COASTAL FARMERS' KNOWLEDGE, ATTITUDE AND PRACTICE REGARDING CLIMATE SMART AGRICULTURE

MD. ABU TOUHID MIA

A DISSERTATION

FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

AGRICULTURAL EXTENSION AND INFORMATION SYSTEM

DEPARTMENT OF AGRICULTURAL EXTENSION

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SHER-E-BANGLA NAGAR, DHAKA-1207, BANGLADESH

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By

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A Dissertation
submitted to the faculty of Agriculture,
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CERTIFICATE

This is to certify that Dissertation entitled **"COASTAL FARMERS' KNOWLEDGE, ATTITUDE AND PRACTICE REGARDING CLIMATE SMART AGRICULTURE"** submitted to the **Faculty of Agriculture,** Sher-e-Bangla Agricultural University (SAU), Dhaka in partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURAL EXTENSION AND INFORMATION SYSTEM**, embodies the result of a piece of bona fide research work carried out by **MD. ABU TOUHID MIA, Registration no. 01511** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: July, 2022
Place: Dhaka, Bangladesh

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DEDICATION

To my Lord,
the Most Mighty, Most Wise,
and the Cherisher and Sustainer of the worlds.
He has power over everything.

DECLARATION

It is hereby declared that except otherwise stated, this Dissertation is entirely the own work of the present researcher under the guidance and supervision of the Advisory Committee and has not been submitted in any form to any other University for any degree.

The Author
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BIOGRAPHICAL SKETCH

The author was born in a reputed and enlightened muslim family on 12 February 1975 at Village- Tarauzial, Upazila- Sreepur, District- Magura, Bangladesh. He passed the SSC examination from Amtoil High School, Sreeprur, Magura in 1989 and HSC examination from Magura Government Hossain Shahid Shohrawardy College, Magura in 1991 and obtained first division in the both examinations. He obtained BSc (Ag) degree in 1996 (held in 2000) from the then Bangladesh Agricultural Institute, Dhaka under Bangladesh Agricultural University and MS in Agricultural Extension and Information System degree in 2006 from Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.

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The Author

ABBREVIATIONS AND ACRONYMS

%	Percent
°C	Degree Celsius
AEO	Agriculture Extension Officer
AEZ	Agro-Ecological Zone
ASA	Association for Social Advancement
AWD	Alternate Wetting and Drying
BBS	Bangladesh Bureau of Statistics
BDT Tk./tk.	Bangladeshi taka
BRAC	Bangladesh Rural Advancement Committee
BRRI	Bangladesh Rice Research Institute
BSs	Block supervisor
CO_2	Carbon dioxide
CAIT	Climate Analysis Indicator Tools
CARE	Cooperative for Assistance and Relief Everywhere
CSA	Climate Smart Agriculture
CV	Coefficient of Variation
DAE	Department of Agricultural Extension
DAP	Diammonium Phosphate
d.f.	Degree of freedom
e.g.	For example
et al.	And others
FAO	Food and Agriculture Organization
FotF	Farms of the Future
FFS	Farmers Field School
GDP	Gross Domestic Product
GHG	Green House Gas
HYV	High Yielding Variety
ha	Hectare
ICT	Information and Communication Technology
IPM	Integrated Pest Management
IPCC	Intergovernmental Panel on Climate Change
IMF	International Monetary Fund
KAP	Knowledge, Attitude and Practice
NGO	Non-Government Organization
SA	Sustainable Agriculture
SAAO	Sub Assistant Agriculture Officer
SD	Standard deviation
SDF	Social Development Foundation
UNFCCC	United Nations Framework Convention on Climate Change
USG	Urea Super Granule
Viz.	Namely
WRI	World Resources Institute

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Coastal Farmers' Knowledge, Attitude and Practice regarding Climate Smart Agriculture

Md. Abu Touhid Mia

Abstract

Climate smart agriculture (CSA) aims to improve food security, help communities adapt to climate change and contribute to climate change mitigation by adopting appropriate practices. The basic premises of the knowledge, attitude and practice (KAP) surveys are that knowledge forms attitude, and that both knowledge and attitude are the building blocks for practice. The study therefore aims to assess the extent of knowledge, attitude and practice of farmers regarding climate smart agriculture and to explore the contributions of the selected characteristics of the coastal farmers to their knowledge, attitude and practice. Data were collected using an interview schedule from 354 coastal farmers under 3 districts namely, Khulna, Bagerhat and Satkhira through Multistage Random Sampling Method during December, 2021 to March, 2022. To explore the contribution of the predictor variables to the outcome variables, full model regression analysis was employed. It was found that about 14.13% of the farmers had poor knowledge, 75.14% had medium-level knowledge and 10.73% had high level knowledge on CSA. The highest proportion (61.01%) of the farmer had medium favourable attitude towards CSA as compared to 18.65% and 20.34% having low favourable and high favourable attitude towards CSA respectively. About 57.91% of the coastal farmers had medium practice followed by 22.88% had high and 19.21% had low practice of CSA. Among the 19 identified CSA practices "using of thread pipe/plastic pipe for irrigation" ranked first and indicated highest extent of use by the coastal farmers. The 2nd position in the rank order was "cultivation of salinity resistant and high yielding crop varieties,". Farmers' education, annual agricultural income, extension contact, decision making ability, benefit obtained from CSA had significant positive contributions and problem faced in CSA had negative contribution to their knowledge on CSA. Again, farmers' education, annual agricultural income, extension contact, training exposure, access to market and benefit obtained from CSA had significant positive contribution whereas farm size had negative contributions to their attitude towards CSA. Furthermore, farmers' education, annual agricultural income, extension contact, training exposure and benefit obtained from CSA had positive significant contribution to their practice of CSA. The topmost problem of coastal farmers was associated with economic problem; 'higher cost of inputs' ranked 1st and 'low price of produced crops' ranked 2nd. For the fully

implementation of CSA requires solving associated problems and making available appropriate technologies to the farmers.

CHAPTER 1

INTRODUCTION

1.1 General Background

The agriculture sector of Bangladesh is the main source of food security, employment, and poverty alleviation of the country. More than 70 percent of the country's population and 77 percent of its workforce lives in rural areas. Nearly half of all Bangladeshi workers and two-thirds of workers in rural areas are directly employed in agriculture. About 87 percent of the nation's rural households rely on agriculture for at least part of their income (World Bank, 2019). The population of Bangladesh has almost doubled since the 1980s, reaching approximately 161 million people in 2016. This increase, coupled with high population density (over 1,000 per square km) and growing urbanization and infrastructure build-up for industrialization, has put considerable pressure on arable land, which decreased from 0.11 ha/capita in 1980 to 0.05 ha/capita in 2014 (World Bank, 2016). Ninety-nine percent of farms in Bangladesh are small-scale and fragmented, with an average area of less than one hectare. The population of Bangladesh is increasing at 1.37% while the cultivable land is decreasing at 1% every year (BBS, 2016). Bangladesh faces growing demand for food and pressure from rapid land use change including significant losses of arable land. Population increases to an estimated 186 million by 2030 and 202 million by 2050, increasing income levels, and rapid urbanization at a rate of 3.5 percent annually (FAO, 2016). At the same time, while Bangladesh produces almost all of its own rice, current yield trends indicate production will not be able to satisfy growing demand for cereals (including rice), which is projected to increase 21 percent by 2030 and 24 percent by 2050 (Bangladesh: Food Utilization. 2017). Given the increasing population density and continued loss of arable land caused by urbanization and other factors, enhancing the productivity of rice and other staple foods remains crucial. These trends suggest that Bangladesh must sustainably increase food production on far less arable land per capita to continue to strive for self-sufficiency in agricultural production (Timsina *et al.*, 2018).

Agriculture (consisting of crops, livestock, forestry, and fisheries) is the most important sector in the Bangladesh economy. Yet the sector is facing several challenges (e.g., climate change and increasing population) that hinder development and cause stagnating growth rates (Mondal, 2010). Some of those challenges relate to: gradual loss of arable land, declining soil fertility and salinization; insufficient investment in agricultural research and training; inadequate credit support for farmers and an unfavorable land-tenure system, resulting in low level technology uptake of a predominantly small-scale farming structure; outmigration and labor shortage in rural areas resulting in rising wage rates; and the need to cope with increasing impacts of climate change and related extreme weather events (Mondal, 2010).

Climate change is expected to further exacerbate these challenges. According to the Global Climate Risk Index (2021), Bangladesh is the 7th most climate change vulnerable (2000-2019) country in the world (Eckstein *et al.*, 2021). The regions with high exposure to sea level rise and salinity intrusion are located in southern Bangladesh (IPCC, 2014). The coastal zone covers 32 percent of the area and 28 percent of the total population of Bangladesh (Islam, 2004). This huge coastal zone of Bangladesh is used for agriculture, shrimp and fish farming, forestry etc. which contribute approximately 16 percent of the total rice production of the country, covering about 70 percent of the total paddy-cropped area (Huq *et al*., 2005). The south, southwest, and southeast coastal regions of Bangladesh are increasingly susceptible to severe tropical cyclones and associated saltwater intrusion (Ramírez-Villegas and Thornton, 2015). The entire coastal region of Bangladesh is affected with floods, water-logging, surges, droughts and salinity intrusion. Bangladesh Soil Resource Development Institute (2009) indicates that approximately 62 percent of coastal land (equivalent to an area of 1.06 million out of 1.70 million hectares) is already affected by some degree of soil salinity, ranging from very slight (0.328 million hectares) to very strong (0.101 million hectares) (FAO, 2012). Salinity intrusion is predicted to advance 8 kilometers north in the country by 2030, implying a significant reduction in land available for agriculture. By 2040, cropland could shrink by almost 18 percent in southern Bangladesh and by 6.5 percent nationally (Planning Commission, 2015). Intrusion of salt water into rivers and canals presents a serious challenge to crop production.

Increased soil and water salinity is projected to cause a 15.6 percent yield reduction in high-yielding rice varieties before 2050 (Dasgupta *et al.*, 2014). Overall production of rice is also projected to decline in all three rice growing seasons by 8–17 percent by 2050 (Sarker *et al.*, 2012). At the same time, extreme heat, floods, cyclones, sea level rise, salinity intrusion, and increasingly irregular rainfall negatively affect livestock production and growth, as well as species composition in fisheries, including a projected 0–10 percent potential decrease in fish production (Fernandes *et al.*, 2016). Climate change is predicted to raise sea level by around 30 centimeters by 2050 and could make an additional 14 percent of the country extremely vulnerable to floods by 2030 (IMF, 2013). With two-thirds of Bangladesh's landmass less than 5 meters above sea level and 30 percent of its arable land in coastal areas (Nash *et al.*, 2016). An estimated 5.3 million poor people will become highly vulnerable to the effects of climate change by 2050 (World Bank, 2014). Extreme weather can cause deaths and significant damage to land and infrastructure. The value of household damage and losses due to climate change and natural disasters between 2009 and 2014 was estimated at 184.25 billion Bangladesh taka. The most extensive damage and losses were caused by floods (23.23 percent) and cyclones (15.41 percent). Between 2009 and 2014, hailstorm and drought were also major causes of crop damage and loss, and storm and tidal surge had a significant impact on fishery (Islam, 2016). Losses related to the 2007 and 2009 cyclones were estimated at around two million metric tons of rice, enough to feed 10 million people (Ramírez-Villegas and Jarvis, 2008). The World Bank estimates that climate change–related economic losses depress gross domestic product (GDP) annually by 0.5 to 1 percent (World Bank, 2016a). Bangladesh is experiencing sea level rise, saltwater intrusion, mean temperature increase, higher rainfall variability, and an increase in the frequency and intensity of extreme weather events. This situation will worsen in the coming years.

Bangladesh is likely to face more hot days and heat waves, longer dry spells, and greater drought risk (Amin *et al.*, 2015). The country has been facing higher temperatures over the last three decades. Annual mean temperature is projected to experience a rise of 1.0°C by 2030, 1.4°C by 2050, and 2.4°C by 2100, but the change will not be evenly distributed throughout the year. The average increase in winter season temperatures (in December, January, and February) is predicted to be slightly more pronounced: 1.1°C by 2030, 1.6°C by 2050, and 2.7°C by 2100. Predictions for the average temperature increase during the monsoon months (May/June through September) are 0.8°C by 2030, 1.1°C by 2050, and 1.9°C by 2100 (Agrawala *et al.*, 2003). Bangladesh will experience higher rainfall variability, more complex rainfall patterns, and diverse exposure to climate risks. Most of the climate models show that precipitation will increase during the summer monsoon (Mirza, 1997). Rainfall is expected to increase in Bangladesh by 9–12% by 2050 (World Bank, 2016a). However, rainfalls in Bangladesh are distributed unevenly from north to south and from east to west, resulting in a diversity of rainfall patterns and thus climate risks across the country.

Bangladesh's GHG emissions reached 192 megatons of CO_2 in 2014, placing the country in the bottom quarter of emitters globally (BBS, 2016.; WRI, 2013) While the CO_2 intensity of the economy is relatively low, it has been increasing steadily over the past decades. Bangladesh's annual CO_2 footprint has increased by 3.6% in 2011 compared to the year before, driven by GDP growth rates of 6-7%. Agriculture contributes to 39% of the country's GHG emissions. Cropland and enteric fermentation (livestock production) contributed equally to agricultural GHGs in 2013. Compared to other sectors, such as energy whose emissions increased by almost 500% between 1990 and 2013, agricultural emissions in Bangladesh have remained relatively stable, increasing by about 30% in that same time period (WRI, 2013). Nevertheless, the agriculture and livestock sector remain the main source of emissions in the country in absolute terms. Climate risks to agricultural production are expected to increase in coming decades, particularly in low-income countries like Bangladesh where adaptive capacity is weaker.

Addressing these challenges will require radical changes in our food systems; food systems have to become, at the same time, more efficient and resilient, at every scale from the farm level to the global level. They have to become more efficient in resource use (use less land, water, inputs to produce more food sustainably) and become more resilient to changes and shocks. It is precisely to articulate these changes that FAO has forged the concept of Climate Smart Agriculture (CSA) as a way forward for food security in a changing climate. CSA aims to improve food security, help communities adapt to climate change and contribute to climate change mitigation by adopting appropriate practices, developing enabling policies and institutions and mobilizing needed finances.

Climate Smart Agriculture (CSA) is an approach for transforming and reorienting agricultural development under the new realities of climate change (Lipper *et al.*, 2014). The most commonly used definition of CSA is provided by the FAO (2013) as "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes Greenhouse gases (mitigation) where possible, and enhances achievement of national food security and development goals". In these definitions, the principal goal of CSA is identified as food security and development (Lipper *et al.*, 2014; FAO, 2013); while productivity, adaptation, and mitigation are identified as the three interlinked pillars necessary for achieving this goal.

1.2 Climate Smart Agriculture

Environmental stresses have always had an impact on crop production, and farmers have always looked for ways to manage these stresses. At the field level, there are a wide range of agricultural practices and approaches that are currently available that can contribute to increased production while still focusing on environmental sustainability. Considering the ecological, social, policy and economic dimensions of a specific location, CSA practices (such as mulching, irrigation using plastic pipe, zero tillage etc.) can contribute to climate smart crop production i.e., approaches to adapt to, and contribute to, the mitigation of climate change (FAO, 2016).

Some of CSA approaches and practices that contribute to climate change adaptation are: ecosystem-based approaches; conservation agriculture; integrated nutrient and soil management; mulch cropping; cover cropping; alterations in cropping patterns and rotations; crop diversification; using high quality seeds and planting materials of adapted varieties; integrated pest management; integrated weed management; grasslands management; water and irrigation management; landscape-level pollination management and organic agriculture (FAO, 2013a). There are also many different approaches and practices for sustainable crop production that can contribute to climate change mitigation. Some of the widely practiced are: conservation agriculture; soil compaction management; improved farming systems with several crop rotations; crop diversification; promotion of legumes in crop rotations; growing cover crops; mulch cropping; restoration of cultivated peaty soils and degraded lands; soil management practices that reduce fertilizer use (e.g., urea deep placement); integrated nutrient management; growing nutrient-use efficient crop varieties; integrated crop and livestock systems; dedicated energy crops to replace fossil fuel use; emission control and reduction; improved rice cultivation techniques; water management/conservation, irrigation, water table management; and agroforestry (FAO, 2016). The CSA practices that are available and widely used in the study area are shown in Table 1.

Table 1. CSA Practices available in the study area with their productivity, adaptation and mitigation strategies

CSA practices	Productivity	Adaptation	Mitigation	Sources*
Saline-tolerant HYV crops/crop varieties	Increases farmers' capacity to limit the crop exposure to climate risks. In the long term, increases in soil biomass accumulation can enhance soil fertility.	Increases in yield stability due to increased resilience to stress caused by salinity.	Provides moderate reduction in GHG emissions per unit of food produced. Promotes C-sinks through increased accumulation of biomass.	3, 5, 6, 7, 9
Flood-tolerant/ submergence resistant HYV varieties/ crops	Promotes high yields per unit area, hence potential increase in income.	Reduces the risk of crop losses caused by temporary or permanent flood conditions.	Promotes above and below-ground carbon sinks through increased accumulation of dry matter.	3, 5, 6, 7, 9
Drought resistance HYV varieties crops	Increased yield	Tolerant to drought	C-sink increased	1, 3, 5, 6
Short duration HYV varieties	Promotes high yields per unit area, hence potential increase in income.	Increases resilience to biotic stress and climate shocks. Enhances water use efficiency.	Provides moderate reduction in GHG emissions per unit of food produced.	3, 7, 9
Adjusting planting time	Reduced likelihood of crop failure.	Maintained production under changing rainfall patterns.	-	4
Crop rotation	Improved or maintained yields.	Improved soil fertility, decreased erosion, and reduced pest and disease pressure by breaking up their cycles and resistance.	Carbon sink increased	1, 3, 4
Relay cropping/ Intercropping with legume	Total productivity increased	Utilization of time and space, reduce risk.	Carbon sink increased	3, 5, 6
Zero tillage	Yield and income increase	Efficient utilization of water, fertilizer, time. Reduce soil erosion	Reduced GHG emission.	2, 3, 4
Minimum tillage	Increased yields over the long term due to greater water-holding capacity of soils.	Improved soil fertility and water-holding capacity increases resilience to climate change.	High mitigation potential through reduced soil carbon losses.	8
Mulching	Increased yields due to greater water retention in soils.	Reduced yield variability in drier conditions.	Positive mitigation benefits.	2, 3, 5, 6,

Table 1 (cont'd)

Rain water harvesting	Increase yield in dry season	Supply water in dry season.	Reduced GHG emission	3, 4, 5, 6
Using of thread pipe/plastic pipe/ buried pipe for irrigation	Increases yield per unit area, especially during the dry season. Ensures income diversification.	Minimizes water use per unit of product, increasing water use efficiency and resilience to climate shocks.	Reduces GHG emissions due to reduced fuel/energy required for pumping and/or carrying water for irrigation.	10
Raised bed planting	Yield and income increase	Can cope with increasing tidal water and excessive rain, soil erosion decreased.	C-sink increased	4, 8
Compost/ Vermicomposting	Increases land productivity, product quality and income.	Promotes the use of organic waste, retain moisture in soil.	Reduces the use of nitrogen-based fertilizers, thus reducing nitrous oxide emissions.	4
Improved livestock breed	Yield and income increase	Allow diverse land use.	Diversification of animal diet can lead to reductions in methane emissions, reducing the amount of GHG emissions per unit of food produced.	4
Traditional gher farming	Increased production, nutrition and income.	Bio-diversity, food availability, reduces climatic risk,	Increase C-sequestration	7, 8, 11
Practicing of 'Hari' system	Increased production, nutrition and income.	Bio-diversity, food availability, Allow diverse land use.	-	11
Ridge plantation/ Pond-side vegetable cultivation	Increased yield and income.	Women empowerment and biodiversity	Carbon sink increased	5, 6, 8
Water melon cultivation	Increased yield and income.	Well adapted to drought and salinity.	Carbon sink increased	6

***Sources**
1. Beyene (2018), 2. Zighe (2016), 3. Billah and Hossain (2017), 4. Afrin et al. (2017), 5. Hasan et al. (2018), 6. Saha et al. (2019), 7. CIAT; World Bank. (2017), 8. Ali and Hossain (2019), 9. Shrestha & Bokhtiar, S.M. (2019), 10. World Bank (2019), 11. FAO (2015a)

1.2.1 Newness of Climate Smart Agriculture

In the last decades, farming systems approaches have brought to light insights related to institutions and policy, participation, multi-stakeholder's partnerships and people's rights, environment and agroecosystems as well as multidisciplinary and multisectoral mechanisms and their interdependence (Mahasin and Roy, 2017). Some of the 'labels' currently used relate to practices at farm level (e.g., sustainable intensification), whereas some others relate to comprehensive, holistic approaches (e.g., CSA). Some of them promote a more 'nature-driven' agriculture (e.g., agroecology), while some others support a more 'technology driven' agriculture (e.g., precision agriculture) (Knaepen *et al.*, 2015).

These concepts have evolved over time in line with new emerging issues and more scientific knowledge becoming available. In principle, all such approaches are complementary**,** and they can be gathered under the 'Sustainable Agriculture' (SA) umbrella, including green agriculture, CSA, agroecology, ecosystem-based adaptation (EbA) for food security, eco-intensive agriculture and sustainable intensification, amongst others. Sustainable agriculture, like 'sustainable development', has encompassing benefits from social, environmental and economic angles. It describes farming systems that are 'capable of maintaining their productivity and usefulness to society indefinitely. Such systems must be resource conserving, socially supportive, commercially competitive, and environmentally sound' (Knaepen *et al.*, 2015).

Though, CSA concept was developed by the Food and Agriculture Organization (FAO) in 2010, it is not considered as a new agricultural system, nor is it a set of practices. It is a new approach, a way to guide the needed changes of agricultural systems, given the necessity to jointly address food security and climate change (FAO, 2013a).

CSA shares with sustainable development and green economy objectives and guiding principles (Roy *et al.*, 2015). The 1992 Earth Summit and Rio Declaration recognized the value of the environment in development activities and integrated economic, environmental and social dimensions. Practically, a green economy is one whose growth in income and employment is driven by investments that simultaneously: reduce carbon emissions and pollution, enhance energy and resource-use efficiency; and prevent the loss of biodiversity and ecosystem services (FAO, 2013b).

The green economy and CSA share the common goal of integrating the three dimensions of sustainable development. Both make sustainable development tangible by focusing on issues that can and must be addressed right now in local communities but that have global, long-term consequences. CSA brings together global and local concerns, climate change to be addressed globally, climate change to get adapted to locally; and first of all, food security, which has to be addressed both locally and globally. To do so it brings together practices, policies and institutions, which are not necessarily new (Roy *et al.*, 2013). What is new is the harmonization and synchronization needed of practices and policies in order to address multiple challenges, faced by agriculture and food systems, now and for the future (Roy *et al.*, 2019). What is also new is the objective of avoiding contradictory and conflicting policies by internally managing trade-offs and synergies in the pursuit of multiple objectives (FAO, 2013a).

1.3 Statement of the Problem

A little research (e.g., Chuang *et al.*, 2020; Severin and Small, 2016) has been conducted to examine the extent of farmers knowledge, attitude and practice (KAP) on climate change adaptation, but no research was found to examine the extent of farmers' KAP on CSA in Bangladesh. Generalization from the studies conducted abroad regarding the KAP on CSA practices may not be applicable due to considerable variation in socio-economic and cultural conditions. The present study is an attempt to provide useful information on CSA. It is necessary to have a clear understanding of the present position in respect of KAP on CSA by the farmers in order to prepare programmes and courses of action for wider implementation and adoption of CSA. It is also necessary to have an understanding of the factors related to KAP on CSA. An understanding of the relationship of farmers' KAP with their characteristics will be helpful to the planners and extension workers for promoting better action among the farmers who are concerned with the technology.

For having an understanding on the farmers' KAP on CSA and related matters, the researcher has undertaken this piece of research entitled "Coastal Farmers' Knowledge, Attitude and Practice (KAP) on Climate Smart Agriculture". In view of the above considerations, the present study was undertaken to find out the answers to the following research questions-

i. What was the extent of farmers' knowledge, attitude and practice regarding CSA?
ii. What were the characteristics of the coastal farmers?
iii. Was there any inter-correlation among farmers' knowledge, attitude and practice regarding CSA?
iv. What were the contributions of the selected characteristics of the farmers to their knowledge, attitude and practice regarding CSA?
v. What were the problems faced by the farmers while practicing CSA?

1.4 Objectives of the Study

The objectives of this study are to:

i. assess the extent of the farmers' knowledge, attitude and practice regarding CSA;
ii. describe selected characteristics of the coastal farmers;
iii. determine the inter-relation among knowledge, attitude and practice regarding CSA;
iv. explore the contributions of the selected characteristics of the farmers to their (a) knowledge, (b) attitude and (c) practice regarding CSA; and
v. identify and compare the problems faced by the farmers in practicing CSA.

1.5 Justification of the Study

Many studies have so far been conducted relating to knowledge, attitudes and practice of farmers on various aspects of agriculture (e.g., Rahman, 2018; Mandal, 2016; Mondal, 2014). There is also a number of studies conducted relating to the adoption of various modern technologies by the farmers (e.g., Israel, 2019; Beyene, 2018; Mango *et al.*, 2018; Mahasin and Roy, 2017; Mutoko, 2014; Ali, 2008; Mia, 2005). Also, a number of research has been conducted abroad to determine farmer's knowledge, attitude and practice (KAP) relating to climate change adaptation and smart agricultural technology (e.g., Chuang *et al.*, 2020; Severin and Small, 2016; Ochieng, 2015). But no research has been found home and abroad that was conducted to determine farmers' knowledge, attitude and practice regarding CSA. It has been reported in many studies and literature (e.g., Rahman, 2018; Mondal, 2014; Zulkifly *et al.*, 2013; Hamidi, 2004) that the attitude of an individual plays a significant role in the adoption or rejection of an innovation. The favorable attitude of farmers towards CSA helps to achieve food security and broader development goals under a changing climate and increasing food demand. Again, if farmers do not have accurate knowledge on CSA, if they do not know how CSA can help them, they will show negative attitude towards them and eventually they will not practice CSA in their farming activities.

