Economic Evaluation of Agricultural Technology Management Agency in Golaghat District of Assam

A Dissertation Submitted

To

Sikkim University

In Partial Fulfillment of the Requirement for the Degree of

Master of Philosophy

Submitted by
Christopher Tirkey

Department of Economics

School of Social Sciences

Sikkim University

July 2021

, सामदुर, तादोंग -737102
, सिक्किम, भारत
592-251212, 251415, 251656
स -251067
ट - www.cus.ac.in

6th Mile, Samdur,Tadong -737102
Gangtok, Sikkim, India
Ph. 03592-251212, 251415, 251656
Telefax: 251067
Website: www.cus.ac.in

सिक्किम विश्वविद्यालय
SIKKIM UNIVERSITY

(भारत के संसद के अधिनियम द्वारा वर्ष 2007 में स्थापित और नैक (एनएएसी) द्वारा वर्ष 2015 में प्रत्यायित केंद्रीय विश्वविद्यालय)
(A central university established by an Act of Parliament of India in 2007 and accredited by NAAC in 2015)

DECLARATION

I, **Christopher Tirkey**, hereby declare that the research work embodied in this dissertation titled, **"Economic Evaluation of Agricultural Technology Management Agency in Golaghat District of Assam"** submitted to Sikkim University for the award degree of Masters of Philosophy, is my original work and it has not been submitted earlier to this or any other University for any degree

Tirkey

Christopher Tirkey

Registration No.: 19/M.Phil/ECO/01
Department of Economics
School of Social Sciences
Date: 27th July, 2021
Place: Gangtok

सामदुर, तादोंग -737102
सिक्किम, भारत
592-251212, 251415, 251656
-251067
- www.cus.ac.in

6th Mile, Samdur,Tadong -737102
Gangtok, Sikkim, India
Ph. 03592-251212, 251415, 251656
Telefax: 251067
Website: www.cus.ac.in

सिक्किम विश्वविद्यालय
SIKKIM UNIVERSITY

(भारत के संसद के अधिनियम द्वारा वर्ष 2007 में स्थापित और नैक (एनएएसी) द्वारा वर्ष 2015 में प्रत्यायित केंद्रीय विश्वविद्यालय)
(A central university established by an Act of Parliament of India in 2007 and accredited by NAAC in 2015)

CERTIFICATE

This is to certify that the Dissertation entitled, **"Economic Evaluation of Agricultural Technology Management Agency in Golaghat District of Assam"** submitted to Sikkim University for partial fulfillment of the degree of **Masters of Philosophy** in the **Department of Economics** embodies the result of bonafide research work carried out by **Mr. Christopher Tirkey**, under my guidance and supervision. No part of this dissertation has been submitted earlier to this or any other University for any degree.

All the assistance received during the course of investigation has been duly acknowledged by him.

We recommend this dissertation to be placed before the examiners for evaluation.

23/7/2021

Supervisor: **Prof. Manesh Choubey**

Department of Economics
School of Social Sciences

HoD: **Dr. Rajesh Raj S N**

Associate Professor
Department of Economics
School of Social Sciences

23/07/2021

Head
अर्थशास्त्र विभाग
Department of Economics
सिक्किम विश्वविद्या
Sikkim Uni...

त, सामदुर, तादोंग -737102
, सिक्किम, भारत
3592-251212, 251415, 251656
स -251067
ट - www.cus.ac.in

6th Mile, Samdur,Tadong -737102
Gangtok, Sikkim, India
Ph. 03592-251212, 251415, 251656
Telefax: 251067
Website: www.cus.ac.in

सिक्किम विश्वविद्यालय
SIKKIM UNIVERSITY

(भारत के संसद के अधिनियम द्वारा वर्ष 2007 में स्थापित और नैक (एनएएसी) द्वारा वर्ष 2015 में प्रत्यायित केंद्रीय विश्वविद्यालय)
(A central university established by an Act of Parliament of India in 2007 and accredited by NAAC in 2015)

PLAGIARISM CHECK CERTIFICATE

This is to certify that plagiarism check has been carried out for the following M. Phil Dissertation with the help of URKUND SOFTWARE and the result is within the permissible limit as per the norms of Sikkim University (upto 10% tolerance rate) (10% tolerance rate)

Prof. Manesh Choubey
Department of Economics
Sikkim University
6th Mile, P.O: Tadong, 737102, Gangtok

"Economic Evaluation of Agricultural Technology Management Agency in Golaghat District of Assam"

Submitted by **Christopher Tirkey** under the supervision of **Prof. Manesh Choubey** of the Department of Economics, School of Social Sciences, Sikkim University,

Gangtok- 737102, India

Signature of the Candidate

Countersigned by Supervisor

Prof. Manesh Choubey
Department of Economics
Sikkim University
6th Mile, P.O: Tadong, 737102, Gangtok

Vetted by Librarian

पुस्तकालयाध्यक्ष
Librarian
केन्द्रीय पुस्तकालय Central Library
सिक्किम विश्वविद्यालय
Sikkim University

ACKNOWLEDGEMENT

At the very outset, I would like to thank my Supervisor Professor Manesh Choubey for his guidance in this work. I am grateful to him for bearing me and my mistakes with patience and for encouraging me throughout this work.

I convey my heartfelt gratitude to my teachers at the department of Economics, Sikkim University, and at the Department of Economics, Debraj Roy College, Golaghat who helped me shape my thoughts and knowledge. I am also grateful to Shri Krishna Ranjan Saikia (SDAO, Golghat) Mr. Tapan Barman (Deputy Project Director, ATMA, Golaghat), Mr Diganta (BTM, Morangi Block), Mr. Mausam Dutta (ATM, Podumoni Block), Dr. Foridur Rohman Bora (BTM, Kathalguri), Dr. Madhurjya Jyoti Bora (BTM, Gomariguri Block) and Mr. Bikha Timung (BTM, Kakodonga Block) at the Krishi Bhawan, Golaghat, Assam for providing me with the secondary data.

I am thankful to the Non-teaching Staff of the Department of Economics for helping me shape this work. Money does play a crucial role in any work. I extend my gratitidue to the UGC Non-Net Fellowship for providing me with Scholarship throughout the work. I would also like to thank Mr. Devojit Phukan (Associate Professor, Dept of Economics, D R College, Golaghat), Mr. Sanjay Saha (Assistant Professor, D R College, Golaghat), Mr. Probenson Terang (Assistant Professor, J B College, Jorhat), Mr. Nimesh Diyali (M.Phil Scholar, Dept of Economics, Sikkim University) for encouraging, motivating and supporting me financially. I am greatly indebted to Fr. Provincial (Salesian Province of Dimapur) for rendering financial support in this study.

I am immensely grateful to all the M. Phil and PhD. Scholars in the Dept of Economics who made themselves available whenever I needed them. Smriti Di, Praveen Da, Purna Hang Da, Pangzor Da and Bijay Chhetri had been of great help to me in this work. I would also like to thank my friends – Pinkimoni Bora, Anshumi Dutta, Himadree Saikia, Sumon Gogoi and Amos Ekka for their help in this work. I express my heartfelt gratitude to the Warden and all the hostellers of Dzongri Boys Hostel, Sikkim University for their support throughout this work. I also express my gratitude to my friends – Priyanka Tigga, Jyotish Ekka, Deonish Tirkey and Debasish Dev Nath and all my well-wishers for their support and encouragement.

Words are never enough to express my gratitude to my family members (Maa, Dada, Bhoji, Didi, Munmi) for being my constant support in all aspects. Without their support this work would not have been possible.

Christopher Tirkey

TABLE OF CONTENT

Chapter 4 : Socio-Economic Profile of The Farmers in the Study Area

Chapter 5 : Impact of Extension Services Provided by ATMA

Chapter 6 : Findings and Conclusion

List of Maps

List of Tables

List of Figures

ABBREVIATIONS

AACP	Assam Agricultural Competitiveness Project
AACP-AF	Assam Agricultural Competitiveness Project Additional Fund
AMC	ATMA Management Committee
ARIAS	Assam Rural Infrastructure and Agricultural Services Society
ATET	Average Effect of Treatment on the Treated
ATM	Assistant Technology Manager
ATMA	Agricultural Technology Management Agency
BAP	Block Action Plan
BFAC	Block Farmers Advisory Committee
BRC	Block Resource Centre
BTT	Block Technology Team
CIALCA	Consortium for Improving Agri-Based Livelihoods in Central Africa
CSS	Centrally Sponsored Scheme
DADS	District Agriculture Development Strategy
DFAC	District Farmers Advisory Committee
ICAR	Indian Council of Agricultural Research
FAC	Farm Advisory Committee
FFS	Farmer Field Schools
FIAC	Farm Information and Advisory Centres
FIGs	Farmer Interest Groups
GPU	Gram Panchayat Unit
MANAGE	National Institute of Agricultural Extension Management
NATP	National Agricultural Technology Project
NGO	Non-Government Organsations
NMAET	National Mission on Agricultural Extension and Technology
PSM	Propensity Score Matching
SREP	Strategic Research and Extension Plan
T&V	Training and Visit
USAID	United States Agency for International Development
VLEW	Village Level Extension Worker
WIGs	Women Interest Groups

Chapter 1

INTRODUCTION

1.1 Introduction

Agriculture extension services are the most logical, scientific, and systematic method of disseminating new knowledge and skill to farmers to successfully adopt innovations and make more efficient use of their land and allied resources (Melkote,1998). It aims to improve the farmers' skills and decision-making for the efficient utilisation of sophisticated agricultural technology. It helps spread information from local and global research leading to a rapid transfer of knowledge, increasing the farmers' managerial ability (Anderson and Feder, 2007). It improves farmers' decisions, enhances efficiency in production for more agricultural growth and higher income (Huffman 1978; Anderson and Feder 2004, 2007; Norton *et al.*2020). According to Swanson and Davis (2014), developing countries engage about 90% of the worlds extension workers, India being the second largest with 90,000 extension agents just after China who has committed more than 600,000 extension workers (Hu, Huang, and Chen 2012; Swanson and Davis 2014). With the shift in agriculture from the traditional method to the modern approach, agriculture extension has broadened its area of activity from its traditional role of technology and farm management information transfer by including new areas like the role of advisory service on marketing, risk management and environmental sustainability, and over time because of changes which occurred in the economic structure, innovations in agriculture, improvements in information and communication technology it has become more pluralistic depending on many delivery mechanisms and funding sources(Davis and Franzel 2018; Norton *et al.*2020). The changes in the extension

services followed a similar global trend and the Training and Visit System, in the decade of 1970s, became the primary public extension system in over 50 countries (Anderson *et al.* 2007; Reddy and Swanson 2006). The Training and Visit system's downfall led to a reform causing the in extension system towards a decentralized, pluralistic and demand-driven system (Rivera and Alex, 2005; Birner and Anderson, 2007).

The Indian Public Extension System has also undergone many changes since independence, focusing on community development and later shifting its attention towards food security in the mid 20th century. The combined effect of Green Revolution technologies in the late 1960s and the Training and Visit (T&V) system from the mid-1970s helped to bring about, in the country, food self-sufficiency during the 1980s and beyond (Ferrou and Zhou, 2011). But since independence, the extension system had only focused on Green Revolution technology and played a role in distributing subsidized technology without having any reasonable goal and paid little importance to farm income and crop diversification. Many other problems beleaguered the extension system and reform was brought into the extension system with the World Bank's support. Consequently, the Training and Visit System was introduced in Rajasthan in 1974 and was extended to other states in 1977 (Ameur,1994). Although the new extension system yielded impressive results, unrelenting fund requirements and employees' quality became a significant challenge in the system. To seek solutions to these challenges, the Indian Government, with aids from the World Bank, introduced to test a new extension model under the National Agricultural Technology Project (NATP) in the late 1990s. This model was a decentralized, market-driven model and was designed to prioritize crop diversification and farmers' income, rural employment and poverty alleviation. It was initially

implemented in 28 districts, with the Agricultural Technology Management Agency (ATMA) being the key institution in implementing this Project. (Feder *et al*., 1987; Anderson and Feder, 2004; Babu *et al*., 2013; Reddy and Swanson, 2006).

Under the National Mission on Agricultural Extension and Technology (NMAET), the Government of India focuses on increasing knowledge and awareness among farmers to raise the production level and productivity at the district level. Under this mission, the ATMA works in 676 districts in 29 states and 3 Union Territories (Ministry of Agriculture and Farmers Welfare, India). Agricultural Technology Management Agency is an autonomous organization registered under the 'Societies Registration Act 1860'. It involves all the stakeholders engaged in agriculture and allied activities at the district level. It holds the primary responsibility for disseminating agricultural technology through extension activities, namely Farmers Training, Demonstration, Exposure Visit, Kisan Mela, Mobilisation of farm Groups, and Farm Schools district level(Ministry of Agriculture and Farmers Welfare, India). Therefore, it involves farmers in the decision-making process, which helps in disseminating farmer-driven technology. As an independent organization, ATMA can receive funds both from the Government and non-government entities. The main elements of the ATMA model are i) integration of extension services for all the in-line departments, ii) formation of Farmers Interest Groups (FIGs) for small scale farmers, including women as well, iii) decentralizing the decision-making process with regards to extension, and iv) linking the farmers' interest group to the market (Reddy and Swanson, 2006) ATMA has strengthened the extension system by following a bottom-up planning process, making the extension system more farmer-driven and farmer accountable. It links all the in-line departments and involves all the stakeholders of the Government and Non-Government Agencies, Farmer Groups,

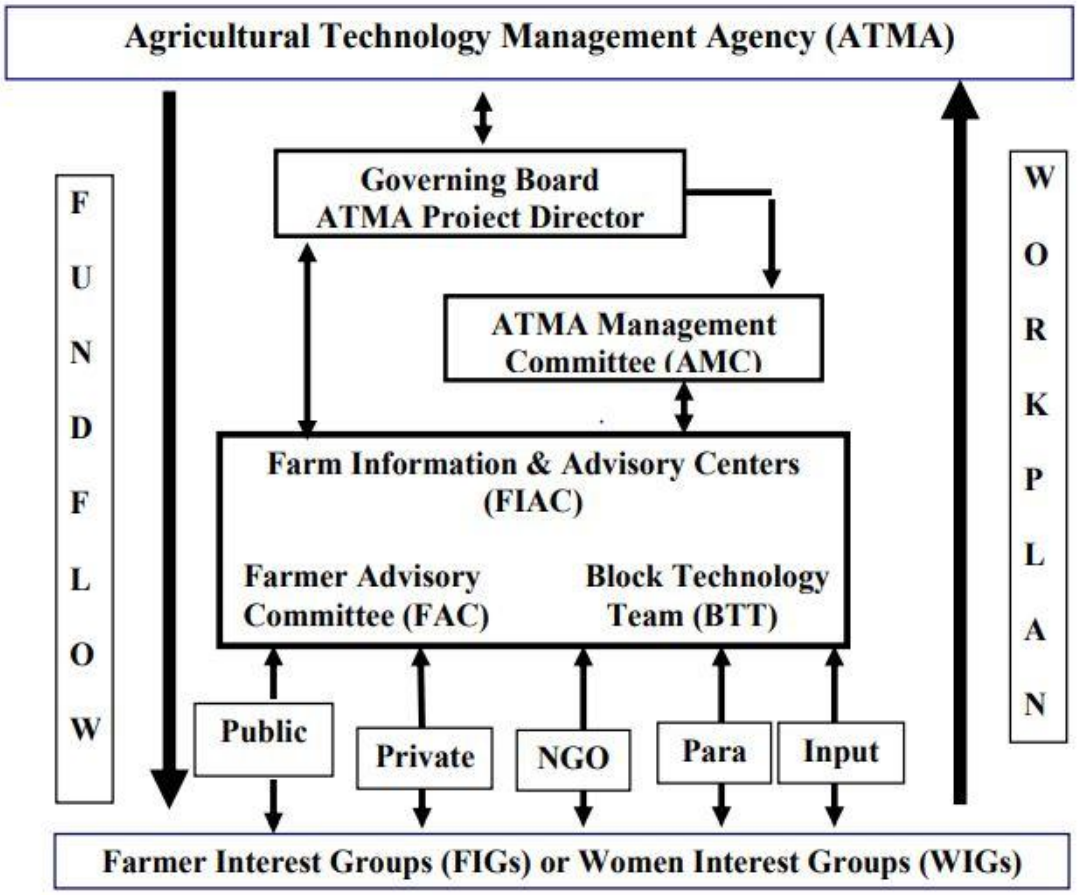
Private extension agents and Public extension agents linked to the Indian Council of Agricultural Research (ICAR) and the Krishi Vigyan Kendra (Ministry of Agriculture and Farmers Welfare), thereby making new and robust institutional arrangements in technology transfer (Norton *et* al., 2020; Reddy and Swanson,2006). Since its inception in 2005-06, over 3.77 crores farmers, of which 24.02% were women, have participated in farmer oriented activities organized by ATMA, over 2.04 lakh Commodity Based Farmer Interest Groups /have been mobilized, around 1.01 lakh Farm School organized and 13,772 specialist and functionaries have been deployed (MANAGE)

Agricultural extension service is an essential input in agriculture that enhances the farmer's output and productivity. Most government schemes are Centrally Sponsored Schemes that emphasize lowering the Small and Marginal farmers' ladder and create opportunities for them to reap the benefits of modern agriculture technologies being distributed. Since ATMA bears the onus of lengthening the benefits of sophisticated agriculture technologies at the district level, this study analyses the impact of extension services provided by the agency in increasing the farmers' agricultural production and income and productivity. In other words, this study aims to evaluate the performance of ATMA at the farm level in the study area.

1.2 Organizational structure of ATMA

ATMA follows a bottom-up strategy for extension services to include farmers in the decision-making process unlike, the earlier Extension system in which the farmers were mere recipients of technology and had no role in the planning process in the system.

