02	0.044**
marry	Marital Status	-.1746424	0.1043	-1.67	0.094*
edu	Educational Qualification	.004823	0.0044	1.08	0.278
exp	Farming Experience	.0004278	0.0015	0.27	0.785
hhsz	Household Size	.0015068	0.0070	0.21	0.831
risk	Risk Perception	.304649	0.0199	15.30	0.000***
coope	Cooperative Membership	-.1741211	0.0354	-4.91	0.000***
olddft	Previous Default	-.0659098	0.0895	-0.74	0.462
deed	Landownership Deed	-.1584151	0.0315	-5.01	0.000***
totaol	Total Owned Land	-.0002923	0.0001	-2.30	0.022**
dbnk	Distance to Bank	.0633147	0.0125	5.06	0.000***
depen	Dependency Ratio	-.0202154	0.0327	-0.62	0.537
tfarm	Type of Farm	.209253	0.0814	2.57	0.010**

Source: Computed by STATA 14.2 using Field survey data 2022
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Risk perception indicates that farmers who think taking bank credit is risky are 30.46% more likely to be constrained. This finding corresponds with our theoretical assumption and is consistent with the findings of Chauke et al. (2013) in South Africa. The marginal effect of cooperative membership showed farmers who are a member of a cooperative society is 17.41% less likely to be constraint and found consistent with the results of Sekyi et al. (2017) in Ghana

and Lemessa, & Gemechu (2016) in Ethiopia. Landownership Deed's marginal effect is -.1584, indicating that having most of the land documents in order, a farmer is 15.84% less likely to be constrained. The marginal effect of total owned land indicates farmers having one additional of owned land makes them 0.02% less likely to be constrained which is similar to the findings of Chandio et al. (2018) in Pakistan. On the other hand, one additional KM distance of the residents of the farmers to the bank's branch makes them 6.33% more likely to be constrained, which corresponds to the finding of Chauke et al. (2013) in South Africa. Interestingly we have found that large farmers are 20.92% more likely to be constrained, which is contradictory according to our expectation. The probable reason behind that because of the limited and flat supply of agricultural credit by banks; thus, the large farmers become quantity constrained though having a high level of creditworthiness.

Table 4.12: Results of Classification Test (Credit Constraint Model)

Classified	**D**	**~D**	**Total**
+	244	28	272
-	17	111	128
Total	261	139	400
Particulars	**Prediction**		**Percentage**
Sensitivity	Pr(+| D)		93.49%
Specificity	Pr(-|~D)		79.86%
Positive predictive value	Pr(D| +)		89.71%
Negative predictive value	Pr(~D| -)		86.72%
False + rate for true ~D	Pr(+|~D)		20.14%
False - rate for true D	Pr(-| D)		6.51%
False + rate for classified+	Pr(~D| +)		10.29%
False - rate for classified-	Pr(D| -)		13.28%
Correctly classified			**88.75%**

Source: Computed by STATA 14.2

Table-4.12 exhibited the classification test of the probit model. The 'estat classification' command is used to generate the outcome of the classification test. This classification test indicates how well our model correctly predicts the outcome variable. The total correct prediction for y=1 is found as 244, and for y=0, it is 111. In total, our model correctly predicts 355 observations out of 400, which is 88.75%. Generally, 70% of correct classification is acceptable, and a higher percentage is preferable. Hence the classification test indicates a good fit of our model.

4.5 Socio-economic Differences by Credit Constraint Status

Table 4.13: Mean Difference of Socio-economic Variables by Credit Constraint Status

Variable Name	Full sample	Constraint	Unconstraint	t-value
Age	50.8020	50.5300	51.3000	0.5975
Gender	0.9150	0.9157	0.9136	-0.0695
Education	5.2950	5.1570	5.5530	0.9065
Experience	30.7875	30.8080	30.7480	-0.0366
Marital Status	0.9800	.9806	0.9784	-0.1646
Household Size	5.2375	5.1609	5.3812	0.9081
Household Labor	1.6925	1.6360	1.7980	1.8699*
Hired Labor	68.7450	73.1455	60.4820	-0.9925
Total Owned Land	110.5732	106.7960	117.664	0.7539
Farm Size	223.8536	249.0726	176.5000	-1.8041*
Owned Equipment	31.1500	26.1370	40.5611	2.6429***
Savings	147.357	108.3100	220.6748	4.0696***
Consumption	252.8200	245.7930	266.0144	1.6592*
Distance to Bank	2.0404	2.4095	1.3473	-7.5870***
Risk Perception	0.6250	0.8659	0.1726	-18.5960***
Cooperative	0.2675	0.1609	0.4676	6.9726***
Dependency Ratio	0.5938	0.6449	0.4978	-2.7740***
Deed	0.5350	0.3678	0.8489	10.3157***

Source: Computed by STATA 14.2 using Field survey data 2022
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

In this section, some socio-economic factors mean difference is calculated between constraint and unconstraint farmers group. Paired t-test is performed to measure the statistical significance of the mean difference. Table-4.13 showed no statistically significant difference between constraint and unconstraint farmers in terms of their age, gender, education, experience, marital status and household size. Unconstraint farmers have more household labor; this difference is found at 10 percent level of significance. Constraint farmers have greater hired labor, and unconstraint farmers have additional owned land though this difference is insignificant. The average farm size is found to be greater for constraint farmers and found significant. Unconstraint farmers' average total income, consumption, and savings are significantly higher at a 1 percent level, indicating unconstraint farmers are in a better financial position. Owned equipment is also found to be significant and higher for unconstraint farmers. The significant gap in the case of distance to the bank indicates the proximity of unconstraint farmers. Finally, we have found a significant difference in risk perception, cooperative membership, dependency ratio, and deed ownership between these two groups.

4.6 Credit Constrain Status and Productivity

Agricultural credit constraint leads misallocation of inputs in the farmer’s production process. This misallocation of resources causes the credit constraint farmers to have lower productivity levels than unconstrained farmers. These lower productivity levels are influenced by several factors, including lower investment and a misallocation of variable inputs (Carter, 1989). At the early stage of a production period, farm households require their available resources to be allocated between current consumption and the purchase of variable inputs for production. Unconstraint farmers can separate consumption decisions from farm production decisions. So, the unconstraint farmers can conveniently choose the combination of production inputs optimally for their production process. Two key theories come from the related literature, i.e., the profit-liquidity effect and the investment demand effect. Profit liquidity theory states that in the short term, agricultural credit unconstraint status allows the farmers to optimize input usage for a given level. In comparison, credit constraint farmers can use inputs only up to their own invested level. Thus, the farmer's liquidity will influence the overall profit level. The investment demand effect states credit constraint farmers will invest a smaller amount in capital assets and will not be able to level their expenses over time, inferring that they will not make long-term investments

(Foltz, 2004). Based on these concepts, theory, and previous findings of related research, the following sections are designated to estimate the effect of credit constraint status on productivity.

4.6.1 Comparison between Constraint and Unconstraint Farmers at the Production Level

Table 4.14: Change in Production Level by Credit Constraint Status

Condition	Not Rise in Production	Rise in Production	Total
Unconstraint	24	115	139
	(17.27)	(82.73)	(100.00)
Constraint	88	173	261
	(33.72)	(66.28)	(100.00)
Total	112	288	400
	(28.00)	(72.00)	(100.00)

Source: Field Survey 2022 Pearson chi2(1) = 12.1745 (Pr = 0.000)
Note: Figures in brackets are respective percentages.

Table-4.14 demonstrates the relationship between constraint status and change in production. We asked the farmers about their perception of the change in current production compared to last year's production. Responding to this question, 288 farmers, 72% of the sampled farmers, said their production increased compared to the previous year, and the remaining 28% reported reduced production. Among the 139 unconstraint farmers, 115 farmers who are 82.73% of the unconstraint farmers, responded that they gained higher production in the current year. On the other hand, 173 farmers from the constraint group, 66.28% of constraint farmers, said they also had increased production. Comparing the relative portion, we conclude that unconstraint farmers are experiencing higher productivity levels. The chi2 test examines this difference since the two variables are nominal. Pearson chi2(1) value is 12.1745 with a corresponding probability value of 0.000, indicating this difference is statistically significant at a one percent level.

4.6.2 Mean Difference of Productivity Indicators Based on Constraint Status

In this part, we estimate the mean difference of different productivity indicators, i.e., input, production and income per acre, between constraint and unconstraint farmers. Paired t-test has been done to measure the difference and its significance level.

Table-4.15: Mean Productivity Difference (Inputs Use) by Credit Constraint

Group	Observation	Mean	Standard Error	Standard Deviation
Unconstraint	139	142.0744	5.2668	62.0956
Constraint	261	97.6243	3.4309	55.4291
Combined	400	113.0707	3.0760	61.5206
Difference		44.4501	6.0720	

Source: Computed using STATA 14.2 t = 7.3204 Pr (|T| > |t|) = 0.0000***
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-4.15 shows the mean difference in inputs used per acre. Unconstraint farmers' average input use per acre is found as 142.07 thousand BDT. On the other hand, the constraint farmer's mean input use per acre is found as 97.62. Clearly, unconstraint farmers have utilized an additional 44.45 thousand input expenditure per acre which indicates 45.53% more than the average inputs expenditure of constraint farmers. The mean difference between these two groups is statistically significant at the 1% level, given that the t-value is 7.3204 and the probability value is 0.0000. This mean difference in input use was relevant to the findings of Feder et al. (1990) in China and Guirkinger &Boucher (2008) in Peru.

Table-4.16: Mean Productivity Difference (Agricultural Production) by Credit Constraint

Group	Observation	Mean	Standard Error	Standard Deviation
Unconstraint	139	294.2450	9.1334	107.6819
Constraint	261	196.5710	6.4978	104.9760
Combined	400	230.5130	5.7792	115.5855
Difference		97.6749	11.1221	

Source: Computed using STATA 14.2 t = 8.7820 Pr (|T| > |t|) = 0.0000***
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-4.16 exhibited the mean difference in production per acre. Production comprises the market value of produced agricultural commodities. Unconstraint farmers' average production per acre is 294.24 thousand, while it is 196.57 for constraint farmers. Hence, constraint farmers' average production per acre is 97.67 thousand less than unconstraint farmers. The t value is 8.7820 with a corresponding probability value of 0.000, indicating this mean difference is also found statistically significant at a one percent level. This finding corresponds with the findings of Feder et al. (1990) in China, Guirkinger &Boucher (2008) in Peru, Omonona et al. (2010), and Oyedele et al. (2009) in Nigeria

Table-4.17: Mean Productivity Difference (Net Agricultural Income) by Credit Constraint

Group	Observation	Mean	Standard Error	Standard Deviation
Unconstraint	139	152.1721	5.9917	70.6418
Constraint	261	98.9460	3.7385	60.3987
Combined	400	117.4421	3.4449	68.8990
Difference		53.2260	6.7344	

Source: Computed using STATA 14.2 t = 7.9035 Pr (|T| > |t|) = 0.0000***
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-4.17 displays the mean difference in agricultural income per acre. Agricultural income states the net income from agricultural activities. Unconstraint farmers' average income per acre is 152.17 thousand, and constraint farmers' income is 98.94. Therefore, we found a 53.22 thousand income difference per acre between these two groups. This mean difference is also found statistically significant at a one percent level with a t-value of 7.9035 and a corresponding probability value of 0.0000. Feder et al. (1990) in China and Guirkinger &Boucher (2008) in Peru also founds significant net revenue differences between constraint and unconstraint farmers.

4.6.3 Impact Assessment of Constraint Status on Productivity Indicators

The preceding section estimated the mean difference of various productivity indicators to compare the production levels of constraint and unconstraint farmers using a paired t-test. However, this evaluation only provides a group-level average difference in productivity metrics.

The average difference cannot precisely capture the individual effect of constraint status. In this section, the Propensity Score Matching (PSM) model was used to analyze the effect of constraint status on various productivity measures. Since it is relevant to observational survey data, PSM has been used to quantify the treatment's effect. Since our data was collected via a field survey, the PSM model has been applied. In addition, the PSM method can lessen the sample selection bias brought on by systemic socio-economic disparities between the treated and untreated groups. In the PSM model, we analyze three productivity indicators, namely inputs utilization, production, and income per acre. In the subsequent section, the econometric modeling of PSM has been discussed.

Modeling Propensity Score Matching (PSM)

When the study relies on observational data, Propensity Score Matching (PSM) is a technique used to estimate the treatment effect by taking into account the variables that influence the treatment status. The PSM approach aims to mitigate potential bias arising from confounding variables that may influence the treatment outcome disparity between the treated and control groups, such as socio-economic factors. These factors predict the treatment effect itself, causing the treatment variable rather than the difference. Therefore, the PSM model has been developed to determine the treatment variable's true impact.

Propensity Score Matching (PSM) has become popular in estimating causal treatment effects (Caliendo & Kopeinig, 2008). The basic idea behind PSM is to match each farmer treated with a similar farmer who is untreated and then measure the average difference in the outcome variable between the treated and untreated farmers. Here constraint status is the treatment variable; constraint farmers belong to the treatment group, and unconstraint farmers belong to the untreated or controlled group. As we found earlier, the observable characteristics of the farmers of these two groups are not the same, and thus creates sample section bias. This model reduces the sample selection bias when the two groups are systematically different (Dehejia and Wahba, 2002). In an experimental study, this problem of sample selection bias is easily addressed by assigning credit to a treatment group with a similar control group. However, this study has been done on observational data; thus, the heterogeneity of the farmers between two groups leads to selection bias. In this regard, the PSM approach is applied in this study which is commonly used in impact evaluation, mainly when sample selection bias occurs. The matching of PSM is based

on the assumption that there are no systematic differences in unobservable characteristics between treated and untreated households. The treatment outcome can be compared by matching an ideal control group (unconstraint farmers) to the treatment group (constraint farmers) based on the propensity scores of X. X represent the set of observable characteristics (e.g., age, gender, marital status, education, experience, household size, total owned land, agricultural income) that determine constraint status. Therefore, selection bias is essentially eliminated. To use the PSM and estimate the effect of credit constraint on productivity, the propensity scores (p scores) are calculated using a Probit Model. Let X denote the set of observable factors that define credit constraint status, and Di = 1 indicates credit constraint, whereas Di = 0 indicates credit unconstraint. Thus, D is a binary variable referred to as the constraint status, and Di = 1 and Di = 0 correspond to the observation of the treatment and observation of the control, respectively. Thereby the formula for calculating the p-score using the probit model is as follows:

$$p(x)= Pr(D=1/x) =E(D/x)$$ Equation 4.6

Here p(x) determined the propensity score based on x's observable characteristics, establishing the constraint status. Based on the same p-score, the outcomes of constraint and unconstraint farmers are determined to assess the actual influence of the treatment variable credit constraint. Based on the calculated propensity score, the second stage of the PSM model generates the average treatment effect on the treated (ATET) and the average treatment effect (ATE) by matching farming households with credit constraints with a similar propensity score of unconstraint farmers. Now assume that the outcome for the constraint farmer (Di = 1) is Y1i, and the outcome for the unconstraint farmers (Di = 0) is Y0i. The treatment effect is, therefore, Y1i - Y0i. The evaluation difficulty occurs since only one of the possible outcomes, E (Y1i/Di = 1), has been observed for each individual i. Thus, the outcome E (Y0i/Di =1), the counterfactual outcome, cannot be observed and must be calculated. The ATET is, therefore, the difference between the treated farmers' results and the treated farmers' outcomes if they had not been treated and expressed in the following equation.

$$ATET = E (Y1i - Y0i/Di = 1) = E (Y1i/Di = 1) – E (Y0i/Di = 1)$$ Equation 4.7

However, the counterfactual effect, i.e., if the farmers had not been treated, cannot be observed since the treatment effect cannot be removed from them. Consequently, a good approximation of

the counterfactual effect is required, and this may be achieved by comparing treated and untreated farmers with comparable p-scores. This allows us to compare the outcomes of treated and untreated observations.

$$ATET = E\,(Y1i/p(x), Di = 1) - E\,(Y0i/p(x), Di = 0)$$ Equation 4.8

The above equation now indicates that the ATET is now calculated based on the same p-score of p(x) between treated (Di = 1) and untreated (Di = 0) farmers on their respective outcomes of Y1i and Y0i. Consequently, this calculation based on p-score matching provides a fair comparison and an accurate estimate of the treatment impact.

The ATE is the difference between the treated and untreated observation outcomes and is represented by the equation below.

$$ATE = E\,(\Delta) = (Y1i/x, Di = 1) - E\,(Y0i/x, Di = 0)$$ Equation 4.9

The ATE combines the ATET and the expected treatment impact on untreated farmers. Therefore, ATE measures the treatment impact on the population level. However, for experimental research, ATE estimate is suitable. Instead, ATET is more appropriate for observational research.

Estimated Outcome of Treatment Effect on Productivity Indicators

As previously stated, three productivity criteria, namely inputs use, production, and income per acre, are included in evaluating the effect of banks' agricultural credit constraint status. The following section will estimate the treatment effect of constraint status using the PSM framework, which accounts for ATE and ATET estimation.

Model 1: (Inputs Use Per Acre)

The outcome variable in the model is input utilization per acre. The treatment variable is credit constraint status. Farmers with credit constraints belong to the treatment group, while unconstraint farmers are in the control group. Table-4.18 demonstrates the average treatment impact of credit constraint status on input utilization. The annual inputs used per acre are shown by pexpa. The results indicated that the average treatment impact of credit constraint is -44.715 thousand per acre. The probability value of this coefficient is 0.000, which corresponds to a

significance level of 1%. As discussed previously, ATE is the mean population-level treatment effect. Hence, this finding demonstrated that constraint farmers had lost 44,715-taka equivalent inputs used per acre every year when comparing both treated and untreated farmers.

Table-4.18: Impact of Credit Constraint on Inputs Use (ATE)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Pexpa (Inputs Use Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Credit Constraint=1, Unconstraint=0 (1 Vs. 0)	-44.715	7.6232	-5.87	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Table-4.19: Impact of Credit Constraint on Inputs Use (ATET)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Pexpa (Inputs Use Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect on the Treated) Credit Constraint=1, Unconstraint=0 (1 Vs. 0)	-44.147	8.7856	-5.02	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Table-4.19 presents the average treatment effect of the treated. The ATET is the average treatment effect for the farmers who ultimately received the treatment. Findings suggest that the coefficient of ATET is -44.147, with a corresponding probability value of 0.000, indicating that the coefficient value is statistically significant at the 1% level. The coefficient value indicates that the constraint farmers may utilize 44,147 BDT more inputs per acre if the farmers were unconstraint. In other words, the constraint farmers lost an equivalent of forty-four thousand one

hundred and forty-seven taka per acre of inputs. This outcome is consistent with the hypothesis that constraint farmers cannot use the inputs at the optimum level. The result also validates our expected negative impact of credit constraint on input use.

Model 2: (Agricultural Production Per Acre)

In model two, the agricultural production per acre is the second outcome variable. The treatment variable is credit constraint status. Similar to the previous model, constraint farmers are the members of the treatment group, and unconstraint farmers are the control group members.

Table 4.20 displayed an ATE calculation of the influence of constraint status on agricultural output per acre. The annual production per acre is recorded as prodpa. The coefficient of -88.779 indicates that the average treatment impact of credit constraint on production per acre is 88.779 thousand per acre. The probability value of this coefficient is 0.000, indicating the statistical significance at the one percent level. The ATE is the mean population-level impact of the treatment, as described in Model 1. Thus, this outcome demonstrated that constraint farmers produced 88,779 Taka less per acre over a year, taking both treated and untreated farmers into account.

Table-4.20: Impact of Credit Constraints on Agricultural Production (ATE)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Prodpa (Production Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Credit Constraint=1, Unconstraint=0 (1 Vs. 0)	-88.779	11.3695	-7.81	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

The average treatment effect of the treated was reported in Table-4.21. The coefficient value of ATET was determined to be -79.639, with a corresponding probability value of 0.000, suggesting that the coefficient value is statistically significant at the 1% level. The coefficient value indicates that constraint farmers generate 79,639 BDT less production per acre than

unconstraint farmers. In other words, constraint farmers can produce seventy-nine thousand six hundred thirty-nine taka more per acre if they are unconstraint. This research finding verifies the conceptual assertion that constraint farmers use sub-optimum levels of inputs that result in reduced output. The result also validates our expected negative impact of credit constraint on output.

Table-4.21: Impact of Credit Constraints on Agricultural Production (ATET)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Prodpa (Production Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect on the Treated) Credit Constraint=1, Unconstraint=0 (1 Vs. 0)	-79.639	11.8946	-6.70	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Model 3: (Net Agricultural Income Per Acre)

Model three's outcome variable is net agricultural revenue per acre, and the treatment variable is constraint status. This model's treatment group and control group are constraint and unconstraint farmers, respectively.

Table-4.22: Impact of Credit Constraint on Net Agricultural Income (ATE)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Netpa (Income Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Credit Constraint=1, Unconstraint=0 (1 Vs. 0)	-44.065	6.9290	-6.36	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Table-4.22 demonstrates the average treatment impact of credit constraint status on net agricultural income. The annual net agricultural income per acre is shown by netpa. The results indicated that the average treatment impact of credit constraint is -44.065 thousand per acre. The probability value of this coefficient is 0.000, which corresponds to a significance level of 1%. As discussed previously, ATE is the mean population-level treatment effect. Hence, this finding demonstrated that constraint farmers had lost 44,065-taka equivalent net income per acre yearly, considering treated and untreated farmers.

Table-4.23 presents the average treatment effect of the treated. The ATET is the average treatment effect for the farmers who ultimately received the treatment. Findings suggest that the coefficient of ATET is -35.493, with a corresponding probability value of 0.000, indicating that the coefficient value is statistically significant at the 1% level. The coefficient value indicates that the constraint farmers lost 35,493 BDT net income per acre than the unconstraint farmers. In other words, if unconstraint, the constraint farmers can earn an equivalent of thirty-five thousand four hundred and ninety-three taka more net income from per acre of land. This outcome is consistent with the hypothesis that constrained farmers cannot produce more, thus resulting in lower net income. The result also validates our expected negative impact of credit constraint on net agricultural income.

Table-4.23: Impact of Credit Constraint on Net Agricultural Income (ATET)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Netpa (Income Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect on the Treated) Credit Constraint=1, Unconstraint=0				
(1 Vs. 0)	-35.493	7.4153	-4.79	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Chapter 5

Access to Agricultural Credit

5.1 Preface

Access to agricultural credit is very decisive for agricultural productivity. It enables the farmers to fulfill their required input and investment need and smoothen the agricultural production process. Moreover, agricultural credit is necessary for enhancing resource utilization and product diversification. Presently in Bangladesh, food and nutrition demand fulfilment for the vast population from a gradually reducing cropping land has become a great challenge and requires more agricultural productivity. Thus, bank financing is very crucial in this regard. However, most farmers in Bangladesh have limited access to banks' agricultural credit. Even for farmers with access to bank credit, whether this access impacts agricultural productivity is unambiguous. Hence, in this chapter, we try to identify the condition of access to banks' agricultural credit. Simultaneously factors affecting access to credit and its corresponding impact assessment on different productivity indicators will also determine through some analytical tools.

5.2 Theoretical Background

A household is said to have access to credit if it can borrow from a particular source of credit. In other words, a household participating in a credit program is referred to have access to credit. According to Yehuala (2008), farmers' access to formal credit status is determined by the use of formal credit in the study area of Ethiopia. Bank credit access of the farmers is explained by predicting the probability that the farm households have received agricultural credit from commercial banks in Kazakhstan (Gaisina, 2010). In another study in Nigeria, the farmers' access to credit status is proxied by the amount of credit obtained (Awotide et al., 2015). Access to bank credit refers to the supply of bank credit or the availability of bank financing (Ganbold, 2008). In some studies, the extent of access to credit is measured by the sufficiency of credit. According to this concept, a household can access credit when it receives as much as it wants. In other words, when the supply of credit exceeds the demand, the farmers are said to have access. In Bangladesh, agricultural credit is given at a concessional rate, which creates more demands among the farmers and indeed, the banks undoubtedly limit the supply of subsidized agricultural credit. Thus, defining access status based on demand fulfilment is difficult.

Meanwhile, in the previous chapter, we have addressed the farmers' different credit constraints status, including quantity constraints. When the farming household cannot borrow as much as they demand is termed as quantity constraint. If the farmers can borrow up to their desired amount, they said to be unconstraint. Since we have addressed the constraint and unconstraint status of the farmers regarding banks' agricultural credit in the previous chapter, here in this chapter, we define access to credit based on borrowing status. Moreover, most of the recent studies[13] proxied access to the bank credit status of the farmers by their inclusion in banks' financing. Hence, in this chapter, we focus on the farmers' participation in the banks' agricultural credit to define access to banks' agricultural credit.