The climate smart agriculture (CSA) concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. CSA initiatives sustainably increase productivity, enhance resilience, and reduce/remove GHGs, and require planning to address tradeoffs and synergies between these three pillars: productivity, adaptation, and mitigation.

Extreme weather conditions (floods and cyclones) are expected to increase in frequency and intensity in Bangladesh. The lack of accessible and reliable climate information among farmers represents a considerable challenge to the scaling out of CSA practices. Strengthening climate information services and making them easily accessible to farmers would greatly improve their capacity to adapt farming practices. For instance, salt intrusion into irrigation canals prevents their use for commercial or household gardening in the southern regions of Bangladesh. Knowing where and when intrusion will occur through the use of simple salinity meters would allow farmers to make crop choices and also plan for appropriate response and mitigation strategies.

Here, an attempt was made to assess the level of knowledge on CSA of the farmers, their attitude towards CSA and the extent of their use of CSA in coastal areas. This research will help us to recognize --

- ✓ the overall present situations of CSA technologies and practices;
- ✓ the benefits (such as, they can continue cultivating crops under adverse climatic conditions and get a good harvest) of practicing CSA;
- ✓ the problems faced by the farmers to practice CSA; and
- ✓ initiatives (such as, making available salinity or submergence tolerant crops/varieties and arranging training for the farmers) needed to fully implement CSA as a means to face climate vulnerability, which will contribute to the development of the existing system as well as the improvement in agricultural sector of Bangladesh.

As a new farming technology in Bangladesh, it is necessary to examine its different aspects (such as, what the farmers know about it, what they are thinking about it etc.). Under the above consideration, the present study is supposed to support the researcher and extension personnel, policy makers and farmers to establish more extensive programmes (such as, under present circumstances, if the farmers need training or any technology or to solve arising problems those can be met through interventions).

1.6 Scope of the Study

The present study was designed to have an understanding of KAP regarding CSA and to determine the contribution of selected characteristics of the farmers to their KAP of the coastal farmers regarding CSA.

i. The findings of the study will, in particular, be applicable to the study area at Dacope upazila of Khulna district, Morrelgonj upazila of Bagerhat district and Tala upazila of Satkhira district. The findings may also be applicable to other locale of Bangladesh where socio-cultural, psychological and economic circumstance do not differ much than those of the study areas.

ii. The findings of the study would ultimately help the extension service providers in formulating appropriate strategies to facilitate CSA.

iii. The findings of the study will be conducive to accelerate the improvement in agriculture, farmers' logistic supports, information needs and the way of dissemination especially tuned to key role players in the society as well as knowledge, attitude and practice regarding CSA by the farmers. The outcomes might also be helpful to the planners and policy makers, extension workers and beneficiaries of the agriculture.

iv. To the academicians, it may help in the further conceptualization of the systems model for analyzing the knowledge, attitude and practice regarding CSA by the farmers. In addition, the findings of this study may have other empirical evidence to all aspects of knowledge, attitude and practice by the farmers which may be used to build an adequate theory of knowledge, attitude and practice.

1.7 Assumptions of the Study

An assumption is the supposition that an apparent fact or principle is true in the light of the available evidence (Goode, 1945). The following assumptions were in the mind of the researcher during conducting the study.

a. The respondents included in the sample were capable of furnishing of proper responses to the questions set-up in the interview schedule.
b. The researcher who acted as interviewer was well adjusted to the social environment of the study area. Hence the data collected by the researcher were free from bias.
c. The responses furnished by the respondents were reliable.
d. The items included in the questionnaire to ascertain the knowledge, attitude and practices of CSA were adequate to reflect the KAP of CSA.
e. The respondents had almost similar background and seemed to be homogenous to a great extent.
f. The information sought by the researcher revealed the real situation to satisfy the objectives of the study.
g. The findings were useful in choosing the clients as well as for planning, execution and evaluation the extension programme.

1.8 Limitations of the Study

The present study was undertaken to have an understanding of the KAP of CSA and to explore the relationship with selected characteristics of the farmers. Considering the time, money and other necessary resources available to the researcher and to make the research manageable and meaningful it become necessary to impose certain limitations. The limitations were as follows-

1. The study was conducted at three coastal districts, namely- Satkhira, Khulna, and Bagerhat.
2. The study was restricted within the farmers who had at least some cultivable land under own cultivation.
3. For information about the study the researcher was dependent on the data furnished by randomly selected respondents during the interview with them.
4. Characteristics of the farmers were many and varied but in the present study only 14 characteristics were selected.

5. The respondents for data collection were kept limited within the farm family who received training on CSA from DAE.
6. The researcher, relied on the data furnished by the farmers from their memory during interview.

1.9 Definition of related Terms

In this section, the terms which have been frequently used throughout the thesis are defined and interpreted below:

Respondents: Randomly selected people considered to be representative of the population are known as respondents. They are the people from whom a social research worker usually gets most data required for her research. In this study the respondents were the village level farmers.

Coastal farmer: The persons who were involved in farming activities are called farmers. They participated in different farm and community level activities like crops, livestock, fisheries, other farming activities etc. In this study coastal farmers refers to the farmers living in coastal areas.

Age: Age of a farmer referred to the period of time in complete years from his/her birth to the time of interview.

Education: Education of an individual farmer was defined as the formal education received up to a certain level from an educational institute (e.g., school, college and university) at the time of interview.

Farm size: Farm size referred to the total area on which a farmer's family carries on farming operations. The area being estimated in terms of full benefit to the farmer's family.

Annual agricultural income: Annual agricultural income referred to the total annual earnings of all the family members of a respondent from agriculture, livestock, fisheries and forestry sources.

Extension contact: Extension contact referred to an individual’s exposure to or contact with different information sources and personalities being contacted for technology dissemination among the farmers.

Innovativeness: Innovativeness is the degree to which an individual is relatively earlier in adopting an innovation with respect to other members of a social system (Rogers, 1983). This was comprehended by the quickness of accepting innovation by an individual in relation to others and was measured on the basis of time dimension.

Access to ICTs: In this study access to ICTs refers to the extent of some information and communication technologies used by an individual.

Access to Market: In this study market access refers to the ability of an individual to sell or buy goods and services into market.

Credit availability: Credit need of a respondent referred to the percentage of difference between total requirement of credit and amount of credit received with total requirement of credit.

Training exposure: Training exposure of a respondent referred to the total number of days that the respondent had undertaken different types of training in his entire life from different organizations.

Decision making ability: Decision making ability refers to the participation of a farmer in various household activities. It may be in daily family expenditure, increase in family income, family saving, education of the children, family health care and treatment, family planning, marriage of children, crop production etc.

Benefit obtained from CSA: Benefits obtained from CSA by a respondent referred to the extent of benefit obtained from using climate smart agricultural practices as perceived by him in terms of social, environmental, technical and economical, and psychological aspects.

Problem faced in CSA: It referred to the extent of problems faced by a respondent in using CSA in terms of social, technical, economical, marketing and psychological problems.

Knowledge on CSA: Knowledge is those behaviour and test situations which emphasized the remembering either by recognition or recall of idea, material or phenomenon (Bloom, 1956). In this study knowledge on CSA indicated the extent of climate smart agricultural knowledge of a respondent at the time of interview as evident from his responses to a set of questions related to CSA logically and scientifically prepared for this purpose.

Attitude: A predisposition or a tendency to respond positively or negatively towards a certain idea, object, person, or situation. Attitude influences an individual's choice of action, and responses to challenges, incentives, and rewards (together called stimuli).

CSA Practices: The method, idea, technology, etc. adopted in agriculture that increase productivity and resilience under climate change threat as well as reduces greenhouse gases emission.

CHAPTER 2

REVIEW OF LITERATURE

The present study is mainly concerned with the determination of the extent of KAP of CSA by the coastal farmers. This is also concerned with the determination of the contributions of the selected factors of the farmers to their extent of KAP of selected CSA practices. This is again concerned with the identification CSA practices being used by farmers, benefits of using CSA practices, and the problems faced by the farmers in using the same. The researcher intensively searched internet, available books, journals and printed materials from different sources of home and abroad. Government extension provider like DAE is providing CSA technologies for the general farmers of Bangladesh for crop production under changing climatic condition. But the important point is that only a few literatures were found directly related to the study. Hence, majority of the literatures were indirectly related with the present study. However, the literatures have been organized into following four sections to set the context of the study:

First section	: Literatures related to the concept of KAP (use/adoption) and CSA related issues
Second section	: Literatures related to KAP (use/adoption) of CSA and related issues
Third section	: Relationships between selected factors of the respondents and their extent of knowledge on CSA practices or other practices
Fourth section	: Relationships between selected factors of the respondents and their attitude towards CSA practices or other practices
Fifth section	: Relationships between selected factors of the respondents and their extent of practice or adoption of CSA technologies or other practices
Sixth section	: Conceptual framework of the study

2.1 Literatures Related to the Concept of KAP (use/adoption) and CSA Related Issues

2.1.1 Concept of knowledge

According to Wikipedia "Knowledge is a familiarity with someone or something, which can include facts, information, descriptions, or skills acquired through experience or education. It can refer to the theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic." (https://en.wikipedia.org/wiki/Knowledge)

According to Oxford dictionary "facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject."

Bhuiyan (2012) indicated that "knowledge may be defined as the scientific fact of an idea which is experimentally or empirically verified."

Boudreau (1995) indicated "Human faculty resulting from interpreted information; understanding that germinates from combination of data, information, experience, and individual interpretation. Variously defined as, Things that are held to be true in a given context and that drive us to action if there were no impediments."

2.1.2 Concept of attitudes

The concept of attitude arises from attempt to observed regularities in the behavior of individual persons. The quality of one's attitude is judged from the observable, evaluative responses he tends to make (Encyclopedia Britannica, 1968).

Fishbein and Ajzen (1975) define an attitude as "a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object".

"An Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993)

The term attitude used by Abate (1999) means ‘a settled opinion’ and ‘behavior reflecting this’. Venes (2001) defined attitude as behavior based on conscious or unconscious mental views developed through cumulative experience.
Zimmerman (2001) defined attitude as-

- The posture, action, or disposition of a figure or a statue.
- The posture or position of a person or an animal, or the manner in which the parts of his body are disposed; position assumed or studied to serve a purpose.
- Position as indicating action, feeling, or mood.

According to American Heritage Stedman’s Medical Dictionary (2001) attitude is-
1. The position of the body and limbs; posture.
2. A manner of acting.
3. A relatively stable and enduring predisposition to behave or react in a characteristic way.

Hogg and Vaughan (2005) defined an attitude is ‘a relatively enduring organization of beliefs, feelings, and behavioral tendencies towards socially significant objects, groups, events or symbols.’

‘Attitude may be defined as a person’s perspective toward a specific target and way of predisposition to act, perceive, think and feel in relation to something. It is expressed as one’s views regarding an object as positive or negative, favorable or unfavorable, like or dislike etc. with varying degrees’ (Bhuiyan, 2012).

2.1.3 Concept of practice

According to Oxford dictionary, ‘Practice is the actual application or use of an idea, belief, or method as opposed to theories relating to it.’ In another words practice is the facts, information, and skills acquired through experience or education; the theoretical or practical understanding of a subject.

Alam (2003) defined practice ‘as the activities of an individual that he/she performed followed by some instructions in order to fulfill some wants that he/she needed.’

According to Sveiby (1997) ‘Practice may be defined as a method, procedure, process, or rule used in a particular field or profession; a set of these regarded as standard.’

A practice is a component or aspect of a process that can be adopted independently and incrementally by an organization or individual to build an organizational or own capability. Practices support easier adoption of lighter processes. Individuals and organizations only use what they really need. They can adopt one or a few practices at a time and/or adopt a practice at higher levels over time (Mandal, 2016).

Practices are designed to be interchangeable, they may be mixed and matched or swapped out for alternative practices. Creating a method is as simple as selecting the practices that you wish to adopt, and then publishing the results. Each practice adds itself into the framework so that content can be viewed by practice, or across practices by work product, role, task and so on (Mandal, 2016).

2.1.4 Conceptualizing climate smart agricultural practices

Climate Smart Agriculture (CSA) as a concept was developed in 2010 by the Food and Agriculture Organization (FAO). It is an approach to reorienting agricultural and cattle production to the new realities of climate change (FAO, 2013). It creates the technical, policy and investment conditions for achieving sustainable agricultural development and food security as climate change unfolds. It is composed of three main pillars:

- sustainably increasing agricultural productivity and incomes;
- adapting and building resilience to climate change; and
- reducing and/or removing GHG emissions where possible.

Climate smart agriculture is not a defined set of practices or an entirely new type of agriculture (Mahasin and Roy, 2017). Rather it is an approach that combines different methods under a climate change umbrella. It assesses the risks and needs of a specific farm or farming community through a climate impact lens, then addresses them using practices chosen for that particular situation (FAO, 2016). It gives farmers tools and a pathway to make their operations and livelihoods more productive and resilient in the face of climate change, while also helping reduce their climate impacts. It integrates the three dimensions of sustainable development by jointly addressing food security and climate change challenges (Nciizah and Wakindiki, 2015). The focus is generally on improving the currently existing techniques, such as the usage of fertilizers and pesticides, but with better-applied efficiency and improved seeds (for instance, drought resistant seeds) (FAO, 2010).

As research and policy links between climate change and agriculture have advanced, CSA has emerged as a framework to capture the concept that agricultural systems can be developed and implemented to simultaneously improve food security and rural livelihoods, facilitate climate change adaptation and provide mitigation benefits (Roy *et al.*, 2014). Since it emerged in 2010, the development of this idea and use of the term itself, has been led by international institutions, particularly the United Nations Food and Agriculture Organization (FAO) and the World Bank. The Consultative Group on International Agricultural Research (CGIAR) has provided leadership to the international research community as the idea has matured (Scherr, 2012).

According to FAO, CSA is a more comprehensive development concept compared to agroecology. At its launch (2010), it was however heavily criticized, especially by civil society and farmers' organizations, for lacking specific indicators, thereby also for risking to focus too narrowly on mitigation instead of adaptation that is more urgent in poor developing countries. The CSA community responded to this criticism by broadening its scope. CSA now links environmental, social and economic pillars of sustainability, and covers farm level practices, landscape level approaches and institutional/policy level frameworks. The CSA concept is relatively flexible and is still "work in progress", since the approach remains context-specific and needs to be always tailored to local and regional realities. The CSA label is extensively used by internationally renowned research centres and organizations such as the World Bank, FAO, the Consultative Group for International Agricultural Research (CGIAR) and its Climate Change, Agriculture and Food Security (CCAFS) programme, the International Center for Tropical Agriculture (CIAT), the International Food Policy Research Institute (IFPRI), the UK Department for International Development (DfID), the Rockefeller Foundation, as well as African policymakers. (Knaepen *et al.*, 2015)

CSA seeks to increase productivity in an environmentally and socially sustainable way, strengthen farmers' resilience to climate change, and reduce agriculture's contribution to climate change by reducing greenhouse gas emissions and increasing carbon storage on farmland (Roy *et al.,* 2019). CSA includes proven practical techniques — such as mulching, intercropping, conservation agriculture, Crop rotation, integrated crop-livestock management, agroforestry, improved grazing, and improved water management — but also innovative practices such as better weather forecasting, early warning systems and risk insurance. It is about getting existing technologies off the shelf and into the hands of farmers and developing new technology such as drought and flood tolerant crops to meet the demands of the changing climate (Mahasin and Roy, 2017). It is also about creating and enabling policy environment for adaptation. CSA fully incorporates attention to climate risk management. In many regions, agriculture is an extremely risky business, and climate change will exacerbate this.

2.1.5 KAP

KAP stands for Knowledge, Attitude and Practice. It is used to investigate human behavior concerning a topic:

• What the respondents know about it (K)

• How the respondents feel about it (A)

• What the respondents do about it (P) (IDAF, 1994)

A KAP survey was found to be the most appropriate tool for the research. It is a representative study of a specific population to collect information on what is known, believed and done in relation to a particular topic (Emanuel, 2010). Knowledge, attitude and practice (KAP) surveys were first used in the 1950s to explore how the concept of family planning was received, understood and practiced by different populations across the globe (Launiala, 2009). The basic premises of the KAP surveys are that knowledge forms attitude, and that both knowledge and attitude are the building blocks for practice. KAP surveys are used for three general purposes: as a diagnostic tool to describe the population's current knowledge, attitude and practice; to provide insights on a current situation in designing specific interventions; and as a tool to evaluate the effectiveness of certain interventions or programmes (Vandamme, 2009). Even though KAP surveys have been criticized in the past for its reliability, validity and measurement that relates to the intensity of opinion or attitude (Vandamme, 2009). Moreover, the surveys in general are well accepted, as a conceptual framework to measure public's understanding, awareness, willingness and participation on a certain issue (Launiala, 2009, Vandamme, 2009). Even though KAP studies are very common, most often knowledge, attitude and practice are not researched at the same time.

2.1.6 Importance of KAP study

At the process of gaining maximum public support for the campaign, before beginning the process of creating awareness in any given community, it is first necessary to assess the environment in which awareness creation will take place. Conducting a KAP study can best do this. KAP Study tells us what people know about certain things, how they feel and also how they behave (Kaliyaperumal, 2004).

Open-ended interviews and focus groups can complement a KAP survey, allowing further exploration of a situation or problem, and potentially highlighting aspects that are not yet known. These methods combine observations and open interviews and help deepen topics addressed in the KAP survey (Monde, 2011).

2.2. Past Research Related to Knowledge, Attitude and Practice (use/adoption) Regarding CSA and Related Issues

2.2.1 Knowledge and climate smart agriculture related issues

Beyene (2018) conducted research on adoption of CSA practices: determinants and challenges in Gerar Jarso Woreda of Oromia Regional State of Ethiopia. It was revealed from the study that the respondents perceived decline in rainfall, increase in temperature and concomitant declines in tree cover and crop production. It also indicated that farmers' perception (knowledge) of past climatic events is in agreement with 30 years of temperature records than precipitation.

Nyasimi *et al.* (2017) conducted research on 'adoption and dissemination pathways for CSA technologies and practices for climate-resilient livelihoods in Lushoto, Northeast Tanzania' and found that more than three-quarters of the households were aware of improved or multiple stress tolerant crop varieties (such as Lyamungo90 bean varieties, composting, inorganic fertilizers, early planting, cut and carry livestock feeding, agroforestry, and local tolerant varieties). More than half of the households were aware of intercropping, minimum tillage, mulching, crop rotation, scientific and traditional weather forecasting, non-burning, terraces and contour planting, and improved fodder. Fewer households (less than 45%) were aware of biogas, Matengo pits (a traditional soil and water conservation technique), SACCOs (Saving and credit cooperatives), and strip cropping CSA practices, the four technologies and practices that farmers who participated in the FotF were exposed to during the learning journey.

Kiptot *et al.* (2012) conducted a study on volunteer farmer trainers: improving smallholder farmers' access to information for a stronger dairy sector, found that dissemination of CSA practices and knowledge in the pilot site applied an innovative farmer-led extension approach that relied on volunteer farmer trainers.

Zighe (2016) Conducted research on adoption of CSA technologies among female smallholder farmers in Malawi and found that a number of the farmers have heard about CSA technologies in one way or another. Only 1.67% of the farmers interviewed had no clear understanding of what the CSA technologies was all about.

Ochieng (2015) conducted research on 'knowledge, attitudes and practices on climate change adaptation by smallholder farmers in Mwala Constituency, Machakos County, Kenya. The study revealed that farmers in Mwala Constituency had a high awareness of changes in rainfall and temperature. Eighty one percent (81%) believed that climate was changing as they had observed changes in their local environment and had taken specific measures to cope with the effects on their crops.

Israel (2019) conducted a study on climate smart agriculture technology adoption and impact in the East Gonja district of Ghana. The result showed that about 72% of the respondents claimed they knew or had heard of climate change and 28% of the respondents claimed they did not know about climate change.

Mondal (2014) conducted research on farmers' knowledge, attitude and practice regarding strawberry cultivation and found that majority (54%) of the farmers possessed medium knowledge while 27.4% and 14.6% of the farmers possessed low and high knowledge respectively.

Mandal (2016) conducted research on 'farmers' knowledge, attitude and practice regarding watermelon cultivation' and found that majority (64.3 %) of the farmers possessed 'medium knowledge' while 20.7% and 15% of the farmers possessed 'low' to 'high knowledge' respectively in watermelon cultivation.

Rahman (2015) conducted research on Farmers' knowledge and attitude regarding cultivation of salt tolerant variety (BRRI Dhan 47) of rice and found that majority (75%)

of the farmer possessed medium knowledge and 20.37% and 4.63% of the farmers possessed high and low knowledge on rice cultivation respectively.

Khan (2005) studied on knowledge of maize cultivation and found that majority (68%) of the farmers had relatively low level of knowledge and 32% of the farmers possessed relatively high level of knowledge.

Sana (2003) studied farmers' knowledge of shrimp culture and showed that majority (61%) of them had medium level of knowledge, while 30% had low and rest 9% possessed high knowledge.

Hassan (2004) reported that the highest proportion of the respondents had medium knowledge on partnership extension approach (70.4%) followed by 16.9% had low knowledge and 13.3% had high knowledge.

Rahman (2004) found in his study that the highest proportion (62.22%) of the respondents had medium knowledge compared to 25.56% having low knowledge and only 12.22% had high knowledge on HYV boro rice cultivation practices.

Hussen (2001) found in his study on farmers' knowledge and adoption of modern sugarcane cultivation practices found that highest proportion (84%) of the farmers possessed medium knowledge, 13% high knowledge and lowest proportion (3%) possessed low knowledge.

Saha (2001) made an attempt on farmers' knowledge in improved practices of pineapple cultivation and found that the majority (62%) of the farmers possessed good knowledge, 33% poor knowledge and only 5% possessed excellent knowledge.

Khan (1996) conducted research on the effectiveness of a farmer primer on growing rice in knowledge change of the farmers in Shaktipur Thana and found that 67% farmers had good knowledge at initial stage, where 21% had excellent knowledge and 12% had poor knowledge.

2.2.2 Attitudes and climate smart agriculture related issues

Beyene (2018) found that 92% of smallholder farmers are positively perceived as CSA practices can overcome several environmental problems such as soil degradation, water resource deterioration, climate change and variability.

Ochieng (2015) conducted research on 'knowledge, attitudes and practices on climate change adaptation by small holder Farmers in Mwala constituency, Machakos county, Kenya. The study revealed that farmers had a positive attitude towards the changes and had joined farmers' groups and cooperative societies for information sharing.

Zulkifly *et al.* (2013) conducted research on 'assessing knowledge, attitude and practice (KAP) on food safety among food handlers in Universiti Teknologi Mara (UiTM)' and found that majority of the food handlers reported positive attitudes on most aspects such as the responsibility to obtain food safety and to ensure that food is save to serve.

Mondal (2014) conducted research on farmers' knowledge, attitude and practice regarding strawberry cultivation and found that almost all (97.3%) of the respondents had favorable attitude towards strawberry cultivation and rest 1.8% and 0.9% of the respondents had neutral and unfavorable attitude towards strawberry cultivation.

Mandal (2016) conducted research on 'farmers' knowledge, attitude and practice regarding watermelon cultivation' and found that the majority (62.1%) of the watermelon farmers had favorable attitude towards watermelon cultivation compared to 31 % having unfavorable and only 9.2% had neutral attitude. Rahman (2015) showed that about 77.78% of the respondents had high favorable attitude towards the rice cultivation and 22.22% of the respondents had low favourable attitude towards the rice cultivation. Monalesa (2014) found that about half (49.5%) of the formers had favorable attitude towards summer *tomato* cultivation.

Samad (2010) made an attempt on farmers' attitude towards aerobic rice cultivation. He found that the majority (69.84%) of the farmers had favorable attitude while 1% had unfavorable attitude and 29.16% had neutral attitude towards aerobic rice cultivation. The attitude score of non-project farmers showed that the majority (58.33%) possessed neutral attitude, 2.08% had favorable attitude and 39.59% had favorable attitude towards aerobic rice cultivation.

Ahmed (2006) conducted a study to determine the attitude of the farmers towards shrimp farming in a selected area of Khulna district and to explore the relationships between ten selected characteristics of the farmers and their attitude. He found that overwhelming majority (87%) of the shrimp farmers had favorable attitude towards shrimp farming compared to 7% having neutral and only 6% had unfavorable attitude.

Uddin *et al.* (2006) conducted a study to determine farmers' attitude towards sustainable agriculture and to explore the relationships between thirteen selected characteristics of the farmers and their attitude towards sustainable agriculture. Equal proportion of farmers (39%) having moderately favorable and highly favorable attitude towards sustainable agriculture. On the other hand, 4% and 18% farmers had highly unfavorable and moderately unfavorable attitude towards sustainable agriculture respectively.

Khan (2005) attempted to determine the attitude of farmers towards groundnut cultivation and to explore relationships between twelve selected characteristics of the farmers and their attitude. From the study he found that the overwhelming majority (93.14%) of the groundnut farmers had favorable attitude towards groundnut cultivation compared to 4.90% having neutral and only 1.96% had unfavorable attitude.