Figure 1.1 Organisational Structure of ATMA



Source: Singh, K.M., 2006

An essential element in the "bottom-up" extension strategy under the ATMA model is the formation of Farmers' Advisory Committee (FACs) who advise the Block Technology Team(BTT) on extension priorities. The BTT in each block bears the onus of preparing the Annual Block Action Plan based on extension activities identified in Strategic Research and Extension Plan (SREP) by considering the group demands placed by the FAC members. It also considers the ongoing schemes of other departments and agencies for dovetailing besides hearkening to the success stories identified for replication. Prior to its submission to the ATMA Governing body for funding, the Block Action Plan is discussed annually or seasonally in the joint meetings of the Farm Information and Advisory Committee, which comprises the

BTT and the FAC. The FAC also monitors the block-level program's implementation and provides the BTT feedback on the BAP implementation. Therefore, information is obtained from the members of FAC and BTT to ascertain separate meetings held by the FAC to discuss BAP amongst the farmers (Ministry of Agriculture and Farmers Welfare, Government of India). The following figure depicts the organisational structure of ATMA at various levels along with its flow of funds and flow of work plan

1.3 Rationale of the study

Agriculture is the source of income for a significant size of the Assamese population. Attaining high produce has always been farmers' motive and even policymakers suggest measures for enhancing productivity to sufficiently meet the rising demand for food of the rapidly growing population. Extension services that are provided by the Agricultural Technology Management Agency (ATMA), aim at increasing knowledge and awareness of the farmers to enhance crop diversification and productivity. The farmers are engaged in rice cultivation in the kharif season, in Golaghat District, but rice production, which is the main crop of the District and Assam, is declining. Similarly, the percentage share production of major crops like Autumn Rice, Summer Rice, Wheat, Jute, Pulses and Sugarcane, produced in the district, is declining (Govt. of Assam). Hence, it is necessary to understand the impact of ATMA's extension services in enhancing the farmers' production and its effect on farm income in Golaghat district of Assam.

1.4 Review of literature

a. Concept of Extension Service and ATMA

Agriculture extension service can be termed as a vehicle for transporting technologies from developing agencies to the farmers. It is the most logical scientific and systematic method of disseminating new knowledge and skills to the farmers (Melkote,1988) to aid them in successfully adopting the sophisticated agricultural technology and use of their land and allied resources more efficiently (Anderson and Feder, 2007, Ullah *et.al,*2014). By providing training and promoting innovations in agriculture technology, agricultural extension services aim to improve productivity (Evenson, 2001) and increase production efficiency (Birkhaeuser *et al*.,1991). It aims to improve the farmers' skill and decision-making for the efficient utilisation of the new agricultural technology (Norton and Alwang, 2020). It helps spread information from local and global research leading to a rapid transfer of knowledge, thereby increasing the farmers' managerial ability (Huffman, 1977). It improves farmers' decisions, enhances efficiency in production for more agricultural growth and higher income (Anderson and Feder 2004, 2007; Norton *et al.*, 2020).

The ATMA model is a decentralized, demand-driven extension model which emphasises on crop diversification, productivity, farmers' income and poverty alleviation (Reddy and Swanson, 2006). ATMA is an autonomous agency with a broad-based extension system having many stakeholders who provide technology testing and training (Ferrouni and Zhou, 2012). Under the National Mission on Agricultural Extension and Technology (NMAET), ATMA provides extension services across all the inline sectors by undertaking extension activities and organizing capacity building programmes like Farmer Training, Demonstrations, Exposure visit, Kishan Mela, Farmer-Scientist interaction, Mobilisation of Farmer

Interest Group(FIGs) and Farm Schools (Ministry of Agriculture and Farmers Welfare, India).

b. Development of ATMA

Soon after independence, the Indian Government introduced several programs to improve the agricultural scenario of the country. The T&V system of extension was first launched in 1974-75 in Rajasthan and Madhya Pradesh with an estimation of meeting about agricultural needs of 90% of India's farm households. Despite some loopholes in the extension system's design and effectiveness, the national experience was positive (Ameur, 1994). Although the new extension system yielded impressive results, a huge number of quality-staff and sustained funding requirements became a significant challenge in the system (Anderson and Feder, 2004). After the World Bank project ended in the early 1990s, low resources and low staff beleaguered the extension system and the national extension system and the existing T&V system became moribund (Anderson *et al*., 2006). The Training and Visit system's downfall led to a reform shaping the extension system towards a decentralized, pluralistic and demand-driven system (Rivera and Alex, 2005; Birner *et al.*, 2007). In 1998 with a motive to bring reforms in the existing National Extension System, following the familiar pattern of decentralized, pluralistic and demand-driven extension system practiced in most developing countries (Babu *et al*., 2013) the Agricultural Technology Management Agency was introduced as a pilot in 28 districts (DAC, 2005) and later in 2006, after having received confirmed positive feedback from the pilot study (IIM,2004) the ATMA model was implemented throughout the country. Now it is actively functioning in 652 districts in 29 states and 3 Union Territories (Ministry of Agriculture and Farmers Welfare, India).

c. Agriculture extension outside India.

Since the development decade, agriculture extension services have convinced people to adopt agriculture technology innovations. According to Melkote (1988), extension service is the vehicle for conveying technology from the developer to the farmers. Communication plays a vital role in the dissemination of knowledge and skill. Birner et al. (2006) argue that since extension services are need-specific, purpose-specific or target-specific, they are incomparable. Therefore, the extension system should be flexible enough to consider and include the local farmers' needs to fit into any situation (Raabe, 2008). Melkote(1988) checked the role of extension communication in the Kitale Maize Project in Kenya organized by USAID and the Kenyan Government. The study found the large farmers benefitted from the project because of the communication gap, inadequate access to knowledge and lack of skill inputs among small farmers. Other reasons which led to less diffusion of new technologies among small farmers were lack of proper resources, risk-averse nature of the farmers and the cost of extension service was beyond their means to meet. Using Stochastic Frontier Analysis, Alene and Hasan (2008) tried to investigate the extent of determinants of technical, allocative and economic efficiencies of the farmers within and outside the Extension Package Program in Ethiopia and found that participation in the Extension Package Program significantly influenced the technical efficiency of the farmers. The study also found that adopting the whole technology helped exploit the new varieties' yield potential and increase production. In their study on the extension systems in Eastern and Southern Africa, Anandajayasekaran *et al*. (2007) studied the various issues surrounding the Farmer Field Schools (FFS) and the small and marginal farmers' participation. FFS are intensive programs where the farmers meet weekly and discuss various topics, thus enhancing the effectiveness, efficiency and

experimental learning of the farmers. The authors suggested integrating Farmer Field Schools into the national extension system, which would create a huge number of trainers within it. Farmer Group is an important mechanism in improving farm productivity and farm inefficiencies (Ainembabazi *et al.,* 2017). Their study on data collected by Consortium for Improving Agriculture-Based Livelihoods in Central Africa (CIALCA) found that membership in farm groups reduces the time lag in the adoption of technology and enhances farm performances. Similar findings were recorded by Läpple *et al*. (2012) from their study on participatory extension programs in Ireland, using Endogenous Switching Regression Analysis. They found that economic returns to participating in Farmers Group were positive suggesting more enrollments in the group. In their study on the Extension Policies in Australia, Maersh and Panell (2007) documented that through the group-based approach practiced in the Australian extension system, the farmers learn about the relevance and importance and understand the problems related to the adoption of the innovations in the changing farming system. Although it positively impacted development, over-reliance on the group-based extension is dangerous as its effectiveness can be plagued by many groups which are worthless over few worthwhile groups. Separate institutional structure, organizational changes in state agencies create a gap in the extension-farmer linkage. The authors suggest a pluralistic extension system with less electronic information delivery system because of the telecommunication deficiencies in rural Australia; moreover, the electronic delivery system also means less social contact. Trying to study the impact of extension services on the farmers' activities in Nigeria, Nwankwo O.C (2010), using the Simple Percentage technique, found that the educated farmers' performance was better than the illiterate ones with regards to food production. The study also revealed that agricultural extension services were accessed

more by the houses close to the government-established agricultural institutions and performed better with regards to agricultural production. According to Ali and Rahut (2013), although agriculture extension services encourage modern agriculture technology, the benefits of agriculture extension are usually reaped by the large farmers. They confirmed this through a study in Pakistan while trying to understand the impact of extension services on the adoption of technology and crop yield. The authors used the Propensity Score Matching Approach for impact evaluation to correct the potential sample bias. Another study was undertaken by Juanwen and Niehof (2011) to understand the technology extension and adoption in China. They found that the demand for extension services and their adoption are influenced by the farmers' perspective on the new technology's productivity, the farmers' knowledge and experience, and migration which causes labour shortage. They also found that the national extension service system was not demand-driven. Neighbours, relatives, friends and shopkeepers meet the diversified information needs of the farmers.

d. Agricultural extension in India and the impact of ATMA

Adhiguru *et al*. (2009), reported that progressive farmers, input dealers and mass media are the main sources of information for many farmers because they are easily available and accessible. On the other hand, public extension workers and cooperatives were less important and were biased towards large farmers. This finding, therefore, provided proclivity for promoting farmer led-extension system with increased coverage and efficiency in the delivery system. Supporting Adhiguru and co-authors, Ferrouni and Zhou(2011) state that dissemination of timely and right knowledge and information with an increased coverage is the challenge for the Indian extension system and a pluralistic extension delivery system is the way to overcome this challenge. Under the NATP by 2006, the ATMA had been adopted in 60 districts

and was planned to be extended nationwide in the next five years (Singh and Swanson, 2006), but it had many implementation bottlenecks like qualified workforce, financial support, etc. Keeping in mind the implementation constraints, the Government introduced new guidelines for ATMA in 2010, which made provisions for specialist strength and functionary support at every level and attempted to fill in the village-block gap, thereby creating a multi-agency demand-driven extension system (Kapoor,2010; Ferrouni and Zhou, 2011).

Different studies in different parts of the country elucidate and shed light on the Agricultural Technology Management Agency's role and impact since its implementation in 2005. The first study of the decentralized, participatory, market-driven extension model undertaken by Indian Institute of Management, Lucknow documented institutional and technological achievements and a positive impact on farm income and rural employment through agricultural diversification (IIM, Lucknow, 2004a; 2004b; Swanson and Singh, 2008). The agriculture extension under ATMA has helped in reducing the adoption lag and growth in income. A study undertaken in Bihar by Singh *et al*.(2009) in the NATP implemented district showed that all categories of farmers had adopted the new technologies and practices leading to the diversification of crops and farm enterprises and added yield and income. A critical assessment of the ATMA model's organizational performance in four states of Bihar, Himachal Pradesh, Maharastra and Tamil Nadu, showed that the local conditions influence the organisational performance of pubic extension agency. The authors found that ATMA has been performing well and a range of activities have been implemented both at the district and block level and public extension to some extent has reached the rural communities (Babu *et al*., 2013). In light of rain-fed agriculture, a study in Andhra Pradesh documented that implementation of a new

technology was complemented by a change in capital use. Adopting improved technology, provided by ATMA, and the farmers' access to credit increases agricultural growth and farm income (Rao *et al*., 2014). Technology adoption is influenced by farm size and year-round irrigation facilities. Small and marginal farmers usually produce to meet the family demand. The farmers also engaged in non-farm activities purchase more inputs than the farmers exclusively engaged in agriculture (Peshin *et al*., 2018). Venkatesh and Nithyashree (2014) in their study on the delivery of agricultural inputs and services to farm households, found an inverse relationship between farm size and fertilizer use and a positive relationship between institutional credit and farm size. The study also provides evidence that the use of power-operated implements over-throws the use of hand-operated tools. Regarding accessing to the information on agriculture and technology, the public extension system was of help to only 40% of the farmers who were mostly large farmers. In contrast, progressive farmers remained the main source of information.

Assessing the change in income of beneficiaries of ATMA over non-beneficiaries and analyzing the change in volume and pattern of employment, using 180 respondents in Nagaland, Imtiwalling *et al*. (2017), found that the beneficiaries had better income with the highest impact on Forest and Plantation which yielded the highest level of average income, and employment generation. Deka *et al*.(2017), in an attempt to check the accomplishment of the cafeteria of activities as per guidelines, using data for the year 2013-14 to 2015-16, found that the achievements of the cafeteria of activities as per ATMA guidelines were less than 50 % in the three consecutive years. Coordination and collaboration of each member at the block-level determine the effectiveness of the research-extension and farmer linkage. (Biam *et al*., 2017) suggested that for effective coordination and collaboration each member of the

linkage in a dyad system should readily cooperate and voluntarily assist in the linkage interface between each subsystem in the communication triangle at the block level ATMA programme.

1.5 Research gap

Many researchers have initiated studies on the impact of Agricultural Extension services on the productivity and income of farmers. However, a few studies have studied the impact of ATMA, emphasising agricultural knowledge received from extension services provided by ATMA as an input in agriculture. Besides, there have been rare studies done in the study area. The present study is an attempt in that direction, focusing on paddy production, which is the district's primary crop.

1.6 Objectives of the study

a. To evaluate the current status of extension services provided by ATMA in Assam.

b. To study and compare the socio-economic status of the beneficiary and non-beneficiary farmers of CSS-ATMA.

c. To evaluate the impact of extension provided by ATMA in enhancing the production of paddy.

d. To identify the drawbacks and limitations in the extension services provided by CSS-ATMA.

1.7 Research questions

a. What is the current status of extension services provided by CSS-ATMA in Assam?

b. Is there any difference in the socio-economic status of the beneficiary and non-beneficiary farmers of CSS-ATMA in Golghat District of Assam?

c. Do the Extension Services provided by ATMA significantly impact the paddy production of the farmers?

d. What are the drawbacks and limitations of the extension services provided by CSS-ATMA?

1.8 Research Hypothesis

a. CSS-ATMA has not helped in enhancing farmers' paddy production in Golaghat District of Assam.

b. CSS-ATMA has not helped in increasing the farmers' income in Golaghat District of Assam.

c. There is no difference in the socio-economic status of the beneficiary and non beneficiary farmers of CSS-ATMA in Golghat District of Assam.

d. There are no drawbacks and limitations of the extension services provided by CSS-ATMA**.**

1.9 Research Methodology

1.9.1 The Study Area

Assam occupies a geographical area of 78,438 sq. kilometers in North East India, the home to 2.6% of the country's total population, with 86 percent of its population living in rural areas (Census 2010-11). The economy in Assam is primarily agrarian which employs 49.45 percent of the total workforce. The production of crops is directly related to the area coverage of various crops cultivated and produced. The total operational landing of Assam is 29.99 thousand hectares (Census 2010-11). The type of soil, topography, rainfall and climate of the state is favourable for agricultural production, especially paddy and has led to the concentration of agriculture in Assam towards paddy cultivation. The contribution of agriculture in the State Gross

Domestic Product is about 20 percent. However, the agriculture sector still holds an important place in the economy. Therefore, any fluctuation in the production of food grains, vegetables and fruits affects the state's economy. (Economic Survey of Assam, 2017-18). In Assam, the CSS-ATMA works in 14 districts namely Bongaigaon, Cachar, Chirang Darrang, Dima Hasao (erstwhile NC Hills), Kokrajhar, Goalpara, Golaghat, Karimganj, Lakhimpur, Morigaon, Sivasagar, Tinsukia, and Udalguri.

Golaghat district sprawls in an area of 3502 square kilometers having 3 agricultural sub-divisions, eight development blocks and six hundred and twenty one revenue villages. The geography and climatic conditions of the district are very conducive for agriculture activities. Agriculture, in the district, is a source of occupation for the majority and is an important sector contributing to the agrarian economy of the state. Fourty percent of the district's total land area comprises forest cover and fourty percent includes the cropped land. The remaining land consists eighteen percent of uncultivable land and two percent of fallow land. A total area of 70544 hectares is under the high yielding variety of rice; autumn rice covers about 1169 hectares area and yields about 2426 kilogram per hectare winter rice covers about 65749 hectares with a yield of 2959 kilograms per hectares, summer rice covers about 3626 hectare with produce of 3353 kilograms per hectare. The district's total farm family is 2,03,lakhs out of which hundred percent of the farm family are engaged during the kharif season and sixty percent farmers are involved during the Rabi season. The net crop area of Golaghat district is 143790 hectares, of which the Kharif area comprises 143790 hectares and Rabi area of the district consists of 67790 hectares (Government of Assam, *www.golaghat.gov.in*) Agricultural Technology Management Agency (ATMA), with its motive of technology dissemination and enhancing agricultural production and raising farmers' productivity, has been actively

functioning in the district since 2006. Most government schemes are Centrally Sponsored Schemes that aim to lower the ladder for the Small and Marginal farmers and provide opportunities to reap the benefits of modern agriculture technologies being distributed. And since the Agricultural Technology Management Agency in the district is a Centrally Sponsored Scheme this study tries to analyse the impact of ATMA in enhancing the farmers' production and its impact on farm income in Golaghat district of Assam.

1.9.2 Data collection

The present study is based on both primary data as well as secondary data. The secondary data was collected from various sources published by the Government. Report of the Economic Survey of Assam 2014-15 to 2018-19 has been used to understand the status of ATMA in Assam. To understand the activities undertaken by ATMA in Assam vis-à-vis Northeast India, data available for the period of 2012-13 to 2014-15 were collected from the reports of the Ministry of Agriculture and Farmers Cooperation, Government of India. To examine and understand the status of Agriculture and ATMA in Golaghat district, the District Census Handbook 2011, published by the Government of Assam, was used for drawing information. Data for the various activities conducted by ATMA in the district were collected from the District Agriculture Office, Golaghat. In order to understand and analyse the impact of extension services provided by ATMA in Golaghat district of Assam, Primary data was collected by conducting a field survey in which the head of the farmer household was interviewed. It is to be mentioned here that, being the main crop produced in the district, Paddy is the crop focused in the study. The universe of the study being vast and resource and time constraint for an individual researcher, four blocks in Golaghat district were selected for field survey given their level of paddy production. For the

selection of farm households, in the present study, a multi-staged stratified random sampling method was used. The sampling design is presented in the following Figure1.2. Initially, four blocks in the district, namely- Kathalguri, Kakodonga, Gomariguri and Morangi, were selected for the present study. From each block, four Gram Panchayat Units(GPU) were selected randomly. From each GPU, one village was selected randomly and finally, from each village, ten farm-households were interviewed randomly. Of the farm-households interviewed in each village unit, five farmers were beneficiaries of extension services provided by ATMA and five farmers were non-beneficiaries. Thus, the total sample included one hundred and sixty farmers, of which fifty percent farmers were beneficiaries of ATMA, and the remaining had never received any extension service in any form from ATMA.