According to the pecking order theory, firms prefer covering their investment needs from their financial sources rather than exposing them to external debt. When the internal sources of funds are insufficient for the farm operation, firms can go for external debts and external equity (Myers 1984). Like this theory, farming households prefer to finance their production system from their resource. Due to the low-income level, most farmers face insufficient funds and thus depend on external sources, i.e., informal lenders, semi-formal and formal lenders for fund acquiring. Considering the importance of the agricultural sector and farmers' credit necessity, Bangladesh Bank has instructed the scheduled bank to finance the agricultural sector at a concessional interest rate and in easy terms and conditions. Besides problems of informal and semi-formal credit, bank loan is getting popular and demandable by farmers. However, the farmers are also constraint in banks' agricultural credit, which has been discussed in the previous chapter in detail. Despite overcoming price, risk, and transaction cost constraints, some farmers are participating in banks' agricultural credit programs and accessing bank credit. According to Madafu (2015), access to bank credit happens when there are no price and non-price obstacles in using bank credit. While considering the determinants of access to bank credit, collateral submission is one of the vital factors most financial institutions consider for lending to the borrowers. The banks more strictly require collateral for access to agricultural credit since most financial institutions perceive the agricultural sector as riskier (Gaisina, 2010). Other than the collateral requirements, some researchers have cited income, past credit history, and banking habits of the farmers as other significant influencing factors in determining access to banks' agricultural credit. Atieno (2001) and Getaneh (2005) indicate that income level and past credit

[13] (Taremwa et al., 2022), (Isaga, 2018), (Temesgen et al., 2018) for reference

participation were significant determinants of borrowers' access to formal credit markets. Apart from the determinants of access to banks' credit explored above, other researchers identified the impact of household heads' characteristics on credit accessibility. Mohieldin and Write (2000) found that the possibility of participating in the formal credit sector was positively affected by gender, educational level, household labor and farm size. The negative effect of age and household size is mentioned by Awotide et al. (2015).

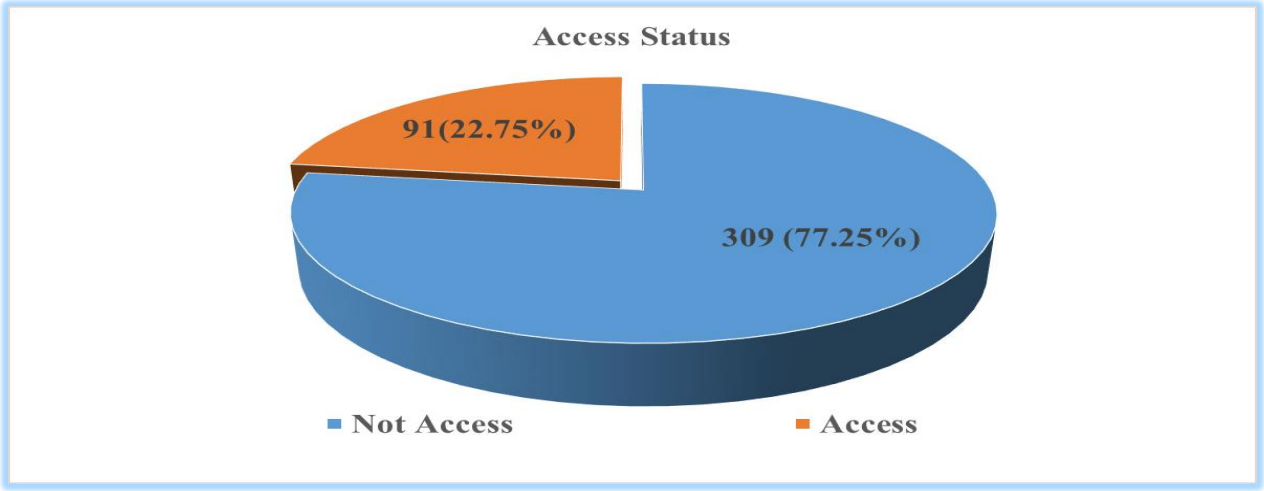
The 5 Cs of credit theory is an approach banks use while giving loans to potential borrowers. The five C's includes character, capacity, capital, conditions and collateral assessment of the borrower used by many banks to evaluate borrower selection. Hence to be a suitable borrower and get access to bank credit, the loan applicant meets the 5 Cs assessment conducted by the banks. Character refers lender's assessment of a debtor's general honesty, credibility and personality. Lending institutions must evaluate the borrowers' character since they want to lend to responsible people who keep commitments. The borrowers' work experience, credit records, identifications, references and reputation are evaluated for character assessment. Capacity refers to the ability to the repayment of the loan. In this regard, banks always need to be assured that the farm operation generates enough income to repay the loan on time. Historical and forecasted cash flow is considered for capacity evaluation. Capital denotes the investment in fixed assets by the farming household. Banks are more willing to lend who have invested some of their funds into the business. Collateral usually refers to assets especially fixed assets like valuable and marketable land, which the banks take for guaranteed a loan in case of business failure. Thus, collateral act as a safeguard for banks if the borrower cannot be able to repay a loan. The condition states that business, industry and economic trends affect borrowers' loan repayment ability.

After discussing the theory mentioned above, concepts and arguments of the different researchers, we have found some farmers, household, farm and institution-specific factors to explain access to banks' agricultural credit by the farmers, which will be measured statistically in the later section.

5.3 Conditions and Problems of Access to Credit

In this section, different conditions of the accessed banks' agricultural credit have been measured through descriptive statistics and discussed accordingly.

Figure 5.1: Access to Banks' Agricultural Credit



Source: Field Survey 2022

Figure- 5.1 displays the access status of banks' agricultural credit by the sampled farmers. As we mentioned earlier, access to credit is proxied by the farmers' participation in the banks' agricultural credit program. Here we have a total of 91 farmers who are 22.75% of the sampled farmers participating in the banks' agricultural credit program. These 91 farmers have borrowed money in the last year from different banks for various purposes. This finding is similar to Akudugu's (2016) findings in Ghana, where 27% of farmers had access to formal credit. On the other hand, most of the sampled farmers containing, 77.25%, did not get access to banks' agricultural credit.

Table 5.1 presents farmers' access to banks' agricultural credit by type of bank. Govt. and private bank categories are considered based on ownership and management of the banks. Govt. bank category comprises SOCBs and SDBs, and the Private bank category includes only PCBs since we have found no FCB branches given agricultural credit in the study area. Results showed that out of 91 farmers who have access to banks' agricultural credit, 44 farmers who are 48.35% of accessed farmers are taking agricultural credit from the private bank. Whilst a total of 47 farmers, 51.65% of the accessed farmers are obtaining credit from Govt. bank. Here we have observed balanced participation in private and Govt. banks by the framers. The primary supplier of agricultural credit from the private bank cluster is Social Islami Bank, Islami Bank Bangladesh Limited and Bank Asia Limited. On the other hand, Bangladesh Krishi Bank, Sonali

Bank and Agrani Bank are the major suppliers of agricultural credit from the Govt. bank category in the study area.

Table 5.1: Access to Banks' Agricultural Credit by Type of Bank

Code	Type of Bank	Frequency	Percent
0	Private Bank	44	48.35
1	Govt. Bank	47	51.65
Total		91	100.00

Source: Field Survey 2022

Table 5.2: Share and Average Agricultural Credit Disbursement by Type of Bank

Code	Type of Bank	Frequency	Share of Total Amount (%)	Total Amount Disbursed ('000)	Average Credit Amount Disbursed ('000)
0	Private Bank	44	30.94	2,865	65.11
1	Govt. Bank	47	69.06	6,395	136.06
Total		91	100.00	9,260	101.76

Source: Field Survey 2022

Table-5.2 exhibits the total and average disbursed amount of agricultural credit by type of bank and their corresponding share. The amount of credit is furnished in thousand BDT. The private banks disburse 2,865 thousand BDT among 44 farming household heads. Therefore, on average, a farmer has obtained 65.11 thousand BDT from a private bank. On the other hand, 47 farmers received 6,395 thousand BDT from Govt. banks, which indicates per head 136.06 thousand BDT

disbursed by the Govt. bank. Farmers are getting twice time more loans from Govt. banks. The share of the private bank is 30.94% in total disbursed credit, which is 69.06% for the Govt. banks. In total, 9,260 thousand BDT is given to 91 farmers in the study area, indicating per head 101.76 thousand receipts of agricultural credit. According to the Agricultural & Rural Credit Policy and Program report, 2021-2022, 25.5113 billion BDT is disbursed to 3.0551 million farmers as agricultural credit by 55 scheduled banks in Bangladesh, which indicates an average of 83.502 thousand BDT is the country average. Hence, we can conclude that the accessed farmers in our study area obtained credit above the country average.

Table 5.3: Interest Rate of Banks' Agricultural Credit by Type of Bank

Code	Type of Bank	Frequency	Total Interest Charged ('000)	Total Amount Disbursed ('000)	Weighted Average Interest Rate (%)
0	Private Bank	44	286.85	2,865	10.01
1	Govt. Bank	47	454.05	6,395	7.10
Total		91	740.90	9260	8.00

Source: Field Survey 2022

Table-5.3 illustrates the interest rate of banks' agricultural credit by type of bank. The weighted average interest rate is 10.01% for private banks and 7.10% for Govt. banks. At the same time, the combined weighted average interest rate is 8.00%. According to section 5.06 of BB's Agricultural & Rural Credit Policy and Program, the highest interest rate ceiling for agricultural credit is 8 percent. Besides, the individual bank can set their interest rate, but the highest ceiling is 8 percent. Moreover, according to section 2.02, banks must lend at a 4 percent interest rate for import substitute crops, i.e., pulses, oilseed, spices, and corn. Results showed that the interest rate of Govt. banks complies with the regulatory rules of BB. While talking to the farmers who have received agricultural credit from private banks reported that those private banks usually impose a 2% risk premium over the base interest rate. Hence, private banks' interest rate is relatively high in the study area. The possible reason behind this risk premium imposition is insufficient information collection regarding the creditworthiness of the farming household

residing in remote areas. As a result, banks tend to impose higher interest rates to compensate for those risks (Madafu 2015). This concept is also mentioned by Coates et al. (2011) in Ghana.

Table 5.4: Tenure of Banks' Agricultural Credit by Type of Bank

Type of Bank	Disbursement in Short-term ('000)	Disbursement in Long-term ('000)	Total Amount Disbursed ('000)	Percentage in Short-term Credit	Percentage in Long-term Credit
Private Bank	2,865	0	2,865	100	0
Govt. Bank	5,895	500	6,395	92.18	7.82
Total	8,760	500	9,260	94.60	5.40

Source: Field Survey 2022

Table-5.4 shows the tenure of disbursed banks' agricultural credit in the study area. A total of 9,260 thousand BDT has been disbursed among the accessed farmers. Of these, 8,760 thousand BDT has been given as short-term credit, 94.60% of the total disbursed credit. On the other hand, only 5.40% of the loan is given in the form of long-term credit. From the annual report of Bangladesh Bank-2021, we have found that 13.48% of the banks' entire agricultural credit is given for the long term. We have seen a low tendency to provide long-term credit by the banks in the study area. While comparing the category of banks, private banks in our study area did not provide any long-term credit. They provide their entire amount in the short-term form. The probable reason for avoiding long-term credit disbursement by private banks' is more risk involvement in long-term financing. Long-term financing by the Govt. bank is 7.82%, above the study area average but below the country average.

Table-5.5 indicates farmers' average actual cost of borrowing for banks' agricultural credit. Estimating the actual cost of borrowing, processing cost and the extra amount incurred by the farmers is considered besides the interest charge. Here processing cost includes application fees, documentation fees and travelling expenses incurred by the farmers for loan processing. The extra amount denotes bribe, broker and lobbying-related costs for loan sanctioning. Farming households receiving agricultural credit from private banks incurred 40.25 and 286.85 thousand

BDT as processing costs and interest charges. They did not have to pay any illegal amount in the form of bribes, brokers and lobbying costs. Therefore, it is apparent that private banks deliver agricultural credit fairly in the study area. However, 327.10 thousand BDT is incurred for borrowing 2,865 thousand BDT, which indicates an 11.42% actual cost of borrowing from private banks.

Table 5.5: Average Actual Cost of Borrowing of Banks' Agricultural Credit

Type of Bank	Interest Charged ('000)	Total Processing Fees ('000)	Extra Amount Paid ('000)	Total Cost Incurred ('000)	Total Amount Received ('000)	Actual Cost of Borrowing (%)
Private Bank	286.85	40.25	0	327.10	2865	11.42
Govt. Bank	454.05	57.60	463.50	975.15	6395	15.25
Total	740.90	97.85	463.50	1302.25	9260	14.06

Source: Field Survey 2022

For Govt. banks' agricultural credit processing, 463.50 thousand BDT, 7.25% of the total disbursed credit, has been given as bribes, brokers and lobbying costs. This alarming rate of illegal money involvement in loan processing manifests massive corruption among bankers and politically involved persons. Most farmers who have taken credit from Govt. banks express their grief and worry regarding this unfair practice and say that without any bribe, broker involvement and lobbying through politically influenced people, it is very tough and rare to get agricultural credit from Govt. banks. Kumar et al. (2013) found that 80% of the farmers reported bribery by bank officials in India. However, considering processing costs, interest charges, and extra payment, 975.15 thousand BDT is incurred for 6395 thousand BDT agricultural credit processing, which shows a 15.25% actual cost of borrowing from Govt. banks. Finally, we have found 14.06% actual cost of borrowing for entire accessed farmers in the study area.

An essential critical insight from the above discussion is that the interest rate is a vital component of the cost of a loan but not the lone component. Transaction costs in the form of processing fees and extra payment in the form of bribes and other illegal payment lead to added

costs burden to the farmers, which evident a wedge between the actual cost of the loan and the market price. Almost similar to our findings has also been identified by Sarap (1990) where he founds the actual cost of borrowing as 13.48%. This high expense of formal agricultural credit is also identified by Amjad & Hasnu (2007) in Pakistan, where they found 14.88% as the actual cost of borrowing from formal financial institutions.

Table-5.6 furnished collateral requirements by the banks. Generally, collateral refers to any asset, i.e., real estate, submitted to the lender by a borrower as a security for a loan. In the event of the loan default, the lender may take possession of the collateral to recover some or all of the loan amount. Section 5.05 of BB's Agricultural & Rural Credit Policy and Program states that banks are not permitted to impose any collateral requirement for crop loans up to cultivating 5 acres of land. Banks are permitted to take the letter of crop hypothecation, letter of personal guarantee and DP note. However, the findings showed that 43.96% of borrowers had to submit collateral in the form of submitting original documents of their owned land. While 82.98 % of loan takers from Govt. banks had to submit collateral, only 2.27% of farmers taking loans from private banks had to submit collateral. These differences are found statistically significant at the 1 percent level. Apparently, private banks are almost following the regulatory guideline of BB. Unfortunately, Govt. banks in our study area do not comply with the rules in this regard. Moreover, the farmers also said that the Govt. bank officials impose a very high requirement of collateral submission compared to the loan amount.

Table 5.6: Collateral Requirement by Type of Bank

Type of Bank	Collateral Not Required	Collateral Required	Total
Private Bank	43	1	44
	(97.73)	(2.27)	(100.00)
Govt. Bank	8	39	47
	(17.02)	(82.98)	(100.00)
Total	51	40	91
	(56.04)	(43.96)	(100.00)

Source: Field Survey 2022 Pearson chi2(1) = 60.0860 (Pr = 0.000)
Note: Figures in brackets are respective percentages.

Table-5.7 presents the average delay in disbursement of agricultural credit from the date of application. Findings showed that the average delay of loan disbursement is 16.54≈17 days considering all accessed farmers. As stated by section 4.0 of the Agricultural & Rural Credit Policy and Program issued by BB, the loan has to be disbursed within a maximum of 10 working days, equivalent to 14 calendar days. Thus, the results revealed the presence of a slight delay in disbursement. However, any delay is undesirable since the crop production process is time-sensitive. Private banks' average delay is 14.07≈14 days, which is acceptable. On the other hand, on average, 18.85≈19 calendar days elapsed to disburse the credit by the Govt. banks in the study area. This delay indicates poor management and non-professionalism among the Govt. bank officials.

Table 5.7: Average Delay in Disbursement by Type of Bank

Type of Bank	Frequency	Delay in Disbursement (Days)
Private Bank	44	14.07
Govt. Bank	47	18.85
Total	91	16.54

Source: Field Survey 2022

Table 5.8: Adequacy Ratio of Disbursed Credit by Type of Bank

Type of Bank	Total Amount Received ('000)	Total Amount Demanded ('000)	Adequacy Rate (%)
Private Bank	2,865	3,865	74.13%
Govt. Bank	6,395	9,480	67.46%
Total	9,260	13,345	69.39%

Source: Field Survey 2022

Table-5.8 displays the adequacy ratio of disbursed agricultural credit by type of bank. Results revealed that all accessed farmers in the study area demanded 13,345 thousand BDT. Out of

which, 9,260 thousand BDT was disbursed among the farmers, indicating 69.39% demand fulfilment was met by the entire banks. This rate is 74.13% and 67.46% for private and Govt. banks, respectively, and indicates the poor performance of the Govt. banks compared to private banks in demand fulfilment and need assessment of the farmers. Since funds for agricultural credit are limited and there is a budget for every bank and their respective branches, a hundred percent demand fulfilment is impractical. In support of this view, the capital constraint model mentioned by Madafu (2015) describes the behavior of banks in restraining credit to agribusiness borrowers because of the limitation of available sector-oriented funds from the banks. According to Obamuyi (2010), banks must comply with regulatory rules regarding capital and liquidity requirements and maintain a loan-to-deposit ratio at a specific rate. Hence, banks are limited in providing loans to borrowers up to a certain level.

5.4 Factors Influencing Access to Credit Status

This section will explore factors influencing access to banks' agricultural credit status. In this process, some empirical factors describing access to credit status are explained first. Subsequently, econometric modelling has been developed. Then summary statistics of the variables used for the study of access to credit status will be furnished. Afterwards, the results of the probit model have been discussed to estimate the influence of the independent variables on the dependent variable, and finally, some post-estimation has been carried out to check the robustness of the model outcome.

5.4.1 Description of the Variables Used in the Study of Access to Credit

The following variables are considered based on the review of conceptual literature on factors influencing farmers' access to credit, previous empirical research findings, the knowledge of the authors and the theoretical background of the study matter to explain the factors behind access to the credit status of the farmers. In other words, among several factors describing access to credit status, the following demographic, socio-economic, farm-specific and institutional factors explain access to credit.

5.4.1 (a) Dependent Variable

Access to banks' agricultural credit is the dependent variable for this analysis. The farmers who got agricultural credit for the study period in Ghana are referred to as having access to credit and

vice versa (Owusu, 2017). In this chapter, access status is denoted as ‘access’ and takes the value one if the farmers obtain banks’ agricultural credit and 0 for those not obtaining credit. This notation is to discriminate between the participation and non-participation condition of the farmers. The use and definition of this dependent variable have been supported by most recent literature, for example, Isaga (2018), Temesgen et al. (2018) and Taremwa et al. (2022), among others. Since the dependent variable takes a value between 0 and 1, our analysis's dependent variable is binary.

5.4.1 (b) Independent Variables

i. Age of the Farmer (age)

This age is a continuous variable since age is measured in completed years and defined as the farming household head's actual age at the interview time. The younger farmers lean towards more risk takers than older farmers, thus expected to have more access than their counterparts (Awotide et al., 2015). Therefore, the age of the household head is expected to be negatively related to the access status. On the other hand, according to Yehuala (2008), older farmers have better life experience and more association with different lending institutions. This assumption leads to a positive relationship between age and access status. Hence, we can hypothesize that there is a chance of both positive and negative associations of age with access to credit.

ii. Gender of the Farmer (gen)

This binary variable takes 1 for male farmers and 0 for female farmers. Female households are comparatively more occupied with childcare and house chores in addition to their farming activities, leading to less interaction with extraneous matter (Temesgen et al., 2018). This independent variable is expected to associate with bank credit access positively. According to Samuel (2010), men are more likely to get credit access than women. Therefore, it is expected to impact male gender status on access to agricultural credit positively.

iii. Educational Qualification (edu)

The number of completed years in formal education is proxied to the educational qualification of the farmers. Therefore, this is a continuous variable. Educated farmers can collect credit information and better understand lending terms and conditions (Sekyi et al., 2016). Ozowa (1995) mentioned that literate farmers are more likely to recognize the advantages of credit use

and have better knowledge about credit sources. Hence, we hypothesized that educational qualifications positively influence access to credit.

iv. Farming Experience (exp)

The total number of full-time farming experiences of the farmers in years measures farming experience. This is another continuous independent variable to explain the dependent variable. According to Madafu (2015), farmers with higher experience have sufficient financial past records that the banks may require to process the loan. This assumption is also supported by Gamage (2011), who argued that less experienced farmers have inadequate information about previous financial performance, which leads to difficulties for lenders in evaluating loan proposals. Therefore, a positive relationship between the experience of the farmers and access status is expected.

v. Household Size (hhsz)

Household size refers to the total number of family members residing together and taking a meal from the same kitchen. This variable is another continuous independent variable. Larger the household size higher the family expenditure, which leads to low savings of farming households and indicates poor creditworthiness. As a result, we assumed a negative relationship exists between household size and access to credit. This assumption also aligns with Oyedele et al. (2009) and Owusu's (2017) findings.

vi. Household Labor (hhl)

Household labor is a continuous variable measured by the number of household members deployed in full-time farming activities. When the farming household head has more family labor for farming activities, they can rely on them, thus getting some time and space for credit information collection and application procedure. Hence, we can assume a positive association of household labor with credit access. However, a negative impact of household labor on access to credit is argued by some researchers as well. Among them, Madafu (2015) mentioned that higher family labor lowers the demand for hired labor, which means no or low cost for outside labor. If the cost of labor decreases, the demand for credit also decreases. Abdallah et al. (2019) argued that full-time farming involvement by family labor leads to more hours spent on farming activities and decreases the time spent on loan processing. Thus, on this ground, we can assume a

negative relation between household labor and access to credit may also prevail. Therefore, we can hypothesize both household labor's positive and negative effects on access status.

vii. Krishi Card (kcard)

Krishi card refers to the identity card of a farmer. It is a dummy variable and takes the value one if the farmer has a krishi card and 0 for not having a krishi card. This krishi card is essential for farmers to obtain Govt. subsidy, grants, and subsidized credit from banks. Banks are instructed to provide agricultural credit to genuine farmers; hence this card is beneficial for lending institutions to identify genuine farmers. Therefore, having a krishi card is expected to relate positively to banks' agricultural credit access.

viii. Non-Agricultural Income (naginco)

The annual off-farm farming household income measures non-agricultural income in thousand BDT. This is a continuous variable. Banks, while providing agricultural credit, also assess the other income sources of the farming household to ensure overall creditworthiness. Thus, we assume that the higher the non-agricultural income of the farming household, the more likely they are to get access to banks' agricultural credit. According to Byerlee et al. (2014), farmers' off-farm income stimulates their capacity for loan repayment on time. For this reason, we can expect non-agricultural income and access to credit to be positively related.

ix. Savings (sav)

This continuous variable is measured by the annual average savings of farming households in thousand BDT. As mentioned by Morris and Meyer (1993) and Dzadze et al. (2012), the propensity to saving acts as an influencing factor in getting access to credit by the farmers since it provides a financial history of the farmers to banks on which they can make lending decisions. On this ground, a positive association is hypothesized between savings and access to credit.

x. Agricultural Income (aginco)

Agricultural income is the farmers' annual income from farming activities, measured in thousand BDT. It is another continuous independent variable. Banks provide agricultural credit to increase agricultural productivity and expect the loan to be repaid from the income generated from the agricultural output. Isaga (2018) mentioned that a higher income level from agricultural activities

implied the enhanced ability of a farming household to repay both the principal and the interest imposed by the bank on time. Hence, we expect a positive association between agricultural income and access to bank credit.

xi. Total Owned Land (totaol)

Total owned land comprises agricultural land as well as homestay and other lands. Total owned land is measured in decimal; thus, it is a continuous independent variable. Banks usually prefer to take real estate property as collateral because of its immovability, marketability, and value. Chandio et al. (2018) argued that owned land is more acceptable for formal financial institutions as a credit risk management tool, assuming their loan is secured since they had collateral in property form. Therefore, we hypothesized that more proportion of land ownership would increase the probability of farmers getting access to banks' agricultural credit. This assumption also corresponds with Zulfiqar et al. (2021) findings.

xii. Purpose of Farming (pfarm)

The purpose of farming is a binary independent variable and takes a value of 1 for commercial farming and 0 for subsistence farming. Some farmers are farming to meet their food demands called subsistence farmers. At the same time, other farmers are sold most of their produce and denote as commercial farmers. Banks always disburse credit based on cash flow generating capacity. Commercial farmers can make cash flow by selling their products and have repayment capacity. Thus, we hypothesized that the purpose of farming is positively associated with banks' access to credit.

xiii. Past Access in Bank Credit (paccs)

Past access in bank credit is another binary independent variable. If any farmer had past access to banks' agricultural credit, it takes the value 1 and 0 for otherwise. Yehuala (2008) mentioned past access to bank credit as an experience dealing with credit use bank formalities. He also stated that farmers with previous access to bank credit have more experience and a higher propensity to take bank credit and vice versa. Therefore, it has been assumed that past access to bank credit is positively related to access to the bank loan.

xiv. Bank Account (bnkacc)

This variable, denoted as bnkacc, takes the value 1 for farmers with a bank account and 0 for otherwise. Thus, it is another binary independent variable. This variable proxied to the banking habit of the farming household. Farmers with bank accounts are in touch with bank officials and are thus informed about different credit schemes. Moreover, savings in those account gives the bankers more assurance about the repayment capacity. Taremwa et al. (2022) found that farmers with bank accounts are twice as likely to access agricultural credit as their counterparts. So, it has been assumed that access to bank accounts is positively associated with access to banks' agricultural credit.

5.4.2 Econometric Modeling

In the study of determining access to the credit status of the farmers, the dependent variable access to credit is a binary variable. However, we have both continuous and dummy variables as independent variables. Empirically we have found that the logit and probit models have been mainly used to explain binary dependent variables. Between these two regression models, most of the researchers have chosen the probit regression model over the logit model due to the normality assumption of the probit model, which specified that due to the properties of the normal distribution, several specification problems are more easily analyzed in the probit model (Wooldridge 2006). As a result, we have applied a binary probit regression model in this study to determine the influence of the explanatory variables to explain the outcome variable access to credit. The probit model has been used to explain access to credit status by Sarap (1990) in India, Spio (2002) in South Africa, Saqib et al. (2016) in Pakistan, Kumar et al. (2020) in India, and Zulfiqar et al. (2021) in Pakistan among the others.