Sarkar (2004) studied the attitude of the imams towards improved agricultural technologies and to explore the relationships between selected characteristics of the imams and their attitude towards improved agricultural technologies. The findings of this study revealed that 28.75% of the imams had favorable attitude towards crop cultivation, while 51.25% had moderately favorable attitude and the rest 20% had less favorable attitude towards crop cultivation. For livestock development, 22.5% of the imams had favorable attitude, while 67.5% had moderate and the rest 10% had less favorable attitude towards livestock development. For fish culture, 28.75% had favorable, 66.25% had moderate and rest 5% had less favorable attitude towards fish culture. Again, 16.25% of the imams had favorable attitude towards overall improved agricultural technologies, while 70% had moderate and rest 13.75% had less favorable attitude towards overall improved agricultural technologies.

Farhad and Kashem (2004) attempted to determine attitude of rural women in using IPM in vegetable cultivation and to explore the relationship between the selected characteristics of the women and their attitude of IPM in vegetable cultivation. The majority (68%) of the respondents had medium attitude while 17% low attitude and 15% high attitude in using IPM in vegetable cultivation.

Chowdhury (2003) carried out research to determine farmers' attitude towards crop diversification in two differently developed villages, one being progressive and other traditional. Majority of the farmers in progressive village held moderately favorable attitude (52%) compared to farmers of traditional village of whom 43% held moderately favorable and 29% held moderately unfavorable attitude towards crop diversification. Farmers of progressive village having favorable attitude towards crop diversification were more than the farmers of traditional village.

Arafad (2002) conducted a study in three villages of Dumki upazila under Patuakhali district. He found that majority (59.1%) of the farmers had favorable attitude towards vegetable cultivation while 40.9% had moderately favorable attitude towards vegetable cultivation.

Haque (2002) carried out a study to assess the extent of attitude of rural women in selected homestead agriculture activities viz. homestead vegetable cultivation, poultry raising, goat rearing, fish cultivation and tree plantation. The highest percentage of the rural women had moderate favorable attitude in each of the five selected activities. These were 85% in poultry raising, 83% in goat rearing, 78% in fish cultivation, 72% in tree plantation and 70% in vegetable cultivation.

Sarkar (2002) conducted a study to determine and describe the attitude of rice growers towards the use of DAP on rice cultivation. The findings revealed that the majority of rice growers (62.37%) had moderately unfavorable attitude towards the use of DAP while 26.73% and 5.95% had moderately favorable and highly favorable attitude respectively towards the use of DAP. Only 4.95% fell in highly unfavorable attitude.

Hussain (2001) investigated the attitude of farmers towards Rice-Fish cultivation program of CARE. The findings revealed that the highest proportion (66%) of the respondents had moderately favorable, 21% slightly favorable and 13% had highly favorable attitude towards Rice-Fish cultivation program of CARE.

Reddy *et al*. (2001) showed that the attitudes of 120 dry land farmers in Andhra Pradesh, India, towards dry land agricultural technology (DAT) were analyzed. Most of the farmers (37.50%) had negative attitude followed by positive (31.63%) and neutral (30.83%) attitudes towards DAT.

Rahman (2001) investigated the attitude of farmers towards Binadhan-6 the highest proportion (49%) of the Binadhan-6 growers had unfavorable, 24% highly unfavorable and 26% had favorable attitude towards Binadhan-6.

2.2.3 Practices and climate smart agriculture related issues

Beyene (2018) found in a study that smallholder farmers have adopted various CSA practices to overcome several environmental problems such as diminishing soil fertility, climate change and variability etc. The most commonly practiced CSA practices in the study area were 'crop diversification', received a high priority among rural farmers (71%). This was followed by other practices such as crop rotation (65.2%) and uses of drought resistance crops (55.2%). Irrigation received the lowest priority as 23 % of the respondents reported to have adopted it.

Mutoko (2014) conducted a study on adoption of CSA practices: barriers, incentives, benefits and lessons learnt from the MICCA Pilot Site in Kenya. Findings clearly revealed the most adopted CSA practices as improved fodder production (i.e., Napier and Rhodes grasses) and planting of agroforestry trees (i.e., Grevillia and Croton). Whereas the least adopted improved practices included establishment of tree nurseries, fodder trees, manure composting and installation of biogas digesters.

Nyasimi *et al.* (2017) found that several factors influence farmers' ability to adopt CSA practices. Among the key factors include (a) availability and access to resources needed to use the practices such as land, labor, and financial capital; (b) potential benefits to be accrued vis-à-vis other practices; (c) whether they have the required skills and information to use it; (d) ability to cope with challenges that might arise during or after using the practices; and (e) compatibility with local social and cultural practices.

Zighe (2016) conducted research on adoption of CSA technologies among female small holders' farmers in Malawi and found that female smallholder's farmers were using manure, zero tillage, mulching, pit planting, crop diversification, sasakawa, irrigation and agroforestry in their farming systems. Mulching had a rate of 73% of the users followed by zero tillage and pit planting which had 71%. Rain water harvesting had the least user's rate of 21%. On the other hand, the male farmers indicated that they use CSA technologies their farming systems were as follows: mulching, zero tillage, pit planting, irrigation, sasakawa, agroforestry, planting hybrid, crop diversification and crop rotation. 94% of the farmers preferred mulching while planting hybrid and crop rotation had a rate of 69% and 50% respectively.

Yameogo *et al.* (2017) conducted a study on barriers to uptake of CSA practices: a case study of Dano and Ouahigouya farmers, Burkina Faso. In this study, six broad groups of CSA practices were considered. The categories were: Farmer managed natural regeneration (FMNR), Conservation agriculture (CA), Climate smart rice production, Crop-livestock integration (CLI), Integrated water resource management (IWRM), and Agroforestry.

Ochieng (2015) conducted research 'knowledge, attitudes and practices on climate change adaptation by small holder farmers in Mwala Constituency, Machakos County, Kenya. The study revealed that the practices adopted by the farmers towards climate variability included agroforestry, farm forestry, planting different varieties of crops, and staggering planting time.

Israel (2019) conducted a study on CSA technology adoption and impact in the East Gonja district of Ghana. The study showed that soil conservation and livelihood diversification practices were highly adopted compared to irrigation and water harvesting.

Onyeneke *et al*. (2017) identified five broad and important practices relevant to CSA practices namely, adjusting agricultural production systems, mobility and social networks, farm financial management, diversification on and beyond the farm, and knowledge management and regulations.

Hasan *et al*. (2018) identified seventeen CSA practices *viz.* saline-tolerant crop varieties, flood-tolerant crop varieties, drought-resistant crop varieties, early maturing rice, vegetables in a floating bed, sorjan method of farming, pond-side vegetable cultivation, the cultivation of watermelon, sunflower or plum, relay cropping, urea deep placement, organic fertilizer, mulching, use of pheromone trap, rain water harvesting and seed storage in plastic bags or glass bottles in Kalapara upazila in Patuakhali, Bangladesh.

Billah and Hossain (2017) also reported cultivating HYV, zero tillage, crop diversification, crop rotation, intercropping, mulching, improved irrigation, use of stress tolerant varieties, integrated farming system, rain water conservation, agroforestry, box ridges, AWD method, pit planting and short duration varieties as existing CSA technologies practiced by the coastal farmers.

Saha *et al.* (2019) identified 15 CSA practices in Kalapara upazila of Patuakhali district. The practices are saline tolerant varieties, submergence-tolerant varieties, drought resistant varieties, early variety of rice, *sorjan* method, pond side vegetable cultivation, watermelon cultivation, sunflower cultivation, plum cultivation, relay cropping, urea deep placement, organic fertilizer, mulching, rainwater harvesting and seed storage in plastic bags.

CIAT and World Bank (2017) found some CSA technologies in coastal areas of Bangladesh. The technologies are: traditional gher farming, floating vegetable gardens, kangkong cultivation, sorjan system, rice field fish rings, the 'hari' system, the use of salt and submergence tolerant high yielding crop varieties, vegetable towers, etc. are mentionable.

Afrin *et al.* (2017) identified 19 CSA practices in Sylhet district of Bangladesh. The practices are: perching, high yielding varieties, adjusting planting time, farm yard manure, green manuring, crop rotation, vermicomposting, cover crop, fallowing, rain water harvesting, AWD, improved livestock breed, community seed bed, USG, IPM, sorjan method, floating bed fodder, zero tillage and raised bed planting.

Mia (2005) conducted research on 'adoption of integrated pest management (IPM) practices by the vegetable growers of Magura district'. The research revealed that only 32% of the vegetable growers were high user of IPM practices, while 63% medium and 5% of the vegetable growers were low user of IPM practices respectively.

Mondal (2014) conducted research on farmers' knowledge, attitude and practice regarding strawberry cultivation and found that majority (69.9%) of the strawberry farmers had medium practice, while 17.7% farmers had high practice and 12.4% farmers had low practice on strawberry cultivation.

Mandal (2016) conducted research on 'farmers' knowledge, attitude and practice regarding watermelon cultivation' and found that majority (71.3 %) of the watermelon farmers had 'medium improved practice', while 16.1% farmers had 'high practice' and 12.6% farmers had 'low practice' of watermelon cultivation.

2.3 Relationships between Selected Factors of the Respondents and Their Extent of Knowledge on CSA Practices or Other Practices

2.3.1 Age and Knowledge on CSA practices or other practices

After reviewing the related literature, it was found that some studies showed age having negative and some studies showed age having positive relationship with knowledge on CSA practices or related matters, but some studies did not show any significant relationship.

Rahman (2015) observed in his study about farmers' knowledge and attitude regarding cultivation of salt tolerant variety (BRRI dhan 47) of rice" that age of rice farmers had a positive significant relationship with knowledge on BRRI dhan 47 cultivation. Hanif (2000) observed in his study that age of FFs farmers had significant relationship with IPM knowledge on environmental awareness. Huda *et al.* (1992) found that older farmers were more careful in keeping moisture content low of their seed.

Amin (2001) observed in his study that age of PETRRA and non-PETRRA beneficiaries had negative significant relationship with their knowledge on organic cocoon and skills on production, processing, storing of seeds. Islam (1996) conducted a study on farmers' use of indigenous technical knowledge (ITK) in the context of sustainable agricultural development. But he found that age of the farmers had significant negative relationship with their extent of use of ITK.

Mandal (2016) conducted research on 'farmers' knowledge, attitude and practice regarding watermelon cultivation' and found that farmer's age had no significant relationship with their knowledge in watermelon cultivation. Roy (2006) found that age of the farmer had no significant relationship with their knowledge on boro rice cultivation. Similar results were observed by Mondal (2014), Khan (2005), Islam (2005) and Rahman (2004) in their respective studies. Hossain (2003) observed same result in his study that the age of farmers had no significant relationship on modern Boro rice cultivation practices. Saha (2003), Sana (2003), Sarker (2002), Saha (2001), Rahman (2001), Hossain (2000), Islam (1993) found no relationship between age and knowledge in their studies.

2.3.2 Education and knowledge on CSA practices or other practices

Mandal (2016) conducted research on 'farmers' knowledge, attitude and practice regarding watermelon cultivation' and found that farmers' education had no significant relationship with their knowledge on watermelon cultivation. Huda *et al.* (1992) found that farmers with education and without education had same level of moisture of their seed.

Mondal (2014) observed in her study that education of strawberry cultivation farmers had positive significant relationship with knowledge on strawberry cultivation at 5% level of significance. Rahman (2015) also observed in his that education of the farmers had positive significant relationship with knowledge on BRRI dhan 47 cultivation. Hossain (2003) found that education of the farmers had significant relationship with modern boro rice cultivation. Amin (2001) found that education of PETRRA and non-PETRRA beneficiaries had positive significant relationship with their knowledge on organic cocoon and skills on production and storing of rice seeds. Saha (2003), Sana (2003), Sarker (2002), Saha (2001), Hossain (2000) found that education of the farmers was positively and significantly related with their knowledge in their researches. Huda (2001) reported that of education of the farmers have motivated them to dry the seed and keep in sealed container to keep the moisture low.

2.3.3 Farm size and knowledge

Rahman (2015) conducted research on farmers' knowledge and attitude regarding cultivation of salt tolerant variety (BRRI Dhan 47) of rice and showed that farm size had no significant relationship with their knowledge on BRRI dhan47 cultivation. Sana (2003) and Hossain (2000) found that farm size of the farmers had no relationship with their knowledge. Amin (2001) found that farm size of PETRRA and non-PETRRA beneficiaries had no relationship with knowledge on organic cocoon and skills on production, procession and storing of rice seed.

Sarker (2002) and Hossain (2001) found that there was a positive relationship between farm size of the farmers and their knowledge in their research. Hossain (2003) reported that farm size of the farmers had significant relationship with modern Boro rice cultivation. Alam (1997) studied the use of improved farm practices farm in rice cultivation by the farmers. The findings of the study showed that the farm size had a significant relationship with their use of improved farm practices in rice cultivation. Islam (1996) found that there was significant and negative relationship between the farm size of the farmers and their extent of use of indigenous technical knowledge.

2.3.4 Annual agricultural income and knowledge

Mandal (2016) conducted research on 'farmers' knowledge, attitude and practice regarding watermelon cultivation' and found that farmers' annual family income, income from watermelon cultivation had significant positive relationship with their knowledge on watermelon cultivation. Dhali (2013) observed in his study that annual income of the farmers on semi-intensive aquaculture had significant and positive relationship. Similar results were observed by Sharif (2011), Kausar (2009), Rahman (2009), Rahman (2006), Roy (2006), Islam (2005), Hossain (2003) and Nurzaman (2000) in their respective studies.

But Mondal (2014) observed in her study that annual family income of farmers had no significant relationship with knowledge on strawberry cultivation. Amin (2001) found that farm size of PETRRA and non-PETRRA beneficiaries had no relationship with knowledge on organic cocoon and skills on production, procession and storing of rice seed.

2.3.5 Farming experience and knowledge

Mondal (2014) conducted research on farmers' knowledge, attitude and practice regarding strawberry cultivation and found that strawberry cultivation experience of the respondents had significant positive relationship with their knowledge on strawberry cultivation.

Anu (2016) conducted a study on farmers' knowledge and practice regarding plant nursery management and found that nursery management experience of the farmers had no significant relationships with their knowledge on plant nursery management.

2.3.6 Extension contact and knowledge

Mandal (2016) conducted research on 'farmers' knowledge, attitude and practice regarding watermelon cultivation' and found that farmers' extension contact had significant positive relationship with their knowledge on watermelon cultivation.

Mondal (2014) observed in her study that extension contact of strawberry cultivation farmers had positive significant relationship with knowledge on strawberry cultivation. Rahman (2015) also observed in his that extension contact farmers had positive significant relationship with knowledge on BRRI dhan 47 cultivation.

Islam (2005) conducted research on 'farmers' knowledge, attitude and practice in using IPM crop production' and found that farmers' extension contact had significant relationship with their knowledge on IPM in crop production.

Khan (2005) conducted research on "farmers' knowledge of maize cultivation in Tilli Union" and found that farmers' extension contact had significant relationship with their knowledge on maize cultivation.

Sana (2003), Sarker (2002) and Rahman (2001) and Hossain (2000) found in their study that media exposure of farmers were highly positive significant relationships with their knowledge.

2.3.7 Training exposure and knowledge

Mandal (2016) conducted research on 'farmers' knowledge, attitude and practice regarding watermelon cultivation' and found that training exposure had significant positive relationship with their knowledge on watermelon cultivation. Manjunatha (1980) and Sadat (2002) also found that training exposure of the farmers had a positive significant relationship with their knowledge.

Mondal (2014) conducted research on farmers' knowledge, attitude and practice regarding strawberry cultivation and found that training of farmers had no significant relationship with their knowledge. Rahman (2015) also showed that training exposure had no significant relationship with their knowledge on BRRI dhan47 cultivation.

2.3.8 Innovativeness and knowledge

Saha (2001) conducted a study on ‘farmers’ knowledge on improved practices of pineapple cultivation’ and found that innovativeness of the farmers had a negative significant relationship with their knowledge on improved practices of pineapple cultivation. Sharma and Sanoria (1983) observed higher average innovativeness among contact farmers than the non-contact farmers. They also found that knowledge of both the contact and non-contact farmers differed significantly with them innovativeness.

2.3.9 Credit availability and knowledge

Rahman (2018) conducted research on ‘farmers’ knowledge, attitude and practice towards agricultural mechanization. The findings indicated that credit availability of farmers had no significant relationship with their knowledge on agricultural mechanization. Anu (2016) conducted research on “farmers’ knowledge and practice regarding plant nursery management” and found that credit receive in plant nursery management of the farmers had no significant relationships with their knowledge of plant nursery management. Mandal (2016) conducted research on ‘farmers’ knowledge, attitude and practice regarding watermelon cultivation’ and found that the credit received of the watermelon growers had no significant relationship with their knowledge on watermelon cultivation.

Hussain (2001) studied on farmers‟ knowledge and adoption of sugarcane cultivation practices and he observed a significant relationship between credit availability and their knowledge. Kausar (2009) found that credit availability of pond owners had a significant and negatives relationship with their knowledge.

2.3.10 Access to market and knowledge

No literature was found related to relationship between market access and knowledge.

2.3.11 Access to ICTs and knowledge

Uddin (2007) conducted research on ‘use of mass media by the farmers in receiving agricultural information’ and found that agricultural knowledge had significant positive relationship with the use of mass media by the farmers. Islam (2005) in his study concluded that the agricultural knowledge of the respondents had positive significant relationship with their use of printed materials. Nuruzzaman (2003) in his study observed that the agricultural knowledge of the farmers had positive and significant relationship with their use of mass media. Parveen (1995) found that the mass media exposure of the respondents had a positive significant relation with their agricultural knowledge.

Kashem and Halim (1999) showed that the use of communication media in the adoption of modem rice technologies had significant positive correlation with agricultural knowledge. Islam (1999) and Sarker (1995) found a highly significant and positive relationship between agricultural knowledge of the farmers and their use of communication media.

2.3.12 Decision making ability and knowledge

No literature was found related to relationship between decision making ability and knowledge.

2.3.13 Benefit obtained from CSA and knowledge

No literature was found related to relationship between benefit obtained for CSA and knowledge.

2.3.14 Problem faced in CSA and knowledge

Rahman (2018) conducted research on ‘farmers’ KAP Towards Agricultural Mechanization. The findings indicate that problem faced of farmers had a significant negative relationship with their knowledge on agricultural mechanization. Mondal (2014) observed in her study that problem faced on strawberry cultivation of farmers had negative significant relationship with knowledge on strawberry cultivation. Rahman (2015) also observed in his that problem faced on BRRI dhan 47 cultivation of farmers had negative significant relationship with knowledge on BRRI dhan 47 cultivation. Mandal (2016) in his study concluded that problem faced in watermelon cultivation of the farmers had negatively significant relationship with their knowledge on watermelon cultivation. Abdullah (2013) in his study concluded that problem faced of the farmers had negatively significant relationship with their knowledge on pond fish culture. Azad (2014) in his study concluded that problem faced in vegetable cultivation of the farmers had negatively significant relationship with their knowledge on postharvest practices of vegetables.

Anu (2016) conducted research on “farmers’ knowledge and practice regarding plant nursery management” and found that problem faced in plant nursery management of the farmers had no significant relationships with their knowledge of plant nursery management. However, Anwar (1994) reported that problems of the farmers had no significant relationship with their knowledge. Raha (2007) also stated that problems of the farmers had no significant relationship with their knowledge. Islam (2001) also showed similar result in his study.

2.4 Relationship between Selected Characteristics of the Farmers and Their Attitude towards CSA

2.4.1 Age and attitude

Mondal (2014) conducted research on farmers’ KAP regarding strawberry cultivation and found that age had significant contribution on their attitude towards strawberry cultivation. Rahman (2015) also observed in his that age of farmers had positive significant relationship with knowledge on BRRI dhan 47 cultivation. Mannan (2001) and Parveen (1993) found that age of the respondents had positive relationship with their attitude towards ecological agriculture. Noor (1995) also found that age had relationship with their attitude towards the cultivation of high yielding varieties of potato.

Mandal (2016) conducted research on ‘farmers’ KAP regarding watermelon cultivation’ and found that farmer’s age had no significant relationship with their attitude in watermelon cultivation. Chowdhury (2003) found that age of farmers had no significant relationship with their attitude towards crop diversification. Habib (2000) found that age of the BSs had no significant relationship with their attitude towards the use of agrochemicals. Nurzaman (2000) observed in his study that age of the FFS and non-FFS farmers had no significant relationship with their attitude towards IPM.

Bari (2000) reported in his study that age of the farmers had no significant relationship with their attitude towards hybrid rice AALOK 6201. Mannan (2001) in his study found that age of Proshika farmers had no significant relationship with their attitude towards the ecological agricultural programmes.

On the other hand, Farhad and Kashem (2004) conducted a study on attitude of rural women towards using IPM in vegetable cultivation and found that age had a negative significant relationship with their attitudes towards using IPM in vegetable cultivation. Ali (2002), Singh and Kunzroo (1985) also found that age of the farmers had negative significant relationship with their attitude in their research studies.

2.4.2 Education and attitude

Mondal (2014) conducted research on farmers' KAP regarding strawberry cultivation and found that farmers' education had significant contribution on their attitude towards strawberry cultivation. Rahman (2015) also observed in his that education of farmers had positive significant relationship with attitude towards BRRI dhan 47 cultivation. Farhad and Kashem (2004), Chowdhury (2003), Shehrawat (2002), Khan (2002), found that education of the farmers had a positive significant relationship with their attitude.

Habib (2000) observed in his study that education of the BSs had significant positive relationship with their attitude towards agrochemicals. Nurzaman (2000) found that education of the FFS and non-FFS farmers were positively correlated with their attitude on IPM. Paul (2000) in his study found that academic qualification of the farmers had positive significant relationship with their attitude towards the use of USG. The academic qualification of Proshika farmers had a positive relationship with their attitude towards the ecological agricultural programme (Mannan, 2001). Chowdhury (2003) found that academic qualification of the farmers had positive significant relationship with their attitude towards crop diversification.

Mandal (2016) conducted research on 'farmers' KAP regarding watermelon cultivation' and found that education had no significant relationship with their attitude in watermelon cultivation. On the other hand, Ali (2002) found that education qualification of Block Supervisor's (BSs) had negative relationship with their attitude.

2.4.3 Farm size and attitude

Rahman (2015) conducted research on farmers' knowledge and attitude regarding cultivation of salt tolerant variety (BRRI Dhan 47) of rice and found that farm size had no significant relationship with their attitude towards BRRI dhan47 cultivation. Ali (2002), Nurzaman (2000) and Noor (1995) revealed in their studies that farm size had no significant relationship with the attitude. Habib (2000) observed in his study that family size of the BSs had no relationship with their attitude towards the use of agrochemicals.

Chowdhury (2003), Shehrawat (2002) and Sadat (2002) found that there was a positive and significant relationship between farm size and attitude of farmers in their studies. Paul (2000) also observed in his study that there was positive and significant relationship between farm size and attitude of farmers towards the use of USG on rice cultivation. Mannan (2001) found that the farm size of Proshika farmers had positive significant relationship with their attitude towards the ecological agriculture programmes.

2.4.4 Annual agricultural income and attitude

Mondal (2014) conducted research on farmers' KAP regarding strawberry cultivation and found that income from strawberry cultivation of the strawberry farmers had significant contribution on their attitude towards strawberry cultivation. Mandal (2016) found that farmers' annual family income, income from watermelon cultivation had significant positive relationship with their attitude towards watermelon cultivation. Chowdhury (2003) and Shehrawat (2002) reported that family income of farmers had positive significant relationship with their attitude. Mannan (2001) observed in his study that there was positive significant relationship between the family annual income and their attitude towards the ecological agriculture programmes. Akanda (2001) found significant relationship with income and attitude towards rice fish programme CARE in Muktagacha upazila of Mymensingh district**.** Paul (2000) reported that annual family income of the farmers had positively significant relationship with their attitude towards use of USG.

Siddique (2002) and Parveen (1993) revealed that annual income had no significant relationship with the attitude of farmers in their studies. Nurzaman (2000) observed in his study that there was no significant relationship between family income of the FFS and non-FFS farmers with their attitude on IPM.

Habib (2000) observed in his study that income of the BSs has significant negative relationship with their attitude towards agrochemicals. Bari (2000) found that there was significant negative relationship between family income and attitude of farmers towards hybrid rice AALOK 6201.

2.4.5 Farming experience and attitude

Mondal (2014) conducted research on farmers' KAP regarding strawberry cultivation and found that strawberry cultivation experience of the respondents had significant positive relationship with their attitude towards strawberry cultivation. Sarker (2002) and Habib (2000) also reported that experience of the farmers had a positive significant relationship with their attitude.

2.4.6 Extension contact and attitude

Mandal (2016) conducted research on 'farmers' KAP regarding watermelon cultivation' and found that farmers' extension contact had significant positive relationship with their attitude towards watermelon cultivation. Rahman (2015) showed that extension contact of the farmers had significant positive relationship with their attitude towards BRRI dhan47 cultivation. Farhad and Kashem (2004), Shehrawat (2002), Sadat (2002) and Siddique (2002) also reported in their studies that there was a significant and positive relationship between extension contact and attitude of farmers.

Chowdhury (2003) observed no relationship between extension contact and attitude of farmers towards crop diversification. Bari (2000) also reported that there is no relationship between extension contact and attitude of farmers towards hybrid rice ALOK 6201.

2.4.7 Training exposure and attitude

Mandal (2016) conducted research on 'farmers' KAP regarding watermelon cultivation' and found that farmers' training exposure had significant positive relationship with their attitude towards watermelon cultivation. Paul (2000) reported that training exposure of the farmers had a positive significant relationship with their attitude.