Primary Data was collected by interviewing the head of the farmer household using an interview schedule which was prepared by consulting the existing literature. Data on various aspects of agriculture like land holding, the socio-economic profile of the farmer household, access to extension services provided by ATMA and the quality and usefulness of the technology disseminated at the district level by Agricultural Technology Management Agency were recorded with the help the interview schedule during October, 2020 and November, 2020 through field survey.

Figure 1.2 Sample Design

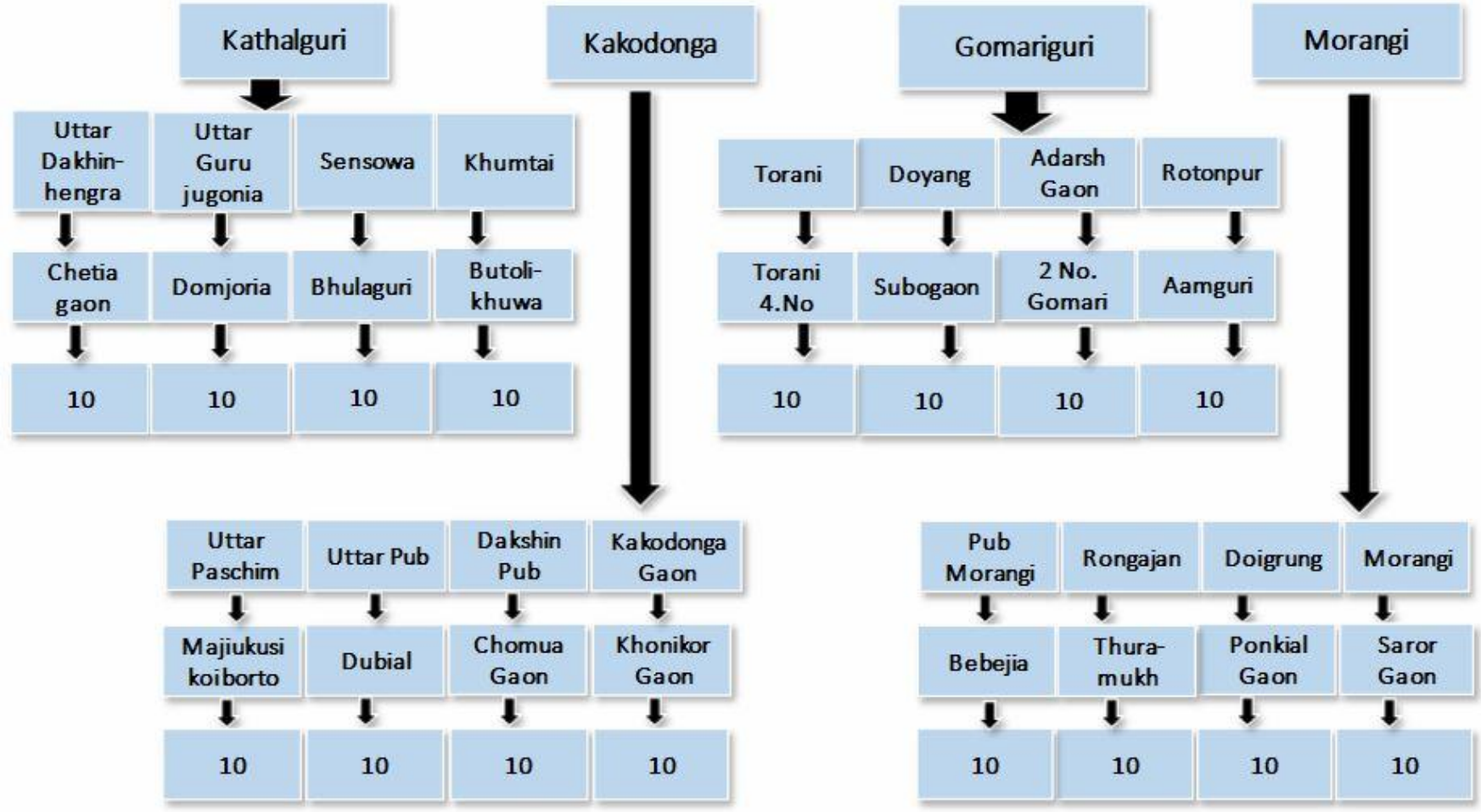
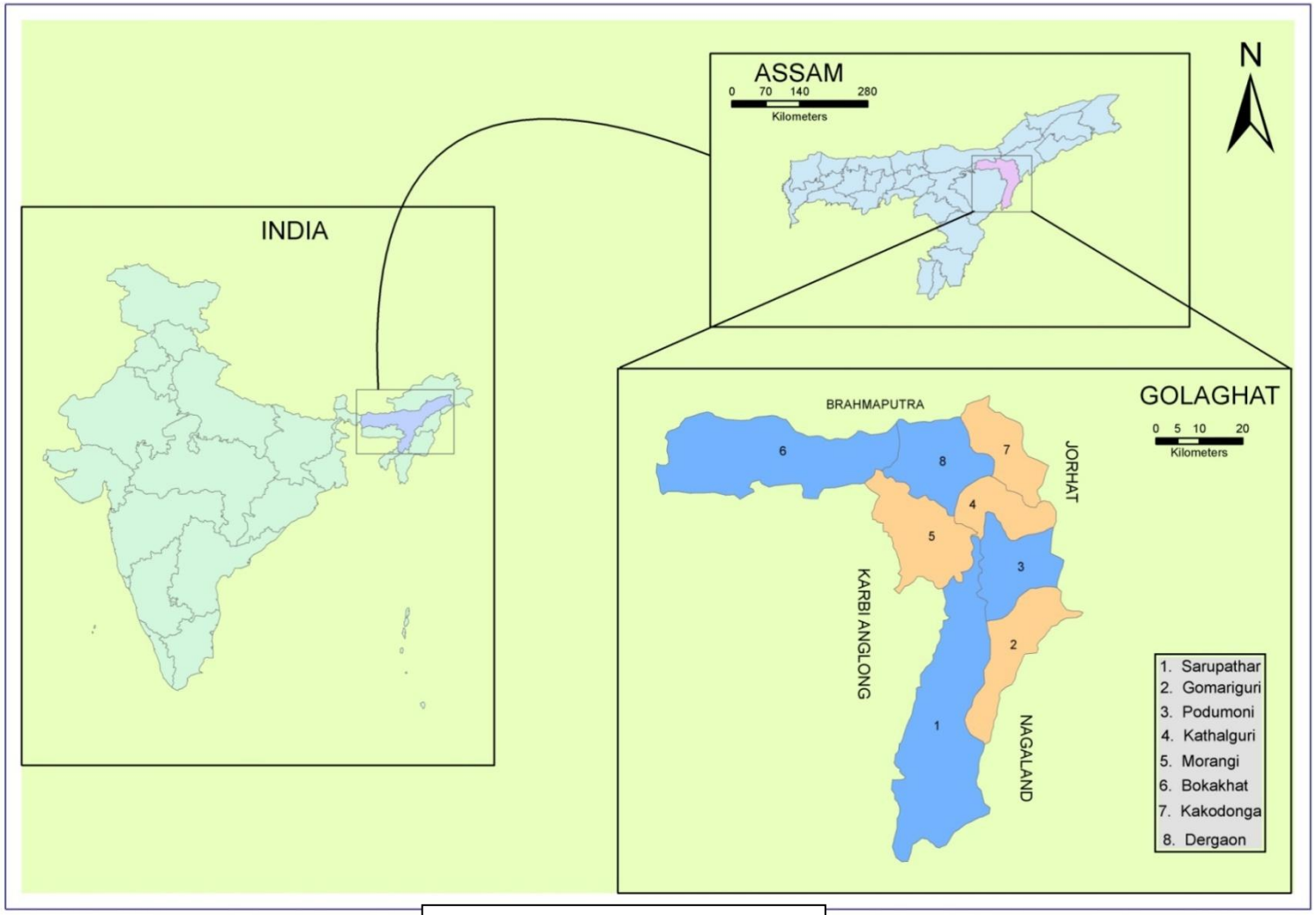


Figure 1.3 Map of the Study Area



Source : www.mapsofindia.com

1.9.3 Line of Analysis

Descriptive statistics and inferential statistics were applied for the analysis of data in the present study. In order to understand the status of extension services provided by ATMA in Assam and Golaghat, descriptive statistics with a combination of tables and graphs are used. Inferential statistics were also used to understand the impact of extension services provided by ATMA in the district.

Propensity Score Matching

The Propensity Score Matching (PSM) technique introduced by Rosenbaum and Rubin(1983) was employed to understand the impact of ATMA in Golaghat district of Assam. Propensity Score Matching refers to the pairing of treatment and controlled observations having similar values on their propensity score and possibly other covariates (Rubin, 2001). Rosenbaum and Rubin (1983) defined Propensity Score for an individual (*i*) as the conditional probability (*p*)of receiving a particular treatment given a vector of observed covariates (*Z*) and is expressed as:

$$p(Z)i = \Pr\{D_i = 1 | Z_i\} \quad \ldots\ldots (1)$$

where D indicates the exposure to treatment. It takes the value 1 for membership in the treatment group and 0 for the controlled group. Z_i is the vector of observed covariates for the i^{th} individual. The exposure to treatment within the cells defined by the values of the mono-dimensional variable *p*(Z) is random if the exposure to treatment within the cells defined by Z is random. *p*(Z) is also known as the Average effect of Treatment on the Treated(ATET) and is the prominent estimator as it explicitly focuses on the effects on those for whom the programme is intended, and is expressed as

$$\text{ATET} = E\{y_{1i} - y_{0i} \mid D_i = 1\} \quad \text{.....(2)}$$

$$= E\{E\{y_{1i} - y_{0i} \mid D_i = 1, (p(Z_i)\}$$

$$= E\{E\{y_{1i} \mid D_i = 1, (p(Z_i)\} - E\{y_{0i} \mid D_i = 0, (p(Z_i)\} \mid D_i = 1\} \quad \text{.....(3)}$$

Where, the outer expectation is over the distribution of $(p(Z_i)\} \mid D_i = 1)$ and y_{1i} and y_{0i} are the potential outcomes in the two counterfactual situations of the treatment and non-treatment respectively. The expected outcome of the average treatment effect for the treated is the difference between the outcomes of the treated and the outcomes of the treatment, had they not been treated. The Propensity Score Matching rests on two important assumptions:

a) Unconfoundedness Assumption: This assumption says that all the variables which affect both the treatment and the outcome variable are observed and can be controlled for. In other words, once the observable factors are controlled for technology adoption is random and uncorrelated with the outcome variables
b) Common Support Assumption: this assumption ensures sufficient overlap in the characteristics of treated and untreated units to find suitable matches. (Rosenbaum and Rubin, 1983).

The Propensity Score Matching technique is usually used in evaluation studies to correct for potential bias arising in the data due to differences between the treatment and controlled observations. It has been used to assess agriculture extension services by Heckman (1997), Godtland *et al.*(2004), Mendola (2007), Ali and Rahut (2013), Teka and Lee(2019) and Shita *et al.*(2020).

Chapter 2

Status of ATMA in North-Eastern Region

The present chapter has attempted to examine the current status of ATMA in Northeast India with special reference to Assam. The Chapter is divided into two sections. The first section examines the status of ATMA in Assam and the second section attempts to compare the state with the Northeastern states based on the varied activities conducted by ATMA in the region. The simple descriptive statistics like frequency, percentage and average have been employed to analyze the data obtained from different secondary sources like the Economic Survey of Assam 2014-15, Government of Assam, Ministry of Agriculture and Farmers Cooperation, Government of India.

2.1 Status of ATMA in Assam

In Assam, since 2012, the Assam Rural Infrastructure and Agricultural Services Society (ARIAS), is the responsible agency for managing extension services. It is a registered body established by the Government of Assam and manages the extension services provided of ATMA at the district level (Goswami and Bezbaruah, 2017). To affect reforms in the agriculture system, the ATMA model was adopted in the state as well as other states of the country in 2005. ATMA is an autonomous body that follows a participatory approach with all the key stakeholders involved in agriculture to develop agriculture. It has the flexibility to receive funds and also to generate funds on its own. It follows a decentralized, bottom-up approach for efficient allocation of the extension machinery and to guarantee effective participation of the farmers in the planning and resource allocation (Economic Survey of Assam, 2012-13). There are two sets of ATMA functioning operating in Assam. One set of ATMA

is under the Centrally Sponsored Scheme (CSS), "Support to State Extension Programmes for Extension Reforms". The World Bank funds the other ATMA set under the Assam Agricultural Competitiveness Project (AACP, now called the AACP-AF or AACP Additional Fund). The centrally sponsored scheme exclusively focuses on providing extension services through ATMA. Under CSS-ATMA, the central Government funds 90 percent of the project and the remaining 10 percent is shared by the state government. At present, the CSS-ATMA operates in 14 districts in the state, namely Bongaigaon, Cachar, Chirang, Darrang, Dima Hasao, Goalpara, Golaghat, Karimmganj, Kokrajhar, Lakhimpur, Morigaon, Sivasagar, Tinsukia and Udalguri. Table 2.1 shows the status of the implementation of CSS-ATMA in Assam.

Table 2.1 Status of implementation of CSS-ATMA

Sl.No	Item	Total
1	Number of ATMA districts	14
2	Number of ATMA registered	14
3	Number of Farm Information and Advisory Centre(FIAC) formed	69
4	Number of Block Technology Team(BTT) registered	69

Source: Economic Survey, Assam, 2014-15

The organisational structure of CSS-ATMA in Assam is the same as that in the other states of the country. At the district level, the project director is the head of ATMA and as a nodal officer is responsible for the management of extension activities in the district. The ATMA Management Committee (AMC) is responsible for coordinating and integrating research and extension activities within the district. The AMC constitutes heads of all line departments and research organization within the district and is chaired by the project director. It scrutinizes the Block Action Plan (BAP) and sends it to the ATMA governing board for its final approval. At the Block level, the block ATMA cell, which consists of a Block Technology Team (BTT) and a Block

Farmers Advisory Committee (BFAC), bears the onus of implementing the Block Action Plan. The Block Technology Team consists of Agriculture and other line departments and the Block Farmers Advisory Committee consists only of the farmers. And finally, at the village level, the Village Level Extension Worker(VLEW) is in charge of the extension works. Taking the help of the Farmers' Interest Groups (FIG) and Progressive Farmers the VLEW prepares the village level action plan.

The AACP-ATMA aims to stimulate the growth of the agrarian economy as a whole with ATMA being its essential component. AACP –ATMA is operational in 12 districts, namely, Baksa, Barpeta, Dhemaji, Dhubri, Dibrugarh, Hailakandi, Jorhat, Kamrup, Karbi Anglong, Nagaon, Nalbari and Sonitpur. Table 2.2 shows the status of implementation of AACP-ATMA in Assam.

Table 2.2 Status of implementation of AACP-ATMA in Assam

Sl.No	Item	Total
1	Number of ATMA districts	12
2	Number of ATMA registered	12
3	Number of District Agricultural Development Strategy (DADS) Approved	12
4	Number of Block Resource Centre (BRC)	118
5	Number of Block Action Plan in action	123

Source: Economic Survey of Assam, 2014-15

AACP-ATMA share the same objective, strategy and structure adopted by CSS-ATMA. The District Agriculture Development Strategy (DADS) is prepared at the district level and at the block level, the Block Resource Centre (BRC) implements the Block Action Plan(BAP) after consultation with the Block Farm Advisory Committee(BFAC).

2.2 Status of Activities Undertaken by ATMA in the Northeast

ATMA follows a decentralized, bottom-up approach for efficient allocation of the extension machinery and to ensure effective participation of the farmers in the planning and resource allocation (Economic Survey of Assam). To make the technology developed in the lab reach the farmers' field, ATMA undertakes various activities like Training, Demonstration, Kisan Mela, Exposure visits, Farmer-Scientist interaction and organizes Farm Schools and helps in forming Farmers Interest Groups. This section discusses the various activities undertaken by ATMA in Assam with the help of the available data.

2.2.1 Exposure visits

Exposure visits facilitate farmers from different regions to interact and learn about new practices from other farming communities. ATMA arranges inter-state, intra-state, inter-district, and intra-district exposure visits for farmers to get crop-specific practical experience on discussion with experts and successful progressive farmers. The data available for exposure visits arranged by ATMA in Assam refers to 2012-13 to 2014-15 as presented in Table 2.3. Table 2.3 shows the number and the percentage share of participants in the exposure visit arranged by ATMA in Northeast India. The table also shows the percentage of female participants in the activity organized by ATMA. The number of beneficiaries in Exposure Visit organized by ATMA in the Northeast has decreased marginally from 19706 farmers to 17559 farmers during the period. Except for Arunachal Pradesh, Manipur, Meghalaya, all the other Northeastern have seen a decrease in the number of participants. The number of beneficiary farmers of Exposure visit from Assam has gone down from 3255 farmers in 2012-13 to only 642 farmers in 2014-15. The percentage share of beneficiaries from Assam has decreased from 16.52 percent to 3.66 percent within two years from

2012-13 to 2014-15. The percentage share of female participants is found to be fluctuating as seen from Table 2.3. Of the total participants in the Northeast, female farmers' percentage share was 34.60 percent in 2012-13, 30.52 percent in 2013-14 and 36.50 percent in 2014-15, respectively. Fluctuation can be observed in the percentage share of Assams' female participants, which comprised 29.98 percent in 2012-13, 23.18 percent in 2013-14 and 29.75 percent in 2014-15.