A linear probability model is a linear regression model where the dependent variable is a dummy variable. Hence, the linear probability model estimates the probability of y=1 as a linear function of the independent variables and express in the in the following equation 5.1. Where P(y=1) is the probability of a binary dependent variable taking the value 1, given k predictor variables x1, x2,..., xk; xβ is in matrix form. β0, β1, β2, ..., βk are the coefficients of the independent variables that need to be estimated from the data, while μ is the error term that accounts for unobserved variation in the response variable.

$$P(y=1) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots + \beta_k x_k + \mu = x\beta + \mu$$ Equation 5.1

However, the major limitation of the linear probability model is that it cannot strict the value of y in between 0 and 1. Since our outcome variable is a dummy variable that takes the value of 0 and 1. Therefore we estimate the probit model, which takes the probability value of y=1 as a non-linear function G of the independent variables and can be expressed in equation 5.2. G is a non-linear function that transforms xβ in between 0 and 1 since P(y=1) is a probability.

$$P(y=1) = G(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots + \beta_k x_k) + \mu = G(x\beta) + \mu$$ Equation 5.2

The probit model used the cumulative density function (CDF) of the normal distribution of Φ, as stated in equation 5.3. In this equation, G is the cumulative distribution function (CDF) of the standard normal distribution, transforming the linear combination of predictor variables (xβ) into a probability value between 0 and 1.

$$P(y = 1) = \theta(x\beta) = \int_{-\infty}^{x\beta} \theta(z)dz$$ Equation 5.3

Equation 5.3 provides an expression that, as a function of the linear predictor x, indicates the probability of the binary outcome y=1. In this equation, x is a vector of predictor variables, is a vector of coefficients that link x to the outcome probability, and θ (z) is the cumulative distribution function (CDF) of a standard normal distribution assessed at z. The normal distribution is assumed for the linear predictor x, which reflects the linear combination of the predictor variables and coefficients.

We can now express our dependent variable access status y as the function of independent variables in the following equation 5.4. Here β_0 is the constant, and μ is the error term. Respective β_i is the coefficient for the corresponding independent variables.

$$P(access=1) = \Phi(\beta_0 + \beta_1 age + \beta_2 gen + \beta_3 edu + \beta_4 exp + \beta_5 hhsz + \beta_6 hhl + \beta_7 kcard + \beta_8 naginco + \beta_9 sav + \beta_{10} aginco + \beta_{11} totaol + \beta_{12} pfarm + \beta_{13} paccs + \beta_{14} bnkacc + \mu)$$

Equation 5.4

The coefficients in the probit model are obtained by maximizing the log-likelihood function, and the function's functional form is presented in equation 5.5.

$$lnL = \sum w_j \, ln \, \Phi (x_j\beta) + \sum wj \, ln \, \{1-\Phi (x_j\beta)\} \quad \text{Equation 5.5}$$

In this equation, wj represents the weights or frequencies of the observations, xj represents the jth row of the design matrix, β is the vector of parameters to be estimated, and Φ is the normal distribution's cumulative density function. The parameters that maximize the probability of observing the data given the model are estimated using the log-likelihood function for the probit model. xjβ is the CDF of a standard normal distribution evaluated at xjβ, and it is written as the sum of the logarithms of the probabilities of observing the data. The log-likelihood function is then the sum of the logarithms of the probability of observing the data, given by Φ(xjβ) for y=1 and 1-Φ(xjβ) for y=0.

5.4.3 Determinants of Access to Credit Status

Table-5.9 presents summary statistics of the variables used in the study of access to credit status determinants. The mean value of the access variable is found as 0.2275, which indicates that 22.75% of farmers have access to banks' agricultural credit. The average value of age of the farmers is found as 50.8025 years. Similar to our findings, Kumar et al. (2020) in India found a mean age of 49.86. The gender of the farmers is a binary variable; its mean value of 0.9150 indicates that 91.50 percent of farmers are male, and the remaining 8.50 percent are female. In India, Kumar et al. (2020) found that 96% of male and 4% of female farmers. The average value of education is 5.2950, similar to Saqib et al. (2016) outcome in Pakistan, where they found the mean education as 5.60 years. The farmers' mean experience is 30.7875, similar to the results of Chandio et al. (2018) in Pakistan, where they found the average experience as 28.37 years. The household size of the farming household is 5.2375 persons per household on average. Sekyi et al. (2017) in Ghana found household size as 6.095. The mean value of household labor showed that on average 1.6925 persons are doing full-time farming activities. Krishi card is another binary variable whose mean value of 0.3175 showed 31.75 percent of farmers have krishi card and the remaining 68.25 percent does not. Yearly agricultural income, savings, and non-agricultural income are continuous variables and found on an average as 191.3095, 147.3570, and 208.8675 thousand BDT, respectively.

Table 5.9: Summary Statistics (Access to Credit Model)

Notation	Short Description	Observation	Mean	Standard Deviation
access	Access to Bank Credit (1=Access, 0=Not access)	400	0.2275	0.4197
age	Age of the Farmer in Years	400	50.8025	12.3703
gen	Gender of the Farmer	400	0.9150	0.2792
edu	No. of Completed Years in Formal Education	400	5.2950	4.1685
exp	Full Time Farming Experience in Years	400	30.7875	15.6473
hhsz	Household Size (No. of Family Members)	400	5.2375	2.3107
hhl	Full Time Household Labor (No. of Persons)	400	1.6925	.8304
kcard	Krishi Card (1=Have Krishi Card, 0=Otherwise)	400	0.3175	0.4660
naginco	Annual Non-Agricultural Income in Thousand BDT	400	208.8675	206.6046
sav	Annual Savings in Thousand BDT	400	147.3570	268.0318
aginco	Annual Agricultural Income in Thousand BDT	400	191.3095	216.6504
totaol	Total Owned Land in Decimal	400	110.5732	137.2050
pfarm	Purpose of Farming (1=Commercial,0=Otherwise)	400	0.8700	0.3367
paccs	Past Access in Bank Credit (1=Access,0=Otherwise)	400	0.1525	0.3599
bnkacc	Bank Account (1=Have Bank Account, 0=Otherwise)	400	0.8200	0.3846

Source: Computed by STATA 14.2 using Field survey data 2022

The mean value of total owned land showed the respondents own an average of 110.5732 decimals land. The purpose of farming showed a mean value of 0.8700 which specifies that 87 percent of the farming households are doing commercial farming and the remaining 13 percent

are involved in subsistence farming. The mean value of past access in bank credit is 0.1525, indicating that only 15.25 percent of farmers had access to banks' agricultural credit last time. Finally, the bank account variable's mean value of 0.8200 showed that 82 percent of farmers have a bank account, and the remaining 18 percent have no bank account.

Table-5.10 exhibited the outcome of the probit regression model for the credit access determinants. STATA 14.2 software has been used, and the following command was applied to produce the outcome of the probit model.

probit access age gen edu exp hhsz hhl kcard naginco sav aginco totaol pfarm paccs bnkacc

Outcomes showed that LR chi2 value is found as 228.54 with a probability value of 0.0000, indicating the overall model is significant at one percent level. The log-likelihood value is found as -100.2227, which is negative. The negative value of the log-likelihood value is acceptable. The zero log-likelihood value indicates an entirely perfect model, which is unrealistic. While the log-likelihood value of one indicates the worst possible model. The desirable outcome of the log-likelihood value is negative, and our results showed a negative log-likelihood value which is satisfactory and acceptable. Then the Pseudo R^2 value is found as 0.5328. R^2 value measures the goodness of fit of the probit model. Unlike the linear regression model, the pseudo R^2 value of the probit model does not quantify the explanatory power of independent variables to explain the variation of the dependent variable. The pseudo R^2 value only indicates how well the model predicts the dependent variable. Typically, 0.40 and above the Pseudo R^2 value is acceptable, and a higher value is preferable. Since we have a pseudo R^2 value of 0.5328, which is above 0.40, thus it indicates a good fit for the model. Table 5.10 also furnished the independent variables' coefficient, standard error and corresponding probability value. From the table, we have found that age, gender, and experience are not statistically significant and as per their expected sign. Education is found according to our expected sign and statistically significant at a five percent level. Both household size and household labor variables are found statistically significant at a five percent level and according to our hypothesized relation. Krishi card is found statistically significant at a one percent level, following our expected sign.

Table 5.10: Outcome of Probit Model for Access to Credit

Probit Regression		LR chi2(14)	=228.54		
Number of observations = 400		Prob > chi2	=0.0000		
Log likelihood	= -100.2227	Pseudo R^2	= 0.5328		
Notation	**Variable Name**	**Coefficient**	**Standard Error**	**z-value**	**P>|z|**
age	Age of the Farmer	.0024708	0.0128	0.19	0.847
gen	Gender of the Farmer	-.3900869	0.3373	-1.16	0.248
edu	Educational Qualification	.061143	0.0279	2.18	0.029**
exp	Farming Experience	-.0153939	0.0105	-1.47	0.143
hhsz	Household Size	-.1345302	0.0674	-2.00	0.046**
hhl	Household Labor	.27715	0.1360	2.04	0.042**
kcard	Krishi Card	.6114337	0.2142	2.85	0.004***
naginco	Annual Non-Agricultural Income	.0002038	0.0013	0.15	0.878
sav	Annual Savings	-.0001062	0.0015	-0.07	0.946
aginco	Annual Agricultural Income	-.0007997	0.0016	-0.50	0.617
totaol	Total Owned Land	-.0026813	0.0013	-1.95	0.051*
pfarm	Purpose of farming	.9981727	0.4164	2.40	0.017**
paccs	Past Access in Bank Credit	2.839677	0.3278	8.66	0.000***
bnkacc	Bank Account	.9393031	0.4588	2.05	0.041**
_cons		-2.398173	0.7991	-3.00	0.003***

Source: Computed by STATA 14.2 using Field survey data 2022
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Results showed that annual agricultural income, savings, and non-agricultural income variables are statistically insignificant. The direction of the total owned land is not found as per our

expectation but found significant at the ten percent level. At the same time, past access to bank credit indicated a positive association as per our assumption and found significant at one percent level. Finally, the purpose of farming and bank account variables are found statistically significant at the five percent level and following our assumed positive direction. From the outcome of the probit model furnished in Table-5.10, we have obtained the impact's direction and the corresponding probability value of the independent variables to the dependent variable. Since the outcome of the probit model provides the coefficient value of the independent variables, however, from those coefficient value, we cannot explain it because those coefficient value does not indicate the magnitude of the independent variables to explain the dependent variable. Therefore, we must estimate the probit model's marginal effect to know the independent variables' magnitude.

Following Table-5.11, the outcome of the marginal effect estimation of the probit model has been displayed. The command 'margins, dydx (*)' has been applied. Column dy/dx stated the marginal effect of independent variables on the dependent variable. The marginal effect of education is found as 0.0085494 at the five percent level, indicating that a farmer has one year of additional educational qualification and is 0.8549 percent more likely to get access to banks' agricultural credit. This finding is similar to the findings of Kosgey (2013) in Kenya, Muhongayire et al. (2013) in Rwanda, Lemessa & Gemechu (2016) in Ethiopia, Sekyi et al. (2017) in Ghana, Zulfiqar et al. (2021) in Pakistan. Then -.0188109 coefficient of household size manifests that an additional one member of a household, a farmer is 1.8810 percent less likely to get access to banks' credit which is also similar to the findings of Kosgey (2013) in Kenya. However, this contradicts Lemessa & Gemechu's (2016) finding in Ethiopia and Owusu's (2017) in Ghana. Household labor indicates that one additional household labor makes the farming household head 3.8752 percent more likely to access bank credit. The marginal effect of the krishi card showed that the farmers with the krishi card are 8.5494 percent more likely to have access to credit than those who do not have the krishi card. Interestingly the impact of the total owned land is found negative, and the magnitude showed that with one additional decimal of owned land, a farmer is 0.0374 percent less likely to access banks' agricultural credit. The possible reason for that is Bangladesh's weak property rights system. Thus, having higher owned

land, due to lack of proper documentation and upgradation of ownership, this increased portion of owned land may not work.

Table 5.11: Estimation of Marginal Effect (Access to Credit Model)

Notation	Variable Name	Marginal Effect (dy/dx)	Standard Error	z-value	P>|z|
age	Age of the Farmer	.0003455	.0017	0.19	0.847
gen	Gender of the Farmer	-.0545444	.0470	-1.16	0.247
edu	Educational Qualification	.0085494	.0038	2.19	0.028**
exp	Farming Experience	-.0021525	.0014	-1.47	0.141
hhsz	Household Size	-.0188109	.0093	-2.02	0.044**
hhl	Household Labor	.0387529	.0189	2.04	0.041**
kcard	Krishi Card	.0854946	.0294	2.90	0.004***
naginco	Annual Non-Agricultural Income	.0000285	.0001	0.15	0.878
sav	Annual Savings	-.0000148	.0002	-0.07	0.946
aginco	Annual Agricultural Income	-.0001118	.0002	-0.50	0.617
totaol	Total Owned Land	-.0003749	.0001	-1.96	0.050**
pfarm	Purpose of farming	.1395709	.0583	2.39	0.017**
paccs	Past Access in Bank Credit	.3970618	.0342	11.59	0.000***
bnkacc	Bank Account	.1313393	.0640	2.05	0.040**

Source: Computed by STATA 14.2 using Field survey data 2022
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

The coefficient of the purpose of farming revealed that the farmers involved in commercial farming are 13.9570 percent more likely to get access to agricultural credit. Past access in bank credit and bank account variable are also found positive and statistically significant. The farmers

who previously obtained agricultural credit is found to be 39.7061 percent more likely, and the farmers having a bank account is found to be 13.1339 percent more likely to get access to banks' agricultural credit in comparison to their counterpart, which corresponds to the findings of Dzadze et al. (2012) in Ghana.

Table 5.12: Classification Test (Access to Credit Model)

Classified	**D**	**~D**	**Total**
+	60	7	67
-	31	302	333
Total	91	309	400
Particulars	**Prediction**		**Percentage**
Sensitivity	Pr(+| D)		65.93%
Specificity	Pr(-|~D)		97.73%
Positive predictive value	Pr(D| +)		89.55%
Negative predictive value	Pr(~D| -)		90.69%
False + rate for true ~D	Pr(+|~D)		2.27%
False - rate for true D	Pr(-| D)		34.07%
False + rate for classified+	Pr(~D| +)		10.45%
False - rate for classified-	Pr(D| -)		9.31%
Correctly classified			**90.50%**

Source: Computed by STATA 14.2 using Field survey data 2022

Table-5.12 presents the outcome of the classification test of the probit model for studying access to credit. The command 'estat classification' has been applied to generate the outcome of the classification test. This classification test showed how well our model correctly predicted the outcome variable. Here we have a correct prediction for y=1 is 60, and for y=0, it is 302. Thus, our model correctly predicts 362 observations out of 400, which is 90.50%. Generally, 70% and above of correct classification is acceptable, and a higher percentage is preferable. Hence the classification test of our probit model for access to credit indicates a good fit model.

5.5 Socio-economic Differences by Access to Credit Status

Table 5.13: Mean Difference of Socio-economic Variables by Access to Credit Status

Variable Name	Full sample	Access	Not Access	t-value
Age	50.8020	48.3510	51.5242	2.1602**
Gender	0.9150	0.8461	0.9352	2.6970***
Education	5.2950	6.8571	4.8349	-4.1492***
Experience	30.7875	26.9011	31.9320	2.7172***
Marital Status	0.9800	0.9670	0.9838	1.004
Household Size	5.2375	5.0769	5.2847	0.7538
Household Labor	1.6925	1.8901	1.6343	-2.6012***
Hired Labor	68.7450	47.0329	75.1391	1.9462*
Total Owned Land	110.5732	88.2857	117.1369	1.7677*
Farm Size	223.8536	180.0769	236.7458	1.2376
Owned Equipment	31.1500	36.1758	29.6690	-1.0419
Savings	147.3570	175.1099	139.1838	-1.1242
Consumption	252.8200	248.8791	253.9806	0.3673
Distance to Bank	2.0404	1.4382	2.2177	4.7079***
Risk Perception	0.6250	0.4065	0.6893	5.0375***
Cooperative	0.2675	0.2747	0.2653	-0.1767
Dependency Ratio	0.5938	0.3849	0.6553	4.5610***
Land Ownership Deed	0.5350	0.6923	0.4886	-3.4657***
IT Access	0.7725	0.8681	0.7443	-2.4889**
Krishi Card	0.3175	0.6373	0.2233	-8.0174***
Purpose Farming	0.8700	0.9560	0.8446	-2.7970***
Previous Access	0.1525	0.6043	0.0194	-18.6109***

Source: Computed using STATA 14.2 from Field survey data 2022

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-5.13 presents mean differences in some socio-economic factors between farmers who have accessed to credit and those who do not. Olagunju (2007), in his study in Nigeria, estimates mean differences using paired t-tests to identify socio-economic differences between the farmers who have access to credit and those who do not. In this section, the researcher has computed the mean difference of some socio-economic variables by access to credit status. Results showed that there is a significant difference is found between accessed and non-accessed farmers in terms of their age, gender, education, and experience. Accessed farmers are found to be younger, having a mean age of 48.3510 years, than non-accessed farmers' mean age of 51.5242. Regarding gender, 84.61 percent of the accessed farmers are male, while 93.52 percent of non-accessed farmers are male. Farming households with access to banks' agricultural credit are more educated with an average educational qualification of 6.8571 years than 4.8349 years of mean educational qualification of the farmers without credit access. However, non-accessed farmers' mean experience is found above accessed farmers. Accessed farmers have higher household labor. However, non-accessed farmers have higher hired labor. Total owned land is 117.1369 decimals on average for non-accessed farmers and 88.2857 for accessed farmers. Findings revealed that there is no statistically significant difference between these two groups in terms of their marital status, household size, farm size, owned equipment, savings, consumption, and cooperative membership. Regarding proximity to banks, accessed farmers' mean distance to the closest bank is found as 1.4382 KM in comparison to 2.2177 KM for non-accessed farmers. 40.65 percent of farmers in the accessed group thought taking banks' agricultural credit was risky, while this rate is relatively high, 68.93 percent for non-accessed farmers. A similar finding is also found about the dependency ratio: the accessed and non-accessed farmers ratio is 38.49 and 65.53 percent, respectively. Concerning land ownership deeds, 69.23 percent of the accessed farmers have most of their land documents in order, while this rate is 48.86 percent for non-accessed farmers. IT access refers to information and technology access of the farmers. 86.81 percent of the accessed farmers reported that they have IT access, and the non-accessed farmers reported that 74.43 percent have IT access. We have found a significant deviation between these two groups in the case of krishi card access. 63.73 percent of farmers in the accessed group have krishi card, while this rate is only 22.33 percent for non-accessed farmers. The purpose of farming is also differing among the farmers' groups. 95.60 percent of farmers in the accessed group are doing commercial farming, whereas 84.46 percent of non-accessed farmers are doing commercial farming. Finally,

we have found an enormous difference in the case of previous access to banks' agricultural credit between the said farmers group. 60.43 percent of accessed farmers obtained agricultural credit previously. On the other hand, only 1.94 percent of the non-accessed farmers obtained credit in the past.

5.6 Access to Credit Status and Productivity

Agricultural production requires timely inputs and investment to smoothen the production cycle. Feder et al. (1990) mentioned that the agricultural production process is characterized by a production cycle where inputs are converted into outputs within a time. Moreover, to increase productivity from a given resource, i.e., cropped area, the farmers need high-yielding inputs and investment in modernized equipment. Since most of the farmers in a developing country have been facing low-income levels, thus this input and investment requirement is not met from their financial resources. In these circumstances, banks' agricultural credit can effectively increase agricultural productivity. According to Sial & Carter (1996), increased agricultural productivity and income of the farmers can be achieved through improved access to credit. A similar conception is also mentioned by Carter & Olinto (2003). Agricultural credit facilitates optimum production levels by enabling farmers to purchase inputs on demand. Using agricultural credit can increase the production rate by injecting capital and raw materials into the production system. Increasing agricultural productivity heavily relies on the modernization and commercialization of the agricultural production system. For instance, agricultural credit allows farmers to use efficient technology for modernization and allocate resources more effectively to ensure commercialization. According to Carter (1988), there are three key avenues where credit might affect to increase productivity and income of the farmers. First, it enables farmers to purchase and apply high-yielding inputs over conventional ones. Such inputs use would positively shift the production surface. Second, credit allows purchasing new technology over a traditional variety of equipment and machinery. New technology might be more costly than traditional technology but it has an impact on increased productivity. Third, credit may also allow more efficient use of fixed inputs, family labor, and farming skill. Credit might permit highly skilled farmers to grasp a better return by increasing production options.

The findings addressing the influence of access to credit on productivity are explored in the next section.

5.6.1 Comparison between Accessed and Non-Accessed Farmers at the Production Level

Table 5.14: Change in Production Level by Access to Credit Status

Condition	Not Rise in Production	Rise in Production	Total
Not Access	86	223	309
	(27.83)	(72.17)	(100.00)
Access	26	65	91
	(28.57)	(71.43)	(100.00)
Total	112	288	400
	(28.00)	(72.00)	(100.00)

Source: Field Survey 2022 Pearson chi2(1) = 0.0191 (Pr = 0.890)
Note: Figures in brackets are respective percentages.

Table-5.14 shows the relationship between access status and change in production level. While collecting data, we asked the farmers about their perception of the present change in production level compared to last year's production. In response to this question, 288 farmers, who are 72% of the sampled farmers, replied that their production has increased this year compared to the previous year, and the remaining 28% of sampled farmers reported a reduction in the current production. Among the 309 non-accessed farmers, 72.17% responded that they have risen in production in the current year. On the other hand, 65 out of 91 farmers with access to credit reported that they also experienced increased production in the current year. Their portion is 71.43% of the accessed farmers. Therefore, the results revealed no significant difference between these two groups regarding the change in production level. Moreover, a chi2 value of 0.0191, having a corresponding probability value of 0.890, also showed that this difference is not statistically significant.

5.6.2 Mean Difference of Productivity Indicators Based on Access Status

In this section, mean difference of several productivity indicators, i.e., inputs use, production, and income per acre, has been estimated based on access to the credit status of the farmers. In the estimation process of mean difference, we have applied paired t-test to measure the difference and its significance level.

Table 5.15: Mean Productivity Difference (Inputs Use) by Access to Credit

Group	Observation	Mean	Standard Error	Standard Deviation
Not Access	309	104.4797	3.3165	58.2994
Access	91	142.2423	6.6579	63.5128
Combined	400	113.0707	3.0760	61.5206
Difference		-37.7625	7.0987	

Source: Computed using STATA 14.2 t = -5.3196 Pr (|T| > |t|) = 0.000***

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-5.15 presents the mean difference of inputs used per acre based on access to credit status. Results showed that for farmers who have no access to banks' agricultural credit, their inputs expenditure per acre is found as 104.4797 thousand BDT. At the same time, the farmers with access to credit. have invested 142.2423 thousand BDT for inputs acquisition. Accessed farmers made 37.7625 thousand BDT more inputs investment than non-accessed farmers. More specifically, accessed farmers' input expenditure is 36.14% more than the input expenditure of non-accessed farmers. The mean difference between these two groups is statistically significant at one percent level since the t-value is -5.3196 with a probability value of 0.000. This finding aligns with Awotide et al. (2015) findings in Nigeria and Kinuthia's (2018) in Uganda & Tanzania. This finding also corresponds with the previous theoretical assumption of high-yielding inputs used by the accessed farmers.

Table-5.16 displays the mean agricultural production per acre difference between accessed and non-accessed farmers. Here we have mean agricultural production per acre for non-accessed and accessed farmers is 211.7736 and 294.1448 thousand BDT, respectively. The mean production per acre for combined farmers stood at 230.5130 thousand BDT. Therefore, it is apparent that accessed farmers' average production is above the mean production of combined farmers, and non-accessed farmers' mean production is below the average production of all farmers. The mean difference is 82.3712 thousand BDT between accessed and non-accessed farmers, which specified that accessed farmers mean production per acre is 38.89% above the farmers who are not using banks' agricultural credit. This mean difference is also found statistically significant at

one percent level since the t-value is -6.2539 with a corresponding probability value of 0.000. These findings correspond with the findings of Carter (1988) in Nicaragua, Yazdani & Gunjal (1998) in Iran, Baffoe et al. (2014) in Ghana, and Kinuthia (2018) in Tanzania.

Table-5.16: Mean Productivity Difference (Agricultural Production) by Access to Credit

Group	Observation	Mean	Standard Error	Standard Deviation
Not Access	309	211.7736	6.1622	108.3217
Access	91	294.1448	12.3032	117.3658
Combined	400	230.5130	5.7792	115.5855
Difference		-82.3712	13.1711	

Source: Computed using STATA 14.2 t = -6.2539 Pr(|T| > |t|) = 0.000***
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-5.17: Mean Productivity Difference (Net Agricultural Income) by Access to Credit

Group	Observation	Mean	Standard Error	Standard Deviation
Not Access	309	107.2934	3.6793	64.6778
Access	91	151.9030	7.5411	71.9380
Combined	400	117.4421	3.4449	68.8990
Difference		-44.6095	7.9182	

Source: Computed using STATA 14.2 t = -5.6338 Pr(|T| > |t|) = 0.000***
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-5.17 demonstrates the average difference in net agricultural income per acre based on the access status of the farmers. The outcome of the table revealed that non-accessed farmers' mean net agricultural income per acre is 107.2934 thousand BDT. On the other hand, 151.9030 thousand BDT is found as the mean agricultural net income for accessed farmers. Hence this difference showed that farmers who have obtained agricultural credit from banks have 44.6095 thousand additional net agricultural income per acre compared to non-accessed farmers. The relative measurement revealed that, on average, accessed farmers' net agricultural income is 41.57% more than the non-accessed farmers. The combined mean agricultural income for all

farmers is 117.4421 thousand BDT. We have observed that non-accessed farmers' average net agricultural income is below the combined average and vice versa. The t-value is found as -5.6338 with a probability value of 0.000, confirming that this mean difference is statistically significant at one percent level. This finding is also similar to the results of Carter (1988) in Nicaragua, Yazdani & Gunjal (1998) in Iran, Baffoe et al. (2014) in Ghana, and Kinuthia (2018) in both Uganda & Tanzania.