On the other hand, Bari (2001) reported that training exposure of the farmers had no relationship with their attitude. Mondal (2015), Rahman (2015) and Bari (2001) in their studies reported that training exposure of the farmers had no relationship with their attitude.

2.4.8 Innovativeness and attitude

Islam (2007) conducted research on attitude of farmers towards modern jute cultivation in Baliakandi upazila under Rajbari district and found that innovativeness had no relationship with their attitude towards modem jute cultivation of the jute growers. Nurzaman (2000) in his study observed that innovativeness of the FFS and non-FFS farmers had no relationship with their attitude towards IPM.

Paul (2001) revealed in his study attitude of farmers towards use of Urea Super Granule (USG) in rice cultivation that there was positive significant relationship between innovativeness and attitude. Hossain *et al.* (2002) revealed that there was significant relationship between attitude and innovativeness in his study on attitude on island farmers towards adoption of modem agricultural technologies.

2.4.9 Credit availability and attitude

Rahman (2018) conducted research on "farmers' KAP towards agricultural mechanization". The findings indicated that credit availability of farmers had significant relationship with their attitude towards agricultural mechanization. Mandal (2016) conducted research on 'farmers' KAP regarding watermelon cultivation' and found that the credit received of the watermelon growers had positive significant relationship with their attitude towards watermelon cultivation. Karim *et al.* (2005) indicated that credit availability of the farmers had significant and positive relationship with their attitude towards the use of urea.

Islam (2007) conducted research on attitude of farmers towards modern jute cultivation in Baliakandi upazila under Rajbari district and found that credit availability had no relationship with their attitude towards modem jute cultivation of the jute growers.

2.4.10 Access to market and attitude

No literature was found related to relationship between market access and attitude.

2.4.11 Access to ICTs and attitude

Khatun (2007) conducted research on 'effectiveness of agriculture related television programmes for dissemination of agricultural information to the farmers and found that attitude of the respondents towards agriculture related TV programmes had significant positive relationship with their perceived effectiveness of agriculture related TV programmes for the dissemination of agricultural information.

Hossain (1996) reported that the attitude towards agricultural technologies of the farmers had no significant relationship with their usefulness of agricultural information from television. Huque (1982) found no relationship between farmers' attitude towards agricultural technologies and their perception of effectiveness of television as a medium of agricultural information.

2.4.12 Decision making ability and attitude

No literature was found related to relationship between decision making ability and attitude.

2.4.13 Benefit obtained from CSA and attitude

No literature was found related to relationship between benefit obtained from CSA and attitude.

2.4.14 Problem faced in CSA and attitude

Rahman (2018) conducted research on 'farmers' KAP towards agricultural mechanization. The findings indicate that problem faced of farmers had a significant negative relationship with their attitude towards agricultural mechanization.

Muttaleb *et al.* (1998) reported in his study that problems of the farmers had a significant relationship with their attitude. Karim *et al.* (1997) also reported that problems of the farmers had a significant relationship with their attitude.

2.5 Relationship between Selected Characteristics of the Farmers and Their CSA Practice related Issues

2.5.1 Age and practice

Mango *et al.* (2018) conducted research on adoption of small-scale irrigation farming as a CSA practice and its influence on household income in the Chinyanja Triangle, southern Africa. The results showed that the farmer's age negatively influence the adoption of small-scale irrigation farming decisions. Mutoko (2014) found that adoption of fodder trees (a CSA practice) such as *Calliandra* and *Leucaena* was associated with comparatively younger farmers as indicated by the negative correlations with farmer's age. Billah and Hossain (2017) conducted research on role of CSA technologies in sustainable crop production by the coastal farmers of Bangladesh. The study indicated that respondent's age showed negative significant relationship with the role of CSA technologies in sustainable crop production.

Ochieng (2015) conducted research on 'KAP on climate change adaptation by small holder farmers in Mwala Constituency, Machakos County, Kenya. The study revealed that age had positive correlation with adaptation practices of climate change. Abdullah (2013) and Akhter (2003) found that practice on agricultural activities has significant and positive relationship with their age.

Mondal (2014) observed in her study age of farmers in strawberry cultivation had no significant relationship with their practice of strawberry cultivation. Mia (2005) found that age of the vegetable growers had no significant relationship with their practice of IPM. Rahman (2004) found that practice on boro rice cultivation has no relationship with their age. Mandal (2016) found that farmer's age had no significant relationship with their practices in watermelon cultivation.

2.5.2 Education and practice

Beyene (2018) found in a study that education of household heads was positively correlated and significantly determine adoption of CSA practices. Ochieng (2015) conducted research on 'KAP on climate change adaptation by small holder farmers in Mwala Constituency, Machakos County, Kenya. The study revealed that formal education had positive correlation with adaptation practices of climate change.

Saha *et al.* (2019) conducted research on factors affecting to adoption of CSA practices by coastal farmers in Bangladesh. Research indicated that farmer's education had affected farmers' selection of adaptation strategies for climate change. Israel (2019) conducted research on CSA technology adoption and impact in the east Gonja district of Ghana. Education was found to significantly influence the participation in emission practices.

Billah and Hossain (2017) conducted research on role of CSA technologies in sustainable crop production by the coastal farmers of Bangladesh. The study indicated that respondent's education showed positive and significant relationship with the role of CSA technologies in sustainable crop production. Rahman (2006) found that practice of prawn culture has significant and positive relationship with their education. Mia (2005) found that IPM practices by the vegetable growers had significant positive correlation with their education. Roy (2006) found that practice of coping with flood condition has significant and positive relationship with their education. Islam (2005) and Hossain (2003) found that practice of boro rice cultivation has significant and positive relationship with their education.

Akhter (2003) found that practice of agricultural activities has significant and negative relationship with their education.

Mandal (2016) conducted research on ‘farmers’ KAP regarding watermelon cultivation’ and found that education had no significant relationship with their practices in watermelon cultivation. Saha (2003) found that practice of rice cultivation has no relationship with their education.

2.5.3 Farm size and practice

Mutoko (2014) found that the adoption of CSA practices had significant associations with varied socio-economic factors. For instance, adoption of Rhodes grass tended to increase among farmers who managed relatively large farms. Saha *et al.* (2019) conducted research on factors affecting to adoption of CSA practices by coastal farmers in Bangladesh. Research indicated that farmer’s cultivated farm size had affected farmers’ selection of adaptation strategies for climate change. Israel (2019) conducted a study on CSA technology adoption and impact in the east Gonja district of Ghana. Farm size was found to influence the adoption of CSA practices in the district.

Rahman (2006) found that there was significant and positive relationship with farm size and practice of prawn culture. Rahman (2004) also found that there was significant and positive relationship with farm size and practice of boro rice cultivation. Mia (2005) also found same result in his study.

Islam (2005) found that there was no relationship with farm size and practice of coping with flood condition. Noor (1995) also observed in his study that farm size of the farmers had no significant relationship with their cultivation of HYV of potato.

2.5.4 Annual agricultural income and practice

Mandal (2016) conducted research on ‘farmers’ KAP regarding watermelon cultivation’ and found that farmers’ annual family income had significant positive relationship with their practice of watermelon cultivation. Mia (2005) conducted research on ‘adoption of integrated pest management (IPM) practices by the vegetable growers of Magura district’. The research revealed that use of IPM practices by the vegetable growers had significant positive correlation with their annual income.

Saha *et al.* (2019) conducted research on factors affecting to adoption of CSA practices by coastal farmers in Bangladesh. Research indicated that farmer’s annual income affects selection of adaptation strategies for climate change.

Billah and Hossain (2017) found that respondent’s annual family income showed positive and significant relationship with the role of CSA technologies in sustainable crop production. Rahman (2006) found that there was significant and positive relationship with annual family income and practice of prawn culture. Roy (2006) found that there was significant and positive relationship with annual family income and practice of boro rice cultivation. Islam (2005) found that there was significant and positive relationship with annual family income and practice of IPM in crop production.

2.5.5 Farming experience and practice

Mondal (2014) conducted research on farmers’ KAP regarding strawberry cultivation and found that strawberry cultivation experience of the respondents had no significant relationship with their practice of strawberry cultivation. Anu (2016) conducted a study on farmers’ KAP regarding plant nursery management and found that nursery management experience of the farmers had no significant relationships with their practice of plant nursery management.

2.5.6 Extension contact and practice

Mandal (2016) conducted research on ‘farmers’ KAP regarding watermelon cultivation’ and found that farmers’ extension contact had significant positive relationship with their practice of watermelon cultivation. Beyene (2018) found in a study that access to extension services was positively correlated and significantly determine adoption of CSA practices.

Mia (2005) conducted research on ‘adoption of integrated pest management (IPM) practices by the vegetable growers of Magura district’. The research revealed that use of IPM practices by the vegetable growers had significant positive correlation with their extension contact. Roy (2006) found significant and positive relationship with extension contact and practice of boro rice cultivation. Islam (2005) found negative relationship with extension contact and practice of IPM in crop production

2.5.7 Training exposure and practice

Mandal (2016) conducted research on 'farmers' KAP regarding watermelon cultivation' and found that farmers' training exposure had significant positive relationship with their practice of watermelon cultivation. Rahman (2006) found significant and positive relationship with training exposure and practice of prawn culture. Sana (2003) found significant and positive relationship with training exposure and practice on shrimp culture. Hossain (2001) found significant and positive relationship with training exposure and practice of crop cultivation. Hamidi *et al.* (2004) conducted research on adoption of integrated pest management practices in rice cultivation by the farmers and found that training experience had positive significant relationship with their adoption of integrated pest management.

Mondal (2014) conducted research on farmers' KAP regarding strawberry cultivation and observed in her study training of farmers in strawberry cultivation had no significant relationship with their practice of strawberry cultivation. Islam (2005) found no relationship with training exposure and practice of IPM in crop production. Alam (2003) conducted research on use of integrated pest management practices by the farmers in vegetable cultivation and found that training received by the farmers had no significant relationship with their use of integrated pest management.

2.5.8 Innovativeness and CSA practices

Mia (2005) conducted research on 'adoption of integrated pest management (IPM) practices by the vegetable growers of Magura district' and found that adoption of IPM practices by the vegetable growers had significant positive correlation with their innovativeness. Islam (2002) in his study revealed that innovativeness of the farmers had significant positive relationship with their adoption of modern agricultural technology.
Nurzaman (2000) found that innovativeness of the FFS farmer had no relationship with the practice of IPM but in case of non-FFS farmers had a positive significant relationship with their practice of IPM.

Hossain (1999) found a positive significant relationship between innovativeness of the farmer's and their adoption of fertilizer and also observed no relationship with adoption of pesticides.

2.5.9 Credit availability and CSA practices/other practices

Rahman (2018) conducted research on farmers' KAP towards agricultural mechanization. The findings indicated that credit availability of farmers had significant relationship with their practice of agricultural mechanization.

Clark and Akinbodo (2006) conducted a study in Nigeria and opined that the most important single factor regarding extensions of the maize adopters was the non-availability of capital or credit. Credit was also the most important determinant of cocoa farm expansion.

Mandal (2016) conducted research on farmers' KAP regarding watermelon cultivation and found that farmers' credit received had significant positive relationship with their practice of watermelon cultivation. Rahman (2000) conducted a study in which he also revealed that there was a substantial positive relationship between the credit availability and adoption of IR-20 by the farmers. Similarly, Hossain (2004) found a significant relationship between credit availability and adoption of improved practices. Haque (2014) opined that there was a significant positive relationship between credit availability and adoption of improved cane cultivation technologies.

Reddy and Kivlin (2006) conducted a study on three Indian villages concluded that credit availability was not significantly related to adoption of HYV. Anu (2016) conducted research on farmers' knowledge and practice regarding plant nursery management and found that credit received in plant nursery management of the farmers had no significant relationships with their practice of plant nursery management.

2.5.10 Access to market and practice

No literature was found related to relationship between access to market and practice.

2.5.11 Access to ICTs and practice

Nira (2006) conducted a study on adoption of roof gardening at Mirpur-10 area under Dhaka city and found that use of information sources on roof gardening had positive significant relationship with their adoption of roof gardening.

2.5.12 Decision making ability and practice

Ali (2004) conducted research on adoption of aquaculture technologies by the selected fish farmers of Mymensingh and Netrokona districts and found that decision making ability of the farmers had no significant relationship with the adoption (practice) of aquacultural technologies.

Reza (2004) conducted research on adoption of selected modern agricultural practices by the Garo women farmers and found that participation in decision making with other household members about farming activities had significant positive relationship with adoption of selected modern agricultural practices.

2.5.13 Benefit obtained from CSA and practice

No literature was found related to relationship between benefit obtained from CSA and practice.

2.5.14 Problem faced in CSA and practice

Rahman (2018) conducted research on farmers' KAP towards agricultural mechanization. The findings indicated that problem faced of farmers had a significant negative relationship with their practice of agricultural mechanization. Mondal (2014) observed in her study problem faced by farmers in strawberry cultivation had negative significant relationship with their practice of strawberry cultivation. Mandal (2016) in his study observed that problem faced in watermelon cultivation of the farmers had negatively significant relationship with their practice of watermelon cultivation.
Anu (2016) conducted research on farmers' knowledge and practice regarding plant nursery management and found that problem faced in plant nursery management of the farmers had no significant relationships with their practice of plant nursery management. Similarly, Rahman (2001) found no relationship between farmers practice on Alok 6201 hybrid rice with problem faced in cultivation.

Saha (2001) in his study reported that there was a significant and positive relationship with practice of pineapple cultivation and problem faced in pineapple cultivation. Islam

(2005) also found a positive and significant relationship between farmers practice of IPM in crop production with problem faced.

2.6 Relationship Between Knowledge, Attitude and Practice of CSA Related Issues

2.6.1 Knowledge and Attitude

Rahman (2018) conducted research on farmers' KAP towards agricultural mechanization. The findings indicate that knowledge on agricultural mechanization had a significant positive relationship with practice of agricultural mechanization. Mondal (2014) conducted research on farmers' KAP regarding strawberry cultivation and found that farmers' knowledge of strawberry cultivation had significant contribution on their attitude towards strawberry cultivation. It was also revealed from the study that farmers' attitude towards strawberry cultivation had significant contribution on knowledge on strawberry cultivation. Rahman (2015) also observed in his study that knowledge of farmers had positive significant relationship with attitude towards BRRI dhan 47 cultivation.

Harun *et al.* (2011) conducted a study among students and stated that their attitudes were influenced by the level of knowledge that they have concerning the environment.
Hossain *et al.* (2002) revealed that there was significant relationship between attitude and agricultural knowledge in his study on attitude on island farmers towards adoption of modem agricultural technologies.

Islam (2007) conducted research on attitude of farmers towards modern jute cultivation in Baliakandi upazila under Rajbari district and found that knowledge on jute cultivation had positive significant relationship with their attitude towards modem jute cultivation. Paul (2001) revealed in his study that attitude of farmers towards use of Urea Super Granule (USG) in rice cultivation that there was positive significant relationship between agricultural knowledge and attitude. Toriman *et al.* (2015) conducted a study on the effectiveness of young environmental scientist program among secondary school students in Terengganu, Malaysia and showed that there was a strong positive relationship between environmental awareness and environmental attitude among the students.

Sarker (2002) found in the study farmers' attitude towards organic homestead gardening programme of World Vision that there was negative significant relationship between knowledge on organic homestead gardening and attitude.

2.6.2 Knowledge and practice

Rahman (2018) conducted research on farmers' KAP towards agricultural mechanization. The findings indicate that knowledge on agricultural mechanization had a significant positive relationship with practice of agricultural mechanization. Beyene (2018) found in a study that the knowledge on environmental regulation was positively correlated and significantly determine adoption of CSA practices. Nyasimi *et al.* (2017) conducted research on adoption and dissemination pathways for CSA technologies and practices for climate-resilient livelihoods in Lushoto, northeast Tanzania and found that there was a high correlation between awareness of the farmers and their use of the CSA technologies. Mondal (2014) conducted research on farmers' KAP regarding strawberry cultivation and found that practice on strawberry cultivation had significant contribution on knowledge of strawberry cultivation.

Ahmad *et al.* (2015) conducted a study on investigating students' environmental knowledge, attitude, practice and communication and found that knowledge does not necessarily lead to practice. There was a weak relationship between students' level of knowledge and sustainable environment practices in the study.

Mia (2005) conducted research on adoption of integrated pest management (IPM) practices by the vegetable growers of Magura district. The research revealed that use of IPM practices by the vegetable growers had significant positive correlation with their knowledge on IPM practices. Rahman (2015) also observed in his study that knowledge of farmers had positive significant relationship with practice of BRRI dhan 47 cultivation. Nurzaman (2000) found that Agricultural knowledge had Positive relationships with Practice of integrated pest management. Hamidi (2004) found that knowledge on integrated pest management had significant positive relationship with adoption of integrated pest management practices. Nira (2006) conducted a study on adoption of roof gardening at Mirpur-10 area under Dhaka city and found that knowledge on roof gardening had positive significant relationship with their adoption of roof gardening.

2.6.3 Attitude and practice

Rahman (2018) conducted research on farmers' KAP towards agricultural mechanization. The findings indicate that attitude towards agricultural mechanization had a significant positive relationship with practice of agricultural mechanization. Zulkifly *et al.* (2013) conducted research on assessing KAP on food safety among food handlers in Universiti Teknologi Mara (UiTM) and found that attitude significantly contributed to food safety practice in this study. This study clearly indicates that attitude strongly determine food handlers' actual practices in their working food premises.

Mondal (2014) conducted research on farmers' KAP regarding strawberry cultivation and found that attitude of farmers towards strawberry cultivation had positive significant relationship with their practice of strawberry cultivation. Rahman (2015) also observed in his study that attitude of farmers had positive significant relationship with practice of BRRI dhan 47 cultivation.

Ahmad *et al.* (2015) conducted a study on investigating students' environmental knowledge, attitude, practice and communication and found that attitude is not a good predictor for sustainable environment practices.

Nurzaman (2000) conducted research on KAP of FFS and non-FFS farmers in respect of IPM and found that attitudes towards integrated pest management had significant relationship with practice of integrated pest management. Hamidi (2004) conducted research on adoption of integrated pest management practices in rice cultivation by the farmers and found that attitudes towards integrated pest management practices had positive significant relationship with adoption of integrated pest management.

2.7 Research Gaps of the Study

Above reviews represents that some studies have been conducted on the effects of climate change, farmers' livelihood, food security, and relevant field of agriculture. Most of the mentioned study reflects the vulnerability of climate change effects, forecasting natural hazards, identifying some adaptation technology etc. Some studies were conducted on adoption of CSA to identify the extent of adoption, CSA practices available in those areas to adopt to climate change, role of climate smart technologies in sustainable crop production, factors affecting adoption of CSA etc.

There are lots of researches on farmers' KAP on various issues (e.g., modern agricultural technology, strawberry cultivation, salt tolerant crop varieties etc.). Few researches conducted on farmers’ KAP on climate change to determine their strategies when faced with climatic changes and for establishing of rural public infrastructure.

To the best of knowledge of the researcher, no study on the KAP regarding CSA of the coastal farmers being found yet. In depth studies on CSA approach and recommendations based on that study could help the policy makers to support the approach to be broadly accepted in the field of agriculture production and productivity. This study was conducted to fill up the gap.

2.8 Conceptual Framework of the Study

Both conceptual ideas and available empirical studies stated above were taken into consideration in developing a framework for this study. At a higher level (especially at the Masters and PhD levels) study, conceptual framework comes in form of a diagram or a figure showing how various variables interplay in the achievement of the research objectives or constructed ideas to solve an identified research problem (Rafael, 2015). The conceptual framework of a study is the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs the research which is a key part of research design (Miles & Huberman, 1994). Miles and Huberman (1994) defined a conceptual framework as a visual or written product, one that “explains, either graphically or in narrative form, the main things to be studied—the key factors, concepts, or variables—and the presumed relationships among them.”

This study is concerned with the farmers’ knowledge, attitude and practice regarding climate smart agriculture. Thus, the knowledge, attitude and practice were the main focus and the dependent variables of the study. Farmers’ knowledge, attitude and practice regarding CSA may be influenced and affected through interacting forces of many independent factors. It is not possible to deal with all the factors in a single study. After consulting with the relevant experts and reviewing of past related literatures, 14 selected characteristics of the farmers were considered for the study as the independent variables, which might have contribution on knowledge, attitude and practice regarding CSA. Based on this discussion the conceptual framework of this study has been formulated as shown in Figure 2.1.

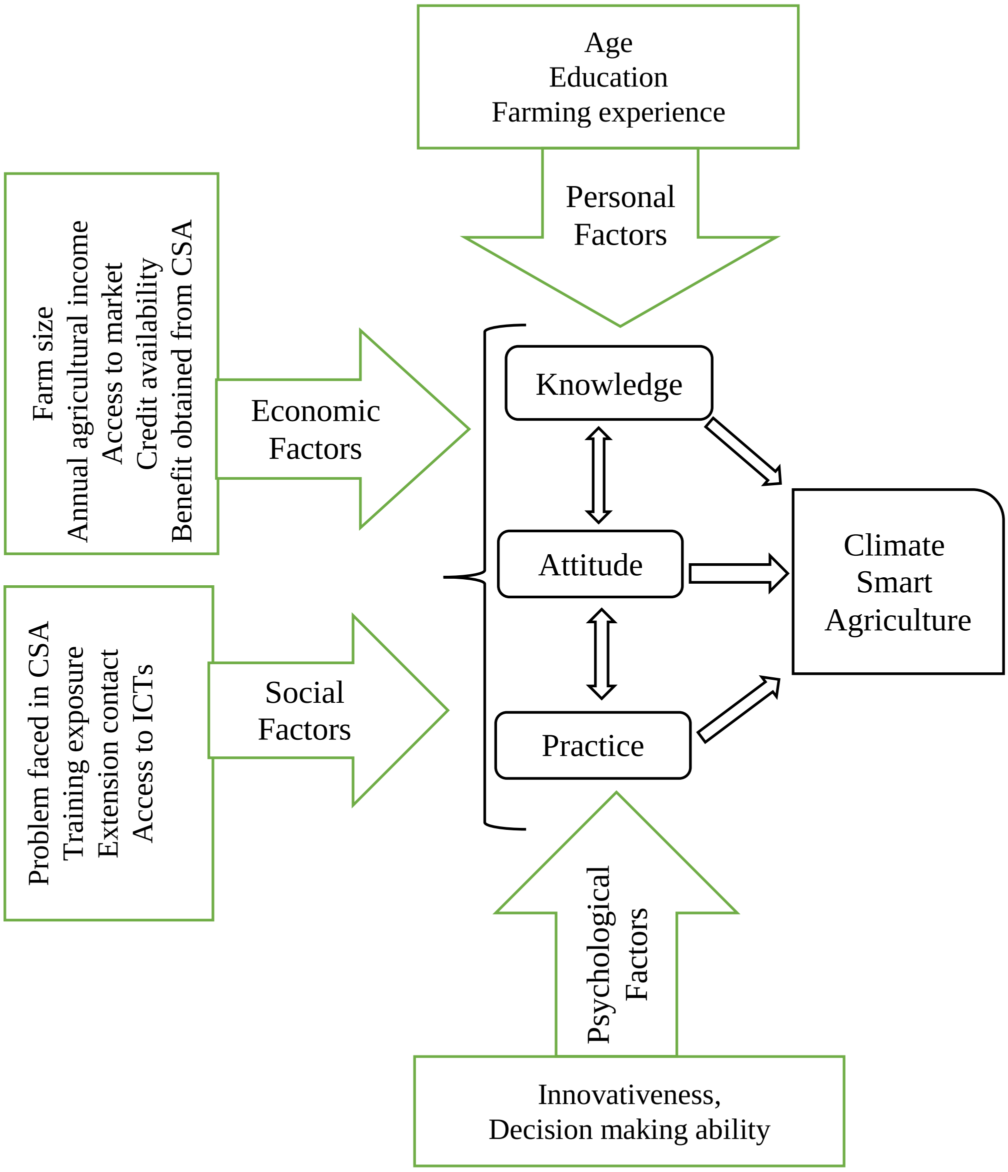


Figure 2.1 The conceptual framework for the study

CHAPTER 3
METHODOLOGY

Methodology is the activity of choosing, reflecting upon, evaluating, and justifying the methods you choose. A reflection of the relationship between strategy of inquiry and specific methods can help the researcher translate approach into practice (Wellington and Szczerbinski, 2007). The purpose of this chapter is to describe the methods and materials of the study regarding objectives and also spells out the methods used to test hypotheses. The survey research design and its applicability in the study are discussed in this chapter. Besides, population, sampling, measurement of variables, research instruments, data collection, hypotheses and statistical procedures are discussed in this chapter.

3.1 Study Area

PDO–ICZMP (2003) delineated that there are 19 coastal districts in Bangladesh. It classified the coastal areas of Bangladesh under two broad categories viz. interior coast and exterior coast or exposed coast. A distinction has been made between upazilas facing the coast or the estuary and the upazilas located behind them. A total of 48 upazilas in 12 districts that are exposed to the sea and or lower estuaries, are defined as the exposed coast or exterior coast and the remaining 99 upazilas of the coastal districts are termed interior coast.

From the coastal areas of Bangladesh 3 upazilas were chosen as the study area of this research. The names of the upazilas are: Tala under Satkhira, Dacope under Khulna and Morrelganj under Bagerhat district. Six maps showing the coastal districts of Bangladesh, selected 3 districts, selected study upazilas are presented in Figure 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6 respectively.