Table 2.3 Exposure visit arranged by ATMA in Northeast (2012-13 to 2014-15)

State	Number of participants (percentage)			Mean(CV)	Percentage of female participants		
	2012-13	2013-14	2014-15		2012-13	2013-14	2014-15
Arunachal Pradesh	350.00 (1.78)	698.00 (2.69)	6033 (34.36)	2360.33 (134.96)	20.46	28.08	28.08
Assam	**3255.00 (16.52)**	**1480.00 (5.70)**	**642 (3.66)**	**1792.33 (74.43)**	**29.98**	**23.18**	**29.75**
Manipur	2525.00 (12.81)	2310.00 (8.90)	5565 (31.69)	3466.6 (52.51)	52.95	30.00	30.04
Meghalaya	508.00 (2.35)	109.00 (0.42)	540 (3.08)	385.67 (62.26)	29.86	30.00	44.44
Mizoram	1055.00 (5.35)	860.00 (3.31)	160 (0.91)	691.67 (68.04)	36.04	27.91	30.00
Nagaland	11347.00 (57.58)	18679.00 (71.93)	2663 (15.17)	10896.33 (73.57)	0.00	30.32	64.25
Sikkim	1016.00 (5.16)	1833.00 (7.06)	683 (3.89)	1177.33 (50.26)	0.00	39.99	19.77
Tripura	0.00 (0.00)	0.00 (0.00)	1273 (7.25)	424.33 (173.20)	30.93	0.00	0.00
Northeast	19706 (100)	25969 (100)	17559 (100)	21078.00 (20.73)	34.60	30.52	36.50

Source: Government of India, Lok Sabha Unstarred Question No. 842, dated on 01.03.2016, Question No.634, dated on 15.07.2014

2.2.2 Farmers Training

In order to support the state governments' efforts to invigorate the extension system and augment the availability the sophisticated technology to promote advanced practices in agriculture and its allied activities, the ATMA scheme enables a decentralized extension system. The data available for training conducted by ATMA in the Northeast region of India is from 2012-13 to 2014-15 as presented in Table 2.4. The table shows the number and percentage share of beneficiaries of the training

programme organized by ATMA in Northeast India. It also shows the percentage share of female farmers who benefitted from the training programme.

Table 2.4 Training Coducted by ATMA (2012-13 to 2014-15)

State	Number of participants (percentage)			Mean (CV)	Percentage of female participants		
	2012-13	2013-14	2014-15		2012-13	2013-14	2014-15
Arunachal Pradesh	4120 (13.19)	1924 (5.26)	14220 (36.14)	6754.67 (97.08)	41.50	25.47	35.00
Assam	8189 (26.22)	2906 (7.94)	5925 (15.06)	5673.33 (46.72)	19.29	19.86	33.01
Manipur	2470 (7.91)	2250 (6.15)	943 (2.40)	1887.67 (43.73)	30.00	30.00	22.06
Meghalaya	1455 (4.66)	1170 (3.20)	1107 (2.81)	1244.00 (14.91)	56.29	57.26	45.80
Mizoram	7336 (23.49)	3385 (9.25)	1100 (2.80)	3940.33 (80.07)	29.25	29.93	30.00
Nagaland	8960 (28.69)	19344 (52.85)	8097 (20.58)	12133.67 (51.59)	38.31	27.67	31.00
Sikkim	2391 (7.66)	5626 (15.37)	6075 (15.44)	4697.33 (42.79)	0.00	22.89	3.21
Tripura	428 (1.37)	0 (0.00)	1877 (4.77)	768.33 (128.03)	0.00	0.00	0.00
Northeast	31229 (100)	36605 (100)	39344 (100)	35276.00 (11.56)	27.92	27.42	27.15

Source: Government of India, Lok Sabha Unstarred Question No. 842, dated on 01.03.2016, Question No.634, dated on 15.07.2014

The number of beneficiaries in training programs organized by ATMA in the Northeast has increased marginally from 31229 farmers in 2012-13 to 39344 farmers in 2014-15. Except for Arunachal Pradesh and Sikkim, the other Northeastern states have witnessed a decrease in the number of participants in 2014-15 compared to 2012-13. The number of the beneficiary farmers of training from Assam has decreased from 8189 farmers in 2012-13 to only 5925 farmers in 2014-15. The percentage share of beneficiaries from Assam has reduced from 26.22 percent to 15.06 percent within two years, from 2012-13 to 2014-15. Not much difference is seen in the percentage share of female beneficiary farmers as evident from Table 2.4 and the percentage share of female participants is about 27 percent. Whereas the other states of the region have shown a decrease in the participation of women in the

training conducted by ATMA, the percentage share of Women Farmers in the Trainings program in Mizoram and Assam has been increasing as evident from the table. The female participants of training programs in Assam comprised 19.29 percent in 2012-13, 19.86 percent in 2013-14 and 33.01 percent in 2014-15.

2.2.3 Demonstration

"Seeing is believing" goes an old saying. Farmers usually like to see how the new idea works and doubt its impact on their crop production. Demonstrations offer the farmers the opportunity to observe the differences between the old practices and the new crop practices, and therefore it should be simple and show the farmers concrete results. Demonstrations are of two types, namely method demonstration and the result demonstration. While the former shows the various steps regarding the use of technology and the cultivation process of a new crop, the latter provides proof of the new practices' adaptability in the local condition. A farmer may not believe in the agents' recommendations unless he sees if the agents' advice yields a positive result. Hence, demonstration helps build the confidence of the farmers on the new agricultural technology. It is, however, time-consuming, costly and could be devastating if the practices fail. ATMA, to make available the latest technologies to the farmers, conducts demonstrations. The available data for the demonstration programs conducted by ATMA in Northeast India is from 2012-13 to 2014-15 and is presented in Table 2.5. The table shows the number and percentage share of beneficiaries of the demonstration programme organized by ATMA in Northeast India. It also shows the percentage share of female farmers who benefitted from the demonstration programme. The number of beneficiaries of the demonstration organized by ATMA in Northeast has decreased from 16559 farmers in 2012-13 to 16153 farmers in 2014-15.

Table 2.5 Demonstration conducted by ATMA(2012-13 to 2014-15)

State	Number of participants (percentage			Mean (CV)	Percentage of female participants		
	2012-13	2013-14	2014-15		2012-13	2013-14	2014-15
Arunachal Pradesh	1.00 (0.01)	1268.00 (19.20)	0.00 (0.00)	423.00 (173.00)	100.00	30.76	0.00
Assam	4617.00 (27.88)	1097.00 (16.61)	929 (5.75)	2214.33 (94.04)	20.38	22.33	33.69
Manipur	105.00 (0.63)	0.00 (0.00)	80 (0.50)	61.67 (88.94)	30.48	0.00	28.75
Meghalaya	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0.00
Mizoram	4500.00 (27.18)	2600.00 (39.37)	1300 (8.05)	2800.00 (57.48)	30.00	30.00	30.00
Nagaland	4980.00 (30.07)	1639.00 (24.82)	13844 (85.71)	6821.00 (92.47)	50.78	0.00	49.65
Sikkim	257.00 (1.55)	0.00 (0.00)	0.00 (0.00)	85.67 (173.21)	0.00	0.00	0.00
Tripura	2100 (12.68)	0.00 (0.00)	0.00 (0.00)	700 (173.20)	0.00	0.00	0.00
Northeast	16559 (100)	6604 (100)	16153 (100)	13105.33 (42.98)	29.30	21.43	47.04

Source: Government of India, Lok Sabha Unstarred Question No. 842, dated on 01.03.2016, Question No.634, dated on 15.07.2014

Except for Nagaland, the other Northeastern states have seen a decrease in the number of participants since 2012-13. Arunachal Pradesh, Meghalaya, Tripura and Sikkim have not conducted any demonstration in 2014-15. The number of the beneficiary farmers of demonstration from Assam has decreased from 4146 farmers in 2012-13 to only 929 farmers in 2014-15. The percentage share of beneficiaries from Assam has reduced from 27.88 percent to 5.75 percent within two years, from 2012-13 to 2014-15. The percentage share of female beneficiary farmers, as evident from Table 2.5, has increased in the region over the years from 29.30 percent to 47.04 percent, during the period of available data. Whereas, the other states of the region have experienced a decrease in women's participation in demonstration programs conducted by ATMA, the percentage share of Women Farmers in the demonstration program in Mizoram and Assam has been increasing as evident from the table. The female participants of training programs in Assam comprised 20.38 percent in 2012-13, 22.33 percent in 2013-14 and 33.69 percent in 2014-15.

2.2.4 Kisan Mela

ATMA aims at reaching out the technology developed in the lab to the farmers. By making the provisions of displaying different technologies together, Kisan Mela creates awareness among the farmers about the varied available agriculture-related crop-specific technologies. It also provides a common platform and opportunity to all the stakeholders of agriculture and its allied activities to come and meet at a single place, showcase their technology and share their ideas and views about sustainable growth of the agriculture sector. The data available for Kisan Mela conducted by ATMA in India's Northeastern region is from 2012-13 to 2014-15 as presented in Table 2.6. The number and percentage share of beneficiaries of the Kisan Mela organized by ATMA in Northeast India. It also shows the percentage share of female farmers who benefitted from the Kisan Mela.

Table 2.6 Kisan Mela conducted by ATMA(2012-13 to 2014-15)

State	Number of participants (percentage			Mean (CV)	Percentage of female participants		
	2012-13	2013-14	2014-15		2012-13	2013-14	2014-15
Arunachal Pradesh	2230.00 (2.72)	5692.00 (8.37)	50540 (38.37)	19487.33 (138.28)	35.47	27.76	33.42
Assam	8770.00 (10.71)	2235.00 (3.29)	329 (0.25)	3778 (117.17)	22.47	23.94	23.71
Manipur	4947.00 (6.04)	3143.00 (4.62)	450 (0.34)	2846.67 (79.49)	30.00	30.00	30.00
Meghalaya	0.00 (0.00)	125.00 (0.18)	0.00 (0.00)	41.66 (173.20)	0.00	64.00	0.00
Mizoram	6200.00 (7.57)	4650.00 (6.84)	600 (0.46)	3816.66 (75.76)	30.32	30.11	30.00
Nagaland	59761.00 (72.96)	52171.00 (76.70)	79808 (60.59)	63913.33 (22.34)	36.56	0.30	36.73
Sikkim	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0.00
Tripura	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00	0.00
Northeast	81908 (100)	68016 (100)	131727 (100)	93883.667 (100)	34.15	6.90	35.38

Source: Government of India, Lok Sabha Unstarred Question No. 842, dated on 01.03.2016, Question No.634, dated on 15.07.2014

The number of beneficiaries in Kisan Mela organized by ATMA in Northeast has increased from 81908 farmers to 131727 farmers during the period of available data. Except for Nagaland, the other Northeastern states have seen a decrease in the number of participants in 2014-15 compared to 2012-13. The number of beneficiaries of Sikkim and Tripura is nill. The number of beneficiary farmers of Kisan Mela from Assam has decreased from 8770 farmers in 2012-13 to only 329 farmers in 2014-15. The percentage share of beneficiaries from Assam has decreased from 10.71 percent in 2012-13 to 0.25 percent in 2014-15. Not much difference is seen in the percentage share of female beneficiary farmers, as evident from Table 2.6, and the percentage share of female participants has increased from 34.15 percent in 2012-13 to 35.38 percent in 2014-15. Whereas the other states of the region have experienced a decrease in women's participation in Kisan Mela conducted by ATMA, the percentage share of Women Farmers in Assam has increased by about 1 percent, as evident from the table.

2.2.5 Farmers Interest Groups and Farm School

Inadequate farmer-extension linkage is one of the primary reasons for the low adoption of innovations and new technologies in Indian Agriculture system, which comprises mostly small and marginal farmers. To meet the agricultural needs like improved access to investment, technology, inputs and markets, agricultural producers' collectivization into Farmers Interest Groups(FIGs) is an effective channel (Sharma,2017). FIGs provide a platform for participatory decision-making (Braun et.al, 2000) and collective self-help action for their socio-economic development (Manalili, 1990). Organising farmers into groups empowers the farmers to produce and market their commodities and build an effective linkage with the input dealers (Singh and Srinivasan, 1998). A farm school is a group of farmers who come together

once a month or on a fixed date under a trained facilitator and discuss a wide range of topics related to agriculture practices in the locality and discuss solutions to problems faced by the farmers. Table 2.7 presents the number of Farmer's Interest Groups (FIGs) and Farm School formed by ATMA during available data, from 2012-13 to 2014-15.

Table 2.6 Farmers Interest Groups and Farm Schools formed by ATMA (2012-13 to 2014-15)

States	Farmers Interest Groups			Farm School		
	2012-13	2013-14	2014-15	2012-13	2013-14	2014-15
Arunachal Pradesh	0	0	0	282	201	119
Assam	644	380	116	395	229	62
Manipur	0	120	240	46	23	0
Meghalaya	0	10	20	39	28	17
Mizoram	300	150	0	104	65	26
Nagaland	550	327	104	104	104	104
Sikkim	40	20	0	35	33	31
Tripura	140	70	0	129	78	26
Northeast	1674	1077	480	1134	760	385

Source: Government of India, Lok Sabha Unstarred Question No. 842, dated on 01.03.2016, Question No.634, dated on 15.07.2014

The number of Farmers' Interest Groups created by ATMA has been decreasing over the years, as seen from Table 2.7. In 2012-13 the total number of Farmers' Interest Groups (FIGs) was 1674, which reduced to 1077 in 2013-14 and it further reduced to only 480 Farmers' Interest Groups (FIGs) in 2014-15. Assam has the highest number of FIGs formed in the Northeast. The number of Farmers' Interest Groups formed by ATMA in Assam in 2012-13 was 644. It reduced to 380 in 2013-14, and it further reduced 116 in 2014-15. The number of Farm School organized by ATMA in the Northeast, have followed a similar negative trend as evident from the

table. The number of farm schools formed in 2012-13 was 1134, and it reduced to 760 in 2013-14 and further reduced to 385 in 2014-15. Assam had 395 Farm Schools formed by ATMA in 2012-13. It declined to 229 in 2013-14 and further reduced to 62 in 2014-15.

Chapter 3

Status of ATMA in Golaghat District

This chapter tries to examine the current status of ATMA in Golaghat District of Assam. The Chapter is divided into two sections. The first section attempts to understand the agricultural scenario in the study area. Since paddy is the main crop produced in the district, an attempt has been made in this chapter to understand the trend and current status of production of the crop. And in the second section attempt has been made to examine the current status of the Agricultural Technology Management Agency in Golaghat District of Assam. The descriptive statistics like percentage and average have been employed to analyse the data obtained from varied secondary sources like the Economic Survey of Assam, Government of Assam, Various issues of Statistical Handbook of Assam, Government of Assam, District census Handbook 2011 of Golaghat District, Ministry of Agriculture and Farmers Cooperation, Government of India.

3.1 General profile of Golaghat District.

Golaghat district is located in the North-Eastern part of Assam. Sprawling in 3502 square kilometres, with three agricultural sub-divisions, eight development blocks, and 621 revenue villages, the district enjoys the climate and topography advantageous for agriculture and allied activities. About forty percent of the total land is cropped land; the forest cover is about 40 percent and of the remaining eighteen percent and two percent are uncultivable land and fallow land respectively.

3.1.1 Population

The district of Golghat is home to a total population of 1066888 which accounts for about 3.42 percent of the total population of the state, with a decadal

growth rate of 12.75 percent (Census 2011). The district is quite densely populated with 305 persons per square kilometre and has a sex ratio of 964. About 91 percent of the total population lives in rural areas. The total percentage of Schedule caste and Scheduled Tribe population in the district are 5.8 percent and 10.5 percent respectively. About 45 percent of the total population comprises the workers and 55 percent of the total population is non-workers. 56.9 percent of the working population in the district is male. Of the entire working population in the district, 39.7 percent are Cultivators, 13.9 percent are agricultural labourers, 3.1 percent are Household industry workers and 43.3 percent are other workers. (District Census Handbook, 2011).

3.1.2 Topography and Climate

The district of Golaghat follows a continuous plain towards the north and southeast and quite heaving towards the southwestern part. The district enjoys a subtropical humid climate with humidity ranging from 93-95 percent in the morning and 53-75 percent in the afternoons. The recorded temperature ranges between 10^0 Celsius in winter to 38 ^{0} Celsius in summer. The intensity and duration are not uniform and the recorded annual average rainfall of the district is 172- mm.