5.6.3 Impact Assessment of Access to Credit Status on Productivity Indicators

The mean difference of various productivity indicators is measured in the previous section to compare accessed and non-accessed farmers' productivity levels through paired t-tests. However, that estimation provides only an average difference in productivity for the group level. The average difference cannot clarify the impact of access status on an individual level. Hence in this section, Propensity Score Matching (PSM) model has been applied to estimate the treatment effect of access status on several productivity indicators. The choice of PSM to measure the treatment effect is for its suitability for observational survey data. Since our data has been collected from a field-level survey, therefore PSM model has been chosen. Moreover, the PSM model can eliminate the sample selection bias arising from systematic socio-economic differences between treated and untreated groups. Like calculating the mean difference of various productivity indicators, in the PSM model, we also consider three productivity indicators, i.e., inputs use, production, and income per acre. In the following section, the econometric modeling of PSM has been discussed.

Modeling Propensity Score Matching (PSM)

In case the study depends on observational data, PSM is a matching technique which aimed to measure treatment effect by considering the variables that determine the treatment status. The PSM model is designed to reduce the possible bias from the confounding variables that could be found because a difference in the treatment outcome between treated and control groups may be caused by some factors, i.e., socio-economic factors. These factors predict the treatment effect itself, causing the treatment variable rather than the difference. Therefore, the PSM model has been developed to determine the treatment variable's true impact.

PSM model reduces the treatment assignment bias by comparing a treatment receiver sample with an untreated sample based on similar observed covariates. This matching is based on the assumption that there are no systematic differences in unobservable characteristics between the treated and untreated groups. In this study, the impact on the outcome of the treatment can be compared by matching an ideal control group (non-accessed farmers) to the treatment group (accessed farmers) based on the propensity scores of X. X represent the set of observable characteristics that determine access to credit status. Within the PSM framework, estimating the effect of access to credit on productivity indicators, first, the propensity scores (p scores) is calculated with the aid of a probit model and then compare treated and untreated farmers having similar p scores. According to Austin (2011), the p score is defined to be the probability of treatment assignment and expressed as (ei = Pr (Zi = 1/Xi)). To develop the estimation process of the PSM model, let Di = 1 indicate access to credit and Di = 0 indicate no access to credit. Here D is a binary variable termed access status, and Di = 1 and Di = 0 stand for treatment observation and control observation, respectively. The p-score is calculated using the probit model and expressed in the following equation.

$$p(x)= Pr(D=1/x) =E(D/x)$$ Equation 5.6

Here p(x) estimated the propensity score based on observable characteristics of x, which determines the access status in banks' agricultural credit of the farmers. The value of the p-score lies between 0 to 1, and then based on the similar p-score, accessed and non-accessed farmers' outcome is estimated to find the true impact of treatment variable access to credit.

According to Garrido et al. (2014), two common impact assessment estimation of treatment variable comprises the average treatment effect on the treated (ATET) and the average treatment effect for the entire sample (ATE). The ATET is the estimated impact of the treatment among the treated farmers. According to Caliendo & Kopeinig (2008), the estimation of ATE requires that the impact of treatment for each observation is independent of treatment participation of the other observations.

Suppose that the outcome of the accessed farmer (Di = 1) is Y1i, and that of non-accessed farmers (Di = 0) is Y0i. Therefore, the treatment effect is Y1i - Y0i. Now the evaluation problem arises because only one of the potential outcomes, E (Y1i/Di = 1), is observed from each individual i. The outcome E (Y0i/Di =1), referred to as the counterfactual outcome, is not

observable and needs to be estimated. The ATET is the difference between outcome of the treated and outcome of the treated farmers if they had not been treated and expressed in the following equation.

$$ATET = E(Y1i - Y0i/Di = 1) = E(Y1i/Di = 1) - E(Y0i/Di = 1) \quad \text{Equation 5.7}$$

However, the counterfactual effect that is if the farmers had not been treated is not observable because we cannot remove the treatment effect away from them. Thus, we need a good approximation of the counterfactual effect, which can be possible by comparing treated and untreated farmers with similar p-score. The following equation presents the ATET estimation after matching on p-score; thus, we can compare the outcome of treated and untreated observations.

$$ATET = E(Y1i/p(x), Di = 1) - E(Y0i/p(x), Di = 0) \quad \text{Equation 5.8}$$

This equation tells us that now the ATET is measured based on a similar p-score of p(x) between the treated (Di = 1) and untreated (Di = 0) farmers on their respective outcomes of Y1i and Y0i. Therefore, this estimation based on p -score matching becomes a fair comparison and gives a proper treatment effect estimation.

The ATE is the difference between the outcome of treated and untreated observation and expressed in the following equation.

$$ATE = E(\Delta) = (Y1i/x, Di = 1) - E(Y0i/x, Di = 0) \quad \text{Equation 5.9}$$

The ATE combines the ATET with the estimated treatment impact for untreated farmers. The ATE estimation is effective for experimental studies. On the other hand, ATET is suitable for an observational study.

Estimated Outcome of Treatment Effect on Productivity Indicators

As discussed earlier, three productivity indicators, i.e., inputs use, production, and income per acre are considered for impact evaluation of access to banks' agricultural credit. Both ATE and ATET estimation has been done in the PSM framework. Awotide et al. (2015) in Nigeria, Owusu (2017) in Ghana, Abdallah et al. (2019) in Ghana, and Agbodji & Johnson (2021) in Togo used the PSM framework to estimate the impact of access to credit status among the others.

Model 1 (Inputs Use Per Acre)

In model one outcome variable is inputs used per acre. The treatment variable is access to credit status. Farmers with access to credit belong to the treatment group and those who did not receive bank credit in the control group.

Table-5.18 exhibited the average treatment effect of access to credit on inputs used. The yearly inputs used per acre is noted as pexpa. Results showed that the average treatment effect of access to credit is 38.349 thousand per acre. This coefficient's probability value is 0.000, indicating a one percent significance level. As we mentioned earlier, ATE is the average treatment effect at the population level. Thus, this result showed that the farmers who have obtained banks' agricultural credit use taka thirty-eight thousand three hundred and forty-nine more inputs per acre in a year, considering both treated and untreated farmers.

Table-5.18: Impact of Access to Credit on Inputs Use (ATE)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Pexpa (Inputs Use Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Credit Access=1, Not Access=0 (1 Vs. 0)	38.349	10.3345	3.71	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Table-5.19 presents the average treatment effect of the treated. The ATET is the average treatment effect on those individuals who ultimately received the treatment. The finding indicates the coefficient of ATET is 34.841 with a corresponding probability value of 0.000, indicating the coefficient value is significant at the one percent level. The coefficient value suggests that the farmers who have ultimately received agricultural credit can use 34.841 thousand BDT more inputs per acre than those not participating in banks' agricultural credit. In other words, the farmers who accessed credit if they had not been treated lost thirty-four thousand eight hundred and forty-one taka equivalent inputs uses per acre. This finding

corresponds with the theoretical assumption that the farmers who obtained agricultural credit can use more high-yielding inputs. The outcome also validates our hypothesized positive impact of access to credit on input use.

Table-5.19: Impact of Access to Credit on Inputs Use (ATET)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Pexpa (Inputs Use Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect On the Treated) Credit Access=1, Not Access=0 (1 Vs. 0)	34.841	9.7598	3.57	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Model 2 (Agricultural Production Per Acre)

In model two, outcome variable is agricultural production per acre. The treatment variable is access to credit status. Like model one, accessed farmers belong to the treatment group and non-accessed farmers are in the control group. Table-5.20 shows the impact assessment of access to credit on agricultural production per acre using ATE estimation. The yearly agricultural production per acre is noted as prodpa.

Table-5.20: Impact of Access to Credit on Agricultural Production (ATE)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Prodpa (Production Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Credit Access=1, Not Access=0 (1 Vs 0)	68.177	15.4624	4.41	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Results showed that the average treatment effect of access to credit on production per acre is 68.177 thousand per acre as the coefficient is 68.177. This coefficient's probability value is 0.000, which indicates the significance of the coefficient value at the one percent level. The ATE is the average treatment effect at the population level, as we mentioned in model one earlier. Therefore, this result showed that the farmers participating in banks' agricultural credit gained taka sixty-eight thousand one hundred and seventy-seven more production per acre in a year considering both treated and controlled farmers.

Table-5.21: Impact of Access to Credit on Agricultural Production (ATET)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Prodpa (Production Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect On the Treated) Credit Access=1, Not Access=0 (1 Vs. 0)	79.365	14.7809	5.37	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Table-5.21 displays the average treatment effect of the treated. The ATET is the average treatment effect on those farmers who have ultimately received the treatment of access to bank credit. The result showed that the coefficient value of ATET is 79.365 with a corresponding probability value of 0.000, indicating the coefficient value is significant at the one percent level. The coefficient value shows that the farmers who have participated in banks' agricultural credit can produce 79.365 thousand BDT more per acre than those without access to banks' agricultural credit. In other words, if they had not been accessed to credit, the farmers who have obtained agricultural credit produce seventy-nine thousand three hundred and sixty-five taka less production per acre. This finding validates the conceptual statement that the farmers who obtained agricultural credit can employ a modern variety of inputs which brings added production from a given resource. The outcome also validates our hypothesized positive impact of access to credit on production. Moreover, this finding is similar to the empirical findings of

Awotide et al. (2015) in Nigeria, Owusu (2017) in Ghana, and Agbodji & Johnson (2021) in Togo.

Model 3 (Net Agricultural Income Per Acre)

The net agricultural income per acre is the outcome variable, and the access to credit is the treatment variable for model three. This model's treatment group and control group are accessed farmers and non-accessed farmers, respectively.

Table-5.22 revealed the average treatment effect of access to credit on net agricultural income per acre. The yearly agricultural net income per acre is denoted as netpa. Results showed that the average treatment effect of access to credit is 29.829 thousand per acre. This coefficient's probability value is 0.000, indicating a one percent significance level. As we mentioned earlier, ATE is the average treatment effect at the population level. Thus, this result showed that the farmers who have obtained banks' agricultural credit earn taka twenty-nine thousand eight hundred and twenty-nine more agricultural net income per acre in a year considering both treated and untreated farmers.

Table-5.22: Impact of Access to Credit on Net Agricultural Income (ATE)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Netpa (Net Income Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Credit Access=1, Not Access=0 (1 Vs. 0)	29.829	8.0003	3.73	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Table-5.23 presents the average treatment effect of the treated. The ATET is the average treatment effect on those individuals who ultimately received the treatment. The finding indicates the coefficient of ATET is 44.525 with a corresponding probability value of 0.000, indicating the coefficient value is significant at a one percent level. The coefficient value revealed that the accessed farmers who obtained agricultural credit achieved 44.525 thousand

BDT more agricultural net income per acre over those who did not obtain banks' agricultural credit. In other words, if they had not been accessed, the farmers who accessed credit missed forty-four thousand five hundred and twenty-five taka equivalent net agricultural income per acre. This finding is evident with the theoretical assumption that the farmers who received agricultural credit can produce more output, leading to increased net income from agriculture. The outcome also validates our hypothesized positive impact of access to credit on agricultural income. Moreover, this finding is similar to the empirical findings of Abdallah et al. (2019) in Ghana.

Table-5.23: Impact of Access to Credit on Net Agricultural Income (ATET)

Estimator: Propensity-Score Matching Number of Observation = 400		Outcome model: Matching Treatment model: Probit		
Netpa (Net Income Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect On the Treated) Credit Access=1, Not Access=0 (1 Vs 0)	44.525	8.2097	5.42	0.000***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: *P<0.10, **P<0.05, ***P<0.01 significance level for z values

Chapter 6

Agricultural Credit Fungibility

6.1 Preface

The availability, accessibility, affordability, and sufficiency of agricultural credit cannot guarantee the ultimate benefits for the farmers**.** The judicious use of agricultural credit is equally important in this regard. Agricultural credit, when appropriately used, facilitates investment, farming innovations, and the diversification of agriproducts. It also improves marketing capabilities, and resource utilization, increasing the size of farming activities and net farm outputs. Therefore, proper and efficient use of agricultural credit should be ensured for its intended use. Unfortunately, the low-income level, poor asset holdings, previous debt., family burden of the farmers, inadequate loans, delay in disbursement and lack of bank monitoring instigate credit diversion among the farmers. This misallocation of credit leads to sub-optimal use of inputs and investment, ultimately affecting production. Hence, this chapter will discuss some theoretical background of causes of credit fungibility and its possible effect on productivity. Different econometric models are developed to identify the factors behind credit fungibility status and their possible effect on productivity indicators.

6.2 Theoretical Background

According to Cohen (1968), credit fungibility occurs when the credit is used for other purposes away from its intended purpose. Therefore, agricultural credit fungibility can be defined as the diversion of agricultural credit to off-farm activities, i.e., living expenditure, medical expenses, educational costs and house repair, instead of its judicious use for buying inputs and investment (Darfor et al., 2021). Farmers experience credit fungibility when credit received for agriculture is used for non-agricultural purposes due to a lack of capital and credit constraint (Ankrah Twumasi et al., 2022). According to the theory of consumer choice, consumers want to maximize their utility by selecting a preference set that provides more satisfaction while remaining within their budgets. According to this theory, farmers are expected to make a logical decision using credit for productive activities. According to this theory, farmers are expected to efficiently allocate received credit to the most productive areas of agricultural activities, which maximizes their satisfaction in increased outputs. However, in most developing countries,

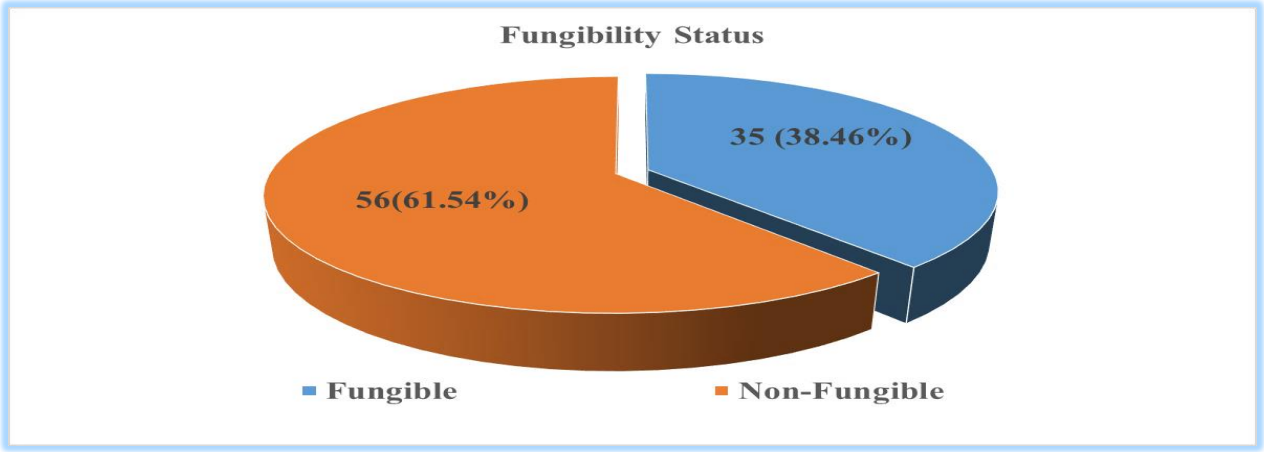
farmers violate this theory by diverting agricultural credit to off-farm activities due to their low income, family emergency and poor financial literacy. Cohen (1970) mentioned two types of credit fungibility, i.e., financial substitution and expenditure substitution. He also argued that both types of fungibility adversely affect farm production levels. Hussain & Thapa (2016) stated that financial substitution happens when farmers use agricultural and other credit as a single pool of funds for a specified purpose. On the other hand, expenditure substitution occurs when farmers use agriculture financing for other purposes. Socio-economic and demographic variables of a farming household, such as gender, household assets, family size, and education; and farm and social characteristics, such as credit sources, farm size, and off-farm employment, have been identified as predictors of agricultural credit fungibility status in prior research in Pakistan by Hussain & Thapa (2016), Saqib et al. (2017), and Chandio et al. (2018). In Africa, Oboh & Ekpebu (2011) measured the intensity of agricultural credit allocation to Nigeria's farm sector based on institutional factors, i.e., bank loan monitoring and farmers' socio-economic and demographic factors. Kuwornu et al. (2012) follow a similar category of factors in Ghana. Then Darfor et al. (2021) in Ghana investigated the factors influencing the credit fungibility status of farmers based on household socio-economic factors, i.e., non-agricultural income, savings; demographic factors, i.e., age, gender, education, chronic disease and household size; farm and institution-specific factor, i.e., farming experiences, farm size, credit sources. A recent study by Ankrah Twumasi et al. (2022) in Ghana identified the determinants of agricultural credit fungibility and off-farm employment status, considering the abovementioned factors. In his study in Bangladesh, Khaleque (2011) examined the loan diversion index of rural households, taking into account factors such as age, education, savings, and non-agricultural income. Besides the empirical evidence discussed above, while farming households have diverse socio-economic and demographic characteristics, it is logical to assume that these factors affect the farmers' credit fungibility status. Moreover, Menaria & Bhandari (2013) in India mentioned some bank-specific factors, i.e., insufficient credit and delay in disbursement, the reasons for credit diversion by the farmers in India. According to Mahajan and Ramola (1996), meeting lean season household expenses and emergencies such as illness in the family, social responsibilities such as weddings and feasts, and repayment of prior informal loans were the primary areas of misused credit. Several previous studies include Saddik (1995) in Egypt, Akram (2008) and Siddiqi et al. (2009) in Pakistan, Cole (2009) in India, Muhumuza (1997) in Uganda have mentioned that a

considerable portion of agricultural financing is used for non-agricultural purposes, such as the buying of consumer goods, the celebration of festivals, house construction and repairs.

6.3 Credit Use and Intensity of Credit Fungibility

In this research section, the fungibility conditions of agricultural credit from banks have been identified and discussed using descriptive statistics.

Figure 6.1: Fungibility Status of the Farmers



Source: Field Survey 2022

Figure 6.1 displays the fungibility status of the farmers in our study area. Ninety-one respondents' fungibility status has been detected since we have 91 farmers who accessed banks' agricultural credit. Therefore, out of those accessed farmers, according to their response, we have segregated them into the fungible and non-fungible groups. The outcome showed that 35 out of 91 farmers, 38.46% of the total farmers who obtained agricultural credit from banks, had been involved in credit fungibility. This result is similar to Ijioma & Osondu's (2015) findings in Nigeria, where the authors found that 37.78% of farmers were involved in credit diversion. On the other hand, in this study, 56 farmers, 61.54% of the total farmers who received credit, did not misappropriate, thereby belonging to non-fungible farmers.

Table-6.1 presents the fungibility status of the farmers based on the type of bank. The table showed that out of 44 farmers who obtained agricultural credit from private banks, 34 of them that is 77.27 percent, did not involve credit fungibility. Only ten farmers who received credit from private banks are found fungible, and their relative frequency is found as 22.73 percent only. Whilst this situation is quiet frustrating for Govt. banks. A total of 47 farmers obtained

agricultural credit from Govt. banks. Of them, 25 farmers, that is 53.19 percent of total farmers who obtained credit from Govt. banks involved with credit fungibility and 22 farmers, 46.81 percent, did not divert credit to non-agricultural purposes. This difference is verified by the Chi-square test and found statistically significant at the one percent level since the probability value is 0.003 with Pearson chi2(1) value of 8.9108. Considering the relative frequency, it is apparent that the fungibility rate is more than twice as much for Govt. banks' borrowers compared to the borrowers from private banks. This finding indicates the poor borrower assessment and selection by the Govt. bank officials.

Table 6.1: Fungibility Status by Type of Bank

Type of Bank	Non-Fungible	Fungible	Total
Private Bank	34	10	44
	(77.27)	(22.73)	(100.00)
Govt. Bank	22	25	47
	(46.81)	53.19	(100.00)
Total	56	35	91
	(61.54)	(38.46)	(100.00)

Source: Field Survey 2022 Pearson chi2(1) = 8.9108 (Pr = 0.003)
Note: Figures in brackets are respective percentages

Table 6.2: Fungibility Status by Type of Farm

Type of Farm	Non-Fungible	Fungible	Total
Small Farm	46	28	74
	(62.16)	(37.84)	(100.00)
Medium Farm	8	6	14
	(57.14)	(42.86)	(100.00)
Large Farm	2	1	3
	(66.67)	(33.33)	(100.00)
Total	56	35	91
	(61.54)	(38.46)	(100.00)

Source: Field Survey 2022 Pearson chi2(2) = 0.1598 (Pr = 0.923)
Note: Figures in brackets are respective percentages

Table-6.2 shows farmers' fungibility status based on the farm type. Hussain & Thapa (2016) said that small farmers with lower land holdings might have a lower farm surplus and greater costs, resulting in a lower net income from agricultural operations and thus more likely to be involved in credit fungibility. Our outcome showed that 37.84 percent of the small farmers diverted credit to non-agricultural purposes, and this rate is relatively low for large farmers, which is 33.33 percent. On the other hand, fungibility tendency is found high among medium farmers. 42.86 percent of the medium framers are found fungible. However, this difference is not statistically significant since the Pearson chi2(2) value of 0.1598 has a corresponding probability value of 0.923.

Table 6.3: Main Reason of Credit Fungibility Status

Code	Cause of Fungibility	Frequency	Percent
1	Inadequacy of Credit	3	8.57
2	Delay in Disbursement	3	8.57
3	Low-Interest Rate	6	17.14
4	Lack of Access to Personal Loans	9	25.71
5	Lack of Awareness	6	17.14
6	Low Income	6	17.14
7	Others	2	5.71
Total		35	100.00

Source: Field Survey 2022

The frequency distribution of the leading cause of fungibility among the fungible farmers are presented in Table-6.3. As we have 35 farmers involved with agricultural credit fungibility, we asked them the main reason for using agricultural credit for off-farm activities. In reply to this question, nine farmers, who are 25.71 percent of total fungible farmers, said that due to lack of personal loans from banks, they were forced to collect loans in the form of agricultural credit and used those credit for their personal requirements. More specifically, banks usually provide personal loans to service holders and businesspersons. Farmers could not access any personal

loan; thus, they received agricultural loans and used those funds for their own necessities. Therefore, this lack of access to personal loans is ranked as the uppermost reason for credit fungibility in our study areas. The second reason for credit fungibility is low income, lack of awareness and low-interest rate since 17.14 percent of the fungible farmers separately reported each of those reasons as their leading cause for credit diversion. Low-income farmers suffer from low cash flow but must maintain a minimum living expenditure to survive. Therefore, they obtained agricultural credit to survive and used that money to maintain living expenses. Some farmers reported that they unconsciously used agricultural credit for off-farm activities without knowing the adverse effect of credit fungibility. Thus, lack of awareness indicates their low financial literacy and educational level. Whilst some respondents confess that they intentionally acquire agricultural credit from banks at a cheap interest rate and swap those funds to unproductive sectors since they experienced high-interest rates of credit from informal and semi-formal sources. Then 8.57 percent of the fungible farmers said that due to inadequacy of credit, they used those funds for off-farm purposes. Those farmers express their unhappiness regarding flat credit disbursement by bank officials. Due to this flat credit disbursement, some farmers cannot obtain adequate credit as per their production requirements and being frustrated misused the credit. Thus, we have found the insufficiency of credit as the third leading reason for credit fungibility. Delay in disbursement is ranked as forth major reason for credit fungibility among the fungible farmers in our study areas. Results showed that three farmers, who are 8.57 percent of the total fungible farmers, misappropriated agricultural credit as they received the loan lately. As the agricultural production process is highly sensitive to weather and time; thus, the farmers need the credit on time. But some farmers said that they obtained their credit after the season due to the high processing time of loan taken by bank officials. Therefore, those delayed loans lost the farmers' productive utility, and then the loan went to non-agricultural activities. These findings are almost similar to the research results of Menaria & Bhandari (2013) in India, where the authors found insufficiency and delay of credit disbursement as the third and fourth major reasons, respectively, for credit diversion by the farmers.

In table 6.4, the sector-wise uses of banks' agricultural credit have been furnished. Both fungible and non-fungible farmers' groups are considered to determine the segmented judicious use of banks' agricultural credit. Results showed that almost half of the credit (more specifically 48.04

percent) had been invested in farming activities and used for inputs acquisition in the form of fertilizer, seeds, pesticides, insecticides, and irrigation costs. Then 17.78 percent of the credit is used for labor payments. Expenses associated with land, i.e., land rent and land preparation, incur 16.80 percent of the credit invested in agricultural purposes. Afterwards, we found 12.64 percent of credit invested in acquiring machinery and equipment in spray machines, threshers, cutting machines, power tillers, deep tube-well etc. Finally, we have found that 2.95 and 1.79 percent credit is invested for building sheds & lofts and vehicle purchases.