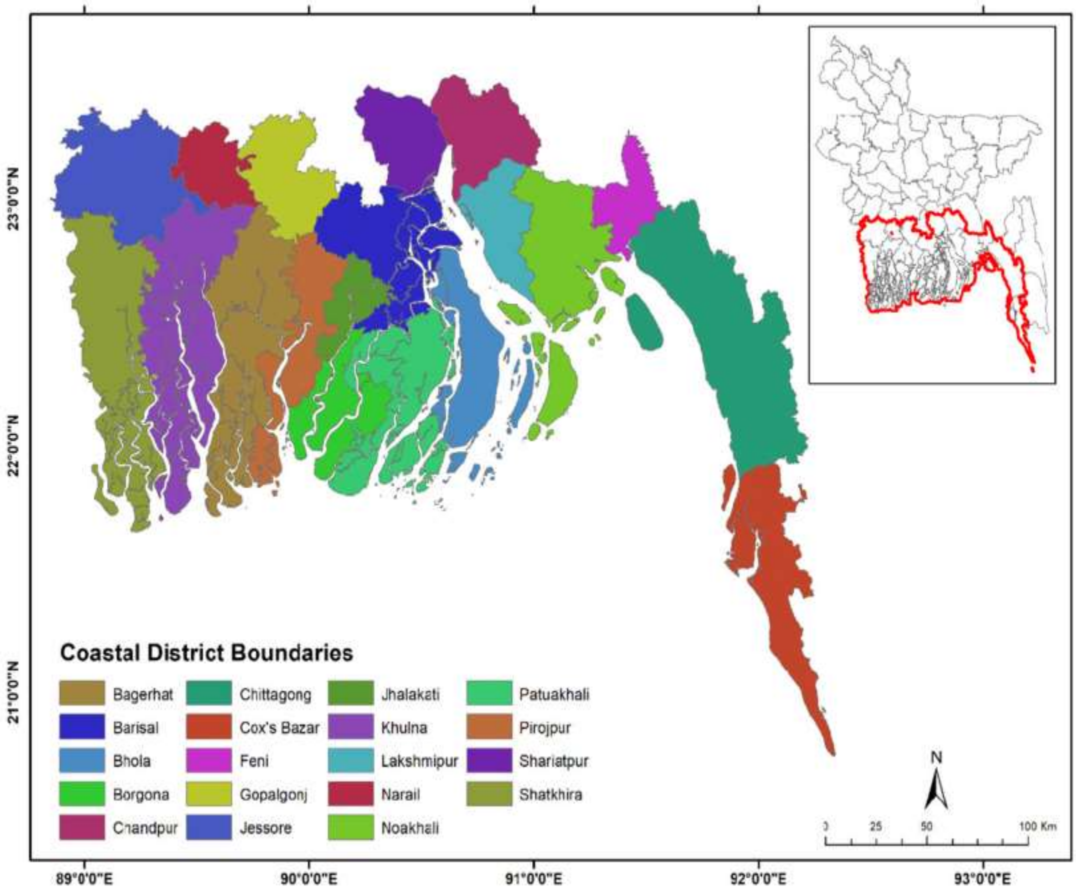


Figure 3.1 Map of coastal districts of Bangladesh

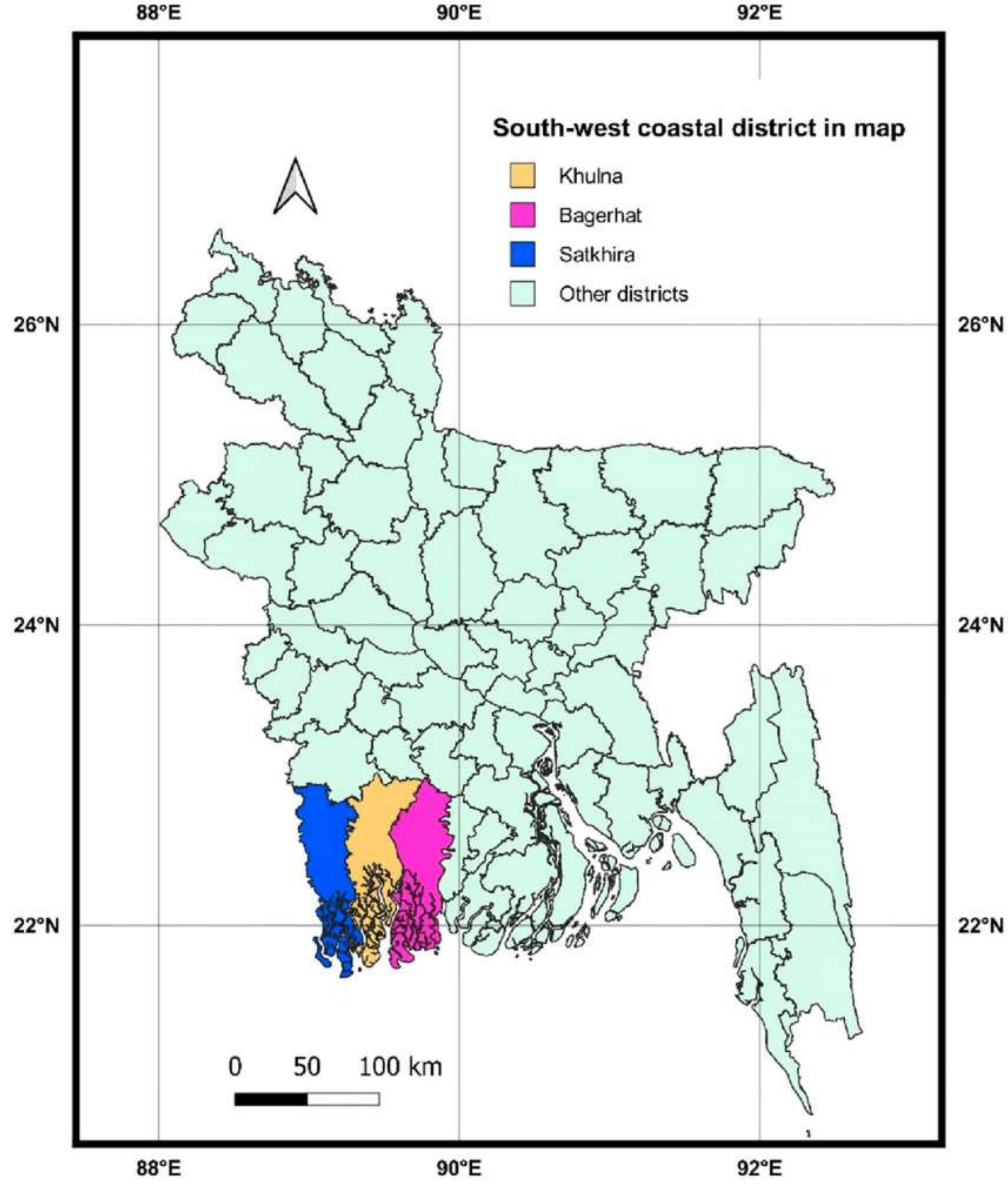
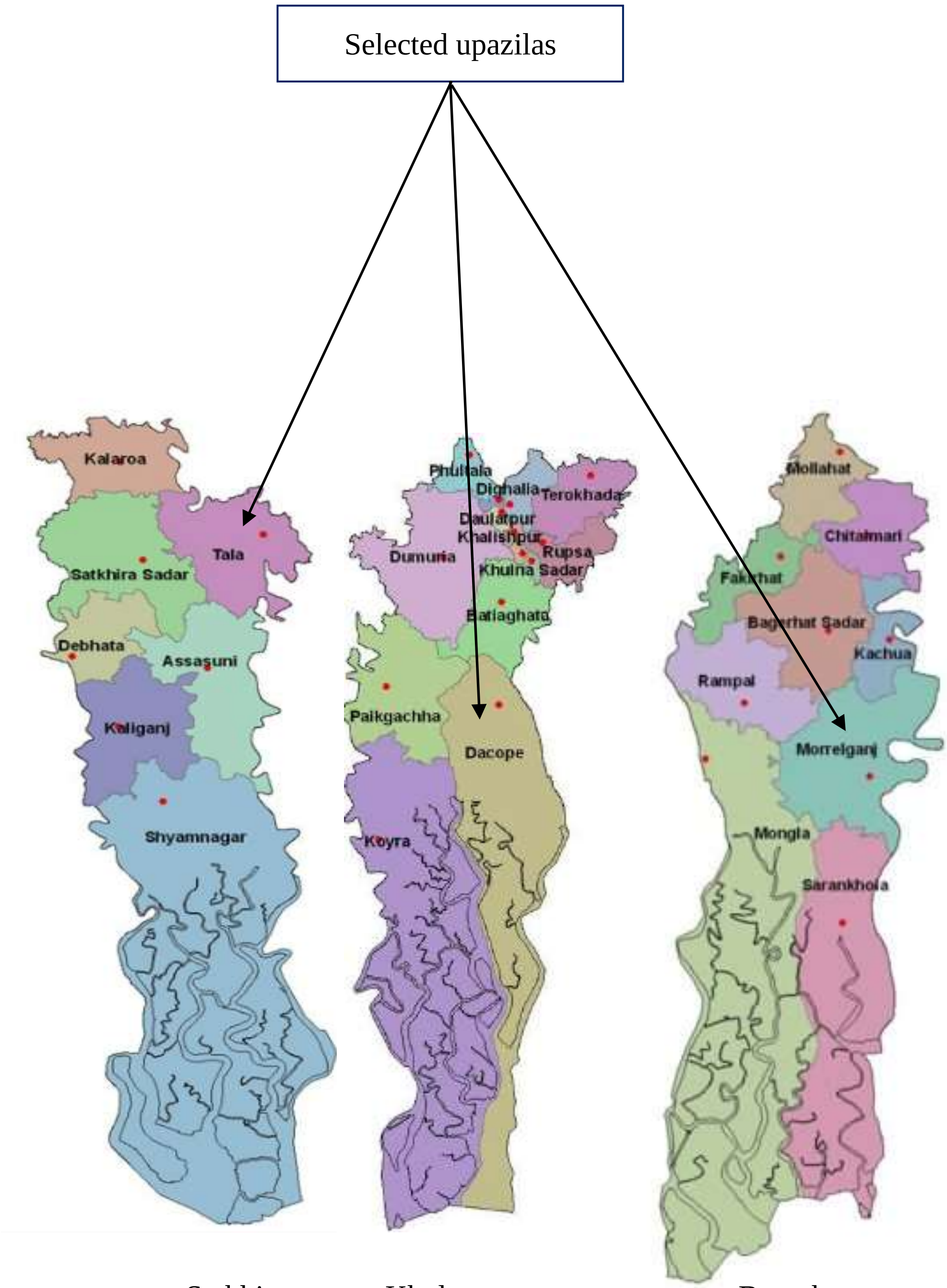


Figure 3.2 Map of Bangladesh showing Satkhira, Khulna and Bagerhat districts



Satkhira Khulna Bagerhat

Figure 3.3 Map of Satkhira, Khulna and Bagerhat districts showing selected upazilas

Figure 3.4 Map of Tala upazila under Satkhira district

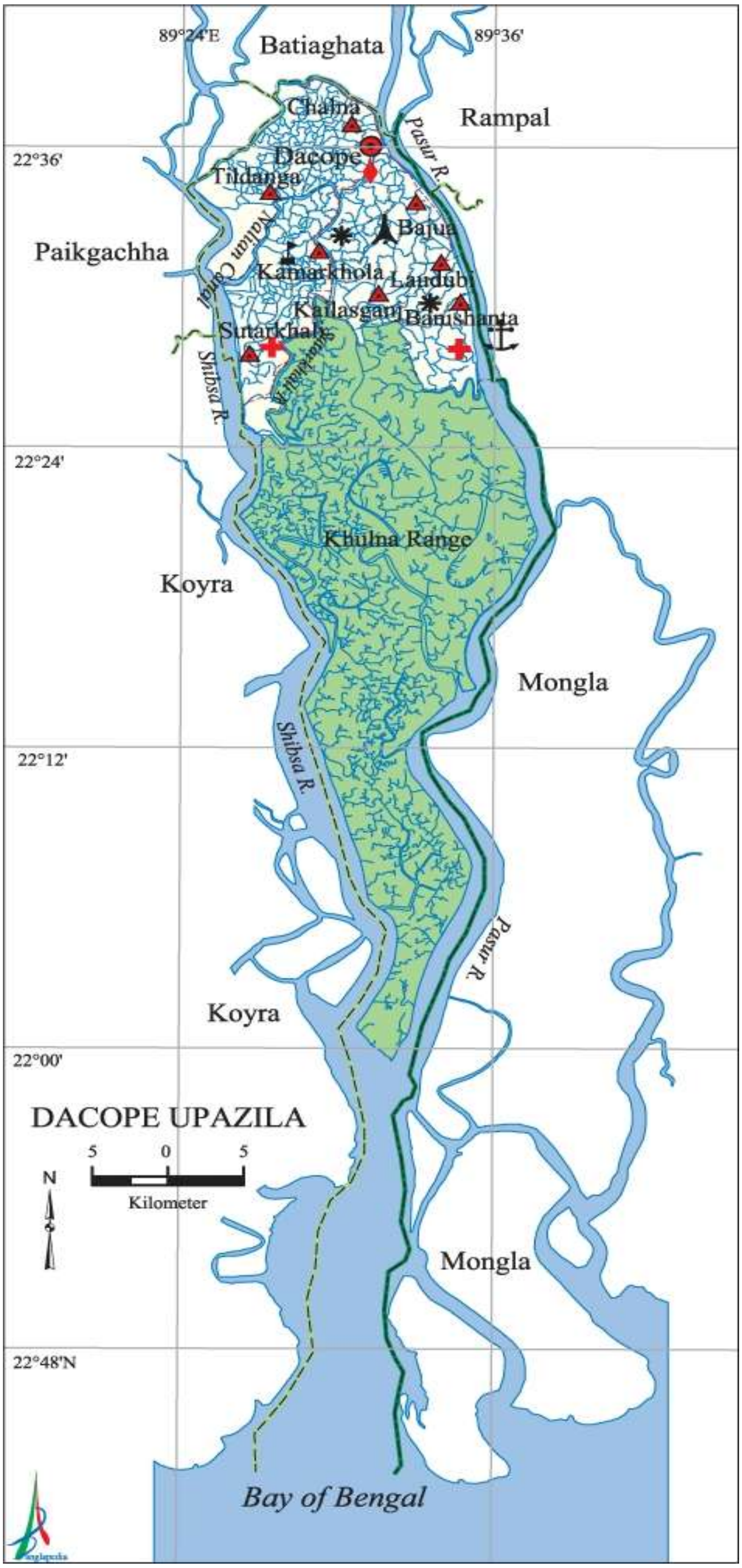


Figure 3.5 Map of Dacope upazila under Khulna district

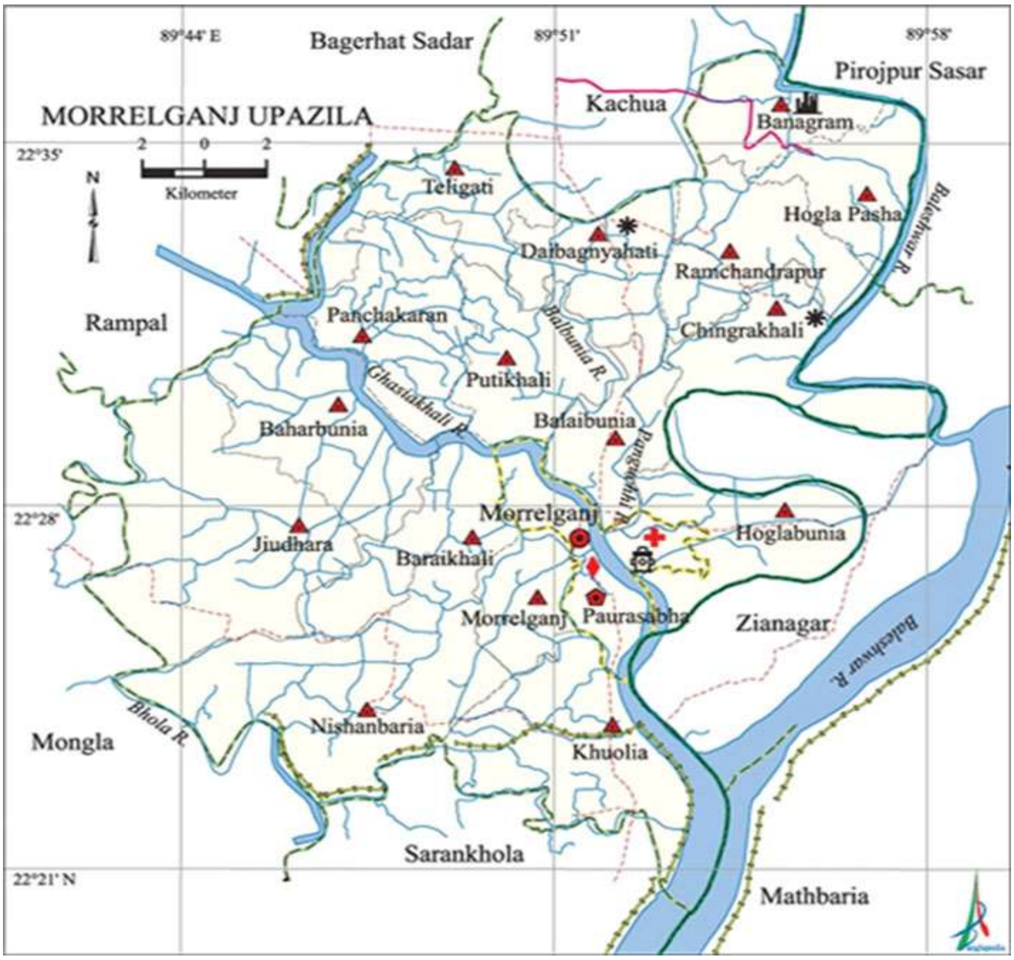


Figure 3.6 Map of Morrelganj upazila under Bagerhat district

3.2 Basic Facts of the Study Area

Some basic facts of the study area like agroecological zone, area, population, literacy rate, major crops, etc. are presented in Table 3.1 as stated in BBS (2021).

Table 3.1 Basic Facts of the Study Area

Study area	AEZ	Area (km^2)	Population (000)	Literacy	Major crops	Operated land area (acre)	Cropping intensity
Tala, Satkhira	11	344.15	300	50.9%	Paddy, Jute, Brinjal, Sugarcane	64939	198
Dacope, Khulna	13	991.58	152	56.0%	Paddy, Watermelon, Potato, pumpkin	44497	114
Morrelgonj, Bagerhat	13	460.90	295	60.7%	Paddy, Potato, sugarcane	79618	132

3.3 Population and Sample of the Study

Primarily 3 coastal districts namely Satkhira, Khulna and Bagerhat were purposively selected. Then 3 upazilas from the selected districts were again selected randomly taking one upazila from each district (Table 3.1). The names of the upazilas are: Tala under Satkhira, Dacope under Khulna and Morrelganj under Bagerhat district. From each of the upazilas, 3 villages were again selected randomly (Table 3.1). The villages were: Sujonshaha, Gopalpur, Bawkhola, Bazua, Purbo Bazua, Chunkuri Modhyapara, PC Baroikhali, Umajori and Nishanbaria (Table 3.1). Thus, all the farmers of the 9 villages were the sample population for this study. A schematic diagram of sampling is shown below.

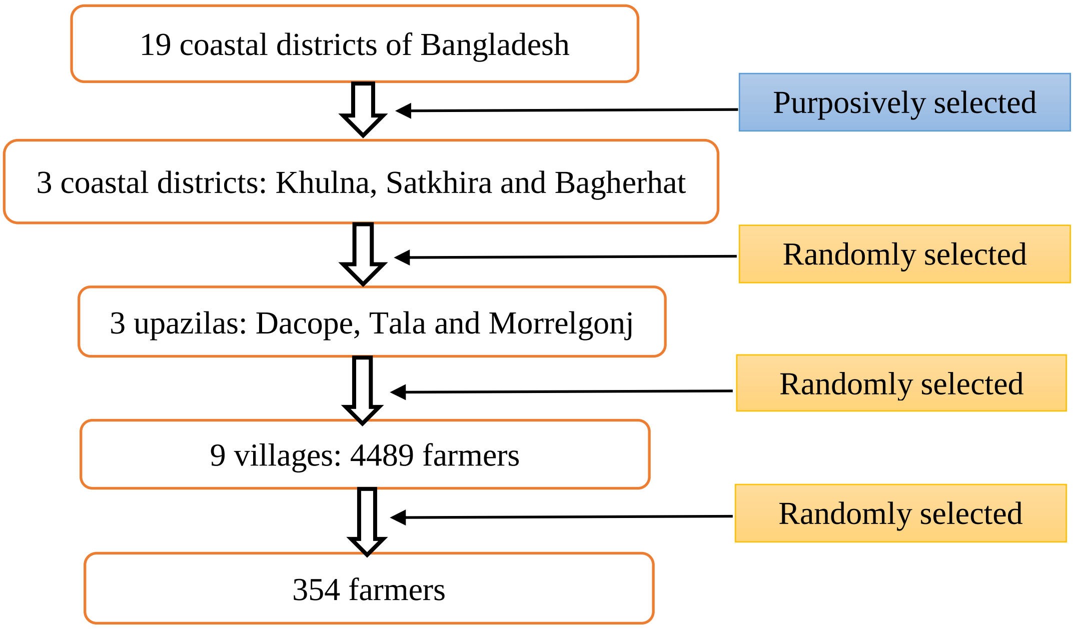


Figure 3.7 A schematic diagram of sampling procedure

On the basis of discussion with the SAAOs and AEOs of the respective upazilas, it was understood that all the farmers of those villages use a number of CSA practices like, cultivation salinity resistant variety (BRRI dhan 47, BRRI dhan 55, BRRI dhan 61 etc.), flood resistant varieties (BRRI dhan 51, BRRI dhan 52), Zero tillage, Dyke farming, etc. Considering the time, financial resources and other constraints, data were collected from a sample of a total 354 respondents (see Table 3.2). To make a respective sample from the population following formula was used as developed by Kothari (2004).

$n = [Z^2 P QN] / [(N-1) e^2 + Z^2 P Q]$

Where, n = Sample size

Z = Table value at 1 df (1.96)

P = Probability (assume 0.5)

Q = Remaining from probability (1-P) = 0.5

N = Total population = 4489

e = The level of precision (5%)

By putting the values in the above formula, the sample size was determined as follows-

$$n = \frac{Z^2 PQN}{(N-1)e^2 + Z^2 PQ}$$

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5 \times 4489}{(4489-1) \times (0.05)^2 + (1.96)^2 \times 0.5 \times 0.5}$$

$$n = \frac{3.8416 \times 0.5 \times 0.5 \times 4489}{4488 \times 0.0025 \quad + 3.8416 \times 0.5 \times 0.5}$$

$$n = \frac{4311.2356}{12.1804}$$

$$n = 353.95 \approx 354$$

The number of total farm families of each village was known from the Upazila Agriculture Office. A total of 4489 farm families were found from selected nine villages and this number was considered as the population of the study. As the number of farmers in each of the villages was not the same, stratified proportionate random sampling technique was used to select sample from each village given in Table 3.2.

Table 3.2 Distribution of population and sample of the study area

Districts	Upazilas	Village	No. of farmers	Sample size
Khulna	Dacope	Bazua	930	73
		Purbo Bazua	726	57
		Chunkuri Modhyapara	530	42
Satkhira	Tala	Sujonshaha	445	35
		Gopalpur	301	24
		Bawkhola	312	25
Bagherhat	Morrelgonj	Nishanbaria	517	41
		PC Baroikhali	406	32
		Umazori	322	25
Total			**4489**	**354**

3.4 Methods/Instruments for Data Collection

An interview schedule (in Bengali language) containing direct questions and some scales was used for data collection from the selected respondents (Appendix-I). The interview schedule was prepared in line with the measurement procedures for different variables. In this connection, the researcher had intensively searched literatures, the internet and consulted with the relevant experts. Meetings of the advisory committee were arranged to draft of the interview schedule. The draft schedule was pre-tested among 24 farmers to test its suitability. Necessary corrections, additions and adjustments were made on the basis of pre-test experience. Another meeting of the advisory committee of the concerned researcher was arranged to finalize the data collecting instruments before going for final data collection. Validity and reliability of CSA knowledge, attitude and practices and some scales of psychological variables were properly determined.

3.5 Variables of the Study

There are two types of variables in any relationship study, viz. independent variable and dependent variable. Knowledge, attitude and practice on CSA of the farmers constituted the dependent variables of the study. However, for determining independent variables, at first, relevant theses, journals, and other literature were reviewed and a list of independent variables was made. After that, the study area was visited by the researcher and discussed with some farmers about the factors that have influence on their practicing of CSA. Then, discussions with the advisory committee members and relevant experts, a final list of independent variables was prepared by following the rules of inclusion and exclusion. Finally, 14 selected characteristics were considered as independent variables of the study and these were: age, education, farm size, annual agricultural income, farming experience, extension contact, training exposure, innovativeness, credit availability, access to market, access to ICTs, decision making ability, benefit obtained from CSA and problem faced in practicing CSA.

The variables of the study were operationalized through direct questions, developing relevant scales by the researcher and adopting scales developed by others as shown in Table 3.3.