3.1.3 Agriculture

Agriculture is an important source of income in the district and provides employment to about 54 percent of the district's working population. The district's soil, climate, and geography are very suitable for agriculture, especially for paddy cultivation. Hence, the major thrust is laid on paddy cultivation both by the farmers and the department of agriculture in the district. Paddy, vegetables, sugarcane, pulses, plantation crops, spices and wheat are commonly grown in the district. A total area of 70544 hectares is under the high yielding variety(HYV) of paddy of which autumn

paddy covers about 1.65 percent and yields about 2426 kilograms per hectare. Winter paddy covers about 93.21 percent and yields about 2959 kilograms per hectare and summer paddy covers about 5.14 percent and yields about 3353 kilograms per hectare. Since paddy is the main crop produced in the district, the following discussion will be based on the crop. Table 3.1 shows the percentage share of Golaghat district in paddy production of the state from 2010-11 to 2017-18

Table 3.1 Percentage share of Golaghat district in Paddy production of the state since 2010-11

Year	Area			Production		
	Autumn Paddy	Winter Paddy	Summer Paddy	Autumn Paddy	Winter Paddy	Summer Paddy
2010-11	0.79	5.65	0.91	2.30	9.88	1.11
2011-12	0.90	5.38	1.16	2.44	10.02	1.71
2012-13	0.83	6.33	1.13	1.37	11.63	1.59
2013-14	0.99	6.17	1.48	1.51	10.30	0.87
2014-15	1.18	6.01	1.80	1.67	9.12	0.19
2015-16	1.24	5.60	2.44	1.86	8.85	2.65
2016-17	1.44	5.56	2.46	2.13	8.58	2.70
2017-18	1.66	5.48	2.49	2.81	8.35	2.75

Source: Government of Assam, Various issues of Statistical Handbook of Assam, Directorate of Economics and Statistics, Guwahati

From Table 3.1, it is evident that the area under Autumn paddy and Summer paddy has increased over the years but fluctuation is seen in the area under winter rice. About 0.79 percent of the total area under autumn paddy in Assam was shared by Golaghat district in 2010-11, which increased to a percentage share of 1.66 percent in 2017-18. The district shared about 5.6 percent of the total area under winter paddy in the state, which increased to 6.33 percent share in 2012-13 but after that, it again decreased and finally, in 2017-18 the district shared about 5.48 percent of the area under winter paddy. Although, on one hand, there is a decrease in the area under winter paddy in the district, on the other hand, the area under summer paddy has increased substantially. There has been a steady increase in the area under summer

paddy from sharing 0.91 percent of the total area under summer paddy in the state in 2010-11 to sharing 2.49 percent in 2017-18.

It is also evident from Table 3.1, that there is fluctuation in the percentage share of Golaghat in the production of Paddy, although it has increased in 2017-18 in comparision to its share in 2010-11, except for the share in winter paddy production. The district's percentage share in the states production of Autumn paddy declined from 2.44 percent in 2011-12 to 1.37 percent in 2012-13. However, after 2012-13, it increased continuously and in 2017-18 the district share in the production of autumn paddy was 2.81 percent. The districts' share in the state's production of winter paddy increased from 9.88 percent in 2010-11 to 11.63 percent in 2012-13, after which there has been a continuous decline and in 2017-18, the districts shared 8.35 percent of the total winter paddy produced in Assam. The district shared about 1.11 percent of the total summer paddy produced in the state in 2010-11 which increased to 1.71 percent in 2011-12. It, however, decreased to 1.59 percent in 2012-13 and further declined 0.19 percent by 2014-15 after which the district's share in the total summer paddy production increased to 2.65 percent in 2015-16 and further to 2.70 percent in 2016-17. In 2017-18 the district shared about 2.58 percent of the total summer paddy produced in the state of Assam. Thus, the data for Golaghat district's percentage share in terms of area and production of paddy in Assam reveal an increase in the area for autumn paddy and summer paddy shared by the district. But fluctuation is seen in the district's share in the production of the two categories of paddy. In the case of winter paddy, the area under winter paddy shared by the district has declined steadily since 2012-13 and so has the share of winter paddy production.

3.1.4 Consumption of Fertiliser

Fertiliser as an input plays a vital role in supplementing the productivity of crops. The Government of Assam has laid stress on meeting the farmers' fertiliser-demand on time. However, the farmers in the state do not show much interest in investing in fertilizer because of the loss caused by heavy rainfall and floods and hence the consumption of fertilizer is very low (Economic Survey of Assam, 2017-18). Table 3.2 shows the consumption of fertiliser in the district of Golaghat from 2011-12 to 2018-19.

Table 3.2 Consumption of fertilizer in Golaghat district from 2011-12 to 2018-19

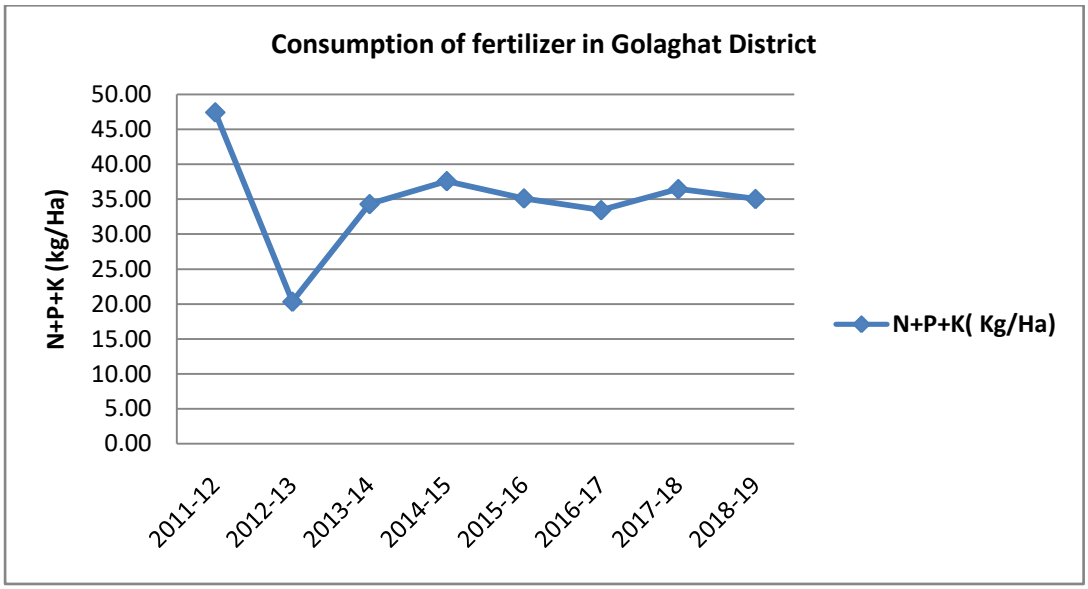
Year	N+P+K	Consumption(Kg/H)
2011-12	6327.00	47.46
2012-13	2692.48	20.33
2013-14	6245.84	34.32
2014-15	6845.84	37.61
2015-16	6428.66	35.13
2016-17	6120.58	33.45
2017-18	6674.72	36.47
2018-19	6519.85	35.05

Source: Government of Assam, Various issues of Statistical Handbook of Assam, Directorate of Economics and Statistics, Guwahati

Refer to Table 3.2, which depicts fluctuation in the consumption of fertilizer. Although it does not exhibit any definite trend, the consumption of fertilizer, however, has declined over the years from 47.46 kilograms per hectare in 2011-12 to 35.05 kilograms per hectare in 2018-19. After seeing a reduction in 2012-13 the consumption of fertilizer in the district increased up to 37.61 kilograms per hectare in 2014-15 but it again declined to 33.45 kilograms per hectare by the next two years. In 2017-18 the consumption of fertilizer was 36.47 kilograms per hectare which declined to 35.05 kilograms per hectare in 2018-19. Table 3.2 is illustrated with the help of Figure 3.1, where it can be seen that the consumption of fertilizer in the Golaghat

district over the years has fluctuations that do not follow any definite trend, however, on average it seems to be around 35 kilograms per hectare.

Figure 3.1 Consumption of fertilizer in Golaght district from 2011-12 to 2018-19



Source: Government of Assam, Various issues of Statistical Handbook of Assam, Directorate of Economics and Statistics, Guwahati

3.2 Status of ATMA in Golaghat District

Golaghat district in Assam is one of the 14 districts of the state in which CSS-ATMA is operating since its nationwide inception. It is managed by the Assam Rural Infrastructure and Agricultural Services Society (ARIAS) since 2012. The ATMA in the district follows a decentralized, bottom-up approach for efficient allocation of the extension machinery and to ensure effective participation of the farmers in the planning and resource allocation. The Deputy Project Director is the head of ATMA and as a nodal officer is responsible for the management of extension activities in the district. The ATMA Management Committee (AMC) is responsible for coordinating and integrating research and extension activities within the district. The AMC constitutes heads of all line departments and research organizations within the district and is chaired by the deputy project director. It scrutinizes the Block Action Plan (BAP) and sends it to the ATMA governing board for its final approval.

Table 3.3 Current status of ATMA functionaries in Golaghat District

Sl.No.	Level	Functionary	Number
1	District	Project Director	1
		Deputy Project Director	1
		Accountant cum Clerk	1
		Computer Programmer	1
2	Block	Block Technology Manager (BTM)	8
		Assistant Technology Manager (ATM)	8

Source: ATMA, District Agriculture Office, Golaghat

There are 8 blocks in the districts namely - Golaghat, Bokakhat, Morangi, Sarupathar, Gomariguri, Podumoni, Dergaon, Kathalguri and Kakodonga. Each block has a block ATMA cell consisting of the Block Technology Team (BTT) and Block Farmers Advisory Committee (BFAC) which are responsible for the implementation of the Block Action Plan. The Block Technology Team consists of block-level officers of Agriculture and Line Departments and the Block Farmers Advisory Committee consists only of the farmers. And finally, at the village level, the Village Level Extension Worker (VLEW) is in charge of the extension works and taking the help of the Farmers' interest groups (FIG) and Progressive Farmers the VLEW prepares the village level action plan. According to the 'Guidelines for Support to State Extension Programmes for Extension Reforms (ATMA) Scheme, 2018' ATMA component is implemented through an institutional mechanism at various levels in the State, District and the Block level. The guidelines state that Committees should be set up at various levels. At the district level, ATMA comprises three Committees namely, ATMA Governing Body, ATMA Management Committee and District Farmers Advisory Committee (DFAC). The Block level committee of ATMA comprises of Block Technology Team (BTT), Block Farmers Advisory Committee (BFAC). To accelerate and properly implement the scheme specialist and functionary support at

the various level have been set up. The current status of ATMA functionaries at the different level in the Golahat district is shown in Table 3.3

3.2.1 Activities undertaken by ATMA in Golaghat

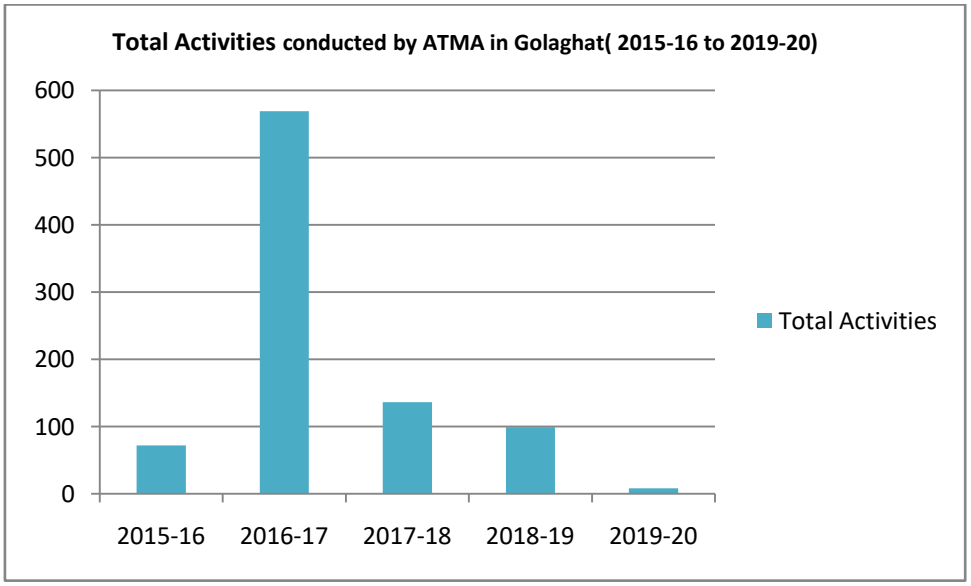
Agriculture Technology Management Agency has been functioning since its inception in the district and following the cafeteria of activities laid down for ATMA, has extended services for the development of agriculture and its allied activities in the district. Table3.4 presents the activities undertaken by ATMA in Golaghat district for the available date from 2015-16 to 2019-20.

Table 3.4 Activities undertaken by ATMA in Golaghat (2015-16 to 2019-20)

Year	Training	Exposure Visit	Demonstration	Total	Kishan Mela	FIGs established	Farm School Established
2015-16	0	0	72	72	0	8	0
2016-17	136	41	392	569	1	24	16
2017-18	16	0	120	136	1	8	8
2018-19	16	11	72	99	1	0	0
2019-20	8	0	0	8	1	0	0

Source: ATMA, District Agriculture Office, Golaghat

Figure 3.2 Activities undertaken by ATMA in Golaghat (2015-16 to 2019-20)



Source: ATMA, District Agriculture Office, Golaghat

From the table, it can be seen that the most number of activities were conducted in 2016-17 which has slowly reduced over the years. Training and demonstrations hold the highest activities conducted by ATMA in the district while a Kisan Mela(Farmers Fair) is organised every year as seen from the data available for 2015-16 to 2019-20. The total number of activities is seen to be decreasing across the years from 2016-17 to 2019-20, as seen from figure 3.2.

3.2.2 Total Beneficiaries of the Activities conducted by ATMA

Agriculture Technology Management Agency has been functioning since its inception in the district and following the cafeteria of activities laid down for ATMA, has extended services for the development of agriculture and its allied activities in the district. The farmers in the district have also been adopting the technologies provided to them by ATMA and implemented the new farming techniques in the agriculture fields. Table 3.5 presents the beneficiaries of ATMA in Golaghat district for the available date from 2015-16 to 2019-20.

Table 3.5 Beneficiaries of ATMA activities in Golaghat District (2015-16 to 2019-20)

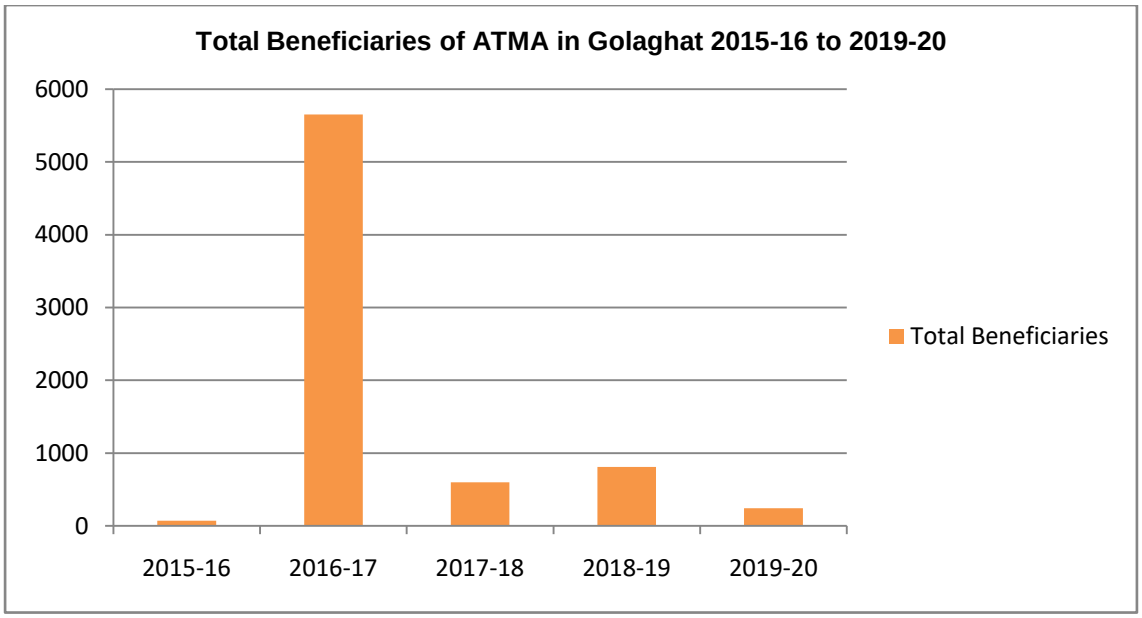
Year	Training	Exposure Visit	Demonstration	Total	FIGs established	Farm School Established
2015-16	0	0	72	72	80	0
2016-17	4030	1230	392	5652	240	16
2017-18	480	0	120	600	80	8
2018-19	480	330	0	810	0	0
2019-20	240	0	0	240	0	0

Source: ATMA, District Agriculture Office, Golaghat

The table shows the number of beneficiaries of training conducted by ATMA is more in all the periods. In 2016-17 the number of beneficiaries from all the activities conducted is found to be highest with 5652 farmers being benefitted. There are fluctuations in the number of farmers being benefitted over the years as seen from

figure 3.2. In 2019-20 the total number of farmers benefited from the activities conducted by ATMA in the district fell to 240 from 810 farmers in 2018-19.

Figure 3.3 Beneficiaries of ATMA activities in Golaghat District (2015-16 to 2019-20)



Source: ATMA, District Agriculture Office, Golaghat

Chapter 4

Socio-Economic Profile of the Farmers in the Study Area

The social and economic position of a farmer influences his access to resources and livelihood pattern, his attitude towards sophisticated technologies. In this chapter, an attempt has been made to understand the socio-economic profile of the farmers in the study area. One hundred and sixty farmers from the study area were sampled following the Multi-staged Stratified Random Sampling method and were interviewed by using a structured questionnaire by the researcher. Statistical tools like frequency and percentage and mean and standard deviation were used to analyse and interpret data. A comparision between the beneficiaries and the non-beneficiaries of ATMA has also been made to understand the differences in the socio-economic status of the two groups of farmers.

4.1 General characteristics of the sampled farmers

The sampled farmers' socioeconomic profile helps to understand the characteristics of the farmers households in the study area. Table 4.1 provides information on the general characteristics of the sampled farmers which helps to identify the broad socio-economic characteristics of the farmers in the study area.