Table 6.4: Uses of Banks' Agricultural Credit in Agricultural Purposes

Code	Purpose of Use	Amount in '000 BDT	Portion of Total Amount in %
1	Inputs (Fertilizers, Seeds, Pesticides, Irrigation Etc.)	2945	48.04
2	Machinery and Equipment	775	12.64
3	Land Rent and Preparation	1030	16.80
4	Labor Cost	1090	17.78
5	Transportation	110	1.79
6	Sheds, Lofts Etc.	180	2.95
Total		6130	100.00

Source: Field Survey 2022

The following Table-6.5 demonstrates the segmented misuse of banks' agricultural credit for non-agricultural purposes. Here we have found that 5.75 percent of diverted credit was used for living expenditure, that is for food consumption. Only 1.28 percent of fungible credit is used for their children's immediate admission and examination fees. Then we have found that 3.51 percent of misappropriated credit goes for emergency medical treatment of the family members of the farmers. 11.50 percent of misused credit has been used for offsetting the previous debt. of the farmers. In the study area, we have found some farmers have old. debt from the local money lenders. Those money lenders charged very high-interest rates and imposed rigid conditions, i.e., the money lenders forced the farmers to sell their produce at a price fixed by the money lenders. Therefore, to get relief from that situation, some farmers obtain credit from banks and repay the

previous debt. of money lenders. This finding is quite similar to the finding of Darfor et al. (2021) in Ghana, where the authors found that 11 percent of the fungible credit was used to repay previous loans. Afterwards, we found that 3.19 percent of total misutilized credit was wasted for meeting the expenses of different social and religious programs, i.e., marriage of children, Akika of grandchildren, etc. The fungible farmers deployed a significant portion of 30.36 percent of fungible credit for house construction and repair. Finally, a significant portion which is 44.41 percent of diverted credit, was found to use for other purposes, i.e., sending their children abroad and investing in other businesses. Some farmers said that agricultural activities have become less profitable nowadays; thus, they do not want their children to be involved in this profession. Keeping this view on mind they obtained large amount of agricultural credit from the Govt. banks and used those credit for visa processing. For the same reason of less profitability of agricultural activities, some farmers have invested the money of agricultural credit in other businesses, i.e., grocery shops, purchasing auto rikshaw etc. However, this alarming fungible situation clearly indicates the integrity of Govt. bank officials and their inefficient credit monitoring after disbursement.

Table 6.5: Diversion of Banks' Agricultural Credit in Non-Agricultural Purposes

Code	Purpose of Use	Amount in '000 BDT	Portion of Total Amount in %
1	Living Expenditure	180	5.75
2	Education	40	1.28
3	Medical Expenditure	110	3.51
4	Repayment of Old Debt	360	11.50
5	Expense in Social Program	100	3.19
6	House Construction/Repair	950	30.36
7	Others (Sending Abroad, Investment in Other Business)	1390	44.41
Total		3130	100.00

Source: Field Survey 2022

Table-6.6 presents the uses of agricultural credit for agricultural purposes as well as uses of agricultural credit for non-agricultural purposes based on the banks' category. The credit margin of investment is the relative portion of credit used in agricultural activities out of the total credit received by the farmers. On the other hand, the fungibility ratio expresses the relative portion of the credit used in off-farm activities out of the total obtained credit. The overall credit margin of investment and fungibility ratio for all farmers is found as 66.19 and 33.81 percent, correspondingly. Results also showed that for the farmers who obtained agricultural credit from private banks, their credit margin of investment is 84.64, and the fungibility ratio is 15.36 percent. This finding revealed that out of every 100 BDT agricultural credit, 84.64 BDT was invested in agricultural purposes, and 15.36 BDT was diverted to off-farm activities by the farmers who received credit from private banks. Whilst credit margin of investment and fungibility ratio was found as 57.94 and 42.06 percent, respectively for the farmers who have taken credit from Govt. banks. This finding disclosed that out of every 100 BDT of agricultural credit, only 57.94 BDT was employed in agricultural activities, and 42.06 BDT was wasted in non-agricultural activities by those farmers who have taken agricultural credit from Govt. banks. As expected, and with no exception, Govt. banks once again fail to perform their designated duty regarding agricultural credit administration and monitoring.

Table 6.6: Fungibility Ratio and Credit Margin of Investment by Type of Bank

Type of Bank	Use in Agricultural Purposes (‘000)	Use in Non-Agricultural Purposes (‘000)	Total Amount Received (‘000)	Credit Margin of Investment (%)	Fungibility Ratio (%)
Private Bank	2425	440	2865	84.64	15.36
Govt. Bank	3705	2690	6395	57.94	42.06
Total	6130	3130	9260	66.19	33.81

Source: Field Survey 2022

Table-6.7 indicates the rate of fungibility based on the loan size. Previous research findings showed that beneficiaries with larger loans allocated a greater proportion of their credit to

agriculture than those with smaller loans. Oboh & Ekpebu (2011) mentioned that there is a high propensity for small loans that are insufficient for extensive farm operations to be redirected to off-farm activities. Our results showed 35 no. of loans are given within the range of 50 thousand BDT. Out of which, only six loans become fungible, which is only 17.14 percent. Then 43.75 percent fungibility rate is found for loans between 51 to 100 thousand BDT. Finally, 62.50 percent fungibility rate is found for loan above 100 thousand BDT. This result contradicts the findings of Oboh & Ekpebu (2011) in Nigeria and Kuwornu et al. (2012) in Ghana, where each research indicates an inverse relationship between loan size and fungibility rate. However, our findings indicate a positive association between loan size and fungibility rate. The probable reason behind this may be poor need assessment and poor pre-sanction evaluation of the farmers by the banks. Bangladesh Bank guided the scheduled banks to assess the loan requirement as per crop specification and cultivable land size. If banks disburse loans without assessing proper need, then it must be diverted. In the study area, we have found that banks, especially Govt. bank officials disburse the loan by taking bribes without identifying the genuine farmers, if so, without proper need assessment, and they do not look for the intended uses of funds at all.

Table 6.7: Fungibility Rate Based on Loan Size

Size of loan in '000 BDT	No. of Loan	No. of Fungible Loan	No. of Non-Fungible Loan	Rate of Fungibility (%)
Up to 50	35	6	29	17.14
51 – 100	32	14	18	43.75
101 and Above	24	15	9	62.50
Total	91	35	56	38.46

Source: Field Survey, 2022

Table-6.8 illustrates the intensity of credit fungibility based on the fungibility ratio. The outcome of the table indicates that up to one-third of the disbursed credit has become diverted by only five farmers, 14.29% of the enter fungible farmers. At the same time, 18 farmers, 51.43% of entire fungible farmers, misappropriated one-third to two-thirds of their received credit for non-

agricultural activities. Finally, we have seen that 0.68 to 1.00 fungibility ratio which is very high prevails among 12 farmers, who comprise 34.28% of the total fungible farmers.

Table 6.8: Intensity of Fungibility by Famers

Fungibility Ratio	No. of Loan	Intensity of Fungibility (%)
Up to 0.33	5	14.29%
0.34 to 0.67	18	51.43%
0.68 to 1.00	12	34.28%
Total	35	100.00%

Source: Field Survey 2022

In brief, we can conclude that in our study area, we have found that a small portion of loans is fungible by a small portion of farmers, and a large portion of farmers diverts a large portion of agricultural credit. This finding indicates a higher propensity of fungibility by a large portion of farmers. This high tendency of fungibility is very alarming. In reality, some fungibility can be allowed for some reasons which are discussed earlier. However, this high fungibility ratio among the large portion of farmers indicates their clear intention to obtain agricultural credit. This outcome also apparently disclosed the poor performance of the banks' officials in loan monitoring after disbursement.

6.4 Factors Influencing Credit Fungibility Status

This part of our research pertains to the study of the factors that causes the fungibility status. In view of this, some empirical factors that determine credit fungibility status are described, followed by the development of an econometric model to assess the impact of the explanatory variables on the outcome variable. Following the presentation of the model's results, some post-estimation has been conducted to assess the robustness of the model's output.

6.4.1 Description of the Variables Used in the Study of Credit Fungibility Status

A review of conceptual literature on variables influencing farmers' credit fungibility status, findings from earlier empirical research, and the authors' knowledge were utilized to identify the

determinants of farmers' credit fungibility status. In other words, some demographic, socio-economic, farm-specific, and institutional aspects are considered to explain credit fungibility status.

6.4.1 (a) Dependent Variable

Agricultural credit fungibility status is the dependent variable for this study. Hussain & Thapa (2016) used agricultural credit fungibility ratio to estimate credit fungibility condition of the farmers in Pakistan. In most recent work regarding credit fungibility, Darfor et al. (2021) considered credit fungibility status as the outcome variable to explain credit fungibility. Therefore, in our study, credit fungibility status has been considered. This fungibility status is a binary variable where the dummy dependent variable takes the value one if the farmers involved in credit fungibility and 0 for the farmers who did not involve in credit fungibility.

6.4.1 (b) Independent Variables

i. Gender of the Farmer (gen)

This is a binary variable which is denoted as ‘gen’ and assigned the value 1 if the farm household's head is male and 0 for female. Male farmers have greater mobility, engage in many activities and are exposed to more information; hence, it is assumed that they may have more scope to use agricultural credit in non-farm activities and are more likely to be fungible compared to female farmers. This assumption also corresponds to the findings of Darfor et al. (2021), where the authors found a positive association between male farmers and credit fungibility. Hence, we guess male farmers are more prone to credit fungibility, and the expected effect is positive on fungibility status.

ii. Educational Qualification (edu)

Educational qualification is measured based on the total no. of completed formal education of the farmers; hence this is a continuous independent variable. Education is a form of social capital that might have a useful effect on a farmer's ability to utilize agricultural loans more effectively. Kuwornu et al. (2012) argued that an educated farmer can distribute agricultural credit more efficiently, everything else equal. So, it has been expected that farmers with more formal

education would allocate more credit to the agricultural sector and become less fungible. Thus, the predicted sign for this variable's coefficient is negative to fungibility status.

iii. Chronic Disease (chro)

Chronic disease is another continuous independent variable that considers the total no. of family members suffering from chronic diseases in the farming household. Darfor et al. (2021) mentioned that farming households with more chronically ill family members are more inclined to be involved with credit fungibility, since they may be compelled to redirect agricultural credit to treat chronic diseases. Hence, we postulate a positive association between chorionic disease and fungibility status.

iv. Bank Loan Type (bltyp)

Bank loan type is proxied as the source of banks' agricultural credit. This dummy independent variable takes the value 1 if the farmers obtain agricultural credit from Govt. banks and 0 if the farmers receive credit from private banks. Since we have found some insight regarding the lack of monitoring and poor assessment of loan sanctions by the Govt. bank officials from the descriptive analysis, we hypothesized that the farmers who obtained credit from Govt. banks are more likely to divert agricultural credit than their counterparts.

v. Delay in Disbursement (delay)

Delay in disbursement is a continuous independent variable. The total no. of calendar days elapsed from the date of a credit application to credit receipt is proxied to measure loan delay. Kuwornu et al. (2012) cited that delayed disbursement of agricultural loans tends to entice farmers to use the funds for inappropriate purposes. The agricultural production process is highly time-sensitive; therefore, untimely credit disbursement loses its productive utility and may be utilized for unproductive purposes. Thus, it has been expected that farmers who obtain credit lately will be more likely to use credit for non-farm activities and vice versa. The anticipated sign for this variable's coefficient is positive to fungibility status of the farmers.

vi. Old debt (olddbt)

This dummy independent variable takes the value 1 if the farmers have previous debt from any sources and 0 for otherwise. The farming household usually borrowed funds from different sources. Most farmers tend to pay off a loan by obtaining another loan from a different source. Therefore, we assumed that the farmers with old debt are prone to use banks' agricultural credit to offset their previous loans. Hence, the expected effect of old debt on fungibility status is assumed to be positive.

vii. Non-fixed Assets (nonfix)

Non-fixed assets comprise immovable assets belonging to a farming household that can be liquidated easily on the occasion of financial distress. The non-fixed assets are measured in thousand BDT; thus, it is a continuous variable. According to Hussain & Thapa (2016), owners of such non-fixed assets might sell them anytime there was a need for cash to fulfill certain immediate family demands, such as purchasing food or obtaining medical services in an emergency. Due to the availability of such assets, they could utilize their credit for agricultural operations to a greater extent. So, we assumed that non-fixed assets have a negative effect on fungibility status.

viii. Loan Monitoring (bnkmon)

Loan monitoring proxied the visitation of bank officials to administer judicious use of agricultural credit. This binary variable takes the value 1 if bank representative has visited the farmers after credit disbursement and 0 for otherwise. Oboh & Ekpebu (2011) found a positive relationship between bank officials' visits and the rate of agricultural credit allocation to the farming sector. Thus, in this study, we can assume that the bank loan monitoring may lower the tendency of credit fungibility among the farmers, and bank officials' visit has a negative impact on fungibility status.

ix. Household Size (hhsz)

Household size refers to the total number of family members of a farming household living and taking meals together. This variable is another continuous independent variable. Ijioma & Osondu (2015) said that larger household size might result in loan diversions due to rising consumption costs. The tendency for agricultural loans to be diverted for consumption increases

as household size increases. From this point of view, we guess household size positively impacts fungibility status.

x. Total Owned Land (totaol)

Total owned land is another continuous variable measured as farmers' total owned land in decimal. Hussain & Thapa (2016) cited that the usage of agricultural credit for non-farm activities decreases as the landholding size increases. The size of owned landholdings is not only crucial as collateral to get larger amounts of credit, but it also increases the likelihood of generating higher agricultural revenue by expanding farm operations, hence lowering credit fungibility. Therefore, we expect a negative relationship between total owned land and credit fungibility.

xi. Adequacy Ratio (adequ)

Adequacy ratio is the ratio of received agricultural credit to required credit, a continuous variable. According to Kuwornu et al. (2012), inadequate agricultural credit, which is insufficient for any meaningful farm operation, is typically redirected to non-agricultural activities. In this regard, we hypothesized that farmers who obtain sufficient agricultural credit are less likely to become fungible than those who receive inadequate credit. The sign of this variable's coefficient is consequently predicted to be negative to explain fungibility status.

6.4.2 Econometric Modeling

Fungibility status, a dummy variable, is the dependent variable for this study, as we previously stated. As independent variables, we have considered both continuous and binary variables. There are several models for analyzing binary outcome data, including the linear probability, logit, tobit, and probit models. In this investigation, the binary probit model has been used to estimate the impact of explanatory factors on the explained variable of fungibility status.

The linear probability model estimates the probability of y=1 as a linear function of the independent variables and is expressed in equation 6.1. Where P(y=1) is the probability of a binary dependent variable taking the value 1, given a set of k predictor variables x1, x2, ..., xk and $\beta 0$, $\beta 1$, $\beta 2$, ..., βk are the coefficients of the independent variables that need to be estimated

from the data, while μ is the error term that accounts for unobserved variation in the response variable.

$$P(y=1) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots + \beta_k x_k + \mu = x\beta + \mu \quad \text{Equation 6.1}$$

Nonetheless, the most significant disadvantage of the linear probability model is that it cannot restrict the value of y to the interval of 0 to 1. As our explained variable is binary, it can only take the values 0 and 1. Thus, we estimate the probit model, which expresses the probability value of y=1 as a nonlinear function G of the independent variables (equation 6.2). As P(y=1) represents a probability, G is a nonlinear function that transforms xβ between 0 and 1.

$$P(y=1) = G(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots + \beta_k x_k) + \mu = G(x\beta) + \mu \quad \text{Equation 6.2}$$

The probit model used the cumulative density function (CDF) of the normal distribution of Φ, as stated in equation 6.2. In this equation, G is the cumulative distribution function (CDF) of the standard normal distribution, transforming the linear combination of predictor variables (xβ) into a probability value between 0 and 1.

$$P(y = 1) = \theta(x\beta) = \int_{-\infty}^{x\beta} \theta(z)dz \quad \text{Equation 6.3}$$

Equation 6.3 provides an expression that, as a function of the linear predictor xβ, gives a chance that the binary result y=1 will occur. In this equation, x is a vector of predictor variables, β is a vector of coefficients that tie x to the outcome probability, and θ(z) is the CDF of a standard normal distribution evaluated at z. The linear predictor x is considered to be normally distributed and represents the linear combination of the predictor variables and coefficients.

With the following equation 6.4, we can define our dependent variable fungibility status y as a function of independent variables. Here, μ is the error term, and β_0 is the constant and respective β_i represents the coefficient for each independent variable.

$$P(fungis=1) = \Phi(\beta_0 + \beta_1 gen + \beta_2 edu + \beta_3 chro + \beta_4 bltyp + \beta_5 delay + \beta_6 olddbt + \beta_7 nonfix + \beta_8 bnkmon + \beta_9 hhsz + \beta_{10} totaol + \beta_{11} adequ + \mu)$$

Equation 6.4

The coefficients in the probit model are obtained by maximizing the log-likelihood function, and the functional form of the log-likelihood function is presented in equation 6.5.

$$lnL = \sum w_j \ ln \ \Phi \ (x_j\beta) + \sum wj \ ln \ \{1-\Phi \ (x_j\beta)\} \qquad \text{Equation 6.5}$$

In this equation, the terms wj represent the weights or frequencies of the observations, xj represents the jth row of the design matrix, β is the vector of parameters to be estimated, and Φ is the cumulative density function of normal distribution. The log-likelihood function for the probit model is used to estimate the parameters β that maximize the probability of observing the data given the model. The function is derived from the assumption that the binary outcome y is explained with the probability function of xjβ, where xjβ is the CDF of a standard normal distribution evaluated at xjβ, and it is expressed as the sum of the logarithms of the probabilities of observing the data. The log-likelihood function can then be expressed as the sum of the logarithms of the probabilities of observing the data, given by Φ(xjβ) for y=1 and 1-Φ(xjβ) for y=0.

6.4.3 Determinants of Credit Fungibility Status

Table 6.9 provides summary statistics for the factors considered in the study of determining credit fungibility status. The average figure for the fungibility status is 0.3846, which suggests that 38.46 percent of farmers are involved in credit fungibility. Male farmers make up 84.61 percent of the total population. It has been found that the mean values for educational qualification is 6.8571 years. According to the 0.3736 mean value of chronic diseases, every farming household has 0.3736 person suffering from long-lasting illnesses. The value of bank loan type on average is 0.5164, which indicates that 51.64 percent of the farmers in the sample have taken agricultural credit from Govt. banks, and the remaining portion of the farmers received loans from private banks. The mean value for delay in disbursement is 16.5384 days, indicating that, on average, the farmers obtained the credit after approximately 17 calendar days from their credit application. Then we have a mean score of 0.3846 for old debt variable, which indicates that 38.46 percent of farmers have notified us that they had previous borrowing from other sources. The average value of non-fixed assets is found as 241.8132 thousand BDT. Afterwards, we have a mean score of 0.6703 for bank loan monitoring variable, indicating that bank officials have visited 67.03 percent of farmers after the credit disbursement.

Table 6.9: Summary Statistics (Fungibility Model)

Notation	Short Description	Observation	Mean	Standard Deviation
fungis	Fungibility Status (1=Fungible, 0= Non-Fungible)	91	0.3846	0.4891
gen	Gender of the Farmer (1=Male,0=Female)	91	0.8461	0.3628
edu	No. of Completed Years in Formal Education	91	6.8571	4.1354
chro	No. of Family Member with Chronic Diseases	91	0.3736	0.6437
bltyp	Bank Loan Type (Govt Bank=1, Private Bank=0)	91	0.5164	0.5024
delay	Delay in Disbursement from Application (Days)	91	16.5384	11.6726
olddbt	Having Old Debt. (Old Debt. =1, Otherwise=0)	91	0.3846	0.4891
nonfix	Value of Non-fixed Assets in Thousand BDT	91	241.8132	104.1007
bnkmon	Loan Monitoring after Disbursement (1=Monitored, 0= Otherwise)	91	0.6703	0.4726
hhsz	Household Size (No. of Family Members)	91	5.0769	2.4001
totaol	Total Owned Land in Decimal	91	88.2857	72.7870
adequ	Adequacy Ratio (Ratio of Received to Demanded Loan)	91	0.7587	0.2395

Source: Computed by STATA 14.2 using Field survey data 2022

Next, the farmers have an average household size of 5.0769 individuals in their families. The average land size held by the respondents was 88.2857 decimals, giving us the mean value of the land they owned. In conclusion, the adequacy ratio is found as 0.7587, stating that every farmer has been given 75.87 percent of their required credit.

Table 6.10: Outcome of Probit Model for Credit Fungibility

Probit Regression		LR chi2(11)	= 99.21		
Number of observations = 91		Prob > chi2	= 0.0000		
Log likelihood	= -11.023867	Pseudo R^2	= 0.8182		
Notation	**Variable Name**	**Coefficient**	**Standard Error**	**z-value**	**P>|z|**
gen	Gender of the Farmer	-2.802111	1.5465	-1.81	0.070*
edu	Educational Qualification	-.0367313	0.1210	-0.30	0.762
chro	Chronic Diseases	2.163161	0.9748	2.22	0.026**
bltyp	Bank Loan Type	-1.022275	1.8350	-0.56	0.577
delay	Delay in Disbursement	.1923953	0.1027	1.87	0.061*
olddbt	Old Debt	2.153647	1.3965	1.54	0.123
nonfix	Non-fixed Assets	-.0395716	0.0182	-2.17	0.030**
bnkmon	Loan Monitoring	.7381227	1.0845	0.68	0.496
hhsz	Household Size	.8022396	0.5123	1.57	0.117
totaol	Total Owned Land	.0182206	0.0117	1.55	0.121
adequ	Adequacy Ratio	4.714948	2.5183	1.87	0.061*
_cons		-3.661368	3.1943	-1.15	0.252

Source: Computed by STATA 14.2 using Field survey data 2022
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6.10 displays the outcomes of the probit regression model. The following command has been applied to the STATA 14.2 program to generate the output of the probit model:
probit fungis gen edu chro bltyp delay olddbt nonfix bnkmon hhsz totaol

The LR chi2 value of 99.21 with a probability value of 0.0000 suggests that the entire model is significant at the 1% level, as indicated by the results. The calculated log-likelihood value is found as -11.023867, which is negative. If the log-likelihood value is found as 0, then it suggests an impractical, totally perfect model. Instead, the log-likelihood value of one indicates the worst

possible model. Therefore, the desired result of the log-likelihood value is to be negative, and our results demonstrated a negative value, which is desirable. The Pseudo R^2 equals 0.8182. Notable that in the probit model, unlike other linear models, pseudo R^2 does not quantify the variation of the dependent variable by the independent variables. It only specifies the accuracy with which the model predicts the dependent variable. Pseudo R^2 values of 0.40 or above are generally acceptable, and higher values are preferred. Given that Pseudo R^2 is 0.8182, which is more than 0.40, it implies that the model fits well. The coefficient, standard error, and associated probability value for the independent variables were also included in Table 6.10.

Educational qualification, bank loan type and old debt variables are not found statistically significant, and the coefficient of bank loan type is not found consistent with its predicted sign. We found gender is statistically significant at the 10% level but not in accordance with its expected positive sign. According to our hypothesized relationship, chronic diseases and non-fixed assets are statistically significant at 5%. The relationship between delay in disbursement and adequacy ratio is found statistically significant at the 10% level; however, the coefficient sign of the adequacy ratio is not found as predicted. Finally, we have found that loan monitoring, household size and total owned land variables are statistically insignificant.
The direction of the influence of independent variables on the dependent variable, together with their associated probability values, are shown in Table-6.10. Although we have coefficient values, but they cannot be used to explain the dependent variable since they do not quantify the magnitude of the independent variables. Thus, we have to evaluate the marginal impact to know the magnitude of the independent variables.

We have provided the results of the marginal effect estimation in Table 6.11. In this regard 'margins, dydx (*)' command is used. In column dy/dx, the marginal impact is displayed. Results showed that if the farmer is male, he is 18.46% less likely to be fungible than his female counterpart, the marginal impact of gender is found as -.1846 at five percent level of significance. However, this result contradicts our expectation, where we assumed that male farmers are more likely to be fungible. According to the marginal effect .1425 of chronic diseases, a farming household with an additional one family member suffering from prolonged illness is 14.25% more likely to be fungible. This finding is quite similar to the finding of Darfor et al. (2021) in Ghana.

Table 6.11: Estimation of Marginal Effect (Credit Fungibility Model)

Notation	Variable Name	Marginal Effect (dy/dx)	Standard Error	z-value	P>|z|
gen	Gender of the Farmer	-.1846283	.0894	-2.06	0.039**
edu	Educational Qualification	-.0024202	.0079	-0.30	0.761
chro	Chronic Diseases	.1425285	.0503	2.83	0.005***
bltyp	Bank Loan Type	-.0673567	.1204	-0.56	0.576
delay	Delay in Disbursement	.0126767	.0059	2.13	0.033**
olddbt	Old Debt.	.1419016	.0837	1.69	0.090*
nonfix	Non-fixed Assets	-.0026073	.0009	-2.63	0.008***
bnkmon	Loan Monitoring	.0486342	.0703	0.69	0.489
hhsz	Household Size	.0528588	.0314	1.68	0.092*
totaol	Total Owned Land	.0012005	.0007	1.70	0.090*
adequ	Adequacy Ratio	.3106632	.1432	2.17	0.030**

Source: Computed by STATA 14.2 using Field survey data 2022
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Delay in disbursement reveals that with an extra day of delay tends the farmers 1.26% more inclined to divert credit for non-agricultural purposes as the marginal effect is found as .0126. Farmers with previous borrowings are 14.19% more likely to be fungible, according to the marginal effect .1419 of old debt. The marginal effect of non-fixed assets is -.0026, indicating that having one thousand BDT more non-fixed assets, a farmer is 0.26% less likely to use agricultural credit in off-farm activities. The finding of Hussain & Thapa (2016) in Pakistan corresponds with our result in this regard. The marginal effect of household size is found as .0528, suggesting an additional member of a farming household tends them 5.28% more likely to become fungible. This result is similar to the result of Oboh & Ekpebu (2011) in Nigeria. Then we found that one decimal of added owned land by the farmers makes them 0.12% more prone to divert agricultural credit. However, this result is inconsistent with our theoretical assumption and contradicts the empirical findings of Hussain & Thapa (2016) in Pakistan. Finally, the marginal

effect .3106 of adequacy ratio indicates a one unit increase in adequacy ratio leads a farmer to become 31.06% more likely to be fungible. However, this result does not correspond with the outcome of Kuwornu et al. (2012) in Ghana as well as with our conceptual assumption.