Table 3.3 Summarized operationalization of the variables of the study with measuring unit

Variables	Measuring unit	Operationalization
Independent Variables		
1. Age	Actual years	Direct question
2. Education	Schooling years	Direct question
3. Farm size	Scores	Scale developed for the study
4. Annual agricultural income	Scores	Scale developed for this study
5. Farming experience	Number of years	Direct question
6. Extension contact	Scores	Scale developed for this study
7. Training exposure	Number of days	Direct question
8. Innovativeness	Scores	Scale developed by Poddar, 2015
9. Credit availability	Scores	Scale developed for this study
10. Access to market	Scores	Scale developed for this study
11. Access to ICTs	Scores	Scale developed for this study
12. Decision making ability	Scores	Scale developed by Ali 2008
13. Benefit obtained from CSA	Scores	Scale developed by Ali, 2008
14. Problem faced in CSA	Scores	Scale developed by Ali, 2008
Dependent Variables		
Knowledge	Scores	Scale developed by Ali, 2008
Attitudes	Scores	Scale developed by Ali, 2008
Practices	Scores	Scale developed by Ali, 2008

3.5.1 Measurement of independent variables

3.5.1.1 Age

The age of respondents was measured in terms of actual years from his/her birth to the time of interview. It appears in item no.1 in the interview schedule (Appendix-I).

3.5.1.2 Education

Education was measured on the basis of the respondent's ability to read or write or attended classes in the formal education system. It was expressed in terms of years of successful schooling. If the respondent could not read or write he/she was given a score of zero. If the respondent could sign his/her name only then he/she was given a score of 0.5. One score was given to a respondent for passing the final examination of each level in the formal education institution. For example, if a respondent farmer passed the final examination of class eight, his/her educational score was given 8. Based on the available information cited by the respondents, they were classified into five categories.

Table 3.4 Measurement of education of the respondent

Categories	Education (Year of schooling)
Illiterate	0 to 0.5
Primary education	1 to 5
Secondary education	6 to 10
Higher secondary	11-12
Above higher secondary	>12

3.5.1.3 Farm size

Farm size refers to the total cultivated area either owned by a farmer or obtained from others on share cropping system or taken from others as mortgage/lease where s/he used to do his/her farming operations during the period of this study. An open question was asked to the respondent to determine her farm size. The farm size of the respondent was calculated by using the following formula:

$F_s = A_1 + A_2 + A_3 + A_4 + A_5$

Where, F_s = Farm size

A_1 = Homestead farm area.

A_2 = Own land under own cultivation

A_3 = Own land taken from others on borga

A_4 = Own land taken from others on lease

A_5 = Other (fruit garden, pond etc.)

There were five categories of farm size, they are shown in table 3.5 below.

Table 3.5 Measurement of farm size of the respondents

Categories	Area (Hectare)	Score
Landless	≤ 0.020	1
Marginal	0.021 to 0.2	2
Small	0.21 to 1.0	3
Medium	1.01 to 3.0	4
Large	> 3.0	5

A respondent was scored 1 if he/she was land less, score 2 was given for marginal farm size, score was 3 if he/she had small farm size, score 4 was given for medium farm size and score was 5 if he/she had large farm size. The farm size score could range from 1 to 5. This categorization was adopted from (Roy *et al.*, 2015).

3.5.1.4 Annual agricultural income

Annual agricultural income of a respondent was measured in taka on the basis of his total yearly earning from agriculture in which the respondent was directly or indirectly involved, or one or more of his family members involved. The yields of all crops in the antecedent year were recorded. Then all the yields were converted into cash income according to prevailing market prices. The price of other enterprises (i.e., poultry, dairy, fish etc.) was also added to the price. The earnings from all farming activities were added together to obtain total agricultural income of a respondent. Agricultural income of the respondents was converted into scores. Respondent was scored 1 if his/her annual agricultural income was under 50,000 BDT. If his/her income was 50,001 to 1,00,000 BDT then his/her score was 2. Respondent was score 3 if his/her income was 100,001 to 150,000 BDT. For an additional income of 50,000 BDT his/her income score was increased 1. This scoring system was adopted from Roy (2015). This variable appears in item number 4 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± SD) namely ‘low’, ‘medium’ and ‘high’ annual agricultural income. The measurement procedure of annual agricultural income is shown in Table 3.6 below.

Table 3.6 Measurement of annual agricultural income of the respondents

Income (Tk)	Score
≤ 50000	1
50001 to 100000	2
100001 to 150000	3
150001 to 200000	4
200001 to 250000	5
250001 to 300000	6
300001 to 350000	7
350001 to 400000	8
400001 to 450000	9
> 450000	10

3.5.1.5 Farming experience

Farming experience of the respondent was measured by the number of years a respondent engaged in farming activities. The measurement included from the year of first farming activities to till the year of data collection. A score of one (1) was assigned for each year of experience.

3.5.1.6 Extension contact

The extension contact of a respondent was measured by the total scores of extension contact on the basis of his/her nature of contact with 14 selected extension media. The extent of contact was determined against a four-point scale and scores were arranged for all 14 related media were shown in Table 3.7.

Table 3.7 Measurement of extension contact of the respondent

Types	Extension media	Extent of use	Scores assigned
	Individual contact		
1.	Model farmer/Friends/ Relatives/Neighbours)	Frequently : 4 or more times/month Occasionally: 1-3 times/month Rarely : 1 time/year Not at all : Never	3 2 1 0
2.	Agricultural input dealer	Frequently : 4 or more times/month Occasionally: 1-3 times/month Rarely : A few times/year Not at all : Never	3 2 1 0
3.	NGO worker (s)	Frequently : 4 or more times/month Occasionally: 1-3 times/month Rarely : A few times/year Not at all : Never	3 2 1 0
4.	Sub-Asstt. Agriculture Officer	Frequently : 4 or more times/month Occasionally: 1-3 times/month Rarely : 3 times/year Not at all : Never	3 2 1 0
5.	Thana agriculture Officer/Additional agriculture Officer/ Agriculture Extension Officer	Frequently : At least 1 time/ month Occasionally: At least 1 time/ 2 months Rarely : 1-5 times/year Not at all : Never	3 2 1 0
6.	Other extension workers (e.g., Health worker, BRDB's field officer, Iman, etc.)	Frequently : 4 or more times/month Occasionally: 1-3 times year Rarely : 1 time/year Not at all : Never	3 2 1 0
	Group Contact		
1.	Participation in group discussion	Frequently : 4 or more times/year Occasionally: 2-3 times/year Rarely : 1 time/year Not at all : Never	3 2 1 0
2.	Participation in demonstration meeting (Result & method demonstration)	Frequently : 4 or more times/year Occasionally: 2-3 times/year Rarely : 1 time/year Not at all : Never	3 2 1 0
3.	Participation in field day/farmers rally	Frequently : 4 or more times/month Occasionally: 1-3 times/month Rarely : A few times/year Not at all : Never	3 2 1 0

Table 3.7 (cont'd)

Types	Extension media	Extent of use	Scores assigned
4.	Participation in training	Frequently : 3 or more times/year Occasionally: 2 times/year Rarely : 1 time/year Not at all : Never	3 2 1 0
Mass Media Contact			
1.	Listening Farm Radio talk	Frequently : 4 or more times/month Occasionally: 2-3 times/month Rarely : 1 time/month Not at all : Never	3 2 1 0
2.	Watching Agricultural Program in TV	Frequently : 4 or more times/month Occasionally: 2-3 times/month Rarely : 1 time/month Not at all : Never	3 2 1 0
3.	Reading agricultural magazine (Krishikatha, booklet, leaflet etc.)	Frequently : 5 or more times/year Occasionally: 3-4 times/year Rarely : At least 1-2 times/year Not at all : Never	3 2 1 0
4.	Visiting agricultural fair	Frequently : 3 or more times/year Occasionally: 2 times/year Rarely : 1 time/year Not at all : Never	3 2 1 0

Extension contact of a respondent was determined by adding his scores for contact with all the media according to the above formula. Thus, the score of a respondent could range from 0 to 42, where 0 indicated no extension contact where 42 indicated very high extension contact.

3.5.1.7 Training exposure

Training exposure was measured by the total number of days that a respondent had undertaken different types of training related to agriculture/CSA in his entire life from different organizations. A score of one (1) was assigned for each day of training received.

3.5.1.8 Innovativeness

An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption (Ray, 1991). According to Rogers (1983) the farmers are generally categorized into five categories on the basis of innovation adoption behavior. Those are termed as; innovators, early adopters, early majority, late majority and laggards.

Innovativeness refers to the degree to which an individual relatively earlier in adopting new ideas than other members of a social system (Rogers, 1995). In this research, farmers` categories were identified on the basis of innovativeness of the respondents. Innovator (Willing to take risk, have the highest social status, have financial liquidity), early adopter (Highest degree of opinion leadership, higher social status, financial liquidity, advanced education), early majority (Adopt an innovation after innovator and early adopter, have above average social status, seldom hold position of opinion leadership), late majority (Adopt an innovation after the average participant, have below average social status, little financial liquidity, little opinion leadership), laggard (show little to no opinion leadership, tend to be focused on tradition, lowest social status, lowest financial liquidity). Scores assigned for respondent's farmer in respect of innovativeness were as 5, 4, 3, 2, and 1 for innovators, early adopters, early majority, late majority and laggards respectively.

3.5.1.9 Credit availability

Credit availability of a respondent referred to the amount of credit received by a farmer against his actual amount of requirement. It was measured in percentage. During the interview each respondent was asked to indicate whether he needed any credit for farming activities during last year or not. If the respondent replied 'yes' then he was asked to mention the sources of credit, amount of credit sought for loan and the amount of credit received against needed amount. Next, by using following formula credit score was calculated.

$$\text{Credit availability} = \frac{\text{Credit received}}{\text{Credit needed}} \times 100$$

3.5.1.10 Access to market

Access to market refers to the ability of a farmer to buy and sell goods and services in different types of market. Access to the market score of a respondent was measured by using a 3-point rating scale. Each respondent was asked to indicate the extent of access to buying inputs and selling goods for his farming activities in each of the ten (10) selected items by checking any one of the responses viz. 'sustained access', 'intermittent access,' and 'no access' (Roy, 2015). The weights were assigned to the responses as 2, 1 and 0 for 'sustained access', 'intermittent access,' and 'no access' respectively. Finally, access to the market score of a respondent was computed by summing up all the scores for his responses to all the items. Thus, access to market scores of the respondents could range from 0 to 20, where 0 indicated no access and 20 indicated sustained access.

This variable appears in item number 10 in the interview schedule as presented in Appendix-I. Based on the available information cited by the respondents, they were classified into three categories (Mean ± SD) namely ‘low’, ‘medium’ and ‘high’ market access.

3.5.1.11 Access to ICTs

Information and communication technologies access refers to the access to technologies that provide information through telecommunications. It was similar to Information Technology (IT), but focused primarily on communication technologies (Roy, 2015). This included the Internet, wireless networks, cell phones, and other communication mediums. A respondent was computed a score of 3, 2, 1 and 0 against any one of the selected five technologies, if his/her extent of access of that technology is ‘regularly’, ‘occasionally’, ‘rarely’ and ‘never’ respectively. Finally, the score of a respondent is computed by summing up all scores for his responses to all the items. Thus, access to ICTs score of a respondent could range from 0 to 15, where zero indicated no ICTs access and 12 indicated highest level of ICTs access. This variable appears in item number 11 in the interview schedule as presented in Appendix-I. Based on the information cited by the respondents, they were classified into three categories (Mean ± SD) i.e., ‘low’, ‘medium’ and ‘high’ ICTs access.

3.5.1.12 Decision making ability

Decision making ability of a respondent was measured by using a 3-point rating scale. Each respondent was asked to indicate the extent of his decision-making ability in each of the six selected items by checking any one of the responses viz. ‘decision making by alone’, ‘decision making with family members’, and ‘decision making with others outside the family’. The weights were assigned to the responses as 3, 2 and 1 for decision making alone, decision making with family members and decision making with others outside the family respectively (Ali, 2008). Finally, the decision-making ability score of a respondent was computed by summing up his all the scores for his responses to all the items. Thus, decision making ability scores of the respondents could range from 6 to 18, where 6 indicated very low decision-making ability and 18 indicated very high decision-making ability.

3.5.1.13 Benefit obtained from practicing CSA

For measuring this variable, items containing social, economic, environmental, technical and psychological benefits were selected after thorough consultation with the extension experts, researchers and from other available sources. A total of 20 items of benefits containing 6 social, 4 environmental, 3 economic, 4 technical and 3 psychological items were arranged in the scale in order to have real feelings on benefits obtained from practicing CSA. The nature of responses from the respondents to the items was; ‘high benefit’, ‘moderate benefit’, ‘less benefitted’, ‘no benefit’ and scores were assigned as 3, 2, 1, and 0 respectively. Score of benefits obtained from CSA of a respondent as perceived by he or she were determined by adding up all the scores for all the responses of the items of that respondent. The possible range of score of benefits obtained from CSA of a respondent was 0 to 60, where 0 indicated not at all benefit and 60 indicated highest benefit obtained from CSA.

3.5.1.14 Problems faced in practicing CSA

For measuring problems faced in practicing CSA, items containing social, technical, economic, marketing and psychological problems were selected after thorough consultation with the extension experts, researchers and from other available sources. Twenty-two items of problems were selected and arranged in the scale in order to have real feelings on problems faced in practicing CSA. The nature of responses of the respondents to the items was ‘severe problem’, ‘moderate problem’, ‘less problem’ and ‘no problem’ and the scores were assigned as 3, 2, 1, 0 respectively. Problems faced in practicing CSA score of a respondent was determined by adding up all the scores for all the responses of the items of that respondent.

The possible range of scores of problems faced in CSA was 0 to 66, while 0 indicating not at all problems and 66 indicating very serious problems faced in CSA.

In order to compare the problems faced by the farmers in practicing CSA, a Problem Faced Index (PFI) was developed and it was computed by summing up the weights following the formula-

$PFI = P_s \times 3 + P_m \times 2 + P_l \times 1 + P_n \times 0$

Where,

PFI = Problem Faced Index

P_s = Number of respondents faced severe problem

P_m = Number of respondents faced moderate problem

P_l = Number of respondents faced less problem

P_n = Number of respondents faced no problem

PFI of a problem indicated the extent of seriousness of a problem faced by the respondents. The higher the value of PFI of a problem, the greater was the magnitude of the problem. The PFI for each the problem could range from 0 to 1062 (354×3), where 0 indicating lowest extent of problem and 1062 indicating highest extent of problem. Based on descending order of PFI, rank order was made to compare the severity among the problems.

3.5.2 Measurement of dependent variables

3.5.2.1 Measurement of knowledge on CSA practices

Knowledge is those behavior and test situations which emphasize the remembering either by recognition or recall of an idea, material or phenomenon (Bloom, 1956). In this study climate smart agricultural knowledge would be indicated by the extent of understanding how they perceived the knowledge of implementing CSA technology and to what extent they are using those. It was measured on the basis of responses to a set of 20 questions by taking 4 from remembering, 4 from understanding, 4 from applying, 4 from analyzing, 2 from evaluating and 2 from creating related to CSA. Score of 2 was given for each of the correct answer. Partial score was assigned for partial correct answer. Thus, the range of score could be 0 to 40, where '0' indicating very low knowledge and '40' indicating very high knowledge on CSA practices.

The steps followed in developing the scale for knowledge test for this study are discussed below:

Collection of items: The content of the knowledge test is composed of questions called items. Items for the test were collected from different sources, such as, literatures;

agricultural scientists of agronomy, horticulture, soil science, agricultural chemistry, entomology, plant pathology, agroforestry, environmental science, and agricultural extension education of home and abroad; extension personnel; NGO personnel; progressive farmers and researcher's own experience. The questions were designed to test the climate smart agricultural knowledge of the coastal farmers. The items were collected and prepared in relation to climate change and its impact on agriculture, productivity, adaptation and mitigation strategies for food production. Twenty-eight items were collected initially which appeared to be relevant.

The selection of items was done on the basis of Bloom's (1956) revised taxonomy as devised by Anderson and Krathwohl (2001). The items contained questions each of remembering, understanding, applying, analyzing, evaluating and creating about CSA. Considering the above-mentioned criteria, 28 questions taking 5 from each of remembering, understanding, applying, analyzing, and 4 questions from each of evaluating and creating climate smart agricultural practices were selected. A schedule was then prepared with these 28 items (Appendix-II) for administering them to the farmers for item analysis.

Item analysis: The item analysis of a knowledge test usually yields two kinds of information, that is, item difficulty and item discrimination. The index of item difficulty indicates how difficult an item is, whereas, the index of discrimination explores the extent to which an item discriminates the well-informed farmers from poorly informed ones.

The items were analyzed on the basis of pre-test data obtained by administering to 24 farmers. The farmers for administering the items were randomly selected and were different from the sample farmers of the present study. Nevertheless, these 24 farmers were representative of the total population on the basis of which the final study was conducted. Each one of the 24 respondents, to whom the test was administered, was given two (2) scores for right answer and zero (0) score for 'wrong' or no answer and one (1) score for partially correct answer with respect to each item. The total number of right answers given by the respondent out of 28 items was the knowledge score secured by him. The maximum score was obviously 56 which could be scored when all the 28 items were answered correctly. The scores of correct answers against each item of all the 24 respondents were also calculated which are presented in Appendix-III.

Calculation of difficulty index: Ali (2008) determined difficulty index (Pi) by the following formula:

$$Pi = \frac{ni}{Ni} x100$$

Where,

Pi = Difficulty index in percentage of *i*th item

ni = Number of farmers giving incorrect answer to *i*th item

Ni = Total number of farmers to whom *i*th item was administered, i.e., 24 in the present study

In the formula, the higher was the difficulty index of an item, the more difficult the item was. Therefore, the difficulty index of all the 28 items were calculated by the above formula. It was ensured that very difficult and very easy items were eliminated. The underlying assumption in the statistics of item difficulty was that the difficulty was linearly related to the level of an individual's climate smart agricultural knowledge. When a respondent gave correct answer to an item, it was assumed, as Coombs (1950) described, that the item was less difficult than his ability to cope with it. The difficulty indices have been presented in Appendix-III.

Calculation of discrimination index: The discrimination index can be computed by calculating the phi-coefficient as formulated by Perry and Michael (1951). However, Mehta (1958) developed $E^{1/3}$ method to find out item discrimination emphasizing that this method was analogous to, and hence, a convenient substitute for phi-coefficient. The method developed by Mehta (1958) was used by Singh (1981), Sagar (1983), Ray and Bora (1991), Choudhury (1998), Islam (2000) and Ali (2008).

Like Mehta (1958), Singh (1981), Sagar (1983), Ray and Bora (1991), Choudhury (1998), Islam (2000) and Ali (2008), the present researcher computed the total scores against all the correct responses of each farmer. The farmers were then arranged in descending order of total scores obtained by them. Then those farmers were divided into 6 equal groups each having 4 farmers as the total number of farmers in the sample for item analysis was 24. These groups were as G_1, G_2, G_3, G_4, G_5 and G_6 respectively. For determination of discrimination index the middle two groups, i.e., G_3, and G_4 were eliminated and kept only extreme four groups with high (G_1 and G_2) and low (G_5 and G_6) scores. Then discrimination index of each item was determined by using following formula:

$$E^{1/3} = \frac{(S_1 + S_2) - (S_5 + S_6)}{N/3}$$

Where, S_1, S_2, S_3, S_4, S_5 and S_6 were the frequencies of correct answer for each item in G_1, G_2, G_3, G_4, G_5 and G_6 groups respectively and N was the total number of farmers in the sample of item analysis.

The discrimination indices of all the 28 items were calculated by the procedure mentioned above and are presented in Appendix-III.

Example of computation of difficulty and discrimination index: An example of computation of difficulty index and discrimination index of an item in connection with climate smart agricultural knowledge is presented below:

Table 3.8 Computation of difficulty and discrimination index

Sl. No. of Item	Frequencies of correct answers						Total frequencies		Difficulty Index (Pi)	Discrimination Index ($E^{1/3}$)
	S_1	S_2	S_3	S_4	S_5	S_6	correct answers	incorrect answers		
1.	1	1	1	0	0	0	3	21	87.5	0.25

Substituting the values for the item number 1 the value of difficulty index and that of discrimination index are indicated below:

Difficulty index: $\text{Pi} = \frac{\text{ni}}{\text{Ni}} \text{x}100 \quad = \frac{21}{24}\text{x}100 \quad = 87.5$

Discrimination index:

$$E^{1/3} = \frac{(S_1+S_2)-(S_5+S_6)}{N/3} = \frac{(1+1)-(0+0)}{24/3} = \frac{2-0}{8} = \frac{2}{8} = 0.25$$

Final selection of items: Two criteria namely, item difficulty index and item discrimination index were considered for the selection of items in the final format of the climate smart agricultural knowledge test.

In the present study items with difficulty index value ranging from 29.17 to 54.17 and discrimination index ranging from 0.375 to 0.750 were included in the final format of climate smart agricultural knowledge scale. In this way, 20 items by taking 4 from each of remembering, understanding, applying, analyzing, and 2 from each of evaluating and creating which fulfilled both the criteria and these items were selected for the final format of the climate smart agricultural knowledge scale.

Scoring system: Each item was an open question and the respondents were asked to answer for that item. A score of two (2) was given for right answer and zero (0) for wrong or no answer and partial score was given for partial correct answer against each item. Summation of all scores of a farmer was considered as the climate smart agricultural knowledge score of that farmer.

3.5.2.2 Measurement of attitude towards CSA

Thurstone (1946) defined attitude as 'the degree of positive and negative affect associated with psychological object like symbol, phrase, slogan, person, institution, or ideas towards which people can differ in varying degrees.' In the present study, an attempt was made to develop an attitude scale for measuring the attitude of coastal farmers towards CSA. Attitude towards CSA referred to the extent of knowledge, belief and action tendency towards CSA. Attitude scale in the present study was a combination of the Thurstone's Technique of Equal Appearing Interval Scale and Likert's Technique of Summated Ratings Scale (Edwards, 1957) with slight modification. The steps followed in constructing the attitude scale are described below:

Collection of attitude statements: Initially 45 statements related to attitude towards CSA were collected through thorough consultation with the agricultural scientists and extension experts and from review of available related literatures of home and abroad. Then these statements were carefully examined in the light of 14 criteria suggested by Edwards (1957) for screening.

Pre-test of the attitude statements: After screening in the light of 14 criteria suggested by Edwards (1957), 30 statements were selected for administering pretest.

Analysis of statements as per Likert's technique of Summated Ratings: The statements were analyzed on the basis of pre-test data obtained by administering to 24 farmers. The farmers for administering the statements were randomly selected and were different from the sample farmers of the present study. But, these 24 farmers were representative of the research population.

Each of the 30 statements (containing 15 positive and 15 negative) had five alternative choices of responses, viz. ‘strongly agree’, ‘agree’, ‘undecided’, ‘disagree’ and ‘strongly disagree’. Scores were assigned for the alternative responses as ‘4’, ‘3’, ‘2’, ‘1’ and ‘0’ respectively for the positive statements and reverse scores were assigned for the negative statements.

Thus, the possible score of attitudes towards CSA of the pretest sample farmers could range from 0-120, while ‘0’ indicating highest unfavourable attitude and ‘120’ indicating highest favourable attitude towards CSA.

Analysis of statements consisted of the frequency distribution of scores based upon the responses to all statements of the pretest. The top 25 percent of the respondents with the highest scores (High group) and the bottom 25 percent of the respondents with the lowest scores (Low group) were used as criterion groups to evaluate individual statements. The critical ratio (t-value) was calculated by using the following formula as suggested by Edwards (1957).

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{S_H^2}{n_H} + \frac{S_L^2}{n_L}}}$$

Where,

$\bar{X}_H$ = The mean score on a given statement for the high group

$\bar{X}_L$ = The mean score on a given statement for the low group

S_H^2 = The variance of the distribution of responses of the high group to the statement

S_L^2 = The variance of the distribution of responses of the low group to the statement

n_H = The number of subject in the high group

n_L = The number of subject in the low group

As n_H = n_L= n (Number of subjects/respondents in each group) and the same percentages of the total number of subjects for the high and low groups were selected, the formula was reformed as-

$$t = \frac{\overline{X}_H - \overline{X}_L}{\sqrt{\frac{\sum(X_H - \overline{X}_H)^2 + \sum(X_L - \overline{X}_L)^2}{n(n-1)}}}$$

where, $$\sum(X_H - \overline{X}_H)^2 = \sum X_H{}^2 - \frac{(\sum X_H)^2}{n}$$

and $$\sum(X_L - \overline{X}_L)^2 = \sum X_L{}^2 - \frac{(\sum X_L)^2}{n}$$

$\sum X_H{}^2$ = Sum of the squares of the individual scores in high group

$\sum X_L{}^2$ = Sum of the squares of the individual scores in the low group

The value of ‘t’ was a measure of the extent to which a given statement differentiates between the high and low groups. As suggested by Edwards (1957), there is a thumb rule of rejecting items with ‘t’ values < 1.75. Usually, a t-value equals to or greater than 1.75 indicates that the average responses of the high and low groups to a statement differ significantly.

Finally, t-values of all the statements were determined (Appendix-IV). The statements having ‘t’ values ≥ 1.75 were finally selected for the attitude towards CSA scale. As such 18 statements were selected in the final scale of attitude towards CSA including 9 positive and 9 negative statements. These selected statements were arranged randomly in the scale in order to have real feelings without any biasness. Ali (2008) used the same procedure.

Scoring system

A layout of final selection of statements in the scale of attitude towards CSA with ‘t’ values ≥ 1.75 is shown in Appendix IV. Finally attitude towards CSA was measured by using selected 18 statements in relation to CSA. The selected statements were expressed in positive and negative views towards CSA. The nature of responses of the respondents to the statements were ‘strongly agree’, ‘agree’, ‘undecided’, ‘disagree’ and ‘strongly disagree’ and scores were assigned as ‘4’, ‘3’, ‘2’, ‘1’ and ‘0’ respectively for the positive statements and the reverse scores were given for the negative statements. The scoring method was slightly modified from that of Likert (1932). The possible range of score of attitudes towards CSA was from 0–72, where 0 indicated very highly unfavourable attitude and 72 indicated very highly favourable attitude towards CSA.