Table 4.1 General characteristics of the sampled farmers

Variable	Unit	Min	Max	Mean	SD
Age	Years	25.00	70.00	43.52	9.41
Education	Years	0.00	17.00	9.84	3.52
Land-holding	Hectare	0.40	2.68	1.26	0.66
Family Size	Number	2	8	4.76	1.161
Experience	Years	1.00	50.00	26.36	10.15
Production	Quintal	12.00	200.00	60.98	38.49
Income	Rupees	50000.00	300000.00	106631.30	62346.18

Source: Estimation based on the field survey conducted by the researcher

Efforts have been made to understand the level of living of the farmers through the sampled farmers' age, experience in agriculture and allied activities, years of schooling, operational land holding, production and annual income. The general

characteristics of the sampled farmers in the study area are illustrated in Table 4.1. It is evident from the table that on average most of the farmers are adults. The average year of schooling of the sampled farmers is about ten years which implies that farmers in the study area have completed high school education level. The average land-holding of the total sampled farmers is 1.26 hectares, which indicates that most of the farmers are small and marginal holders, but they seem to have considerable farming experience in paddy cultivation, as evident from Table 4.1 which shows the average experience of the farmers to be of nearly two and a half decades. The average family size of the sampled farmer household is about 5 members. It is also seen that on average the farmers produce 60.98 quintals of paddy and their average annual income is about INR 106631.

Table 4.2 General characteristics of the beneficiary farmers

Variable	Unit	Min	Max	Mean	SD
Age	Years	25.00	59.00	43.52	7.784
Education	Years	0.00	17.00	10.16	3.830
Land-holding	Hectare	0.40	2.68	1.32	0.589
Family Size	Numbers	3	8	4.85	1.091
Experience	Years	10.00	47.00	29.41	8.343
Production	Quintal	12.00	176.00	73.62	44.271
Income	Rupees	50000.00	298000.00	129267.50	70277.08

Source: Estimation based on the field survey conducted by the researcher

Table 4.2 presents information on the general characteristics of the sampled beneficiary farmers in the study area which reveals that on average most of the farmers are adults. The average years of education as seen in the table is about 10 years implying that the beneficiary farmers have completed their high-school level of education. The average land-holding of the sampled beneficiary farmers is 1.32 hectares, which indicates that the beneficiary farmers comprise mostly of the small and marginal farmers but they seem to have considerable years of experience in agriculture. The average family size of the sampled beneficiary farmer household is

about 5 members. The beneficiary farmers produce about 74 quintals of paddy on average and their average income is about INR 1.29 lakhs.

Table 4.3 General characteristics of the non-beneficiary farmers

Variable	Unit	Min	Max	Mean	SD
Age	Years	25.00	70.00	43.78	10.839
Education	Years	3.00	17.00	9.52	3.237
Land-holding	Hectare	0.40	2.94	0.84	0.428
Family Size	Number	2	8	4.68	1.228
Experience	Years	1.00	50.00	23.30	10.894
Production	Quintal	16.00	200.00	48.33	26.413
Income	Rupees	50000.00	298000.00	83995.00	42972.73

Source: Estimation based on the field survey conducted by the researcher

Table 4.3 reveals that like the beneficiary farmers, on average the non-beneficiary farmers are adults. They comprise mostly small and marginal farmers who have completed their elementary-school level of education and seem to have considerable years of experience in agriculture. The non-beneficiary farmers produce about forty eight quintals of paddy on average and their average income is about INR.83995.

Table 4.4 Operational land-holding of the sample farmers

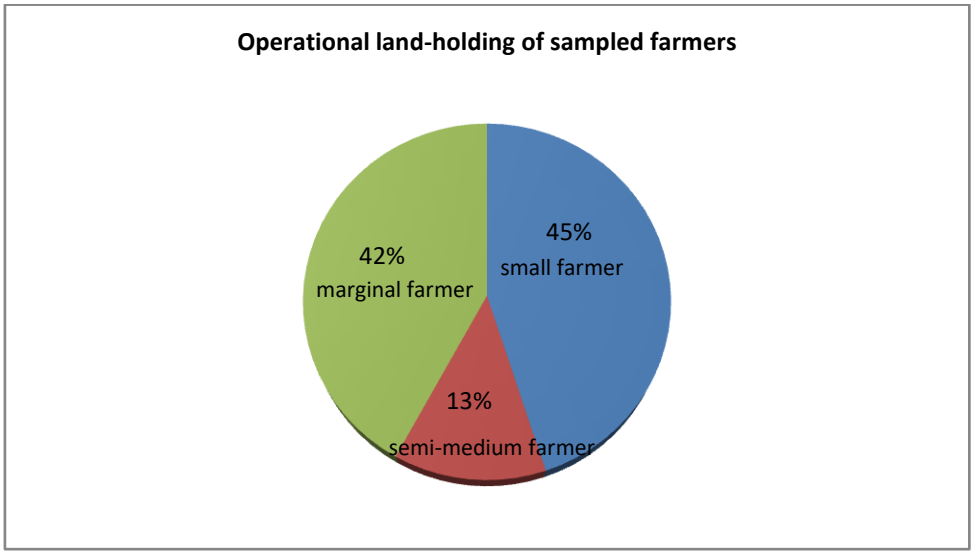
Sl. No	Operational Land-holding of farmers		
	Classification	Size of land-holding(in hectares)	Total (%)
1	Marginal	Less than 1	42.00
2	Small	1 to 2	45.00
3	Semi-Medium	2 to 4	13.00
4	Medium	4 to 10	00.00
5	Large	Above 10	00.00
Total			100.00

Source: Estimation based on the field survey

In the agricultural census, farmers are categorized into five different groups as marginal, small, semi-medium, medium and large farmers, according to their land-holding. Marginal farmers are the farmers who hold land less than one hectare. Small farmers are categorized as farmers having land from one hectare to two hectares. While the semi-medium and the medium category include farmers holding sizes

between two hectares to four hectares and between four hectares to ten hectares, respectively, the farmers holding land above ten hectares are categorized as large farmers. The classification of the sampled farmers according to the size of their operational land-holding can be seen from, Table 4.4. It is evident that the marginal farmers and the small farmers hold a lion's share of the operated land while semi-medium farmers hold only 13 percent of the operational land. The marginal farmers and the small farmers have 42 percent and 45 percent of the operational land, respectively. The following pie diagram clearly illustrates the categorization of the farmers in the study area, according to the size of their operational land-holding.

Figure 4.1 Operational land-holding of the sampled farmers



Source: Estimation based on the field survey

4.2 Comparing the Beneficiary farmers and the non-beneficiary farmers

To understand the difference in the socio-economic status of the non-beneficiary farmers and the beneficiary farmers of ATMA, the two groups of farmers have been compared on the basis of variables like age, education, ownership of farm power, land-holding, family size, income and caste. Comparing the two groups of farmers based on these variables helps assess and understand the level of living of the

farming households. The selected variables along with their frequency distribution have been discussed separately.

4.2.1 Education

Education stands as an important indicator of the living standard of living. It determines the effort required by the extension workers to provide training and convince them to adopt a technology. Table 4.5 presents the classification of the two categories of farmers according to their attained level of education.

Table 4.5 Distribution of respondents according to their level of education

Sl. No.	Categories	Beneficiary Farmers		Non- Beneficiary Farmers	
		Frequency	Percentage	Frequency	Percentage
1	Illiterate	5	6.25	0	0
2	Primary	2	2.5	2	2.5
3	Elementary	9	11.25	22	27.5
4	High School	23	28.75	25	31.25
5	Intermediate	30	37.5	22	27.5
6	Graduate and above	11	13.75	9	11.25
Total		80	100	80	100

Source: Estimation based on the field survey

From Table 4.5 it is seen that the majority of the beneficiary farmers have completed their Intermediate education whereas majority of the non-beneficiary farmers have completed high school education. In the case of the beneficiaries, the percentage of farmers who have completed High School, Intermediate and Graduate and above is 28.75 percent, 37.5 percent and 13.75 percent respectively. And the case of non-beneficiaries, the percentage of farmers who have completed High School, Intermediate and Graduate and above are 31.25 percent, 27.5 percent and 11.25 percent respectively. Illiteracy percentage is nill in case of non-beneficiary whereas in the case of beneficiaries it is as low as 6.25 percentage. The beneficiary farmers are better of in term of education.

4.2.2 Family Size

The family size of a farm household affects his income and expenditure and establishes imputed labour. It is commonly believed that since labour is distributed more easily in large families, hence, it becomes easier for families of this type to bear more risks. Table 4.6 presents the classification of the two categories of farmers according to their family size.

Table 4.6 Distribution of respondents according to their family size

Sl.No.	Category	Beneficiary Farmers		Non- Beneficiary Farmers	
		Frequency	Percentage	Frequency	Percentage
1	Small(upto 5 Members)	59	73.75	59	73.75
2	Medium(6 to 8 members)	21	26.25	21	26.25
Total		80	100	80	100

Source: Estimation based on the field survey

The table shows that the farm households in both the categories of farmers shared similar characteristics, in terms of size. The small family shared about 74 percent of the farmers in both categories and the medium-sized family shared about 26 percent of farmers in both categories.

4.2.3 Land Holding

The size of land held by a farmer is often considered an important determinant in his/her decision to adopt the technology. It is often a decisive factor in his participation in an extension programme and it also is essential to successfully implement technology or use any special machinery. It also determines the farmer's purpose and quantity of production. A marginal farmer does not have enough land for commercial cultivation and mostly cultivates for household consumption and the surplus is used for commercial purposes. Unlike the marginal farmers, the large farmers produce more by owning more land to cultivate for commercial purposes.

Table 4.7 Distribution of respondents according to their size of land-holding

Sl.No.	Land Holding	Beneficiary Farmers		Non- Beneficiary Farmers	
		Frequency	Percentage	Frequency	Percentage
1	Marginal Farmers (below 1 ha.)	36	45	31	39
2	Small (1 to 2 ha.)	32	40	40	50
3	Semi-Medium (2 to 4 ha.)	12	15	9	11
4	Total	80	100	80	100

Source: Estimation based on the field survey

From Table 4.7, it is observed that most of the farmers in both categories of farmers are small and marginal farmers. 45 percent of the beneficiary farmers are marginal farmers whereas 39 percent of the non-beneficiary farmers hold land below 1 hectare. 40 percent of the beneficiary farmers comprised small famers and similarly, 50 percent of the non-beneficiary farmers marginal farmers. Semi-medium farmers comprised 15 percent of the beneficiaries and 11 percent of the non beneficiaries. Table 4.7 reveals that the small and marginal farmers comprised of 85 percent of beneficiary farmers and 89 percent non-beneficiary farmers.

4.2.4 Farm Power Possession

Possession of farm power indicates the farmers' ability to cultivate on a large land area and produce more. It also shows his level of income and living standard. Refer to Table 4.8, which shows the distribution of respondents according to their farm power possession.

Table 4.8 Distribution of respondents according to their farm power possession

Items	Beneficiary Farmers		Non- Beneficiary Farmers	
	Frequency	Percentage	Frequency	Percentage
Tractor	6	7.50	3	3.75
Power tiller	37	46.25	8	10.00
Bullock pair	0	0	0	0
Threshing Machine	0	0	0	0
Electric motor set	56	70	32	40

Source: Estimation based on the field survey

About 7.5 percent and 46.25 percent of the beneficiary farmers own tractor and power tiller respectively. But only about 4 percent of the non-beneficiary farmers have a tractor and 10 percent of them have a power tiller. The Farmers in the district seem to have given up with traditional farming and have adopted modern farming to adopt agricultural machinery. The farmers who do not own any machinery, hire them when required. 70 percent of the beneficiary farmers own electric motor sets while only 40 percent of the non-beneficiaries own this farm equipment. It is however worth mentioning that, the motor is used for irrigation only in rabi crop cultivation

4.2.5 Farming Experience

A farmer's knowledge is tied with his action or experience. It shows the number of years the farmer has engaged himself in agriculture and allied activities. The more the farmer's experience, the more he can monitor and evaluate his activities and adjust and readjust his/her decision whenever he discovers his lack of knowledge. In the process, he increases his knowledge and ability by learning and doing. Adoption of technology by the farmer is often determined by the farmers' experience (Giddens 1984).

Table 4.9 Distribution of respondents according to their farming experience

Sl. No	Experience	Beneficiary Farmers		Non- Beneficiary Farmers	
		Frequency	Percentage	Frequency	Percentage
1	10 years and below	1	1.25	15	18.75
2	11 to 20 years	13	16.25	24	30.00
3	21 to 30 years	38	47.5	27	33.75
4	31 to 40 years	19	23.75	9	11.25
5	41 to 50 years	9	11.25	5	6.25
Total		80	100	80	100

Source: Estimation based on the field survey

Table 4.9 presents the distribution of the sampled farmers according to their farming experience. It is seen that most of the beneficiary farmers have years of experience

between 21 years to 30 years and it is the same for the non-beneficiary farmers. About 47.50 percent of the beneficiary farmers having experience between 21 years to 30 years, whereas it is about 33.75 percent in the case of the non-beneficiary farmers. If an experience above 21 years is considered as the differentiating age of experiences between the two group of, then it is seen that about 49 percent of the non- beneficiary farmers have years of experience less than 21 years whereas it is only 17.50 percent in the case of the beneficiary farmers.

4.2.6 Family annual Income

The income of the farm household is the estimated annual income earned by the respondent in a year. Table 4.10 presents the distribution of farmer households based on their annual family income. It is evident that most of the farmers in both categories have a yearly family income of Rupees 50000 and above. Only 10 percent of the beneficiary farmers have an annual income of less than Rupees 50000 and in the case of non-beneficiary farmers it is about 14 percent. 63 percent of the beneficiary farmers have income above Rupees One lakh while only 17 percent of the non-beneficiary farmers have income above Rupees 1 lakh.

Table 4.10 Distribution of respondents according to their family income

Sl. No.	Income	Beneficiary Farmers		Non- Beneficiary Farmers	
		Frequency	Percentage	Frequency	Percentage
	Below 50000	8	10.00	11	13.75
1	50001 to 100000	29	36.25	55	68.75
2	100001 to 1500000	16	20.00	8	10.00
3	1500001 to 200000	11	13.75	5	6.25
4	200001 and above	16	20.00	1	1.25
Total		80	100	80	100

Source: Estimation based on the field survey

4.2.7 Caste

Table 4.11 presents the distribution of the respondent farmers according to the social category to which they belong. A perusal of the table gives the idea that most of

the farmers in the district belong to the Other Backward Castes (OBC) category. About 74 percent of the beneficiary farmers belong to the OBC category and about 86 percent of the non-beneficiary farmers belong to the OBC category. Unlike the farmers of Scheduled Caste(SC) and Scheduled Tribe(ST) who comprise about 9 percent and 5 percent of the beneficiary farmers respectively, the Farmers belonging to Schedule caste comprised only 5 percent of the Non-beneficiary farmers with the share of Scheduled Tribes farmers being nill. Farmers belonging to the general category from both the category of farmers are 12.50 percent and 9 percent, respectively. It can thus be seen that most of the farmers from both the category of farmers belong to the Other Backward Castes category.

Table 4.11 Distribution of respondents according to their social category

Caste	Beneficiary Farmers		Non- Beneficiary Farmers	
	Frequency	Percentage	Frequency	Percentage
SC	7	8.75	4	5.00
ST	4	5.00	0	0.00
OBC	59	73.75	69	86.25
GENERAL	10	12.50	7	8.75
Total	80	100.00	80	100.00

Source: Estimation based on the field survey

Chapter 5

Impact of Extension Provided By ATMA

Extension services, in the form of training, exposure visit, field demonstration and new technology distribution, have been delivered to the farmers in the district by the Agriculture Technology Management Agency, since its inception. By employing the Propensity Score Matching Technique, attempt has been made, in this chapter, to assess and understand the impact of extension services provided by ATMA in the Golaghat district of Assam. This chapter is divided into two sections. The first section attempts to understand the impact of extension services and the second section discusses the drawbacks and limitations of the extension services provided by ATMA in the Golaghat district of Assam. The analysis was carried forward using STATA 13 software.

5.1 Test of Significance in Socio-Economic Variables

The perusal of Table 5.1 shows that there is significant mean difference in Production and Income between the beneficiaries of ATMA and the non- beneficiary farmers who have not received any benefits from ATMA. A statistically significant difference in the production between the two categories of farmers, with a mean production difference of about 25 kilograms, is seen in the table. The observation is similar between the two groups of farmers in terms of Income. A statistically significant difference in the income between the two categories of farmers, with a mean income difference of INR.45272, is noticed from the table. However, no statistically significant differences are noticed in the other variables between the farmers who have received extension services form ATMA and the Farmers who have not received any agricultural extension benefits, as seen in table 5. 1. Therefore, it can

be said that there is significant evidence that to support the fact that extension services provided by ATMA impact the farmers' production and income.

Table 5.1 Test of Significance in Socio-Economic Variables

Variables	Beneficiaries	Non-Beneficiaries	Mean Difference	t (SE)
Age	43.52 (7.78)	43.78 (10.83)	-.5375	-0.3603 (1.491)
Education	10.16 (3.83)	9.52 (3.23)	.6375	1.1370 (.560)
Family Size	4.85 (1.09)	4.68 (1.22)	.1625	0.8844 (0.183)
Land-Holding	1.34 (0.77)	0.84 (0.38)	.5003	1.4578 (0.146)
Income	129000 (70277.08)	83995 (42972.73)	45272.5	4.9157*** (9209.725)

Source: Estimation based on field survey. Note: *** indicates significant at 1 percent level of Significance

5.2 Treatment Effect

Treatment effect refers to the average causal effect of a binary variable on an outcome variable of interest. In this study, it refers to the effect of extension services delivered by ATMA on the productivity of the farmers. One of the major problems in estimating treatment effects is the selection biases that arise because of the differences between the treated and non-treated groups for reasons other than treatment status per se. To correct this potential sample selection biases in the data, Propensity Score Matching (Rosenbaum and Rubin,1983) as mentioned in Chapter 1, is employed in the study. Propensity Score Matching refers to pairing treatment and controlled observations with similar values on their propensity score and possibly other covariates (Rubin, 2001). This technique has been employed in the assessment of agriculture extension services by Heckman (1997) and Ali and Rahut (2013).