Table 6.12: Classification Test (Credit Fungibility Model)

Classified	**D**	**~D**	**Total**
+	32	3	35
-	3	53	56
Total	35	56	91
Particulars	**Prediction**		**Percentage**
Sensitivity	Pr(+| D)		91.43%
Specificity	Pr(-|~D)		94.64%
Positive predictive value	Pr(D| +)		91.43%
Negative predictive value	Pr(~D| -)		94.64%
False + rate for true ~D	Pr(+|~D)		5.36%
False - rate for true D	Pr(-| D)		8.57%
False + rate for classified	Pr(~D| +)		8.57%
False - rate for classified	Pr(D| -)		5.36%
Correctly classified			**93.41%**

Source: Computed by STATA 14.2 using Field survey data 2022

The classification test of the probit model has been displayed in Table-6.12. The outcome of the classification test has been generated with the help of the 'estat classification' command. This classification test demonstrated how accurately our model predicts the target variable. Here, the total number of accurate predictions for y=1 is 32 and for y=0, it is 53. Consequently, our model accurately predicts 85 out of 91 observations, or 93.41 percent. Generally, a classification accuracy of 70% or more is acceptable, and a higher proportion is preferred. Therefore, the classification test of our probit model for credit fungibility reveals that the model is well-suited.

6.5 Socio-economic Differences by Credit Fungibility Status

Table-6.13 displays the differences in mean socioeconomic characteristics between credit fungible and non-fungible farmers. In this part, the researcher has calculated the mean difference of specific socio-economic characteristics based on paired t-test.

The mean value of age, education, and experience varied significantly between fungible and non-fungible farmers, according to the findings of the t-test. The average age of fungible and non-fungible farmers is 52.20 and 45.9464 years, respectively, which indicates that non-fungible farmers are younger than fungible farmers. Farmers who have used agricultural loans properly are shown to be better educated, with an average educational qualification of 7.4285 years compared to 5.9428 years for farmers who have misused agricultural credit. Yet, fungible farmers have greater experience than non-fungible farmers since the mean score of experience is 32.3142 and 23.5178 years, correspondingly, for non-fungible and fungible farmers. The results also confirmed that no statistically significant mean difference prevails between fungible and non-fungible farmers regarding gender, marital status, household size, household labor, hired labor, total owned land, farm size, owned equipment, and adequacy ratio. Then we found the average annual savings of non-fungible farmers as 213.8036 thousand BDT compared to fungible farmers' 113.20 thousand BDT. The mean value of bank loan type 0.3928 for non-fungible farmers suggests that 39.28% of them obtained credit from Govt. banks. On the other hand, 71.42% of famers who diverted credit, received their loan from Govt. banks. Fungible and non-fungible farmers' mean values of 0.80 and 0.1071 of chronic diseases variable revealed significant differences at one percent level. Next, it has been observed that bank officials have visited 45.71 percent of the farmers who misappropriated credit after disbursement. This portion is found as 80.35% for the farmers who properly utilized agricultural credit. Non-fungible farmers' average days to receive the credit is only 11.51 days, whereas this is 24.57 days for fungible farmers. Regarding non-fixed assets, fungible farmers and non-fungible farmer's mean score is 158.85 and 293.66 thousand BDT, respectively; this difference is statistically significant at one percent level.

Table-6.13: Mean Difference of Socio-economic Variables by Fungibility Status

Variable Name	Full sample	Fungible	Non-Fungible	t-value
Age	48.3516	52.2000	45.9464	-2.3596**
Gender	0.8461	0.8857	0.8214	-0.8209
Education	6.8571	5.9428	7.4285	1.6843*
Experience	26.9011	32.3142	23.5178	-2.6902***
Marital Status	0.9670	0.9714	0.9642	-0.1836
Household Size	5.0769	5.5428	4.7857	-1.4735
Household Labor	1.8901	1.7714	1.9642	0.9809
Hired Labor	47.0329	43.5714	49.1964	0.3483
Total Owned Land	88.2857	92.8571	85.4285	-0.4716
Farm Size	180.0769	167.9571	187.6518	0.3022
Owned Equipment	36.1758	29.4000	40.4107	0.9252
Savings	175.1099	113.2000	213.8036	2.3905**
Bank Loan Type	0.5164	0.7142	0.3928	-3.1082***
Chronic Diseases	0.3736	0.8000	0.1071	-5.8426***
Loan Monitoring	0.6703	0.4571	0.8035	3.6232***
Adequacy Ratio	0.7587	0.8025	0.7314	-1.3853
Delay in Disbursement	16.5384	24.5714	11.5178	-6.1655***
Non-Fixed Assets	241.8132	158.8571	293.6607	7.7237***
Old Debt.	0.3846	0.5714	0.2678	-3.0057***

Source: Computed using STATA 14.2 from Field survey data 2022
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Lastly, we discovered a substantial disparity between the two groups of farmers in terms of their previous borrowing from other sources. 57.14 percent of fungible farmers have previous debt. In contrast, just 26.78 percent of non-fungible farmers have old debt.

6.6 Credit Fungibility Status and Productivity

Agricultural credit fungibility severely affects agricultural productivity as the funds are diverted to other unproductive purposes. Therefore, production inputs are deviated from the optimal level, and the sub-optimal use of the inputs and equipment may lower the production level from a given resource. As mentioned earlier, the likelihood of the farmers increasing productivity and, ultimately, their income depends on their access to credit and their efficiency in utilizing credit properly. Oboh & Ekpebu (2011) mentioned that increasing agricultural productivity also necessitates the efficient and judicious use of credit in framing activities. The agriculture industry may overcome stagnation and increase productivity by utilizing credit effectively. Hence, properly utilized agricultural finance may infuse cash and raw materials into production and enhance output rates. It has also been demonstrated that properly administered farm-level financing promotes capital formation, agricultural diversification, resource productivity, farm operation size, agricultural innovations, marketing efficiency, and net farm income (Nwagbo et al., 1989). According to Pischke and Adams (1980), the detrimental impact of loans on the economic well-being of rural households occurs due to the diversion of credit. The adverse link between agriculture credit and farm productivity can also be attributable to farmers' behavior regarding the fungibility of agriculture loans. As discussed previously, credit fungibility has a negative impact on agriculture production because credit for agriculture inputs, such as seeds, fertilizers, and equipment, is diverted to non-agriculture purposes, such as consumption, repayment of previous loans, and home repair. Therefore, an insufficient supply of inputs and the use of traditional equipment interrupts production, yielding low returns from farming operations. Saqib et al. (2017) also posit that low farm production, which affects low farm income happens when agricultural credits are used for purposes other than farming. However, the importance of proper use of accessed credit and the adverse effect of credit fungibility has been discussed long at the conceptual level. However, in the next section, we tried to find empirical evidence of the impact of credit fungibility on productivity indicators.

6.6.1 Comparison between Fungible and Non-Fungible Farmers in Production Level

Table 6.14: Change in Production Level by Credit Fungibility Status

Condition	Not Rise in Production	Rise in Production	Total
Non-Fungible	10	46	56
	(17.86)	(82.14)	(100.00)
Fungible	16	19	35
	(45.71)	(54.29)	(100.00)
Total	26	65	91
	(28.57)	(71.43)	(100.00)

Source: Field Survey 2022 Pearson chi2(1) = 8.1900 (Pr = 0.004)
Note: Figures in brackets are respective percentages.

The link between fungibility status and production change is seen in Table 6.14. We inquired about the farmers' perceptions of the current production change compared to the previous year's output. In response to this question, 65 farmers, or 71.43% of the accessed farmers, reported an increase in production compared to the previous year, while 28.57% reported a decrease. 46 out of the 56 non-fungible farmers, or 82.14%, reported an increase in production in the current year. In contrast, 19 of the 35 fungible farmers, or only 54.29%, replied rise in the production level. While comparing the relative portion, the non-fungible farmers experience a higher-level positive change in production. Since these two variables are nominal, this difference is examined with the chi2 test. With a chi2(1) value of 8.1900 and a corresponding probability value of 0.004, this difference is found statistically significant at 1% level.

6.6.2 Mean Difference of Productivity Indicators Based on Fungibility Status

This section estimates the mean difference of several productivity measures, such as the amount of inputs used, production, and income per acre, depending on the farmers' credit fungibility status. Throughout estimating the mean difference, we used the paired t-test to determine the magnitude of the difference and the level to which it was significant.

Table-6.15: Mean Productivity Difference (Inputs Use) by Credit Fungibility

Group	Observation	Mean	Standard Error	Standard Deviation
Non-Fungible	56	160.9798	8.3828	62.7313
Fungible	35	112.2623	8.9580	52.9964
Combined	91	142.2423	6.6579	63.5128
Difference		48.7175	12.7563	

Source: Computed using STATA 14.2 t = 3.8191 Pr(|T| > |t|) = 0.0002***
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6.15 displays the average difference in input use per acre based on fungibility status. Input costs per acre for farmers without fungibility were determined to average 160.9798 thousand BDT. In contrast, those who have diverted credit, invested 112.2623 thousand BDT in purchasing inputs. Clearly, non-fungible farmers invested 48.7175 thousand BDT more in agricultural inputs than fungible farmers. The input expenditures of non-fungible farmers are 43.39 percent higher than those of fungible farmers. The mean difference between these two groups is statistically significant at 1% level, given that the t-value is 3.8191 and the probability value is 0.002. This result is consistent with the earlier theoretical assumption that non-fungible farmers can spend more on inputs expenditure.

Table-6.16 revealed the mean difference in agricultural production per acre for farmers with and without fungibility. The average agricultural output per acre for non-fungible and fungible farmers is found as 331.4116 and 234.5180 thousand BDT, respectively. The average yield per acre for all farmers is 294.1448 thousand BDT. Hence, it is evident that the average output of non-fungible farmers is higher than the average production of all farmers, whereas the average production of fungible farmers is lower than the average production of all farmers. The average difference between non-fungible and fungible farmers is 96.8936 thousand BDT, which indicates that the average production per acre of non-fungible farmers is 41.32% higher than that of fungible farmers. This mean difference is statistically significant at 1% level, as the t-value of 4.1649 corresponds to a probability value of 0.0001.

Table-6.16: Mean Productivity Difference (Agricultural Production) by Credit Fungibility

Group	Observation	Mean	Standard Error	Standard Deviation
Non-Fungible	56	331.4116	15.3457	114.8372
Fungible	35	234.5180	16.1972	95.8241
Combined	91	294.1448	12.3032	117.3658
Difference		96.8936	23.2645	

Source: Computed using STATA 14.2 t = 4.1649 Pr(|T| > |t|) = 0.0001***
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table-6.17: Mean Productivity Difference (Net Agricultural Income) by Credit Fungibility

Group	Observation	Mean	Standard Error	Standard Deviation
Non-Fungible	56	170.4323	10.1912	76.2643
Fungible	35	122.2560	8.9758	53.1018
Combined	91	151.9030	7.5411	71.9380
Difference		48.1763	14.7272	

Source: Computed using STATA 14.2 t = 3.2712 Pr(|T| > |t|) = 0.0015***
Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6.17 displays the average variance in net agricultural revenue per acre based on farmers' fungibility status. The results indicate that the average net agricultural revenue per acre for non-fungible farmers is 170.4323 thousand BDT. Conversely, fungible farmers' average agricultural net income is 122.2560 thousand BDT. Furthermore, this disparity demonstrated that farmers who have judiciously used credit had 48.1763 thousand BDT more net agricultural revenue per acre than farmers who have not. The relative assessment found that non-fungible farmers' average net agricultural revenue is 39.41% more than fungible farmers. The average agricultural revenue of all farmers is calculated as 151.9030 thousand BDT. Noticeably, fungible farmers' average net agricultural income is less than the combined average, and vice versa. The t-value of 3.2712 and the probability value of 0.0015 indicate that this mean difference is statistically significant at 5% level.

6.6.3 Impact Assessment of Fungibility Status on Productivity Indicators

In the preceding section, the mean difference of different productivity indicators has been calculated to compare the productivity levels of fungible and non-fungible farmers using a paired t-test. Unfortunately, this assessment only offers an average difference in group-level comparison for some productivity indicators. The average difference cannot precisely depict the individual-level impact of fungibility status. In this part, the Propensity Score Matching (PSM) model has been used to evaluate the treatment effect of fungibility status on several productivity metrics. PSM has been used to quantify the treatment impact since it is suitable for observational survey data. The PSM model was used as our data was acquired through a field survey. In addition, the PSM approach can reduce the sample selection bias caused by systematic socio-economic inequalities between the treated and untreated groups. In the PSM model, we evaluate three productivity indicators, namely input usage, production, and income per acre. In the section that follows, the econometric modeling of PSM is explored.

Modeling Propensity Score Matching (PSM)

Garrido et al. (2014) mentioned that when evaluating the effect of a treatment on an outcome using observational data and when selection bias is expected, PSM is appropriate. Yet, in observational data, treatment assignment is not randomized. This results in selection bias, in which measurable and unmeasured features of individuals are related to the probability of receiving treatment and the outcome. Thus, the PSM model is intended to minimize the potential bias resulting from confounding factors. In the initial step of the process, a probit model is used to calculate propensity scores based on observable factors that determine the fungibility status of the farmers. The propensity score offers a method for balancing measurable factors across treatment and comparison groups and more closely approximates the counterfactual effect for the treated individual. When factors are added to the matching process, it becomes more challenging to discover precise matches for individuals, i.e., it is uncommon to find individuals in both the treatment and comparison groups with the same gender, educational level, family size, and land holding. Propensity scores alleviate this differing issue by condensing the relevant variables into a single score. Afterward, individuals with similar propensity scores are compared between the treatment and control groups.

Let X denote the set of observable factors that define credit fungibility status and Di = 1 indicates credit fungibility, whereas Di = 0 indicates without credit fungibility. Thus, D is a binary variable referred to as the fungibility status, and Di = 1 and Di = 0 correspond to the observation of the treatment and the control, respectively. Thereby the formula for calculating the p-score using the probit model is as follows:

$$p(x)= Pr(D=1/x) =E(D/x)$$ Equation 6.6

Here, p(x) computed the propensity score based on observable factors of x, which defines the fungibility status. The p-score is between 0 and 1, and based on the same p-score, the outcomes of fungible and non-fungible farmers are calculated to determine the genuine influence of the treatment variable credit fungibility. Based on the calculated propensity score, the second stage of the PSM model generates the average treatment effect on the treated (ATET) and the average treatment effect (ATE) by matching farming households with credit fungibility with a similar propensity score to those without credit fungibility. Now assume that the outcome for the fungible farmer (Di = 1) is Y1i, and the outcome for the non-fungible farmers (Di = 0) is Y0i. The treatment effect is, therefore, Y1i - Y0i. Now the evaluation difficulty occurs since only one of the possible outcomes, E (Y1i/Di = 1), has been observed for each individual i. Thus, the outcome E (Y0i/Di =1), also known as the counterfactual outcome, cannot be observed and must be calculated. The ATET is, therefore the difference between the result of the treated farmers and the outcome of the treated farmers if they had not been treated and expressed in the following equation.

$$ATET = E (Y1i - Y0i/Di = 1) = E (Y1i/Di = 1) – E (Y0i/Di = 1)$$ Equation 6.7

However, the counterfactual effect, i.e., if the farmers had not been treated, cannot be observed since the treatment effect cannot be removed from them. Consequently, a good approximation of the counterfactual effect is required, and this may be achieved by comparing treated and untreated farmers with comparable p-scores. This allows us to compare the outcomes of treated and untreated observations.

$$ATET = E (Y1i/p(x), Di = 1) – E (Y0i/p(x), Di = 0)$$ Equation 6.8

The above equation now indicates that the ATET is now calculated based on the same p-score of p(x) between treated (Di = 1) and untreated (Di = 0) farmers on their respective outcomes of Y1i and Y0i. Consequently, this calculation based on p-score matching provides a fair comparison and an accurate estimate of the treatment impact.

The ATE is the difference between the treated and untreated observation outcome and is represented by the equation below.

$$ATE = E(\Delta) = (Y1i/x, Di = 1) - E(Y0i/x, Di = 0) \quad \text{Equation 6.9}$$

The ATE combines the ATET and the expected treatment impact on untreated farmers. Therefore, ATE measures the treatment impact on the population level. However, for experimental research, ATE estimate is suitable. Instead, ATET is more appropriate for observational research.

Estimated Outcome of Treatment Effect on Productivity Indicators

As previously indicated, three productivity metrics, namely inputs utilization, production, and income per acre, are included when evaluating the impact of banks' agricultural credit fungibility status. Estimating the outcome of the treatment effect of fungibility status carried out through the PSM framework, accounting for both ATE and ATET estimation.

Model 1 (Inputs Use Per Acre)

The outcome variable in the model is inputs used per acre. The treatment variable is credit fungibility. Farmers involved in credit fungibility belong to the treatment group, while non-fungible farmers are in the control group.

Table 6.18 demonstrates the average treatment impact of credit fungibility on input utilization. The results indicated that the average treatment impact of credit fungibility is -40.108 thousand per acre. The probability value of this coefficient is 0.021, which corresponds to a significance level of 5%. As discussed previously, ATE is the mean population-level treatment effect. Hence, this finding demonstrated that farmers who have diverted acquired agricultural credit for unproductive purposes lost 40,108-taka equivalent inputs uses per acre when comparing both treated and untreated farmers

Table-6.18: Impact of Credit Fungibility on Inputs Use (ATE)

Estimator: Propensity-Score Matching Number of Observations = 91		Outcome model: Matching Treatment model: Probit		
Pexpa (Inputs Use Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Fungible=1, Non-Fungible=0 (1 Vs 0)	-40.108	17.3535	-2.31	0.021**

Source: Computed using STATA 14.2 from Field survey data 2022
*P<0.10, **P<0.05, ***P<0.01 significance level for z values

Table-6.19: Impact of Credit Fungibility on Inputs Use (ATET)

Estimator: Propensity-Score Matching Number of Observations = 91		Outcome model: Matching Treatment model: Probit		
Pexpa (Inputs Use Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect on the Treated) Fungible=1, Non-Fungible=0 (1 Vs 0)	-68.641	25.9694	-2.64	0.008***

Source: Computed using STATA 14.2 from Field survey data 2022
*P<0.10, **P<0.05, ***P<0.01 significance level for z values

The average treatment effect of the treated is presented in Table-6.19. The ATET is the average treatment effect for the farmers who ultimately received the treatment. Findings suggest that the coefficient of ATET is -68.641, with a corresponding probability value of 0.008, indicating that the coefficient value is statistically significant at the 1% level. The coefficient value indicates that farmers who have misused agricultural credit may utilize 68,641 BDT more inputs per acre if the farmers did not involve in credit fungibility. In other words, the farmers who have involved in credit fungibility lost an equivalent of sixty-eight thousand six hundred and forty-one taka per acre of inputs uses. This outcome is consistent with the hypothesis that farmers who

misappropriate the credit leading a sub-optimal use of inputs. The result also validates our expected negative impact of credit fungibility on input use.

Model 2 (Agricultural Production Per Acre)

In model two, the agricultural production per acre is the second outcome variable. The treatment variable is credit fungibility status. Similar to the previous model, fungible farmers are the members of the treatment group, while non-fungible farmers are the control group members. Table 6.20 displays ATE calculation of the influence of fungibility status on agricultural output per acre.

Table-6.20: Impact of Credit Fungibility on Agricultural Production (ATE)

Estimator: Propensity-Score Matching Number of Observations = 91		Outcome model: Matching Treatment model: Probit		
Prodpa (Production Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Fungible=1, Non-Fungible=0 (1 Vs 0)	-57.696	23.3613	-2.47	0.014**

Source: Computed using STATA 14.2 from Field survey data 2022
*P<0.10, **P<0.05, ***P<0.01 significance level for z values

The coefficient of -57.696 indicates that the average treatment impact of credit fungibility on production per acre is 57.696 thousand per acre. The probability value of this coefficient is 0.014, indicating that its value is significant at the five percent level. The ATE is the mean population-level impact of the treatment, as described in Model 1. Thus, this outcome demonstrated that farmers involved in agricultural credit diversion produced 57,696 Taka less per acre over a year, taking both treated and untreated farmers into account.

The average treatment effect of the treated was reported in Table-6.21. The coefficient value of ATET is found as -90.243, with a corresponding probability value of 0.001, suggesting that the coefficient value is statistically significant at 1% level. The coefficient value indicates that farmers with credit fungibility generate 90,243 BDT less production per acre than the farmers without credit fungibility. In other words, farmers who have diverted credit can produce ninety

thousand two hundred forty-three taka more per acre if they had not been involved in credit fungibility. This research finding verifies the conceptual assertion that farmers who have misused agricultural credit cannot utilize an optimal range of inputs which results in reduced output. The result also validates our expected negative impact of credit fungibility on output

Table-6.21: Impact of Credit Fungibility on Agricultural Production (ATET)

Estimator: Propensity-Score Matching Number of Observations = 91		Outcome model: Matching Treatment model: Probit		
Prodpa (Production Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect on the Treated) Fungible=1, Non-Fungible=0 (1 Vs 0)	-90.243	28.0187	-3.22	0.001***

Source: Computed using STATA 14.2 from Field survey data 2022
*P<0.10, **P<0.05, ***P<0.01 significance level for z values

Model 3 (Net Agricultural Income Per Acre)

In model three, the outcome variable is net agricultural revenue per acre and the treatment variable is fungibility status. This model's treatment group and control group are farmers with credit fungibility and without credit fungibility, respectively.

Table-6.22: Impact of Credit Fungibility on Net Agricultural Income (ATE)

Estimator: Propensity-Score Matching Number of Observations = 91		Outcome model: Matching Treatment model: Probit		
Netpa (Net Income Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATE (Average Treatment Effect) Fungible=1, Non-Fungible=0 (1 Vs 0)	-17.588	15.3970	-1.14	0.253

Source: Computed using STATA 14.2 from Field survey data 2022

The average treatment impact of credit fungibility on net agricultural income per acre is presented in Table 6.22. The results indicated that the average treatment impact of credit fungibility is -17.588 per acre. The probability value of this coefficient is 0.253, which indicates that this finding is not statistically significant. As discussed previously, ATE is the mean population-level treatment effect. Hence, this outcome demonstrated that farmers who have involved with credit fungibility earn 17,588 thousand lower net income per acre annually compared to non-fungible farmers.

Table-6.23: Impact of Credit Fungibility on Net Agricultural Income (ATET)

Estimator: Propensity-Score Matching Number of Observations = 91		Outcome model: Matching Treatment model: Probit		
Netpa (Net Income Per Acre)	Coefficient	Standard Error	z-value	P>|z|
ATET (Average Treatment Effect on the Treated) Fungible=1, Non-Fungible=0				
(1 Vs 0)	-21.603	26.5334	-0.81	0.416

Source: Computed using STATA 14.2 from Field survey data 2022

The average treatment effect of the treated is presented in Table-6.23. The ATET is the average treatment effect for farmers who involved in credit fungibility. Findings suggest that the coefficient of ATET is -21.603, with a corresponding probability value of 0.416, indicating that the coefficient value is not statistically significant. The coefficient value suggested that those farmers who misappropriate agricultural loan earn 21,603 BDT lower per acre in net agricultural income than farmers who do not involved in agricultural credit diversion. In other words, the farmers who have redirected agricultural loans to off-farm activities can earn twenty-one thousand six hundred and three taka per acre if they had not been involved in credit fungibility. This result is consistent with the assumption that farmers who divert credit may produce less, leading to a reduction in net agricultural income. The result also confirms our expected adverse impact of credit fungibility on farm revenue however found statistically insignificant.

Chapter 7

Conclusions and Recommendations

7.1 Summary of Findings

This section summarizes the significant findings, the results of testing hypotheses, and other pertinent information about our entire study. While investigating the application status for banks' agricultural credit, it was found that 77% of farmers did not apply for agricultural credit. They mentioned complex application procedures, extra costs in the form of bribes, broker and lobbying payments, and extensive documentation and paperwork as the chief reasons for not applying for banks' agricultural credit. On the other hand, the farmers reported that they did not get sufficient credit because they could not convince the bank officials, lack of interest in agricultural credit lending, and lack of collateral submission as required by the bank officials. Moreover, this study found that only 42.39% of the applicant farmers received sufficient credit. The study also revealed that most of the farmers are transaction cost constraints (39.75%), and considering all constraint categories, 65.25% of the sampled farmers are credit constraints. Out of all constraint farmers, 79.69% are constrained for the demand side issue. Following that, we have found constraint differences in the various regions of our study area. The farmers of the Keraniganj area have the highest, and the Nawabganj area has the lowest constraint rate among the five sub-districts. Afterward, outcomes of the probit model for determining the credit constraint status revealed that marital status, gender, risk perception, cooperative membership, land ownership deed, total owned land, and distance to bank variables are found statistically significant, according to our assumed direction. However, the type of farm was found to be significant but not as per our expected sign. The paired t-test confirmed the socio-economic difference between the constraint and unconstraint farmers. The chi-square test further disclosed a significant production level gap between the constraint and unconstraint farmers. Then the mean productivity difference also revealed that the unconstraint farmers have higher input use, production, and income per acre compared to constraint farmers. Next, the PSM estimation using both ATT and ATET confirms that the treatment effect of constraint status negatively impacts the farmers' inputs use, production, and income.