3.5.2.3 Measurement of CSA practice

A good number of technologies are being practiced now-a-days by the farmers in their farming activities against climate change as CSA practices. A total of 30 practices were selected primally based on review of available related literatures of home and abroad and thorough consultation with the agricultural scientists and extension experts. Pretest was done among 24 randomly selected coastal farmers with these 30 practices to see what extent they were using those practices. The farmers for administering the statements were randomly selected and were different from the sample farmers of the present study. But, these 24 farmers were representative of the research population.

A four-point rating scale was used to determine extent of farmers' practices of CSA. The respondents indicated their use of selected CSA practices by choosing a suitable answer from four options, such as "frequently", "occasionally", rarely, and 'never'. Scores assigned to the above four responses were '3', '2', '1', and '0' respectively. Thus, the range of CSA practice score of respondents could range from 0 to 90, where '0' indicating use of no practice and '90' indicating highest practice of selected CSA technologies in the field.

Analysis of the CSA scores obtained from pretest: From the pretest, for each of the CSA practice, 24 different scores from 24 different farmers were obtained. The top 25 percent of the respondents with the highest scores (High group) and the bottom 25 percent of the respondents with the lowest scores (Low group) were used as criterion groups to evaluate individual CSA practices. The critical ratio (t-value) was calculated by using the following formula as described in calculating attitude scores.

The value of 't' was a measure of the extent to which a given CSA score differentiates between the high and low groups. As suggested by Edwards (1957), there is a thumb rule of rejecting items with 't' values < 1.75. Usually, a t-value equal to or greater than 1.75 indicates that the average responses of the high and low groups to a CSA practice differ significantly.

Finally, t-values of all the CSA practices were determined (Appendix-V). The CSA practice having 't' values ≥ 1.75 were finally selected for the practice of CSA scale. As such 19 CSA practices were selected the finally.

Scoring system: A layout of final selection of the CSA practices with 't' values ≥ 1.75 is shown in Appendix V. Finally, practice of CSA was measured by using selected 19 practices in relation to CSA. A four-point rating scale was used to determine extent of farmers' practices of CSA. The respondents indicated their use of selected CSA practices by choosing a suitable answer from four options, such as "frequently", "occasionally", rarely, and 'never'. Scores assigned to the above four responses were '3', '2', '1', and '0' respectively. Thus, the range of CSA practice score of respondents could range from 0 to 57, where 0 indicating use of no practice and 57 indicating highest use of selected CSA technologies in the field.

However, besides having calculated the "extent of farmers' practices of CSA" score for each of the 354 respondents, an effort was also made to compare the relative use of these practices. A CSA Practice Use Index (CSAPUI) was developed to fulfill this objective using the following formula:

$$CSAPUI = (N_f \times 3) + (N_o \times 2) + (N_r \times 1) + (N_n \times 0)$$

Where, CSAPUI = CSA Practice Use Index

N_f = Number of farmers used CSA practices frequently

N_o = Number of farmers used CSA practices occasionally

N_r = Number of farmers used CSA practices rarely

N_n = Number of farmers never used CSA practices

The CSAPUI for each of the CSA practice could range from 0-1062. Based on descending order of CSAPUI, rank order was made to compare the relative use of CSA.

3.6 Validity and Reliability of the Instruments

To give due attention to the validity and reliability of the instruments used for collecting data is one of the important tasks of research work. A scale possesses validity when it actually measures what it claims to measure. A scale is reliable when it can consistently produce the same results repeatedly when applied to the same sample (Goode and Hatt, 1952). Enough care was taken to prepare the interview schedule in general and the scales in particular for this study. However, validity and reliability of the scales used for measuring climate smart agricultural knowledge, attitude towards CSA and selected practices of CSA were examined. Validity and reliability of these scales were tested both from pre-test data and a portion of final data. However, validity and reliability of the important scales have been described below.

3.6.1 Validity of knowledge scale on climate smart agriculture

In the final selection of items for climate smart agricultural knowledge scale, care was taken to include items covering the entire universe of relevant behavioural aspects of the farmers with respect to climate smart agricultural knowledge. Items were collected through various sources including related publications and specialists of different related disciplines of home and abroad. Twenty-eight items were pre-tested by administering to 24 farmers of the sample population, but with the exclusion of the sample. On the basis of difficulty index and discrimination index, 20 out of 28 items were selected for the final scale. Aforesaid discussion indicates that the content validity was built in the process of constructing the scale. Hence it was assumed that the scores obtained by administering this test measured climate smart agricultural knowledge of the respondents as intended.

Again, validity of climate smart agricultural knowledge scale was measured by the relationships between the scores of individual items of climate smart agricultural knowledge and the composite climate smart agricultural knowledge score of 36 farmers by taking 12 from each of 3 upazilas of the study area (based on a portion of final data). The coefficient of correlations between the scores of 20 individual items of climate smart agricultural knowledge and the score of composite climate smart agricultural knowledge of the scale were found to be 0.476, 0.334, 0.434, 0.453, 0.320, 0.416, 0.452, 0.443, 0.289, 0.366, 0.437, 0.402, 0.386, 0.462, 0.318, 0.523, 0.339, 0.363, 0.469, and 0.473 which were significant at 0.000 to 0.05 level with 34 degrees of freedom. On the basis of the procedure followed, it can be assumed that the climate smart agricultural knowledge scale had content validity. Therefore, the scale may be taken as valid instrument to measure the climate smart agricultural knowledge of the farmers.

3.6.2 Reliability of knowledge scale on climate smart agriculture

The reliability of climate smart agricultural knowledge scale was measured by split-half method. The scale was administered to 36 farmers by taking 12 from each of 3 upazilas of the study area (based on a portion of final data). All the 20 items of the climate smart agricultural knowledge scale were divided into 2 equal halves. These two sets of items, each having 10 items, one with odd numbers and the other with even numbers were the major two components of the scale. The coefficient of correlation between the two sets of score was computed and the value was found to be strongly significant (0.753) at 0.000 level with 34 degrees of freedom. The reliability co-efficient, thus obtained indicated that the 'internal consistency' of the climate smart agricultural knowledge scale developed for the present study was quite high.

3.6.3 Validity of attitude scale on climate smart agriculture

The content of the scale was obtained by discussion with agricultural scientists, extension specialists, and review of previous studies made in this connection. Initially 45 statements were collected and 30 statements were carefully screened in the light of 14 criteria suggested by Edwards (1957). The statements indicated different phases of attitude towards CSA. Finally, with the help of Likert's Technique of Summated Ratings, 18 statements were selected for the scale having t values ≥1.75 based on pre-test data by administering 24 farmers of the research population. The values of t of the statements have been shown in Appendix-IV. Accordingly, the content validity was built in the process of constructing the scale.

Again, validity of attitude towards CSA scale was measured by the relationships between the scores of individual items of attitude towards CSA and the composite attitude towards CSA score of 36 farmers by taking 12 from each of 3 upazilas of the study area on the basis of a portion of final data. The coefficient of correlations between the score of individual 18 items of attitudes towards CSA and the score of composite attitudes towards CSA scale were found to be 0.524, 0.483, 0.351, 0.411, 0.371, 0.467, 0.569, 0.343, 0.501, 0.384, 0.509, 0.378, 0.483, 0.512, 0.436, 0.353, 0.462 and 0.435 which were significant at 0.000 to 0.03 level with 34 degrees of freedom. On the basis of the procedure followed, it could be said that the attitude towards CSA scale had content validity. Therefore, the scale may be taken as valid instrument to measure the attitude towards CSA of the farmers.

3.6.4 Reliability of attitude scale on climate smart agriculture

The reliability of attitude towards CSA scale was measured by split-half method. On the basis of a portion of final data of 36 farmers (by taking 12 from each of 3 upazilas), all the 18 statements of attitude towards CSA scale were divided into 2 equal halves. The scale had two sets of statements each having 9 statements, one with odd numbers and the other with even numbers. The coefficient of correlation between the two sets of scores was computed and the value was found to be significant (0.572) at 0.000 level with 34 d.f. The reliability co-efficient, thus obtained indicated that the 'internal consistency' of the attitude towards CSA scale was high.

3.6.5 Validity of practice scale on climate smart agriculture

Initially 30 items were collected for this scale after discussion with agricultural scientists, extension specialists and review of previous studies made in this connection. As many as 19 items were finally selected based on the pretest experience and 't' value. The CSA practice having 't' values ≥ 1.75 were finally selected for the practice of CSA scale. Therefore, the content validity was built in the process of constructing the scale.

Again, validity of CSA practice scale was measured by the relationships between the scores of individual items of CSA practice and the composite CSA practice score of 36 farmers by taking 12 from each of 3 upazilas of the study area on the basis of a portion of final data. The coefficient of correlations between the score of individual 19 items of CSA practice and the score of composite CSA practice scale were found to be 0.344, 0.463, 0.454, 0.315, 0.471, 0.401, 0.531, 0.443, 0.501, 0.323, 0.479, 0.438, 0.453, 0.362, 0.536, 0.453, 0.412, 0.391 and 0.525 which were significant at 0.000 to 0.01 level with 34 degrees of freedom. On the basis of the procedure followed, it could be said that the CSA practice scale had content validity. Therefore, the scale may be taken as valid instrument to measure the practice of CSA of the farmers.

3.6.6 Reliability of practice scale on climate smart agriculture

The reliability of selected CSA practices scale was measured by split-half method. The scale was administered to 36 farmers by taking 12 from each of 3 upazilas of the study area. All the 19 items of selected CSA practices scale were divided into 2 halves. The scale had two sets of items, one with odd numbers having 10 items and the other with even numbers having 9 items. The coefficient of correlation between the two sets of scores was computed and the value was found to be significant (0.518) at 0.000 level with d.f. 34. The reliability co-efficient, thus obtained indicated that the 'internal consistency' of the selected CSA practices scale developed for the present study was high.

3.7 Collection of Data

For the study, data were collected by means of interviewing with the sample respondents. The researcher himself collected the data by using interview schedule to maintain the quality. Before going to the respondents for interviewing, helps were taken from respective upazila extension agents working at field level to ensure the availability of the sample respondents. While starting interview with any respondent, the researcher took all possible care to establish rapport with them so that s/he does not feel hesitant to furnish data. A commendable corporation was obtained from all the respondents during data collection. The questions were explained and clarified whenever any respondent failed to understand. Data were collected during the period from December, 2021 to March, 2022. Several visits were made to conduct the case during interviewing. Respective personnel of the concerned authority helped the researcher to be acquainted with the farmers to whom the data collection was conducted.

3.8 Statement of Hypotheses

Hypothesis may be broadly divided into two categories, namely research hypothesis and null hypothesis.

3.8.1 Research hypothesis

The following research hypothesis was put forward to test contribution of the selected characteristics of the farmers to their knowledge, attitude and practice regarding climate smart agriculture. The research hypothesis was: "Selected characteristics of the farmers have significant contribution to their knowledge, attitude and practice regarding climate smart agriculture".

3.8.2 Null hypothesis

The aforesaid research hypothesis was converted into null hypothesis for testing the conceptual model of the study. The major hypothesis formulated for testing the conceptual model of the study is presented below:

“There is no significant contribution of the selected characteristics of the respondent farmers to their knowledge, attitude and practice regarding climate smart agriculture.”

The selected characteristics of the respondent farmers were-

Personal: Age, education, farming experience

Economical: Farm size, annual agricultural income, credit availability, access to market, and benefits obtained from CSA

Social: Extension contact, training exposure, access to ICTs and problem faced in CSA

Psychological: Innovativeness and decision-making ability

3.9 Statistical Techniques Used

After collecting the data from the respondents, compilation, tabulation and analysis was done in accordance with the objectives of the study. Statistical treatments such as number, percent, rank order, range, mean, standard deviation and coefficient of variance were used to interpret data. To explore the contribution of the predictor variables to the outcome variables, full model regression analysis was employed. Data were analyzed using Microsoft Excel and Statistical Package for Social Science (SPSS) software, version 21. Data checking tools like outliers checking and removing multi-collinearity was employed. Multicollinearity exists when there is a strong correlation ($r > 0.9$) between two or more predictors in a regression model (Field, 2009). The correlation matrix (Appendix-VII) shows that there is no multicollinearity in the data as there is no substantial correlations ($r > 0.787$) between predictors. Pearson product moment correlation test was initially done. Finally, path analysis was done to find out the direct and indirect effects of the independent variables on the dependent variable. Main results from the survey were presented in tables, graphs, using pictures and narratives in the text.

CHAPTER 4

RESULTS AND DISCUSSION

A sequential and detailed discussion on the findings of the study and its interpretation has been presented in this chapter. The chapter is divided into following eight sections in accordance with the objectives of the study:

First section: Extent of the farmers' knowledge, attitude and practice regarding CSA

Second section: Description of selected characteristics of the farmers

Third section: The inter-correlation among farmers' knowledge, attitude and practice regarding CSA

Fourth section: Contribution of the selected characteristics of the farmers to their knowledge CSA

Fifth section: Contribution of the selected characteristics of the farmers to their attitudes towards CSA

Sixth section: Contribution of the selected characteristics of the farmers to their practice of CSA

Seventh section: Direct and indirect effects of the selected characteristics of the farmers

Eighth section: Comparison of the problems faced by the coastal farmers in practicing CSA

4.1 Extent of the Farmers' Knowledge, Attitude and Practice regarding Climate Smart Agriculture

The salient features of the knowledge, attitude and practice of the farmers are presented in Table 4.1 below.

Table 4.1 Salient features of knowledge, attitude and practice of the coastal farmers on CSA

Characteristics	Unit of Measurement	Possible range	Observed range	Mean	SD	CV
Knowledge	Score	0-40	17-32	25.45	3.86	15.17
Attitude	Score	0-72	35-57	49.16	5.36	10.90
Practice	Score	0-57	20-36	28.47	5.19	18.23

4.1.1 Knowledge on climate smart agriculture

Coastal farmers' knowledge scores could range from 0 to 40. But their observed knowledge scores ranged from 17 to 32, the mean was 25.45 and standard deviation was 3.86. Based on the observed scores, the farmers were classified into three categories as: “poor knowledge”, “medium-level knowledge” and “high level knowledge”. The distribution of the farmers according to their knowledge level is shown in Table 4.2

Table 4.2 Distribution of the coastal farmers according to their knowledge on CSA

Categories	Number	Percent	Mean	SD	CV
Poor knowledge (up to 20)	50	14.13	25.45	3.86	15.17
Medium-level knowledge (>20-30)	266	75.14			
High level knowledge (>30)	38	10.73			
Total	354	100.00			

Results shown in Table 4.2 reveals that majority of (75.14%) of the farmers had medium-level knowledge, and the remaining two categories of the farmers (14.13% poor knowledge and 10.73% high level knowledge) collectively became one-third (24.86%) of the majority group based on knowledge on CSA. Farmers having poor to medium-level of knowledge constitute 89.27% of the total farmers.

Possible reasons behind this result might be due to the followings-

i. The adverse climatic conditions compelled majority of the farmers to adopt a number of practices available for them and by practicing CSA they acquired some knowledge on it.

ii. The education of the farmers might influence their knowledge as the literacy rate in the study area was 87.29 % (Table 4.8) and the education of the farmers is positively correlated with their knowledge on CSA (Appendix-VII). On the other hand, due to some constraints, a portion (14.13% having poor knowledge) of the farmers were not well known to CSA. For example, extension contact and training exposure can be noticeable factors as majority (86.15%) of the farmer had low to medium extension contact (Table 4.12) while both the factors had positive relationship with knowledge (Appendix-VII) and 73.45% of the coastal farmers did not receive any training (Table 4.13).

iii. Knowledge of the farmers was also positively correlated with their farm size, annual agricultural income, innovativeness, access to market, decision making ability, benefit obtained from CSA, attitude of the farmers towards CSA and practice of CSA (Appendix-VII). Therefore, it is clear that due to the influences of these factors knowledge of the farmers varied different degrees. To cope up with the frequent adverse climatic condition all the coastal farmers should have proper knowledge on CSA which enable them to continue agricultural production.

Zighe (2016) found only 1.67% of the farmers had no clear understanding of what the CSA technologies was all about. Ochieng (2015) found 81% of the respondents who believed that climate was changing as they had observed changes in their local environment. Israel (2019) found about 72% of the respondents having heard of climate change and 28% were unaware about it. Rahman (2015) and Hassan (2004) found that majority (75% and 70.4% respectively) of the farmers had medium knowledge on rice cultivation and partnership extension approach in their respective studies.

4.1.2 Attitude towards climate smart agriculture

Attitude scores of the coastal farmers varied from 35 to 57 against the possible range of 0 to 72, with a mean of 49.16 and standard deviation 5.36. Based on the observed attitude scores, the respondents were classified into three categories namely ‘low favourable attitude’, ‘medium favourable attitude’, and ‘high favourable attitude’. The distribution of the respondents under each of the four categories has been shown in Table 4.3

Table 4.3 Distribution of the farmers according to their attitude towards CSA

Categories	Number	Percent	Mean	SD	CV
Low favourable attitude (<Mean-sd, i.e., <44)	66	18.65	49.16	5.36	10.90
Moderate favourable attitude (Mean±sd, i.e., 44-54)	216	61.01			
High favourable attitude (>Mean+sd, i.e., >54)	72	20.34			
Total	354	100.00			

Results presented in Table 4.3 indicates that the highest proportion (61.01%) of the farmer had moderate favourable attitude towards CSA as compared to 18.65% and 20.34% having low and high favourable attitude towards CSA respectively. The data also reveal that the most (79.76 %) of the respondent farmers had low to moderate favourable attitude towards CSA.

Possible reasons behind this result might be due to the followings-

i. The majority of the farmers had medium knowledge on CSA (Table 4.2) and knowledge is positively correlated with attitude (Appendix-VII) which influenced majority of the farmers forming favourable attitudes towards CSA.

ii. The majority of the farmers were practicing CSA (Table 4.4) and getting benefits from it (Table 4.19) as these two factors i.e., 'practice of CSA' and 'benefits obtained from CSA' had relatively higher degree of positive correlation with their attitudes towards CSA (Appendix-VII) which influenced majority of the farmers forming favourable attitudes towards CSA.

iii. The other factors, such as, farmers' education, farm size, annual agricultural income, extension contact, training exposure, innovativeness, access to market, credit availability and problems faced in CSA are positively correlated with their attitudes towards CSA which influenced them forming attitudes towards CSA in different degrees.

Farhad and Kashem (2004) found majority (68.00%) of the respondents having medium attitude while 17.00% low attitude and 15.00% high attitude in using IPM in vegetable cultivation. Samad (2010) found majority (69.84 %) of the farmers having favorable attitude towards aerobic rice cultivation. Sarkar (2002) and Hussain (2001) found almost similar result in their respective studies.

4.1.3.1 Practice of climate smart agriculture

Practice score of coastal farmers could range from 0 to 57, but their observed practice scores ranged from 20 to 36. The mean and standard deviation was 28.47 and 5.19 respectively. Based on the practice scores, the coastal farmers were classified into three categories namely 'low practiced farmer', 'medium practiced farmer' and 'high practiced farmer'. The distribution of the respondents under each of the three categories has been shown in Table 4.4.

Table 4.4 Distribution of the farmers according to their practice of CSA

Categories	Number	Percent	Mean	SD	CV
Low practiced (<Mean-sd, i.e., <23)	68	19.21			

Medium practiced (Mean±sd, i.e., 23-33)	205	57.91	28.47	5.19	18.23
High practiced (Mean+sd, i.e., >33)	81	22.88			
Total	354	100.00			

Findings reveal that about 57.91% of the coastal farmers had medium practice followed by 22.88% high and 19.21% low practice of CSA. It means that overwhelming majority (77.12%) of the farmers had low to medium practice of CSA. Low practice indicates vulnerable agricultural production system, and that's why this group needs more attention to CSA.

Possible reasons behind this result might be due to the followings -

i. The majority of the farmers had medium-level knowledge (Table 4.2) and medium favourable attitudes regarding CSA (Table 4.3) while knowledge and attitude are positively correlated with CSA practice (Appendix-VII) which influenced majority of the farmers practicing CSA.

ii. The majority of the farmers were practicing CSA (Table 4.4) and getting benefits from CSA (Table 4.19). Once a farmer started to use any CSA practice, he tried to continue to use it for the benefits.

iii. The majority of the farmers (50.56%) fell under 'low-income group' followed by 40.68% 'medium income group' (Table 4.10) while the major problem of them was 'economic problem' (Table 4.32). Their top problems relating to CSA (Table 4.31) are 'higher cost of inputs' and 'lower price of produced crops' that hindered farmers to adopt CSA practices consequently a portion of farmers (19.21%) fell under 'low practiced farmer' group.

iv. Farmers' education, farm size and extension contact are positively correlated and age and farming experience were negatively correlated (Appendix-VII) with their practice of CSA which influenced them adopting CSA in different degrees and fell under different categories.

Mondal (2014) found that majority (69.90%) of strawberry farmers had medium practice, while 17.7% farmers had high practice and 12.4% farmers had low practice on strawberry cultivation. Mia (2005) found 32.0% of the vegetable growers were high user of IPM practices, while 63% medium and 5% were low user of IPM practices.

4.1.3.2 Comparison among the extent of use of selected CSA practices

In order to compare among the selected CSA practices regarding their extent of use, CSA Practices Use Index (CSAPUI) was developed following the formula as described in Chapter 3. The CSAPUIs along with their associated ranks has appeared in Table 4.5.

Table 4.5 Comparison of identified CSA practices used by the respondent farmers

CSA Practices	N_f	N_o	N_r	N_n	CSAPUI	Rank
Using of thread pipe/plastic pipe for irrigation	153	79	105	17	722	1
Cultivation of salinity resistant and HYV crop varieties	71	180	94	9	667	2
Mulching	39	237	69	9	660	3
Ridge planting (Bank of pond/gher/in Ails)	80	135	132	7	642	4
Adoption of raised bed planting	89	119	124	22	629	5
Rain water harvesting for irrigation	114	98	83	59	621	6
Cultivation of short duration and HYV crop varieties	98	61	183	12	599	7
Practicing of minimum tillage	31	174	131	18	572	8
Rearing improved livestock breed	17	190	137	10	568	9
Adjusting planting time	5	210	129	10	564	10
Adoption of crop rotation	14	188	85	67	503	11
Applying of compost/vermicompost	13	141	174	26	495	12
Watermelon cultivation	112	41	73	128	491	13
Traditional gher farming	40	79	173	62	451	14
Cultivation of submergence resistant and HYV crop varieties	10	72	248	24	422	15
Cultivation of drought resistant and HYV crop varieties	5	95	206	48	411	16
Adoption of relay cropping/ intercropping with legume	11	68	232	43	401	17
Practicing of zero tillage	2	72	249	31	399	18
Practicing of 'Hari' system	8	65	106	175	260	19

N_f = Number of farmers used CSA practice frequently (3), N_o= Number of farmers used CSA practice occasionally (2), N_r = Number of farmers used CSA practice rarely (1), N_n = Number of farmers used CSA practice never (0),

CSAPUI= Climate Smart Agriculture Practice Use Index

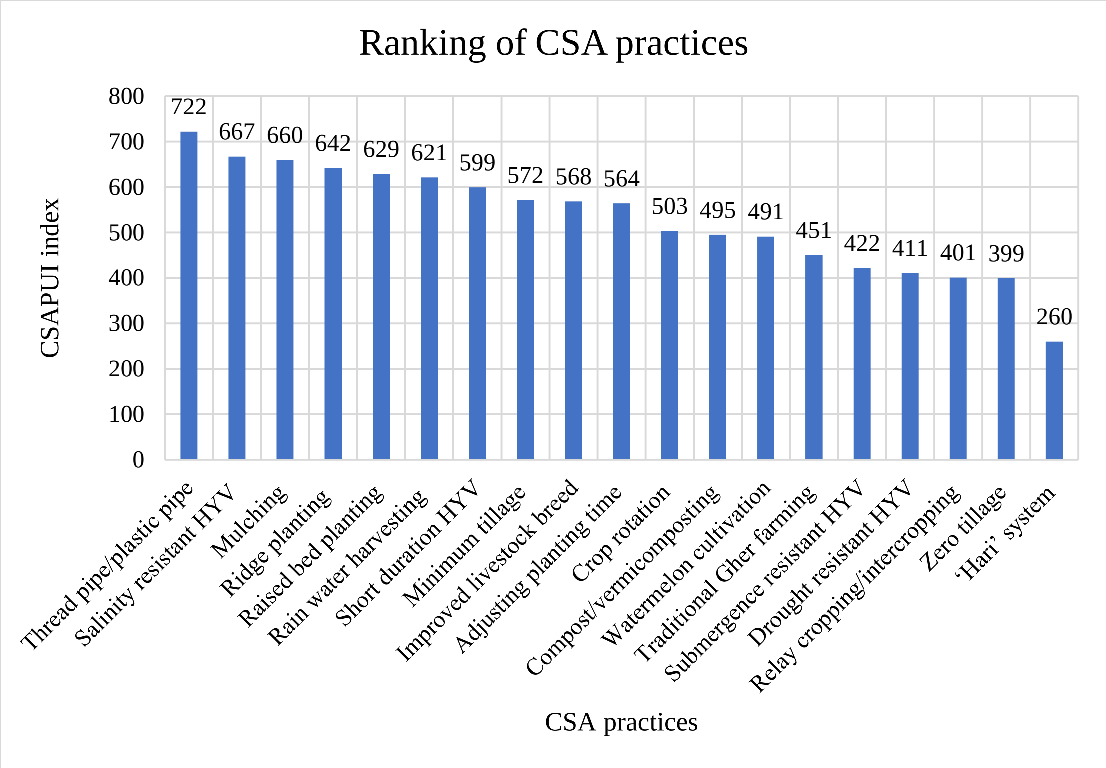


Figure 4.1 Comparison of identified CSA practices used by the respondent farmers

It is interesting to note that water smart agriculture technologies were mostly used by the coastal farmers. Water smart agriculture includes a blend of "best-fit" water management practices that increase water availability, water access and the effectiveness, efficiency and equity of water distribution and use (Nicol *et al.*, 2015). It is commonly acknowledged that most of the impacts from climate change will relate to water (UN-Water, 2010). Challenges of global warming and climate change would have to be met through the judicious application of water in agriculture through water smart agriculture technologies. In the rank order, the top six practices are water smart agriculture technologies. The practices are: using of thread pipe/plastic pipe for irrigation, cultivation of salinity resistant and HYV crop varieties, mulching, ridge planting (bank of pond/gher/in ails), adoption of raised bed planting, rain water harvesting for irrigation. This might be due to the increase of soil and water salinity and scarcity of water in dry season hampering crop production in the coastal region of the country.