For estimating models with limited dependent variables, logit and probit models are the standard approaches. However, both methods yield analogous results when employed to estimate the probability of an individual farmer being or

beneficiary or non-beneficiary (Caliendo et al., 2005). In this study, the Probit model, with extension beneficiary as the dependent variable and other demographic and socioeconomic variables as explanatory variables, is used to estimate the propensity scores. It is preferable to either include those variables that affect the outcome or those variables that affect both treatment selection and the outcome (Austin et al, 2007). All the estimations were done using the "pscore.ado" module in the STATA software. The result of the Probit Regression, based on which the propensity scores were estimated, is presented in Table 5.2

Table 5.2 Results of Probit estimation of propensity scores

Explanatory Variables	Coefficients	P value
Age	- 0.105 (0.022)	0.000
Education	0.037 (0.034)	0.255
Experience	0.111 (0.019)	0.000
Family size	- 0.040 (0.105)	0.703
Land holding	0.860 (0.336)	0.000
Income	0.000 (3.120)	0.010
Constant	1.060 (0.854)	0.214
Number of Observation		160
LR X^2 (6)		69.41
P > X^2		0.000
Pseudo R^2		0.312

Source: Estimation based on field survey data

The dichotomous variable extension beneficiary was treated as the dependent variable that assumed a value of "1" if the farmer household was a beneficiary and "0" if not. The explanatory variable included the farmer's age, the farmer's experience in paddy farming, size of land-holding of the farmers, and the farmer's income. The probability of the LR χ^2 statistic is 0.000, indicating that the estimated probit regression is significant at a 1 percent level. The table shows that the farmers' participation in the extension services is significantly influenced by age, experience, land-holding and income. The variable age has a negative sign indicating that younger farmers have a greater probability of receiving extension services and the probability

of participation in extension services decreases as the farmers get older. Similar finding was recorded by Suvedi *et al.* (2017). This implies that the younger farmers are the main audience of the extension services provided by ATMA. It could be due to the risk bearing nature of the young farmers than the older farmers. The coefficient of experience is positive and significant indicating that farmers with more years of experience in paddy farming had greater probability of receiving extension services delivered by ATMA. Similar findings recorded by Li *et al.* (2019), Mugisha and Ainembabazi (2013), however, suggest that experience determines the farmers attitude and decision towards adoption, retention and rejection of a technology. The coefficient of land is positive and significant indicating that land-ownership as an important factor for receiving extension services. Similarly, farmers with higher income had greator probability of receiving extension services. The farmers with higher income can purchase new technologies and bear their maintenance charges.

To proceed with the estimation of the Average Treatment Effect on the Treated (ATT), all the assumptions of propensity score matching have been achieved and the region of the "common support" is 0.005 and 0.999. Table 5.1A (See Appendix) presents the description of the estimated propensity scores in the region of common support. The mean value and the standard deviation of the estimated propensity score within this region of common support are 0.513 and 0.290 respectively. The balancing property of the was satisfied and the estimated propensity scores are categorised into five blocks which ensured that the mean propensity score of the treated and control group in each block is not different and facilitates matching to be done with minimum bias. Table 5.1B (see Appendix) presents the description of the five blocks into which the propensity were categorised.

The propensity score matching results for the Average Treatment Effect on the Treated (ATT) are presented in the Table 5.4. Different matching algorithms like Nearest Neighbour Matching (NNM), Radius Matching (RM), Kernal Matching (KM) and Stratification Matching(SM) were employed for the analysis. The outcome variable is the total paddy production.

Table 5.3 Effect of extension services provided by ATMA on paddy output: Matching Estimates

Matching Algorithm	Outcome Variable	ATT	Standard Error	Number of Treated	Number of Observed
NNM	Paddy production	2.075	5.401	80	26
KM	Paddy production	4.349	5.678	80	78
RM	Paddy production	5.385	2.815	62	77
SM	Paddy production	0.466	8.625	80	78

Source: Estimation based on field survey data

From the above discussion, it is seen that the total production of the beneficiary farmers is more than the non-beneficiaries. The ATT results from the different matching methods indicate that the difference of the total production of the beneficiaries and the non-beneficiaries ranges between 0.47 quintals to 5.38 quintals.

5.3 Drawbacks and limitations of the extension services provided by ATMA

This section discusses the problems and the drawbacks in extension services delivered by ATMA in the Golaghat district of Assam. In order to understand the possible drawbacks and the problems of the extension services, beneficiary farmers in the district were interviewed using a structured interview schedule which included questions on the frequency of contacts between the farmers and the ATMA members, time and quality of supply of technology and inputs and the practical applications of the new techniques or practices taught or advised by ATMA. The sampled farmers

were also interviewed regarding sources of extension services other than ATMA in the district.

5.3.1 Awareness about ATMA

About 40 percent of the ATMA beneficiaries were unaware of the existence of ATMA and its functions. They believed that the extension benefits they received were provided from the district agriculture office and not from ATMA. This happened because in most cases the Village Level Extension Worker or the Krishak Bandhu, which is the Assamese term for Farmer Friend, acted as a mediator between the ATMA and the farmers and had not explained to them regarding the work of ATMA. The farmers who lacked awareness about ATMA rarely visited the Office of ATMA, except for the times when new machinery was introduced and distributed, while most of the times they depended on the Village Level Extension Worker(VLEW) or Krishak Bandhu for information on new technologies and cited the distance from the Office, means of conveyance and the daily farm work as reasons for not visiting. None of the non-beneficiary farmers were found to be aware of the existence of ATMA and its functions in technology dissemination in the district. They had little knowledge about the VLEW and the Krishak Bandhu in their locality. The village farmers and private input dealers acted as the main source of information about new technology and practices to these farmers.

5.3.2 Supply of Inputs and technology

About 55 percent of the beneficiary farmers stated the delivery of seeds and fertilizers and essentials inputs for production are not delivered in time and are delivered to the farmers at the end of the season. This creates a risky situation for the farmers as they have to cultivate the new seed variety at the season end, which creates a probability of less production of the crop. The supply of fertilizers from ATMA is

also behind time as learned from the farmers. And in most cases, the farmers have to go without fertilizers or manage their fertilizers for the crops which often leads to drastic results due to little knowledge on behalf of the farmers regarding the fertilizer requirement of the crop variety.

5.3.3 Quality of seed and Seed Replacement

On interviewing the farmers it was found that about 20 percent of the beneficiary farmers complained about the quality of seeds and the lack of a seed replacement mechanism. These farmers stated that the seed technology they received were of poor quality in extreme cases, the seeds never sprouted. Lack of seed replacement mechanism was observed in the study area as seeds were not replaced by ATMA even after being informed by the farmers, and, as a result, the farmers, after a few days of waiting, had to do with the local seeds of better quality than the seed provided by ATMA. However, 80 percent of the beneficiary famers' had received good quality seeds which yielded better than the local and owned seeds.

5.3.4 Practical applicability of the new techniques and technologies.

About 50 percent of the farmers who had attended training, field demonstrations and exposure visits stated that these activities helped in enriching their agricultural knowledge. However, the new techniques learned during these activities were either expensive or time-consuming or not implementable because of local conditions and threats like rodents, wild animals and natural calamities like floods.

5.3.5 Threats from Natural calamities and wild animal

Floods and Wild animals pose a threat to the farmers in the district. While wild elephants cause a lot of destruction to the crops in the Morangi block, monkeys

eat up the grains in the Kathalguri block, and leave very little to harvested. Floods clear up the crop fields in the Morani, Kakodonga and Kathalguri blocks.

5.3.6 Unreliable technology dissemination

Although the dissemination of technology by ATMA is prevalent in the district, the farmers' doubted the technology. 25 percent of the farmers complained that the new technology especially the seeds were not reliable because of the delayed sprouting and inadaptability to the local condition. These farmers stated that due to delayed sprouting, transplanting and harvesting, the produce from the new crop varieties was often attacked by birds and rodents in the field and as a result, they preferred to use the local varieties. On interviewing the farmers it was also learnt that the new seed varieties distributed by ATMA often was a mixture of different varieties and did not follow uniformity in yield.

Chapter 6

Findings and Conclusion

Agriculture extension services help the farmers in successfully adopting innovations and making more efficient use of their land and allied resources (Melkote,1998). Under the National Mission on Agricultural Extension and Technology (NMAET) the Government of India focuses on increasing knowledge and awareness among farmers with a motive of raising the production level and productivity of the farmers at the district level. Under this mission, the ATMA is working in 676 districts in 29 states and 3 Union Territories and bears the onus of disseminating agricultural technology through extension services like Farmers Training, Demonstration, Exposure Visits, Kisan Mela, Mobilisation of Farm groups and setting up Farm Schools at the district level (Ministry of Agriculture and Farmers Welfare, India). In order to understand the role of ATMA at the district level, this study was undertaken in Golaghat district of Assam with the following four objectives:

a) To evaluate the current status of extension services provided by ATMA in Assam.
b) To study and compare the socio-economic status of the beneficiary and non-beneficiary farmers of CSS-ATMA
c) To evaluate the impact of extension provided by ATMA in enhancing the production of paddy.
d) To identify the drawbacks and limitations in the extension services provided by CSS-ATMA

The first objective was an attempt to understand the existing status of ATMA in the state of Assam as well as in the North-Eastern states of the country, with the available data obtained from different secondary sources. An attempt was also made to understand the current status of extension services provided by ATMA in Golaghat district of Assam. With field-level data collected from 4 randomly selected blocks by interviewing 160 farmers by using a structured interview schedule, the second and the third objectives of the study attempts to understand the impact of ATMA in Golaghat district of Assam. The Fourth objective in this study was to understand the drawbacks and limitations of the extension services provided by ATMA in the study area. Keeping in mind the study's objectives, the following section summarises the major findings of the study.

6.1 Status of extension services provided by ATMA in Assam

From the analysis of the available data obtained from varied sources, in Chapter 2, it is learnt that Agriculture Technology Management Agency has provided extension services in the form of Exposure Visit, Training, Demonstration, Kisan Mela, formation of Farmers Interest Group and Establishing Farm Schools in Assam. The frequency of exposure visits has been decreasing over the years in Assam well as in the entire Northeast region and fluctuations are noticed in the participation of women in the exposure visits over the years. Participants in the training programs organized by ATMA are found to be increasing in the North-eastern region with participants in Assam decreasing over the years. However, the percentage of female participants over the years has increased in Assam as well as in the other North-eastern states of the country. This indicates the presence of a huge population of trained farmers on the varied technologies provided by ATMA. Fluctuations are seen in the number of participants as well as the frequencies of demonstration conducted

by ATMA in the northeastern states, but the percentage of participants in Assam is seen to be decreasing. However, the share of female farmers in the demonstrations organised by ATMA in the region as well as in the state of Assam has increased over the years. Although, an increase is seen in the number of participants in the kisan melas in the entire region of northeast India, the participation of farmers of Assam in the kisan melas is found to be decreasing, over the years. An increase is seen in the share of female participants in the region and Assam as well. The number of FIGs and farm school in all the states of the North-eastern region provide figures which follow a downward trend over the years. Thus, from the above discussion, it is found that, excepting training programs, the participation of farmers in the other activities of ATMA is found to be decreasing. However, ATMA has been able to include an increased share of female participants in the various activities; it has organized in the state, over the years.

ATMA in Golaghat district of Assam has delivered extension services in the form of Exposure Visit, Training, Demonstration, Kisan Mela and formation of Farmers Interest Group (FIGs) and establishing Farm Schools, as learned from discussions on the available data obtained from varied sources. ATMA, in the district, is in operation since its nationwide inception but the frequency of extension services conducted by the organization responsible for technology dissemination at the district level has declined over the years, as observed from the above discussion. Beneficiaries of the extension services provided by ATMA have also reduced to a large extent since its implementation in the district, over the years. Previous researches conducted by scholars and organisations have identified issues on which the growth and success extension services' dissemination relies upon. Limited field technicians for a large population with varied information-needs often weaken the research-extension-farmer

linkage (World Bank, 2016; FAO, 2010; Mendola, 2007; Kassie *et al.*,2011). Relevence and quality, adequacy, availability and timely access by farmers are the prime factors for an effective extension system (Zainuddin and Teh, 1982; Ander and Feder, 2004; Cunguara and Darnhofer, 2011; Lopokoiyit *et al.*, 2012). These factors also determine the participation of the farmers on the extension services being disseminated.

The agricultural scenario reveals the increase in the area and production of summer paddy and the decrease in the consumption of chemical fertilizer in the district of Golaghat over the years.

6.2 Comparing the socio-economic status of the beneficiary and non-beneficiary farmers of ATMA in Golghat District of Assam.

Discussion on the socio-economic profile of the farmers in the study area revealed that on average the farmers in the study area are adults, and have completed their elementary school education and are literate. Farmers in the area comprise mostly the marginal farmers and their average production of paddy is about 60 quintals per hectare. The comparision of the farmers based on a few selected variables revealed that the beneficiary farmers are better off in terms of experience, farm power ownership and productivity and income. The non-beneficiary farmers are better off in terms of education. Most of the farmers in both the group of farmers have small family sizes, belong to the category of Other Backward Castes (OBCs) and are marginal farmers whose land-holding below one hectare.

6.3 Impact of ATMA in Golaghat District of Assam

Extension services aims at disseminating new knowledge and skill to farmers to aid them in adopting new agricultural technologies and use their resources

efficiently. Agricultural knowledge improves their skill and decision-making and enhances more efficient utilization of agricultural technologies. (Melkote,1988; Anderson and Feder, 2007; Norton *et al.,* 2020). ATMA provides extension services to the farmers through capacity-building activities like Trainings, Demonstrations, and Exposure visits, Kisan Mela and formation of Farmer Interest Groups (FIGs) and Farm Schools.

These activities serve as the means of conveyance of agricultural knowledge from the extension agents of the ATMA to the farmers who utilize the acquired knowledge in their farm fields. The agriculture knowledge acquired by the farmers from the extension services which they receive serves as an important input in agriculture because it enhances their skill and decision-making in their agricultural activities. Timely usage of fertilizer and pesticides in the accurate dosage and the selection of the best technology related to the crop that is cultivated by the farmer rely on the decisions of the farmers. A careless decision can lead to drastic consequences like crop failure and low production. Extension services increases the farmers' agricultural knowledge and expertise which enhances their decision-making in adoption of technology, fertilizer and pesticides and also their managerial ability, which leads to increased production. The demonstration effect of the disseminated technology also attracts more farmers to adopt the technology.

In this study, it is found that after sharing similar characteristics, farmers who were beneficiaries of ATMA had total production higher than the farmers who had never received extension benefits in any form. Differences in the average production of the beneficiary farmers and the non-beneficiary farmers have been found in the study, with the average production of the beneficiary farmers being more than that of the non-beneficiary farmers. This difference in the total production of paddy between

the two groups of farmers can be credited to the utilization of the agricultural knowledge which the beneficiary farmers had received in the form of extension services provided by ATMA. The treatment effect analysis employed in the study revealed that the extension services provided by ATMA in the Golaghat district of Assam positively impact the income and production of the farmers.

Since the majority of the farmers in the district comprise small and marginal farmers, therefore, the extension activities undertaken by ATMA are projected mostly towards these farmers and towards paddy cultivation which is the main crop cultivated in the district. After being informed about the functions of ATMA in the district, the eagerness and enthusiasm of the non-beneficiary farmers to avail the services provided by ATMA were observed during the field survey. Like any other public project which has its snags, questionable drawbacks and limitations in the extension services provided by ATMA pertaining to timely supply and quality of technology were also found in the study.

6.4 Policy Recommendations

In order to function more effectively in the district, with more targeted farmers, initiatives by ATMA may help to create awareness among the farmer regarding its existence and function in the district. Keeping in mind the season and time for a technology to be disseminated, pre-delivery and post-delivery enquiry into the nature and quality of the technology distributed to the farmers, besides, developing a Technology Replacement Mechanism may help in building a strong and faithful relationship between the farmers and the Agricultural Technology Management Agency, thereby, more farmers benefitting from the extension activities provided.

References:

Abadie, A., Drukker, D., Herr, J. L., & Imbens, G. W. (2004). Implementing matching estimators for average treatment effects in Stata. *The Stata Journal , 4* (Number 3), 290-311.

Adhiguru, P., Birthal, P. S., & Kumar, B. G. (2009). Strengthening Pluralistic Agricultural Information Delivery Systems in India. *Agricultural Economics Research Review , 22*, 71-79.

Agholor, I. A., Monde, N., Obi, A., & Sunday, O. A. (2013). Quality of Extension Services: A Case Study of Farmers in Amathole. *Journal of Agricultural Science , 5* (2), 204-212.

Ainembabaji, J. H., Asten, P.V., Vanlauwec, B., Ouma, E., Blomme, G., Birachi, E.A., Nguezet, P.M.D., Migouna, D.B., & Manyong, V.M. (2017). Improving the speed of adoption of agricultural technologies and farmperformance through farmer groups: evidence from the Great Lakes region. *Agricultural Economics 48* , 241–259.

Ainembabazi, J. H., & Mugisha, J. (2014). The Role of Farming Experience on the Adoption of Agricultural Technologies: Evidence from Smallholder Farmers in Uganda. *Journal of Development Studies , 50* (5), 666-679.

Akobundu, E., Alwang,J., Essel, A., Norton, G.W. & Tegene,A.(2004) Does Extension Work? Impacts of a Program to Assist Limited-Resource Farmers in Virginia. *Review of Agricultural Economics , 26* (3), 361–372.

Alene, A. D., & Hasan R.M. (2008). Efficiency of Food Production under Old and New Technology:A Case of Farmers Within and Outside the Extension Package Program in Ethiopia. *The Journal of Developing Areas , 41* (2), 233-249.

Ali, A., & Rahut, D. B. (2013). Impact of Agricultural Extension Services on Technology Adoption and Crops Yield: Empirical Evidence from Pakistan. *Asian Journal of Agriculture and Rural Development , 11* (3), 801-812.

Anandajayasekaran, P., Davis, K.E., & Workneh, S. (2007). Farmer Field Schools: An Alternative to Existing Extension System? Experience from Eastern and Southern Africa. *Journal of International Agricultural and Extension Education , 14* (1).