Regarding access to credit, we have found that only 22.75% of the farmers get access to credit. The average amount of disbursed credit to individual farmers is much higher for Govt. banks

compared to private banks. The weighted average interest rate is lower for Govt. banks than private banks. 94.60% of the total credit is disbursed in the short-term period. The actual cost of borrowing is 14.06% and this rate is 15.25% for Govt. banks and 11.42% for private banks. Regarding collateral submission, the Govt. banks are found to be more rigid compared to private banks. At the same time, the average delay for loan disbursement is relatively high for the Govt. banks. The Govt. banks also failed to fulfill farmers' credit demand compared to the private banks. Following that, the probit regression outcome for determining the access to credit status disclosed education, household size, household labor, krishi card, past access in bank credit, the purpose of farming, and bank account variables are found statistically significant and following our assumed direction. However, the direction of total owned land is not found as per our expectation but found significant at the ten percent level. Subsequently, we found mean differences in socio-economic variables between the accessed and non-accessed farmers. Then the mean productivity difference also revealed that the accessed farmers have higher input use, production, and income per acre than non-accessed farmers. Following that, the PSM estimation using both ATT and ATET confirms that access status's treatment effect positively impacts farmers' inputs use, production, and income.

The study of credit fungibility discovered that 38.46% of the accessed farmers are involved with credit fungibility. Lack of access to personal loans, low-income levels of the farmers, and lack of awareness of the farmers are identified as the leading reasons for the misuse of credit for non-agricultural purposes. While we have found that 48.04% of the properly utilized credit is used for inputs acquisition, and 17.78 and 16.80% are used for labor and land. In contrast, we identified that 44.41% of the diverted credit is used for investment in other business and for sending farmers' children abroad. Then 30.36% of the misappropriated credit was invested in farmers' house construction and repair, and 11.50% was used to repay old debt. Later we discovered that the fungibility ratio is relatively high for the Govt. banks' agricultural credit which is almost three times higher than the private banks. Interestingly, the fungibility rate is positively associated with the loan size, which contradicts the theoretical assumptions and empirical findings. Then intensity of fungibility among the farmers signifies that a large portion of agricultural credit is diverted by a large portion of farmers, indicating the intention of the farmers as well as the poor borrower selection by the bank officials. Following that probit model confirms that chronic diseases, delay in disbursement, old debt, non-fixed assets, and household

size variables are statistically significant and consistent with our hypothesized direction. However, gender, total owned land, and adequacy ratio indicate an opposite direction, though found significant. Afterward, we found mean differences in several socio-economic variables between the fungible and non-fungible farmers. The chi-square test further disclosed a significant production level gap between the fungible and non-fungible farmers. Then the mean productivity difference also revealed that the non-fungible farmers have higher input use, production, and income per acre than fungible farmers. Following that, the PSM estimation using both ATT and ATET confirms that the treatment effect of fungibility status negatively impacts on inputs use and production of the farmers. In contrast, the impact of fungibility status on income is also found to be negative but statistically insignificant.

7.2 Suggestions and Recommendations

The followings suggestion and recommendations are presented based on the findings of our study. The respective policymaker can give attention to our empirical findings, suggestions, and policy modification recommendations.

The application procedure for banks' agricultural credit should be simplified following the literacy level of the farmers. A complete checklist of required documents should be provided through a leaflet in the Bengali language. Bank officials can also set up a billboard in front of the bank or the marketplace to reduce the information gap regarding loan application and processing.

The local administration should take proper actions to free agricultural credit processing from the involvement of any broker and political lobbying. ACC should take strict action against the dishonest bank officials who takes bribes from the farmers.

The bank officials should keep the documentation process as simple as possible. They should not take unnecessary and complicated documentation. Moreover, they should be more cordial with the farmers regarding agricultural loan processing.

Property transfer and tenancy systems should be updated and free from any corruption. The land ministry can facilitate farmers by providing fast and low-cost land ownership, mutation, and ledger management services. Thus, the collateral submission becomes easy for the farmers, and the supply-side constraint situation will improve.

Bank should not ask for over-collateral submission. The bank officials should follow the guideline of BB to take the collateral based on the loan amount and take the charge documents as per BB's guidelines.

Development of the agricultural insurance sector may help overcome the farmers' risk constraint by protecting their income flow. IRDA should take the initiative to develop the agricultural insurance system.

Branch expansion in rural areas, agricultural credit processing through agent banking, and mobile banking should be introduced. Credit disbursement and recovery via mobile banking can reduce farmers' time and travel costs and save bankers' valuable time. Therefore, BB should take some policy implications regarding this issue.

BB currently instructs banks to provide at least 2.5% of their total credit to the agricultural sector. However, our findings suggest that the mean adequacy of the credit is around 70% in the study area. Thus, we recommend increasing this rate to at least 3.5% of the total credit. Moreover, in the study area, we have found that almost 95% of the agricultural credit is disbursed in the short term. Therefore, we also recommend that BB maintain 15% of the credit for long-term financing to ensure capital investment in the agricultural sector.

In the study area, we have found that some private banks impose extra charges as risk premiums and some Govt. banks impose very high collateral submission. Hence, we recommend that the central bank take proper inspection and actions accordingly.

The agricultural production process is highly time sensitive; thus, bank officials are suggested to disburse credit according to the production calendar and season. They should also follow the stipulated time frame for loan processing, as stated by BB.

The Ministry of Education, in partnership with agricultural and credit officials, should arrange informal civic educational seminars and programs for farmers regarding farming techniques, financial literacy, record keeping, credit access, proper management of credit, marketing of products etc.

Krishi cards should be disseminated to genuine farmers. The UAO of the respective sub-district should maintain the proper identification of farmers, their farming records, income, subsidy

needs etc. Besides that, the UAO should ensure the proper distribution of subsidies and grants. A unit can be established under the supervision of UAO to take care of agricultural financing issues such as credit, insurance, subsidy, grants, aids, and cooperative formation. Thus, the UAO and SAAO can take care of the technical part of the agricultural production system.

The inclusion of the farmers in the banking channel can be possible through mobile banking financial services. Those service providers should give them some incentives to encourage savings and habituate them to transact in the banking channel.

The income generation of the farmers can be increased by commercialization, cropping intensity, and crop diversification. Moreover, preharvest contracts and group farming can ensure the fair price of agricultural commodities. UAO and SAAO of the respective area can contribute in this regard. Therefore, the farmers can increase their earnings, and the fungibility tendency would be reduced.

Our study found that many farmers reported that they do not know where and how to apply for agricultural credit. Campaign of the banks, booth, and billboard set up at the local market. Agricultural television and radio programs also can distribute information regarding this issue.

BB can include NBFI to participate in agricultural financing since they provide finance on a long-term basis. Hence long-term credit needs and lease financing demand by large farmers can be fulfilled.

As our respondents reported, the repayment schedule of the banks' agricultural credit is flat and inflexible. The gestation and marketability of all crops are not same; thus, the weekly, monthly, or quarterly repayment system based on the English calendar is unsuitable for farmers. Therefore, banks can consider crop and season-wise repayment schedules for the farmers.

The impact of cooperative membership is significant in our study to determine access and constraint status. Therefore, the regulatory body of cooperatives should be farmer friendly, and the UAO should take care of forming and maintaining the CIG of farmers. However, the farmers should also maintain unity and mutual respect to each other to properly function as a cooperative.

Regular visitation of bank officials after and before disbursement is very decisive in administering agricultural credit regarding borrower selection and fungibility issues. The bank

should form a separate monitoring cell from sanctioning authority. The bank may ask the farmers to submit the receipt of their spending in agricultural activities as a memo or money receipt.

The bank officials should stop flat credit disbursement without assessing the proper need of the farmers. That flat credit does not impacts since those credit does not invest in the productive sector. Sometimes bank officials do this to enrich their performance by stating the number of included farmers regardless of their demand fulfillment. Though the bank has a limited budget, thus they should provide adequate credit to one instead of flat credit to more than one to bring ultimate effectiveness of credit and avoid credit fungibility.

Under and over-financing both occur fungibility, so proper need assessment by the bank officials should be ensured. Credit can be disbursed through the booth, agent, check, pay order, and direct deposit in the seller's name of inputs and machinery. Alongside this, the farmers should be aware and honest about the judicious use of credit. Monitoring and visitation of bank officials cannot alone ensure reduced fungibility.

Many farmers reported that for their personal requirement they could not get a loan from banks thus they collect agricultural loan and uses those loans to non-agricultural purposes. Therefore, bank can develop personal loan schemes for farmers to meet their personal loans and to prevent agricultural credit fungibility.

Due to subsidized low-interest rate, many non-farming individuals, with the aid of political influence and bribes, manage the agricultural credit, and thus the truly needy farmers become deprived, and the fund goes to other unproductive sectors. In this regard, actual needy famers identification is very crucial. Since the supply of banks agricultural credit is limited, bank officials must identify the genuine farmers for agricultural credit disbursement.

Banks should provide some incentives for the proper use of credit to the farmers who invested credit in agricultural purposes to encourage them and also charge some penalty to the fungible farmers to discourage them.

The loan amount should be disbursed on an installment basis as per production processes such as land preparation, cultivation, and harvestings instead of providing them at a time to prevent misuse of agricultural credit.

The social welfare ministry can include some marginal farmers in the social safety net to protect the agricultural credit from becoming fungible.

7.3 Conclusions

In this study, we tried to identify the conditions of agricultural credit constraint, the farmers' access and fungibility status, and the factors that influence constraint, access, and fungibility status. Moreover, an impact assessment of constraint, access, and fungibility status is also done on farmers' inputs use, production, and income based on micro-level data to provide insight regarding banks' agricultural credit and agricultural productivity.

Increasing agricultural output is a crucial factor in drastically reducing poverty and improving the subsistence position of rural farmers. This productivity would increase farm income, food security, poverty reduction, and enhanced rural household welfare at the micro level while contributing to inclusive industrial development and economic growth at the macro level. In order to ensure long-term food security and industrial development, a cost-effective, sustainable, and environment-friendly agricultural production system is crucial. Being a developing country, Bangladesh has to rely on this primary sector in every respect of economic activities. The acceleration of agricultural production heavily depends on modernization and thus needs an adequate inflow of funds. Inclusion in credit, removal of credit constraints and fungibility, designing farmers-friendly agricultural credit products, and, most importantly, establishing a structured credit market should get the policymaker's attention for the development of the agricultural sector and the overall economic development.

However, we have been facing some economic downturns in recent times due to the aftershock of COVID-19 and the current Russia-Ukraine war. As a result of this war, whole world is now affected and the food supply chain throughout the world has been hampered. Due to the increase of imported food stuff and raw materials, we are facing a foreign reserve crisis. In this situation, import substitute and export-oriented crop production should be increased to protect our valuable foreign reserve. Because of our country's limited and gradually decreasing cultivable land, we must focus on improving productivity by investing in high-yielding inputs and innovative farming systems. Moreover, the provision of food is likely to be the greatest challenge to humankind in the future due to the rapid population growth; therefore, paying significant attention to key food producers (farmers) is essential. Thus, financing in the agricultural sector

through credit should be increased and distributed on time with integrity and proper monitoring. Thus, we can overcome the present challenges and will be able to achieve the future development goals, i.e., 8th Five Year Plan, Sustainable Development Goals, Vision 2041, Deltaplan-2100 etc.

7.4 Scope of Future Research

This study has been done on the data of crop farmers only. Therefore, future research based on banks' fisheries, dairy, and poultry credit will bring more findings to the policymaker about cattle and fish farmers. Due to time and budget constraints, we have selected our study area as the rural area of Dhaka. However, extending this study to other parts of the country will bring more insight to the policymakers. This research has been conducted based on the responses of the farmers. In contrast further research regarding the same issue can be done based on the banker's point of view. Besides banks' credit, agricultural credit constraints, access, and fungibility issues of semi-formal and informal sectors can be done in the future. This study is based on the survey of 2022 data. Our study was an observational study. Experimental studies can be done through baseline and end line survey method. We also expect a future cross-sectional survey over several district's rural areas and longitudinal data of two different periods can bring some new avenues of findings.

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Appendices

Appendix-A

Table 7.1: Correlation Matrix (Credit Constraint Model)

	age	gen	marry	edu	exp	hhsz	risk	coope	olddft	deed	totaol	dbnk	depen	tfarm
age	1.00													
gen	0.24	1.00												
marry	0.22	0.02	1.00											
edu	-0.36	-0.09	-0.17	1.00										
exp	0.76	0.24	0.19	-0.42	1.00									
hhsz	0.18	0.10	0.06	-0.03	0.23	1.00								
risk	0.03	0.04	0.07	-0.08	0.07	-0.05	1.00							
coope	-0.00	-0.13	-0.03	0.09	0.03	0.04	-0.23	1.00						
olddft	0.05	0.04	0.02	0.03	0.06	0.04	-0.001	-0.005	1.00					
deed	0.06	0.02	-0.02	0.12	-0.007	-0.02	-0.40	0.12	0.09	1.00				
totaol	0.05	0.03	-0.02	0.21	0.04	0.18	0.02	0.07	-0.006	-0.002	1.00			
dbnk	0.07	0.07	0.08	-0.03	0.11	0.02	0.28	0.01	-0.10	-0.25	0.008	1.00		
depen	-0.08	0.04	0.11	-0.07	0.03	0.22	0.18	-0.05	-0.07	-0.24	0.05	0.11	1.00	
tfarm	-0.07	0.03	0.03	0.12	-0.07	0.10	0.05	-0.07	-0.03	0.005	0.29	0.016	0.050	1.00

Note: Output of Stata 14.2. Refer to the Table 3.3: Description of Variables for Determining Factors Affecting Credit Constraint for elaboration of the names of the variables.

Table 7.2: Correlation Matrix (Access to Credit Model)

	age	gen	edu	exp	hhsz	hhl	kcard	naginco	sav	aginco	totaol	pfarm	paccs	bnkacc
age	1.00													
gen	0.24	1.00												
edu	-0.36	-0.09	1.00											
exp	0.76	0.24	-0.42	1.00										
hhsz	0.18	0.10	-0.03	0.23	1.00									
hhl	0.05	-0.08	0.05	0.10	0.44	1.00								
kcard	-0.01	-0.10	0.17	-0.04	-0.06	0.09	1.00							
naginco	0.10	-0.01	0.14	0.04	0.21	0.11	0.06	1.00						
sav	-0.02	-0.05	0.20	-0.03	0.04	0.11	0.14	0.68	1.00					
aginco	-0.04	0.006	0.15	-0.01	0.18	0.17	0.13	0.23	0.80	1.00				
totaol	0.05	0.03	0.21	0.04	0.18	0.09	0.06	0.19	0.37	0.47	1.00			
pfarm	-0.08	0.01	0.07	-0.11	0.07	0.01	0.10	0.04	0.14	0.23	0.16	1.00		
paccs	-0.02	-0.07	0.10	-0.001	0.10	0.14	0.32	0.10	0.11	0.09	-0.01	0.08	1.00	
bnkacc	0.03	-0.02	0.15	-0.008	0.04	0.05	0.23	0.11	0.12	0.13	0.09	0.18	0.19	1.00

Note: Output of Stata 14.2. Refer to the Table 3.4: Description of Variables for Determining Factors Affecting Access to Credit for elaboration of the names of the variables.

Table 7.3: Correlation Matrix (Credit Fungibility Model)

	gen	edu	chro	bltyp	delay	olddbt	nonfix	bnkmon	hhsz	totaol	adequ
gen	1.00										
edu	-0.12	1.00									
chro	0.01	-0.17	1.00								
bltyp	0.44	-0.34	0.22	1.00							
delay	0.04	-0.10	0.28	0.20	1.00						
olddbt	-0.03	-0.17	0.13	0.22	0.11	1.00					
nonfix	-0.04	0.07	-0.38	-0.05	-0.22	-0.24	1.00				
bnkmon	-0.10	-0.02	-0.13	-0.21	-0.12	-0.35	0.19	1.00			
hhsz	0.23	-0.22	0.20	0.42	0.09	0.07	0.10	-0.07	1.00		
totaol	0.21	-0.10	0.02	0.39	0.21	0.08	0.30	-0.03	0.28	1.00	
adequ	-0.12	0.07	-0.08	-0.02	0.06	0.07	0.02	-0.24	0.03	0.05	1.00

Note: Output of Stata 14.2. Refer to the 3.5: Description of Variables for Determining Factors Affecting Credit Fungibility for elaboration of the names of the variables.

Q. No.

Appendix-B

Survey Questionnaire (English Version)

This questionnaire has been prepared for the study entitled "Agricultural Credit and Its Impact on Agricultural Productivity: A Study on Rural Areas of Dhaka." All the information received with this will be kept secret and will not be used for other purposes except this study.

Farmer's Name:		Farmer's Mobile No:	
Union:		Upazila:	☐ Keraniganj [1] ☐ Nawabganj [2] ☐ Dhamrai [3] ☐ Savar [4] ☐ Dohar [5]
Signature:		Date of Data Collection:	

1. Farmer and Household Related Information

1. Age: ……Years, ☐ 18 or below [1] ☐ 19–35[2] ☐ 36–50[3] ☐ 51–64[4] ☐ 65 or above [5]

2. Educational Qualifications: ……Years, ☐Illiterate [1] ☐Primary [2] ☐Secondary [3] ☐Higher Secondary [4] ☐Degree or above [5]

3. Farming Experience: …Years, ☐0-10[1] ☐11-20[2] ☐21-30[3] ☐31-40[4] ☐40 or above [5]

4.Gender: ☐Male [1] ☐Female [0]

5. Marital Status: ☐ Married [1] ☐ Unmarried [0]

6. Household Size: …… Persons, ☐1-3[1] ☐4-6[2] ☐7-9[3] ☐10 or above [4]

7. Among Household Members,0-14 Age: ……, 15-64 Age: …..., 65 & Above Age: ……

8. Nature of Farming: ☐ Commercial [1] ☐ Subsistence [0]

9. Occupation: ☐Agriculture Only [1] ☐ Agriculture and Others [0]

10. Do You have Krishi Card? ☐ Yes [1] ☐ No [0]

11. Did You Obtained Any Kind of Agricultural Training? ☐ Yes [1] ☐ No [0]

12. Are You a Member of Any Co-Operatives Society? ☐ Yes [1] ☐ No [0]

13. Do You Have Access to /Satellite TV/Smart Phone/Internet? ☐ Yes [1] ☐ No [0]

14. No. of Family Labor Deployed Full Time in Agricultural Works: ……... No.

15. Health Status of the Farmer: ☐ Good Health [1] ☐ Not in Good Health [0]

16. No. of Family Members Suffered from Chronic Diseases: ……..... No.

17. Do You or Your Family Members Have Any Political Connection? ☐ Yes [1] ☐ No [0]

*** Question No. 17 is applicable in case of receiving banks' agricultural credit

2. Banks' Agricultural Credit Related Information

18. Do You Applied for Banks' Agricultural Credit? ☐ Yes [1] ☐ No [0]

(If the answer is no, moved to question no. 20)

19. If Yes, Whether Received the Total Amount Applied For?
☐ Yes (Unconstraint) [1] ☐ No (Quantity Constraint) [0]

(If the answer is yes then moved to question no. 23, if no moved to question no. 21)

20. Reasons Behind Not Applied for the Loan:
☐ No Need/Have Sufficient Fund [1] (Unconstraint)
☐ High-Interest Rate [2] (Price Constraint)
☐ Bribes, Brokers and Lobbying [3]
☐ Frequent Travel to Bank [4]
☐ Huge Paper Work Involved [5]
☐ Complex Application Procedure [6]
☐ Long Processing Time [7]
☐ Not Having Sufficient Security [8]
☐ Don't Know Where and How to Apply [9]
{(3-9) Transaction Cost Constraint}
☐ Don't Like to be Indebted [10]
☐ Believe Would be Rejected [11]
☐ Fear of Non-Payment [12]
☐ Fear of Losing Collateral [13]
☐ Fear of about Legal Issues [14]
{(10-14) Risk Constraint}
☐ Others…….[15]

21. Reasons Behind Not Getting Sufficient Loan:
☐ Required Documents Incomplete [1]
☐ Did Not Pursue, Lobbing [2]
☐ Did Not Give Bribe [3]
☐ Did Not Have Political Connection [4]
☐ Lack of Collateral [5]
☐ Failed to Convince Bank Officials [6]
☐ Contact No Broker [7]
☐ Lack of Interest of Bank [8]
☐ Others: ……. [9]

22. Constraint Category:
☐ Unconstraint [1]
☐ Quantity Constraint [2]
☐ Price Constraint [3]
☐ Transaction Cost Constraint [4]
☐ Risk Constraint [5]
☐ Others: …… [6]

23. Amount, Source, Interest Rate, Uses and Tenure of Received Banks' Agricultural Credit:

Sector	Amount ('000)	Source	Interest Rate	Amount Used in Agriculture ('000)	Amount Used in Non-Agriculture ('000)	Short Term ('000)	Long and Mid Term ('000)
Bank							
Semi-Formal							
Non-Institutional							
Total							

Sources of Agricultural Credit: ☐ Only Bank [1] ☐ Only Non-Bank [2] ☐ Both Bank and Non-Bank [3]

*** If question 18 is answered as No then moved to questions 38-58

*** If question 18 is answered as Yes then all questions are applicable

24. Amount Spent on Loan Processing (Application Fees, Dee Etc.):…….Tk.(‘000)

25. Amount Spent on Lobbying, Bribe, Broker for Loan Processing: …… Tk. (‘000)

26. Does the Bank Takes Any Collateral for Loan Sanction? ☐ Yes [1] ☐ No [0]

27. After How Many Days of Application Loan Was Received? ……...Days

28. Demanded Bank’s Agricultural Credit: …… Tk. (‘000)

29. Received Bank’s Agricultural Credit: ……Tk. (‘000)

30. Form of Received Credit: ☐ In Cash [1] ☐ In Kind [0]

31. Uses of Credit for Agricultural Purposes		32. Uses of Credit for Non-Agricultural Purposes	
Purpose	(‘000 Tk.)	Purpose	(‘000 Tk.)
☐ Input Expenditure [1]		☐ Living Expenditure [1]	
☐ Equipment and Machinery [2]		☐ Educational Expenses [2]	
☐ Land Preparation [3]		☐ Medical Expenditure [3]	
☐ Labor Cost [4]		☐ Repayment of Old Debt.[4]	
☐ Marketing & Transportation [5]		☐ Religious/Social Program [5]	
☐ Shed/Buildings [6]		☐ House Construction/Repair [6]	
☐ Others: …….……[7]		☐ Others: ……. [7]	
Total		Total	

33. Causes of Credit Diversion: ☐ Inadequacy of Credit [1] ☐ Delay in Disbursement[2] ☐ Concessional Interest Rate [3] ☐ Lack of Access to Personal Loans [4] ☐ Lack of Awareness [5] ☐ Low Income [6] ☐ Others: …… [7]

34. Did You Get Any Agricultural Bank Loan Before? ☐ Yes [1] ☐ No [0]

35. Did You Defaulted Bank’s Agricultural Loan in Past? ☐ Yes [1] ☐ No [0]

36. Do You Have Any Default of Bank’s Agricultural Loan at Present? ☐ Yes [1] ☐ No [0]

37. If So. Reasons For Default: ☐ Damage of Crops [1] ☐ Low Prices of Crops [2] ☐Interest Exemption Expected [3] ☐ Counsel of Influential Local People [4] ☐High Expenditure of Household [5] ☐Medical Emergency [6] ☐Other:…….…….……..[7]

38. Problems of Bank’s Agricultural Credit: ☐Genuine Needy Farmers do not Get Loan[1] ☐Problematic Repayment Schedule [2] ☐Lack of Cooperation by Bank Official [3] ☐ Complex Application Procedures [4] ☐ Delay in Loan Disbursement [5] ☐High Int. [6] ☐Insufficient Loan[7] ☐ Bribe [8] ☐ Broker [9] ☐ Lobbying [10] ☐ Lengthy Procedure[11] ☐Don’t Know [12] ☐Other:…….…… [13]

39. Do You Think Taking Bank’s Agricultural Credit Is Risky? ☐ Yes [1] ☐ No [0]

40. Do You Had Any Old Debt. from Any Source Other Than Bank? ☐ Yes [1] ☐ No [0]

*** Question No. 40 is applicable in case of receiving banks’ agricultural credit

3. Financial and Farm Related Information

41. Have Your Overall Production Increased Compared to the Previous Year? ☐ Yes [1] ☐ No [0]

42. Total Owned Cultivated Land: …… Pakhi/ Bigha/ Kani/ @ ……., Total …… Decimal

43. Total Leased/Rented/ Cultivated Land: …… Pakhi/ Bigha/ Kani/ @ ……, Total …… Decimal

44. Market Value of Total Produce (Sold and Consumed) During the Year: …… Tk (‘000)

45. Total Agricultural Production Cost (Inputs Variable) During the Year:……Tk (‘000)

46. How Much Agricultural Subsidy Have You Received During the Year? …… Tk (‘000)

47. Annual Household Income from Non-Agricultural Activities: …… Tk (‘000)

48. Monthly Livelihood Expenses of Household: …… Tk (‘000) @12=…….. Per Year

49. Total Investment in Equipment, Machinery and Planting Materials: …… Tk. (‘000)

50. Hired Workers: ……..No. @……Days@……Taka, [Total ……No., ……Taka Yearly (‘000)]

51. Total Area of Owned Homestay: ……. Decimal

52. Do You Have Deed/Mutation/Documents of Your Land’s Ownership? ☐ Yes [1] ☐ No [0]

53. Household’s Total Non-Fixed Assets: ……. Tk. (‘000)

*** Question No. 53 is applicable in case of receiving banks’ agricultural credit

54. Have You Ever Opened an Account at the Bank?☐ Yes [1] ☐ No [0]

55. Have You Ever Taken Agricultural Insurance (Crop Insurance)? ☐ Yes [1] ☐ No [0]

4. Institutional and Other Information

56. Distance to the Nearest Bank from Your Home: …… Km

57. Distance to the Nearest Agricultural Market from Your Home: …… Km

58. Does the Government Agricultural Officials Visit Your Farm Regularly? ☐ Yes [1] ☐ No [0]

59. After Disbursement of Loan, Did the Bank Officials Monitor the Loan?☐ Yes [1] ☐ No [0]

*** Question No. 59 is applicable in case of receiving banks’ agricultural credit

Appendix-C: Survey Questionnaire (Bangla Version)

প্রশ্নমালা নংঃ

পরিশিষ্ট-ক

জরিপ প্রশ্নমালা (বাংলা সংস্করণ)

এই প্রশ্নমালাটি "কৃষি ঋণ এবং কৃষি উৎপাদনশীলতার উপর এর প্রভাবঃ ঢাকার গ্রামীণ এলাকার একটি অধ্যয়ন" শীর্ষক গবেষণার জন্য প্রস্তুত করা হয়েছে। এর সাথে প্রাপ্ত সমস্ত তথ্য-উপাত্ত গোপন রাখা হবে এবং এই গবেষণা ব্যতীত অন্য কোন উদ্দেশ্যে ব্যবহার করা হবে না।

কৃষকের নামঃ		কৃষকের মোবাইল নাম্বারঃ	
ইউনিয়নঃ		উপজেলাঃ	☐কেরানীগঞ্জ[১] ☐নবাবগঞ্জ[২] ☐ধামরাই[৩] ☐সাভার [৪] ☐দোহার [৫]
তথ্য সংগ্রহকারীর স্বাক্ষরঃ		তথ্য সংগ্রহের তারিখঃ	

১. কৃষক এবং তার পরিবার সংশ্লিষ্ট তথ্য

১. **আপনার বয়সঃ** ……বছর, ☐১৮ বা তার নিচে[১] ☐১৯-৩৫[২] ☐৩৬-৫০[৩] ☐৫১-৬৪[৪] ৬৫ বা তার উর্ধ্বে [৫]

২. **আপনি কতদূর পড়াশোনা করেছেন?** …… বছর, ☐নিরক্ষর [১] ☐প্রাথমিক[২] ☐মাধ্যমিক[৩] ☐উচ্চ মাধ্যমিক [৪] ☐ডিগ্রি বা তদুর্ধ্ব[৫]

৩. **আপনার কৃষিকাজের অভিজ্ঞতাঃ**…… বছর, ☐০-১০[১] ☐১১-২০[২] ☐২১-৩০[৩] ☐৩১-৪০[৪] ৪০ বা তার উর্ধ্বে [৫]

৪. **লিঙ্গঃ** ☐পুরুষ [১] ☐মহিলা [০]

৫. **বৈবাহিক অবস্থাঃ** ☐ বিবাহিত [১] ☐ অবিবাহিত [০]

৬. **আপনার পরিবারে এক রান্না ঘরের খাওয়া কত জন খান?** …… জন ☐১-৩[১] ☐৪-৬[২] ☐৭-৯[৩] ☐১০ বা তদুর্ধ [৪]

৭. **পরিবারে সদস্যদের মধ্যে, ০-১৪ বছরঃ** …… জন, ১৫-৬৪ বছরঃ…… জন, ৬৫ বা তার উর্ধ্বেঃ …… জন

৮. **আপনি কৃষিকাজ করেন কেনো?** ☐ ব্যবসায়িক কারনে [১] ☐ নিজের জীবিকার জন্য [০]

৯. **আপনি কী শুধুমাত্র কৃষিকাজ করেন? না পাশাপাশি অন্যান্য কাজও করেন?** ☐শুধুমাত্র কৃষিকাজ [১] ☐কৃষিকাজ ও অন্যান্য [০]

১০. **আপনার কি কৃষি কার্ড আছে?** ☐হ্যাঁ [১] ☐ না [০]

১১. **আপনি কি কোন ধরণের কৃষি প্রশিক্ষণ পেয়েছেন?** ☐ হ্যাঁ [১] ☐ না [০]

১২. **আপনি কি কোনো সমবায় সমিতির সদস্য?** ☐ হ্যাঁ [১] ☐ না [০]

১৩. **আপনি স্যাটেলাইট টিভি/ স্মার্ট ফোন / ইন্টারনেট ব্যবহার করেন কী?** ☐ হ্যাঁ [১] ☐ না [০]

১৪. **আপনি সহ আপনার পরিবারের কতজন নিয়মিত কৃষিকাজে শ্রম দেয়?** …… জন

১৫. **আপনার শরীর-স্বাস্থ্যর অবস্থা ভালো আছে তো?** ☐ শরীর-স্বাস্থ্য ভালো [১] ☐ ভালো না [০]

১৬. **আপনার পরিবারে দীর্ঘদিন ধরে রোগে আক্রান্ত সদস্যদের সংখ্যাঃ** …… জন

১৭. **আপনি বা আপানার পরিবারের সদস্যদের কেউ কী কোন রাজনৈতিক দলের সাথে যুক্ত আছেন ?** ☐ হ্যাঁ [১] ☐ না [০]

পৃষ্ঠা-১/৪

২. ব্যাংক কৃষি ঋণ সংক্রান্ত তথ্য

১৮. আপনি কি ব্যাংকের কৃষি ঋণের জন্য কখনো আবেদন করেছেন? ☐ হ্যাঁ [১] ☐ না [০] (উত্তর না হলে ২০ নং প্রশ্নে সরাসরি)

১৯. যদি করে থাকেন, তাহলে চাহিদাকৃত ঋণ এর টাকা পুরোটা পেয়েছেন কী ?

☐ হ্যাঁ (ঋণ সীমাবদ্ধ নয়) [১] ☐ না (পরিমাণগত ঋণ সীমাবদ্ধ) [০] (উত্তর হ্যাঁ হলে ২৩ নং প্রশ্নে সরাসরি, না হলে ২১ নং প্রশ্নে সরাসরি)

২০. আপনার ব্যাংক কৃষি ঋণের জন্য আবেদন না করার মূল কারণ কী?

☐প্রয়োজন নেই/ নিজের যথেষ্ট অর্থ আছে [১] (ঋণ সীমাবদ্ধ নয়)
☐কৃষি ঋণের সুদের হার বেশী [২] (মূল্যজনিত ঋণ সীমাবদ্ধতা)
☐ঘুষ, দালাল, তদবির বাবদ অনেক টাকা দিতে হয় [৩]
☐ব্যাংক কৃষি ঋণের জন্য অনেক ছুটাছুটি, যাতায়াত করতে হয় [৪]
☐অনেক কাগজপত্র দলিল জমা দিতে হয় [৫]
☐ব্যাংক কৃষি ঋণের আবেদন প্রক্রিয়া ঝামেলাপূর্ণ মনে হয় [৬]
☐ব্যাংক কৃষি ঋণ পাশ হতে অনেক সময় নেয় [৭]
☐ব্যাংক কৃষি ঋণের জন্য প্রয়োজনীয় জামানত নেই [৮]
☐কোথায় এবং কিভাবে আবেদন করতে হয় জানা নেই [৯]
{(৩-৯)- লেনদেন খরচজনিত ঋণ সীমাবদ্ধতা}
☐ঋণী হতে চাই না [১০]
☐ঋণ প্রত্যাখ্যান করা হবে বলে মনে করি [১১]
☐ঋণ পরিশোধ করতে পারবো না বলে মনে করি [১২]
☐জামানত হারানোর ভয় কাজ করে [১৩]
☐আইনগত জটিলতায় পড়ার ভয় কাজ করে [১৪]
{(১০-১৪)- ঝুঁকিজনিত ঋণ সীমাবদ্ধতা}
☐অন্যান্যঃ ..... [১৫]

২১. পর্যপ্ত কৃষি ঋণ না পাওয়ার পেছনের মূল কারণ কী বলে মনে করেন

☐ ব্যাংক কর্মকর্তাদের ঋণ প্রদানে আন্তরিকতার অভাব ছিলো [১]
☐ ব্যাংক কর্মকর্তাদের ঋণের প্রয়োজনীয়তা বুঝাতে ব্যর্থ হয়েছি [২]
☐ প্রয়োজনীয় কাগজপত্র ছিলো না [৩]
☐ প্রয়োজনীয় জামানতের ছিলো না [৪]
☐ ব্যাংক কর্মকর্তাদের পর্যপ্ত ঘুষ দেইনি [৫]
☐ দালাল ধরি নাই [৬]
☐ রাজনৈতিক প্রভাব ছিলো না [৭]
☐ তদবির করি নাই [৮]
☐অন্যান্যঃ ..... [৯]

২২. ঋণ সীমাবদ্ধতার শ্রেণীবিভাগ

☐ঋণ সীমাবদ্ধ নয় [১]
☐পরিমাণগত ঋণ সীমাবদ্ধতা [২]
☐মূল্যজনিত ঋণ সীমাবদ্ধতা [৩]
☐লেনদেন খরচজনিত ঋণ সীমাবদ্ধতা [৪]
☐ঝুঁকিজনিত ঋণ সীমাবদ্ধতা [৫]
☐অন্যান্যঃ ..... [৬]

২৩. প্রাপ্ত ব্যাংক কৃষি ঋণের পরিমাণ, উৎস, সুদের হার, ব্যবহার এবং মেয়াদঃ

(ক) কৃষি ঋণের খাত	(খ) প্রাপ্ত কৃষি ঋণের পরিমাণ ('০০০ টাকা)	(গ) কৃষি ঋণের উৎস	(ঘ)কৃষি ঋণের সুদের হার	(ঙ) কৃষিখাতে ব্যবহৃত কৃষি ঋণের পরিমাণ ('০০০ টাকা)	(চ)অ-কৃষিখাতে ব্যবহৃত কৃষি ঋণের পরিমাণ ('০০০ টাকা)	(ছ)স্বল্পমেয়াদী (১৮ মাস পর্যন্ত) ঋণের পরিমাণ ('০০০ টাকা)	(জ) দীর্ঘ এবং মধ্যম মেয়াদী (১৮ মাস এর উর্ধ্বে) ঋণের পরিমাণ ('০০০ টাকা)
ব্যাংক							
সেমি-ফরমাল							
অ-প্রাতিষ্ঠানিক							
সর্বমোট							

সামগ্রিক কৃষি ঋণের উৎসঃ ☐শুধুমাত্র ব্যাংক ঋণ [১] ☐ শুধুমাত্র অ-ব্যাংক ঋণ [২] ☐ ব্যাংক ও অ-ব্যাংক ঋণ উভয়ই [৩]

***** ১৮ নং প্রশ্নের উত্তর না হলে ৩৮ নং প্রশ্নে সরাসরি এবং পরবর্তীতে (৩৮-৫৮) সকল প্রশ্ন প্রযোজ্য**
***** ১৮ নং প্রশ্নের উত্তর হ্যাঁ হলে সকল প্রশ্ন প্রযোজ্য (যারা ঋণের কোনো টাকাই পাননি তাদের শুধু ৩০-৩৩ প্রযোজ্য নয়)**

২৪. ব্যাংক কৃষি ঋণ প্রক্রিয়াকরণ বাবদ (আবেদন ফি, কাগজপত্র, যাতায়াত, দলিল ইত্যাদি) খরচের পরিমাণঃ .....টাকা। ('০০০)

২৫. ব্যাংক কৃষি ঋণের জন্য (ঘুষ, দালাল, তদবির ইত্যাদি) বাবদ খরচের পরিমাণঃ .....টাকা। ('০০০)

২৬. কৃষি ঋণের জন্য ব্যাংক কী কোন জামানত নিয়েছিলোঃ ☐ হ্যাঁ [১] ☐ না [০]

২৭. আবেদনের কত দিন পর ব্যাংক কৃষি ঋণের টাকা পাওয়া গিয়েছিলো? .....দিন

২৮. চাহিদাকৃত ব্যাংক কৃষি ঋণের পরিমাণঃ ..... টাকা। ('০০০)

২৯. প্রাপ্ত ব্যাংক কৃষি ঋণের পরিমাণঃ ..... টাকা। ('০০০)

৩০. আপনি ব্যাংক কৃষিঋণ পেয়েছেনঃ ☐ নগদে [১] ☐ উপকরণে [০]

৩১. ব্যাংক কৃষি ঋণের ব্যবহার কৃষি কাজের জন্যঃ

খাত	('০০০ টাকা)
☐কৃষি উপকরণ খরচ [১] (সার, বীজ, সেচ ইত্যাদি)	
☐কৃষি যন্ত্রপাতি ও সরঞ্জাম [২]	
☐জমি সংক্রান্ত খরচ [৩] (নিড়ানী, পত্তন, ইত্যাদি)	
☐শ্রমিকের মজুরী [৪]	
☐বাজারজাতকরণ, পরিবহন, প্যাকিং [৫]	
☐ছাউনি/ গোলাঘর নির্মান [৬]	
☐অন্যান্য [৭]	
সর্বমোট	

৩২.ব্যাংক কৃষি ঋণের ব্যবহার অ-কৃষি কাজের জন্যঃ

খাত	('০০০ টাকা)
☐জীবনযাত্রার ব্যয় নির্বাহ [১] (খাদ্য, বস্ত্র)	
☐ছেলেমেয়েদের পড়াশোনার খরচ [২]	
☐পরিবারের চিকিৎসা ব্যয় [৩]	
☐পুরাতন ঋণ পরিশোধ [৪]	
☐ধর্মীয়/সামাজিক অনুষ্ঠানে ব্যয় [৫]	
☐বসতবাড়ি নির্মাণ/মেরামত [৬]	
☐অন্যান্য [৭]	
সর্বমোট	

৩৩. ব্যাংক এর কৃষি ঋণ অ-কৃষি কাজে ব্যবহারের কারণঃ ☐ঋণের স্বল্পতা [১] ☐ ঋণ বিতরণে বিলম্ব [২] ☐ সুদের হার কম [৩] ☐ ব্যক্তিগত ব্যাংক ঋণ না পাওয়া [৪] ☐ সচেতনতার অভাব [৫] ☐ কৃষি কাজ থেকে অপর্যাপ্ত আয় [৬] ☐ অন্যান্যঃ..... [৭]

৩৪. আপনি এবারের ব্যাংক কৃষি ঋণ পাওয়ার আগে কখনো কোন ব্যাংক কৃষি ঋণ পেয়েছিলেন কী? ☐ হ্যাঁ [১] ☐ না [০]

৩৫. আপনি কি আগে কখনো ব্যাংকের কৃষিঋণ খেলাপি হয়েছিলেন? ☐ হ্যাঁ [১] ☐ না [০]

৩৬.বর্তমানে আপনার কি ব্যাংকের কোনো কৃষিঋণ খেলাপি হয়েছে? ☐ হ্যাঁ [১] ☐ না [০]

৩৭. খেলাপির কারণঃ ☐ ফসলের ক্ষতি [১] ☐ ফসলের দাম কম পাওয়া [২] ☐ সুদের টাকায় ছাড় প্রত্যাশা করা [৩] ☐প্রভাবশালী লোকজনের কুপরামর্শে [৪] ☐ পরিবার নির্বাহের উচ্চব্যয়ের ফলে [৫] ☐ জরুরি চিকিৎসা ব্যয় নির্বাহের ফলে [৬] ☐ অন্যান্যঃ..... [৭]

৩৮. ব্যাংক কৃষিঋণের মূল সমস্যা কীঃ ☐ প্রকৃত অভাবী কৃষকরা ঋণ পান না [১] ☐ঋণপরিশোধের সময়সূচী সমস্যাযুক্ত [২] ☐ব্যাংক কর্মকর্তাদের অসহযোগিতা [৩] ☐আবেদন প্রক্রিয়া জটিল ও ঝামেলাপূর্ণ [৪] ☐ঋণ প্রাপ্তিতে বিলম্ব [৫] ☐উচ্চ সুদের হার [৬] ☐ অপর্যাপ্ত ঋণ প্রদান [৭] ☐ ঘুষ [৮] ☐ দালাল [৯] ☐ তদবির [১০] ☐ সময়সাপেক্ষ [১১] ☐বলতে পারছি না [১২] ☐ অন্যান্যঃ..... [১৩]

৩৯. আপনি কি মনে করেন যে ব্যাংক কৃষিঋণ নেওয়া ঝুঁকিপূর্ণ? ☐ হ্যাঁ [১] ☐ না [০]

৪০. আপনার কি ব্যাংক ছাড়া অন্য কোন উৎস থেকে নেয়া আগের কোনো ঋণ এখনো বকেয়া আছে? ☐ হ্যাঁ [১] ☐ না [০]

*** কৃষিঋণ প্রাপ্ত হলে প্রযোজ্য

৩. আর্থিক এবং কৃষিখামার সম্পর্কিত তথ্য

৪১. আগের বছরের তুলনায় আপনার সামগ্রিক ফলন বৃদ্ধি পেয়েছে কী? ☐ হ্যাঁ [১] ☐ না [০]

৪২. আপনার মালিকানাধীন চাষাবাদকৃত মোট কৃষি জমির পরিমানঃ ..... পাখি/বিঘা/কানি/ @ ..... শতাংশ, মোট ..... শতাংশ

৪৩. পত্তন/বর্গা/রেহান বাবদ চাষাবাদকৃত মোট কৃষি জমির পরিমানঃ ..... পাখি/বিঘা/কানি/ @ ..... শতাংশ, মোট ..... শতাংশ

৪৪. সারা বছরে মোট উৎপাদিত (বিক্রিত ও ভোগ করা) কৃষি পণ্যের বাজার মূল্যঃ..... টাকা ('০০০)

৪৫. সারা বছরে মোট কৃষি উৎপাদন (সার, বীজ, সেচ, কীটনাশক, শ্রমিক, পত্তন ইত্যাদি) খরচঃ..... টাকা ('০০০)

৪৬. বিগত বছরে কত টাকার কৃষি ভর্তুকি (বিনামূল্যে সার, বীজ, কীটনাশক, যন্ত্রপাতি ক্রয়ে রেয়াত) পেয়েছেন? ..... টাকা ('০০০)

৪৭. বিগত বছরে আপনার অ-কৃষি খাত (জমির ব্যবসা, দোকানদারি/ভাড়া, সন্তান/ স্ত্রীর আয়) থেকে পারিবারিক আয়ঃ ..... টাকা ('০০০)

৪৮. পরিবারের মাসের জীবিকা নির্বাহের (খাদ্য,বস্ত্র, চিকিৎসা, শিক্ষা, গ্যাস, বিদ্যুত ইত্যাদি) খরচঃ ..... টাকাX১২=..... বছরে ('০০০)

৪৯. কৃষি সরঞ্জাম ও যন্ত্রপাতি (মই, স্প্রে মেশিন, পানির পাম্প, কোদাল, নিড়ানী, পাওয়ার টিলার) ইত্যাদি আছে? ..... টাকা ('০০০)

৫০. নিয়োজিত ভাড়া করা শ্রমিকের সংখ্যাঃ .....জন X.....দিন X.....টাকা প্রতিদিন, [মোট .....জন, ... টাকা বছরে ('০০০)]

৫১. আপনার মালিকানাধীন বসত-ভিটার জমির পরিমানঃ ..... শতাংশ

৫২. আপনার মালিকানাধীন জমিজমার কী খাজনা, খাতিয়ান, দলিলপত্র সব ঠিক আছে? ☐ হ্যাঁ [১] ☐ না [০]

৫৩. আপনার পরিবারের মোট অস্থায়ী সম্পদের (আসবাবপত্র, ফ্রীজ, টিভি, গয়নাপাতি ইত্যাদি) পরিমানঃ ..... টাকা ('০০০)

*** ৫৩ নং প্রশ্ন কৃষিঋণ প্রাপ্ত হলে প্রযোজ্য

৫৪. আপনার কি কখনো ব্যাংক এ কোন হিসাব খুলেছিলেন? ☐ হ্যাঁ [১] ☐ না [০]

৫৫. আপনি কি কখনো কৃষি বীমা (শস্যবীমা) করিয়েছিলেন বা এই সুবিধা পেয়েছিলেন? ☐ হ্যাঁ [১] ☐ না [০]

৪. প্রাতিষ্ঠানিক এবং অন্যান্য তথ্য

৫৬. আপনার বাড়ি থেকে সবচেয়ে কাছের ব্যাংকের দূরত্বঃ.....কিলোমিটার

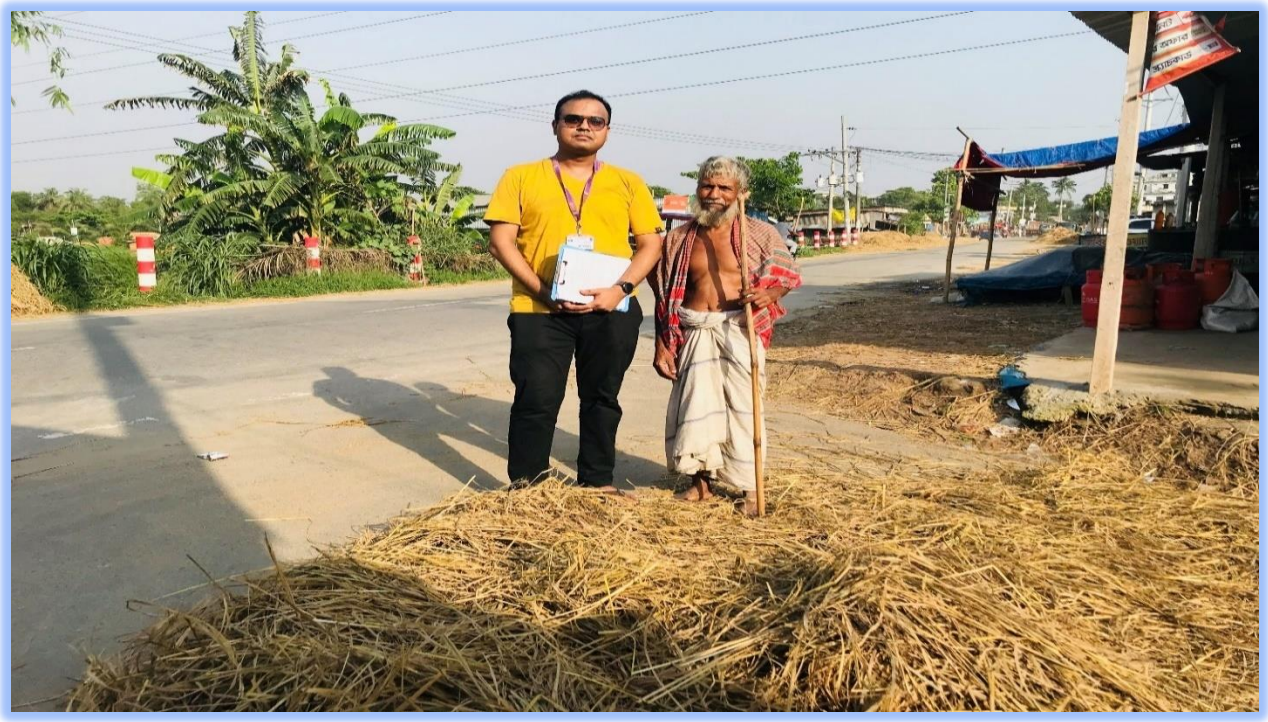
৫৭. আপনার বাড়ি থেকে সবচেয়ে কাছের আপনার কৃষি পণ্য বিক্রির বাজার/আড়তের দূরত্বঃ ..... কিলোমিটার

৫৮.সরকারি কৃষি কর্মকর্তারা কি নিয়মিত কৃষিকাজ সরেজমিনে মাঠপর্যায়ে পরিদর্শন করেন? ☐ হ্যাঁ [১] ☐ না [০]

৫৯. ঋণ বিতরণের পর ব্যাংক কর্মকর্তারা কি নিয়মিত ঋণ তদারকি (চিঠী/ ফোন দেয়া, পরিদর্শন) করেন? ☐ হ্যাঁ [১] ☐ না [০]

*** ৫৯ নং প্রশ্ন ব্যাংক কৃষি ঋণ প্রাপ্ত হলে প্রযোজ্য

Appendix-D: Data Collection Pictures



Picture taken at Sharifbagh Village, Dhamrai Sadar Union, Dhamrai.

Picture taken at Katakhali Village, Sombhag Union, Dhamrai.

Picture taken at Kandamatra Village, Barrha Union, Nawabgonj.

Picture taken at Chondrokhola Village, Jantrail Union, Nawabgonj.

Picture taken at Bilashpur Village, Bilashpur Union, Dohar.

Picture taken at Moddho Dhoyair Village, Nayabari Union, Dohar.

Picture taken at Chakulia Village, Bongaon Union, Savar.

Picture taken at Daspara Village, Shimulia Union, Savar.

Picture taken at Asamdipur Village, Kalatia Union, Keranigonj.

Picture taken at Alukanda Village, Konda Union, Keranigonj.