Anderson, R.J., & Feder, G. (2004). Agricultural Extension:Good Intenstion and Hard Realities. *The World Bank Research Observer , 19* (1), 41-60.

Anderson, R.J., & Feder, G. (2007). Agricultural Extension. Handbook of Agricultural Economics, Vol 3, ed. R. Evenson and P. Pingali, 2343–2378. Amsterdam, The Netherlands: North Holland Press.

Anderson, J.R., Feder, G., & Ganguly,S.(2006). The rise and fall of training and visit extension: An Asian mini-drama with an African epilogue. Policy Research Working Paper 3928. Washington, D.C.: World Bank.

Babu, S.C., Joshi, P.K., Glendenning, C.J., Asenso-Okyere, Kwadwo., & Sulaiman V., R. (2013). The State of Agricultural Extension Reform in India: Strategic Priorities and Policy Options. *Agriculture Economics Research Review , 26* (2), 159-172.

Becker, S. O., & Ichino, A. (2002). Estimation of average treatment effects based on propensity scores. *The Stata Journal , 2* (4), 358–377.

Biam.K.P., Barman.U. & Gogoi.D.K. (2017). Relationship of Dyadic Variables with the Linkage Effectiveness of the Research-Extension-Farmer Linkages under Extension Reform Programme (ATMA) in Assam. *International Journal of Pure & Applied Bioscience , 5* (5), 1512-1520.

Bindlish, V., & Evenson, R.E (1993). Evaluation of the Performance of T&V Extension in Kenya. *World Bank Technical PaperNumber 208* .

Bindlish, V., & Evenson, R.E. (1997). The Impact of T&V Extension in Africa: The Experience of Kenya and Burkina Faso. *The World Bank Research Observer , 12* (2), 183-201.

Birner,R.,& Anderson, J.R. (2007). How to Make Agricultural Extension Demand-Driven?The Case of India's Agricultural Extension Policy, IFPRI Discussion Paper 00729, International Food Policy Research Institute (IFPRI), Washington, DC.

Birkhaeuser, D., Evenson, R. E., & Feder, G. (1991). The Economic Impact of Agricultural Extension: A Review. *Economic Development and Cultural Change , 39* (9), 607-650.

Bitzer, V., B, Wennink., & B, de Steenhuijsen Piters. (2016). The Governance of Agricultural Extension Systems. . *KIT Working Paper* .

Braun, A. R., Thiele, G., & Fernández, M. (2000). Farmer Field Schools And Local Agricultural Research Committees: Complementary Platforms Sustainable Agriculture. *Agricultural Research & Extension Network* , Network Paper No.105.

Buck, S., & Alwang, J. (2011). Agricultural extension, trust, and learning: results from economic experiments in Ecuador. *Agricultural Economics , 42*, 685–699.

Caliendo, M., & Kopeinig, S. (2008). Some Practical Guidance For The Implementation Of Propensity Score Matching. *Journal of Economic Surveys , 22* (1), 31–72.

Cunguara, B., & Darnhofer, I. (2011). Assessing the impact of improved agricultural technologies on household income in rural Mozambique. *Food Policy , 36*, 378–390.

Deka, C., Mishra, P., & Baruah, R. (2017). Organisational Performance of ATMA under New Extension Reforms in the State of Assam. *Asian Journal of Agricultural Extension, economics and Sociology , 19* (2), 1-7.

Davis, K., & Franzel, S. (2018). Extension and Advisory Services in 10 Developing. Countries: A Cross-Sectional Analysis. USAID, Feed the Future DLEC Project, September. https://www.digitalgreen.org/wp-content/uploads/2017/09/EASin-Developing-Countries-FINAL.pdf (accessed June 2, 2020).

Evenson, R.E., & Mwabu, G. (2001). The Effect of Agricultural Extension on Farm Yields in Kenya. *African Development Review , 13*, 1-23.

Feder, G., & Slade,R. (1986). The impact of agricultural extension: the training and visit system in india. *World Bank Research Observer , 1* (2), 139-161.

Ferroni, M., & Zhou, Y. (2012). Achievements and Challenges in Agricultural Extension in India. *Global Journal of Emerging Market Economies 2012 , 4* (3), 319-346.

Food and Agriculture Organization (FAO). (2010). *Agricultural Extension Services Delivery System in Nepal.* Pulchowk: Food and Agriculture Organization of the United Nations.

Godtland, E. M., Sadoulet, E., Janvry, A. d., Murgai, R., & Ortiz, O. (2004). The Impact of Farmer Field Schools on Knowledge and Productivity: A Study of Potato Farmers in the Peruvian Andes. *Economic Development and Cultural Change , 53*, 63-92.

Government of Assam (2014-2015). *Economic Survey of Assam 2014-15.* Guwahati: Directorate of Economics and Statistics

Government of Assam (2015-2016). *Economic Survey of Assam 2015-16.* Guwahati: Directorate of Economics and Statistics

Government of Assam (2016-2017). *Economic Survey of Assam 2016-17.* Guwahati: Directorate of Economics and Statistics

Government of Assam (2017-2018). *Economic Survey of Assam 2017-18.* Guwahati: Directorate of Economics and Statistics

Government of Assam (2018-2019). *Economic Survey of Assam 2018-19.* Guwahati: Directorate of Economics and Statistics

Government of Assam (2011). *District Census Handbook 2011.* Guwahati: Directorate of Economics and Statistics

Government of India (2012).*Lok Sabha Unstarred Questions 2011-12.* New Delhi: Ministry of Agriculture and Farmers Cooperation

Government of India (2013).*Lok Sabha Unstarred Questions 2012-13.* New Delhi: Ministry of Agriculture and Farmers Cooperation

Government of India (2014).*Lok Sabha Unstarred Questions 2013-14.* New Delhi: Ministry of Agriculture and Farmers Cooperation

Government of India (2015).*Lok Sabha Unstarred Questions 2014-15.* New Delhi: Ministry of Agriculture and Farmers Cooperation

Guidelines For 'Support To State Extension Programmes For Extension Reforms (Atma)' Scheme, 2018, *ATMA GUIDELINES, 2018 under Krishonnati Yojana,* Accessed from Government of India, Directorate of Extension , Ministry of Agriculture and Farmers Welfare, Visited on 2nd March,2020.

Guidelines For 'Support To State Extension Programmes For Extension Reforms' Scheme, 2010, Accessed from www.manage.gov.in/studymaterial/PEM.pdf, visited on 2nd March,2020.

Harris, H., & Horst, S. J. (2016). A Brief Guide to Decisions at Each Step of the Propensity Score Matching Process. *Practical Assessment, Research, and Evaluation , 21* (4), 1-11.

Heckman, J. J., & Todd, P. E. (2009). A note on adapting propensity score matching and selection models to choice based samples. *Econometrics Journal (2009), volume 12, pp. S230-S23 , 12*, S230-S234.

Huffman, W. E. (1977). Allocative Efficiency: The Role of Human Capital. *The Quarterly Journal of Economics , , 91* (1), 59-79.

Huffman, W. E. (1978). Assessing Returns to Agricultural Extension. *American Journal of Agricultural Economics , , 60* (5), 969-975.

Imtiwalling, Sharma, A., Yadav, M.K.,Rajbhar, A.K., & Kalai, K., (2017). Impact of Agricultural Technology Management Agency on Rural Economy of Nagaland. *Plant Archives , 17* (2), 1511-1516.

Jin, Y., & Huffman, W.E. (2016). Measuring public agricultural research and extension and estimating their impacts on agricultural productivity: new insights from U.S. evidence. *Agricultural Economics , 47*, 15–31.

Juanwen, Y., & Neihof A. (2011). Agricultural Technology Extension and Adopion in China: A Case From Kaizou Township Guizhou Province. *The hina Quarterly , 206*, 412-425.

Kassie, M., Shiferaw, B., & Muricho, G. (2011). Agricultural Technology, Crop Income, And Poverty Alleviation In Uganda. *World Development , 39* (10), 1784–1795.

Kumar, S., Kumar, R., & Sah, U. (2001). Linkages Among Research, Extension And Farmers - A Review. *Agricultural Reviews , 22* (3), 215-221.

Läpple, D., Hennessy, T., & Newman, C. (2013) Quantifying the Economic Return to Participatory Extension Programmesin Ireland: an Endogenous Switching Regression Analysis. *Journal of Agricultural Economics, , 64* (2), 467–482.

Li, M. (2012). Using the Propensity Score Method to Estimate Causal Effects: A Review and Practical Guide. *Organizational Research Methods , 00* (0), 1-39.

Lopokoiyit, M. C., Onyango, C., Kibett, J. K., & Langat, B. K. (2012). Human Resource Development in Agriculture Extension and Advisory Services in Kenya. (pp. 371-388). Nairobi: The Eighth African Farm Management Association Congress.

Manalili, A. (1990). *Community organizing for people's empowerment.* Manila: Kapativan-Kaunlaran Foundation.

Mariano, M. J., Villano, R., & Fleming, E. (2012). Factors influencing farmers' adoption of modern rice technologies and good management practices in the Philippines. *Agricultural Systems , 110*, 41-53.

Marsh, S.P., & Pannell, D.J. (2007). Agricultural Extension Policy in Australia:The Good, The Bad and The Misguided. *The Australian Journal of Agriculture and Resource Economics , 44* (4), 605-627.

Melkote, S. R. (1988). Agricultural Extension and the Small Farmers: Revealing the Communication Gap IN an Extension Project in Kenya. *22* (2).

Mendola, M. (2007). Agricultural Technology Adoption and Poverty Reduction: A Propensity-Score Matching Analysis for Rural Bangladesh. *Food Policy , 32* (3), 372–393.

Mittal, S., & Kumar, P. (2000). Literacy, Technology Adoption, Factor Demand and Productivity: An Econometric Analysis. *Indian Journal of Agricutural Economics , 55* (3).

Norton, G. W., & Alwang, J. (2020). Changes in Agricultural Extension and Implications for Farmer Adoption of New Practices. *Applied Economic Perspectives and Policy , 42* (1), 8-20.

Nwankwo, O.C. (2010). Impact of Agricultural Extension Services on Agricultural Development in The Rural Areas of Ikono Local Governent Area, Nigeria: A Case Stuy of Ibiaku Community. *Journal of Environmental Issues and Agriculture in Developing Countries , 2* (2-3).

Pannell, D. J., & Claassen, R. (2020). The Roles of Adoption and Behavior Change in Agricultural Policy. *Applied Economic Perspectives and Policy , 42* (1), 31-41.

Patil, S. S., Hiremath.G.M., & Lokesh.G.B. (2014). Economic Sustainability through Farmers Interest Groupsand their Linkage with Institutional Agencies —An Evidence from Karnataka. *Agricultural Economics Research Review , 27* , 141-146.

Peshin, R., Sharma, R., Kumar, R., Sharma, L.K., Dwivedi, S., Nanda, R., Gupta, V., & Risam,K.S.(2018). Technology adoption by small-scale full-time and part-time family farm households in the subtropics of Jammu & Kashmir. *Agricultural Economics Research Review , 31* (2), 259-269.

Raabe, K. (2008). Reforming the Agricultural Extension System in India : What Do We Know About What Works Where and Why. *IFPRI Discussion Paper 00775* .

Rao, C.A.R., Samuel, J., Kumar, S., Raju, B.M.K., Dupdala,R., & Venkateswarlu, B. (2014). Role of Technology and Credit in Improving Farm Incomes in Rainfed Regions in Andhra Pradesh. *Agricultural Economics Research Review , 27* (2).

Reddy, M., & Swanson, B.E. (2006). Starategy for Upscaling the ATMA Model in India. *Proceedings of the 22nd Annual Meetings of the Association for International Agricultural and Extension Education* , Clearwater Beach, FL, 14–17 May, 2006.

Rivera, W. M. (2006). Agricultural Knowledge and Development in a New Age and a Different World. *Journal of International Agricultural and Extension Education , 13* (2), 57-67

Rosenbaum, P.R., & Rubin, D.B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrica , 70*, 41-55.

Rosenbaum, P., & Rubin, D. (1983). Assessing sensitivity to an unobserved binary covariate in an observational study with binary outcome. *Journal of the Royal Statistical Society, Series B , 45*, 212-218.

Roy, M. L., Chandra, N., Kharbikar, H. L., Joshi, P., & Jethi, R. (2013). Socio-economic Status of Hill Farmers: An Exploration from Almora District in Uttarakhand. *International Journal of Agriculture and Food Science Technology , 4* (4), 353-358.

Sajesh, V.K., & Suresh, A. (2016). Public Sector Agricultural Extension in India. *Review of Agrarian Studies , 6* (1), 116-131.

Santucci, F., Alrefae'e, A.H., Nassour, G., Saker. S.E., Othmans.S. & Hamzah.W. (2002). Farmers' opinion about agricultural extension service in Syria. *NEW MEDIT N. 1*.

Scott, A.J., & Wild, C.J. (1986). Fitting Logistic Models Under Case-Control or Choice Based Sampling. *Journal of the Royal Statistical Society. Series B (Methodological), , 48* (2), 170-182.

Sharma, N., Joshi, P., Ahmad, N., Dabas, J.P.S., Chakravorty, S., & Singh, B.K. (2017). Knowledge and Resource base for Farmers' Interest Groups. *Journal of Agroecology and Natural Resource Management , 4* (4), 318-320.

Sharma, P., Dupare, B. U., & Patel, R. M. (2018). Technology Adoption, its Impact and Determinants: the Case of Soyabean in Madhya Pradesh. *Agriculture Economics Research Review , 31* (2), 281-289.

Shita, A., Kumar, N., & Singha, S. (2020). Productivity and welfare effects of agricultural technologies: A study of maize producing households in Ethiopia using PSM approach. *Indian Journal of Engineering & Materials Sciences , 27*, 921-926.

Singh, K. M., & Swanson, B. E. (2006). Developing Market Driven Extension System in India. *Journal of International Agricultural and Extension Education, 13* (2), 627-637.

Singh, K.M., Meena, M.S., Singh, R.K.P., Kumar, A., & Kumar, U. (2009). Agricutlural Technology Management Agency (ATMA): a Study of its Impact in Pilot Districts in Bohar , India. Available from http://mpra.ub.uni-muenchen.de/45549/8/MPRA_paper_45549.pdf (visited 24th February, 2020).

Singh, K., & Srinivasan, R. (1998). Role of Farmers' Organization in the Context of New Economic Policy with Particular Reference to Agriculture Marketing and Agro Processing. *Indian Journal of Agricultural Marketing (Conference Special), 12* (3), 161-164.

Subba, R., & Mukhopadhyay, D. (2019). Impact of ATMA (Agricultural Technology Management Agency) in Changing Knowledge, Skill and Adoption Behavior of Farmers in Sikkim. *International Journal of Current Microbiology and Applied Sciences, 8* (3), 1493-1505.

Swanson, B. E. (2006). The Changing Role of Agricultural Extension in a Global Economy. *Journal of International Agricultural Extension Education, 13* (3), 5-13.

Swanson, B.E.,& K. Davis. (2014). Status of Agricultural Extension and Rural Advisory Services Worldwide: Summary Report. Global Forum for Rural Advisory Services, Lindau, Switzerland

Teka, A. M., & Lee, S.-K. (2019). The impact of agricultural package programs on farm productivity in Tigray-Ethiopia: Panel data estimation. *Cogent Economics & Finance , 7*:1631987.

Venkatesh, P., & Nityashree, M.L. (2014). Institutional Changes in Delivery of Agricultural Inputs and Services to Farm Households in India. *Agricultural Economics Research Review , 27*, 85-92.

World Bank, (2006). *Enhancing Agricultural Innovation: How to Go Beyond the Strengthening of Research Systems.* Washington, DC: The World Bank.

World Bank. (2017). ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions. Updated Edition, Washington, DC. http://documents. worldbank.org/curated/en/522141499680975973/pdf/117319-PUB-Date-6-27- 2017-PUBLIC.pdf (accessed June 2, 2020).

Zainuddin, A. P., & Teh, S. B. (1982). *Approaches Towards Distict Development Models for Multi-agency team work: Training for Agriculture and Rural development.* Rome: United Nations Food and Agriculture Organisation.

Appendix

Table 5.1A Description of the Estimated Propensity Score in the region of common support

Percentage	Percentiles	Smallest
1 %	0.0088	0.0054
5%	0.0303	0.0088
10%	0.0967	0.0088
25%	0.2647	0.0119
50%	0.5384	
Percentage	Percentiles	Largest
75%	0.7745	0.9829
90%	0.9107	0.9871
95%	0.9574	0.9952
99%	0.9952	0.9989
Number of Observation		158
Mean		0.5131
Standard Deviation		0.2908
Variance		0.0845

Table 5.1B Description of the five blocks into which the propensity scores were categorised.

Number of blocks	Lowest pscore in each block	Beneficiaries	Non-beneficiaries	Total
1	0.0054	27	4	31
2	.2	25	1	26
3	.4	15	20	35
4	.6	8	24	32
5	.8	3	31	34
Total		78	80	158

Source: Estimation based on field survey

Table 5.1C Test of balance of the variables

Variable	Unmatched / Matched	Mean		Standard bias	Percentage of bias reduction
		Treated	Control		
Age	Unmatched	43.25	43.788	-5.7	-934.9
	Matched	43.25	48.813	-58.9	
Education	Unmatched	10.163	9.525	18.0	72.5
	Matched	10.163	10.338	-4.9	
Experience	Unmatched	29.413	23.3	63.0	59.5
	Matched	29.413	31.887	-25.5	
Family Size	Unmatched	4.85	4.687	14.0	61.5
	Matched	4.85	4.787	5.4	
Income	Unmatched	129267	83995	77.7	90.5
	Matched	129267	129267	-7.4	
Land	Unmatched	1.328	1.209	23.0	-56.3
	Matched	1.328	1.142	36.0	

Source: Estimation based on field survey data.