Among the 19 identified CSA practices "using of thread pipe/plastic pipe for irrigation" ranked first and indicated highest extent of use by the coastal farmers. The reasons behind this due to-

- the most of the land requires irrigation and plastic pipe is less costly than concrete irrigation channel;
- it is set to the land temporarily and for its light weight it can be easily conveyed to the land; and
- loss of water is much less than earthen channel.

The 2nd position in the rank order was 'cultivation of salinity resistant and HYV crop varieties.' Farmers were compelled to adopt salinity resistant HYV varieties as the salinity intrusion and salt concentration are increasing day by day. The 3rd was 'mulching' as the mulch (e.g., water hyacinth, straw etc.) is available there and the local extension office influenced them to apply mulch to preserve soil moisture easily. The 4th was 'ridge planting (bank of pond/gher/in ails)'. Cultivable land is gradually decreasing due to increasing salinity and water stagnation in many areas. Therefore, the farmers tried to use normally uncultivated area like the banks of pond or gher and ails between lands to grow vegetables.

On the other hand, 'hari system' and 'zero tillage' ranked at the bottom of the list because all the land were not suitable for adopting the two practices.

4.2 Distribution of selected characteristics of the farmers

Fourteen characteristics of the farmers were selected to describe and to find out relationships of each of the characteristics of the farmers with their knowledge, attitude and practice regarding CSA. These selected characteristics were Age, Education, Farm size, Annual agricultural income, Farming experience, Extension contact, Training exposure, Innovativeness, Credit availability, Access to market, Access to ICTs, Decision making ability, Benefit obtained from CSA and Problem faced in CSA. The salient features of the selected fourteen characteristics of the farmers are presented in Table 4.6.

Table 4.6 Salient features of the selected characteristics of the respondent farmers (n=354)

Characteristics	Unit of measurement	Possible range	Observed range	Mean	SD
Age	Year	Unknown	27-68	48.42	9.97

Education	Year of schooling	Unknown	0-15	7.01	3.51
Farm size	Score	1-5	2-5	3.25	0.73
Annual agricultural income	Score	1-10	1-10	3.94	1.85
Farming experience	Year	Unknown	10-50	24.60	9.89
Extension contact	Score	0-42	15-31	23.02	4.56
Training exposure	No. of days	Unknown	0-7	0.81	1.52
Innovativeness	Score	1-5	1-5	3.39	0.97
Credit availability	Score	0-100	0-83	11.65	23.25
Access to market	Score	0-20	10-17	13.47	1.79
Access to ICTs	Score	0-15	3-10	6.29	1.57
Decision making ability	Score	6-18	11-17	13.76	1.77
Benefit obtained from CSA	Score	0-60	34-55	45.91	5.09
Problem faced in CSA	Score	0-66	32-56	46.04	5.33

4.2.1 Age

Age of the respondent farmers was determined by the number of years from their birth to the time of interview. The age of the farmers ranged from 27 years to 68 years, the mean being 48.42 with standard deviation of 9.97. Wang *et al.* (2019) classified population into four age groups: (1) early adulthood people: 18 ≤ age ≤ 24, (2) young people: 25 ≤ age ≤ 39, (3) middle-aged people: 40 ≤ age ≤ 59, and (4) elderly people: 60 ≤ age. In this study early adulthood people was not found. Therefore, respondents of the study area were classified into three categories on the basis of their age as young, middle-aged and old. The distribution of the respondents according to their farm size is presented in Table 4.7.

Table 4.7 Distribution of the respondent farmers according to their age

Categories	Number	Percent	Mean	SD	CV
Young (<40)	76	21.47	48.42	9.97	20.59
Middle-aged (40 to 59)	220	62.15			
Old (> 59)	58	16.38			
Total	354	100.00			

Information contained in Table 4.7 indicate that the majority (74.14%) of the respondent farmers were middle-aged compared to 13.71% being young and 12.15% old. Findings indicate that the number of young farmers is slightly greater than those of old farmers in the study area.

It is also found that age of the farmers had no significant relationship with their knowledge and attitude towards CSA (Appendix-VII). Mandal (2016), Mondal (2014), Roy (2006), Khan (2005), Islam (2005) and Rahman (2004) also reported in their respective studies that age of the farmers had no significant relationship with their knowledge on different agricultural technologies. But, Mandal (2016), Chowdhury (2003), Bari (2000), Habib (2000) and Nurzaman (2000) found in their respective studies that age of the farmers had no significant relationship with their attitudes towards different agricultural technologies.

However, this study reveals that there was a negative relationship between age and practice of CSA (r = -0.134, significant at 0.05 level). Mango *et al.*, (2018), Billah and Hossain (2017), Mutoko (2014) and Sana (2003) also found negative relationship between age and different agricultural practices. These findings indicate that agricultural practice is associated with comparatively younger farmers. The reason might be that younger farmers are more likely to be courageous, initiative and interested in practicing agricultural technologies hoping to get benefits from them.

4.2.2 Education

Education of a respondent was measured by the level of his/her formal education i.e., highest grade (class) passed by him/her. The education score of the respondents ranged from 0 to 15, the average being 7.53 and the standard deviation was 3.20. Based on their education, the respondents were grouped into five categories: “Illiterate” (0-0.5), "Primary education" (1-5), "Secondary education" (6-10), “Higher secondary education” (11-12) and “Tertiary education” (above 12). The distribution of the respondents according to their farm size is presented in the Table 4.8.

Table 4.8 Distribution of the respondent farmers according to their education

Categories	Number	Percent	Mean	SD	CV
Illiterate (0-0.5)	45	12.71	7.01	3.51	50.07
Primary education (1-5)	71	20.06			
Secondary education (6-10)	210	59.32			
Higher secondary education (11-12)	19	5.37			
Tertiary education (>12)	9	2.54			
Total	354	100.00			

Results presented in Table 4.8 indicate that a large proportion (59.32%) of the respondents had secondary education compared to 12.71% illiterate, 20.06% had primary education, 5.37% had higher secondary education and 2.54% had tertiary education. The educational status of the respondents was somewhat better due to the awareness of the respondents and interventions made by different agencies. The findings thus, indicate that the current literacy rate (87.29 %) in the study area was higher than that of the national average of 72.8% (BBS, 2021). However, education had positive relationship with knowledge (r = 0.275, significant at 0.01 level), attitude (r = 0.259, significant at 0.01 level) and practice (r = 0.304, significant at 0.01 level) regarding CSA. Rahman (2015), Mondal (2014), Saha (2003), Sana (2003), Sarker (2002), Saha (2001) and Hossain (2000) also found that education of the farmers was positively and significantly related with their knowledge in their researches. It might be due to that education makes awareness in a person and lead him to acquire knowledge on a matter that he is concerned.

Again, Rahman (2015), Chowdhury (2003), Shehrawat (2002), Khan (2002), Sadat (2002), Haque (2002), Habib (2000) and Paul (2000) also found that education of the farmers had a positive significant relationship with their attitudes. This indicates that education plays significant role to form and change farmers attitudes. Furthermore, Beyene (2018), Billah and Hossain (2017), Ochieng, (2015), Rahman (2006), Mia (2005), Islam (2005) and Hossain (2003) found that education of the farmers had positive significant relationship with various agricultural practice. This means that education helps farmers practicing agricultural technologies and for this reason proper education for the farmers should be ensured.

4.2.3 Farm size

The farm size scores of the respondents ranged from 2 to 5 with a mean and standard deviation of 3.25 and 0.73 respectively. Based on their farm size, the respondents were classified into four categories (adopted from Roy *et al.*, 2015). The distribution of the respondents according to their farm size is presented in Table 4.9.

Table 4.9 Distribution of the respondent farmers according to their farm size

Categories	Number	Percent	Mean	SD	CV
Marginal (0.021 to 0.2)	36	10.20			
Small (0.21 to 1.0)	214	60.50			
Medium (1.01 to 3.0)	80	22.60	3.25	0.73	22.46

Large farmer (> 3.0)	24	6.80			
Total	354	100.00			

Results represented in Table 4.9 indicate that the small farm holder constituted the highest proportion (60.50%) followed by medium farm holder (22.60%). The findings of the study reveal that most of the respondents were small to medium sized farm holder. Besides, the marginal farm holder and large farm holder constituted 10.20% and 6.80% respectively. There was no landless farmer among the respondents.

However, farm size had positive relationship with knowledge (r = 0.292, significant at 0.01 level), attitude (r = 0.116, significant at 0.05 level) and practice (r = 0.228, significant at 0.01 level) regarding CSA (Appendix-VII). Hossain (2003), Sarker (2002) and Alam (1997) also found that farm size had significant relationship with their knowledge. Again, Chowdhury (2003), Shehrawat (2002), Sadat (2002), Mannan (2001) and Paul (2000) found that there was a positive and significant relationship between farm size and attitude of farmers in their studies. Furthermore, Mutoko (2014), Rahman (2006), Mia (2005) and Rahman (2004) found in their respective studies that farm size had significant relationship with different agricultural practices.

This might be due to that larger farm size engages farmers more times in different farming activities that influences acquiring knowledge on that farming practices. As knowledge, attitudes and practice of the farmers were positively correlated (Appendix-VII) and for this, farmer having large farm acquiring more knowledge on CSA, show positive attitude towards it and practice more of it.

4.2.4 Annual agricultural income

Annual agricultural income score of the respondents ranged from 1 to 10 with a mean and standard deviation of 3.94 and 1.85, respectively. On the basis of annual income, the respondents were classified into three categories (Mean ± SD) namely ‘low-income farmer’, ‘medium income farmer’ and ‘high income farmer’ annual agricultural income. The distribution of the respondents according to their annual family income is presented in Table 4.10.

Table 4.10 Distribution of the respondent farmers based on their annual agricultural income

Categories	Number	Percent	Mean	SD	CV
Low-income (<150000)	179	50.56			

Medium income (151000-300000)	144	40.68	3.94	1.85	46.95
High income (>300000)	31	8.76			
Total	354	100			

Results reveal that the respondents having low annual agricultural income constituted the highest proportion (50.56%); their annual agricultural income is up to Tk.150000, while the lowest proportion belongs to high income group (8.76%) and medium income category constitutes the second majority having 40.68% of the respondents. Overwhelming majority (91.24%) respondents have low to medium level annual agricultural income. As the majority of the farmers' farm size are small (Table 4.9), this majority had low annual agricultural income. It is often said that the majority of the farmers of our country are poor. Mittra and Akanda (2019) found similar result in their study that majority (62.2%) of the farmers had low annual income.

However, annual agricultural income had positive and significant relationship with knowledge (r = 0.158, significant at 0.01 level), attitude (r = 0.205, significant at 0.01 level) and practice (r = 0.295, significant at 0.01 level) regarding CSA.

Mandal (2016), Dhali (2013), Sharif (2011), Kausar (2009), Rahman (2009), Rahman (2006), Roy (2006), Islam (2005), Hossain (2003) and Nurruzzaman (2000) also found in their respective studies that annual income of the farmers had positive significant relationship with their knowledge. Mandal (2016), Mondal (2014), Chowdhury (2003), Shehrawat (2002), Mannan (2001) and Akanda (2001) found in their respective studies that annual income of the farmers had positive significant relationship with their attitudes. Billah and Hossain (2017), Mandal (2016), Rahman (2006), Roy (2006), Mia (2005) and Islam (2005) found that annual income of the farmers had positive significant relationship with their practice.

4.2.5 Farming experience

The observed farming experience of the coastal farmers ranged from 10 to 50 years. The mean and standard deviation were 24.6 and 9.9 respectively. Based on this score, the farmers were classified into three categories according to Taskeen (2014) which is presented in the Table 4.11

Table 4.11 Distribution of the respondent farmers based on their farming experience

Categories	Number	Percent	Mean	SD	CV

Low experienced (<15)	65	18.36	24.6	9.9	40.24
Medium experienced (15-35)	247	69.77			
High experienced (>35)	42	11.87			
Total	354	100.00			

Results presented in Table 4.11 reveal that majority proportion (69.77%) of the farmers had medium experience compared to 18.36% of them had low experience and 11.87% of them high experience. The findings again reveal that overwhelming majority (84.75%) of the farmers had medium to high experience. This may be due to the social system that people are traditionally involved in farming activities from their boyhood for many years in study area.

However, farming experience had a negative relationship with knowledge (r = -0.211, significant at 0.01 level) and practice (r = -0.204, significant at 0.01 level) and no relationship with attitude regarding CSA.

Mondal (2014) found significant positive relationship and Anu (2016) found no significant relationships between farming experience and knowledge of the farmers. Mondal (2014), Sarker (2002) and Habib (2000) found significant positive relationship between farming experience and attitudes of the farmers. Mondal (2014) and Anu (2016) found no significant relationships between farming experience and practice of the farmers. The variation among the findings might be due to the differences of socioeconomic conditions and geographical locations. Over times, farmers might have been involved in other occupation along with farming activities. For these reasons, correlation of the farming experience with knowledge, attitudes and practice may be changed.

4.2.6 Extension contacts

The observed agricultural extension contact scores of the coastal farmers ranged from 15 to 31 against the possible range of 0 to 42, the mean, standard deviation and coefficient of variation were 23.02, 4.56 and 19.80 respectively. Based on this score, the farmers were classified into three categories (BRRI, 2015) which is presented in Table 4.12

Table 4.12 Distribution of the respondent farmers based on their extension contact

Categories	Number	Percent	Mean	SD	CV
Low contact (< 18)	62	17.51			
Medium contact (18-28)	243	68.64			

High contact (>28)	49	13.85	23.02	4.56	19.80
Total	354	100.00			

Results presented in Table 4.12 show that majority proportion (68.64%) of the farmers had medium extension contact compared to 17.51% of them had low extension contact and 13.85% of them had high extension contact. Thus, majority (86.15%) of the farmer had low to medium extension contact. Rahman (2018) found similar result that majority (65.1%) of the farmers had medium extension contact.

However, extension contact had positive relationship with knowledge (r = 0.402, significant at 0.01 level), attitude (r = 0.177, significant at 0.01 level) and practice (r = 0.249, significant at 0.01 level) regarding CSA. Mandal (2016), Mondal (2014), Islam (2005), Khan (2005), Sana (2003), Sarker (2002), Rahman (2001) and Hossain (2000) found in their study that extension media exposure of farmers had positive significant relationships with their knowledge. Mandal (2016), Rahman (2015), Shehrawat (2002), Sadat (2002) and Siddique (2002) reported in their studies that there was a significant and positive relationship between extension contact and attitude of farmers. Beyene (2018), Mandal (2016), Roy (2006) and Mia (2005) found significant and positive relationship with extension contact and practice of various agricultural technologies. This indicates that extension contact plays an important role for increasing farmers knowledge, forming favourable attitude and eventually adopting modern farming practices. Therefore, farmers should be exposed to various extension media.

4.2.7 Training exposure

The training exposure score of the coastal farmers ranged from 0 to 7 with a mean of 0.81 and standard deviation of 1.52. Based on the training experience scores, the coastal farmers were classified into four categories: "no trained farmer" (0), "low trained farmer" (1-2), “medium trained farmer” (3-4) and “high trained farmer” (above 4 days). The distribution of the coastal farmers according to their training experience is presented in the Table 4.13.

Table 4.13 Distribution of the respondent farmers based on their training exposure

Categories	Number	Percent	Mean	SD	CV
No trained farmer (0)	260	73.45			
Low trained farmer (1-2)	71	20.06			

Medium trained farmer (3-4)	14	3.95	0.81	1.52	187.65
High trained farmer (>4)	9	2.54			
Total	354	100.00			

Around three-fourths (73.45%) of the coastal farmers did not receive any training while 20.06% received low training, 3.95% received medium training and 2.54% received high training. Training increases knowledge and skills of the coastal farmers in a specific subject matter. Individuals who gained high training are likely to be more competent in performing different farming activities. But the fact that overwhelming majority of the coastal farmers did not receive any training. Providing proper training on CSA will likely to increase the knowledge, attitude and practice of the farmers.

However, training exposure had positive relationship with knowledge (r = 0.167, significant at 0.01 level), attitude (r = 0.249, significant at 0.01 level) and practice (r = 0.266, significant at 0.01 level) regarding CSA.

Mandal (2016) and Sadat (2002) found that training exposure had significant positive relationship with their knowledge. Mandal (2016) and Paul (2000) reported that training exposure of the farmers had positive significant relationship with their attitude. Mondal (2014) and Islam (2005) found no relationship between training exposure and agricultural practice. It means that training increases knowledge and form favourable attitude. On the other hand, the farmers in the coastal areas received training on different subjects relating to farming (e.g., seed production, seed preservation, fish production, egg preservation, IPM, etc.) rather than CSA. In addition to it, due to the majority of the farmers was beyond training exposure, and perhaps for this reason, training was not associated with the practice of CSA.

4.2.8 Innovativeness

Innovativeness is related to the 'Diffusion of Innovations Theory' and has been applied to a number of studies, including marketing, organizational studies; knowledge management, communications and complexity studies, among others. Categories were first named and described in the landmark book "*Diffusion of Innovations*" by sociologist Everett Rogers in 1962. According to Rogers' research, there are five adopter categories — innovators, early adopters, early majority, late majority and laggards. Rogers identified key characteristics of each adopter category, such as the fact that early adopters have the highest degree of opinion leadership among the adopter categories, while the laggards are likely to be the oldest and most traditional individuals. In this study to identify the farmer's innovativeness category's score weight was adopted from Poddar (2015).

Table 4.14 Distribution of the respondent farmers based on their innovativeness

Categories	Number	Percent	Mean	SD	CV
Innovator (5)	39	11.03	3.39	0.97	28.61
Early adopter (4)	122	34.46			
Early majority (3)	140	39.54			
Late majority (2)	45	12.71			
Laggard (1)	8	2.26			
Total	354	100.00			

Results shown in Table 4.14 indicate that early majority of the farmers are belonging to the highest percentage (39.54%) followed by early adopter (34.46%), late majority (12.71%), innovator (11.03%) and laggard (2.26%). However, innovativeness had positive relationship with knowledge (r = 0.232, significant at 0.01 level), attitude (r = 0.127, significant at 0.05 level) and practice (r = 0.129, significant at 0.05 level) of the farmers regarding CSA.

Saha (2001) found negative relationship between innovativeness and knowledge on improved practices of pineapple cultivation. Relationship differed with the variation of practices. Islam (2007) and Nurzaman (2000) found similar result in their respective studies that there was no relationship between innovativeness and attitude of the farmer. Nurzaman (2000) and Hossain (1999) also found similar result that was no relationship between innovativeness and practice.

Comparing to Rogers (1995) categorization, it is observed that percent of Innovator and Early adopter have been increased whereas 'Late majority' and 'Laggard' have been decreased considerably. This may be due to education, technological expansion, effect of extension services and others reasons. Therefore, the curve reversed to some extent as show in the Figure 4.2 below.

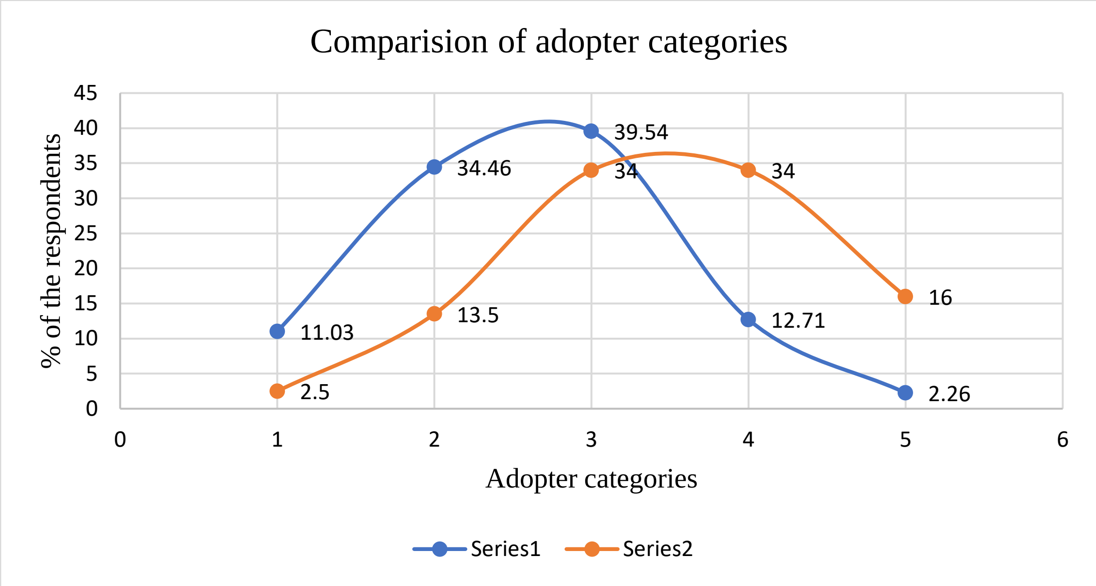


Figure 4.2 Adopter categories as compared to those of Rogers

1= Innovator, 2= Early adopter, 3= Early majority, 4= Late majority, 5= Laggard

Series 1: Adopter categories of coastal farmers

Series 2: Adopter categories according to Rogers

4.2.9 Credit availability

The observed credit availability scores of the farmers ranged from 0 to 83 against the possible score 0 to 100. The mean, standard deviation and coefficient of variation were 11.65, 23.26 and 199.66 respectively. According to this score, the farmers were classified into four categories is presented in Table 4.15

Table 4.15 Distribution of the respondent farmers based on their credit availability

Categories	Number	Percent	Mean	SD	CV
No credit (0)	288	81.36	11.65	23.26	199.66
Low credit (<50)	18	5.08			
Medium credit (50-70)	43	12.15			
High credit (>70)	5	1.41			
Total	354	100.00			

Results shown in Table 4.15 indicate that majority proportion (81.36%) of the coastal farmers had no need of credit compared to 12.15% of them had medium credit availability, 5.08% had low credit availability and 1.41% of them had high credit availability.

However, credit availability had no relationship with knowledge and practice but positive significant relationship with their attitude (r = 0.133, significant at 0.05 level) towards CSA. Rahman (2018), Mandal (2016), Anu (2016) found similar result that credit availability had no significant relationship with their knowledge. Rahman (2018) and Mandal (2016) found similar result that credit availability had positive significant relationship with their attitudes. Again, Anu (2016) found that credit received by the farmers had no significant relationship with the practice of plant nursery management. Reddy and Kivlin (2006) also found no relationship between credit availability and practice of HYV cultivation.

It also reveals that the farmers received credit from different sources like Bangladesh Krishi Bank, Grameen Bank, NGOs like BRAC, Heed Bangladesh, Ekti bari ekti khamar project, Agrani bank, SDF, ASA, etc. It may be concluded that financial institutions provided credit for different farming activities thus could be helped the farmers to change their attitude and adopt practices.

4.2.10 Access to market

Market access scores of the respondents ranged from 10 to 17 against possible score of 0 to 20. The average score and standard deviation and coefficient of variation were 13.47 and 1.79 and 13.29 respectively. Based on the access to market scores, the respondents were classified into three categories (Mean ± SD) namely low, medium and high market access.

Table 4.16 Distribution of the respondents according to their access to market

Categories	Number	Percent	Mean	SD	CV
Low access (<11)	29	8.19	13.47	1.79	13.29
Medium access (11-15)	266	75.14			
High access (>15)	59	16.67			
Total	354	100.00			

Findings contained in Table 4.16 reveals that a great majority (75.14%) of the coastal farmers have medium access to market followed by high access to market (16.67%) and low access to market (8.19%). However, access to market had positive relationship with knowledge (r = 0.265, significant at 0.01 level) and attitude (r = 0.151, significant at 0.01 level) but no relationship with practice of the farmers regarding CSA. This indicates that if farmers' access to market can be increased their knowledge and attitudes towards CSA will be increased, but it will have no effect on their CSA practice. No previous result relating to this is available to the researcher.

4.2.11 Access to ICTs

Access to Information and Communication Technologies (ICTs) scores of the respondents ranged from 3 to 10 against possible score of 0 to 15. The average score, standard deviation and coefficient of variation were 6.29, 1.57 and 24.96 respectively. Based on the ICTs scores, the respondents were classified into three categories (Mean ± SD) namely low, medium and high Information and Communication Technologies (ICTs) access. The distribution of the respondents according to their access to ICTs is presented in Table 4.17.

Table 4.17 Distribution of the respondents according to their access to ICTs

Categories	Number	Percent	Mean	SD	CV
Low access (<5)	47	13.28	6.29	1.57	24.96
Medium access (5-8)	274	77.4			
High access (>8)	33	9.32			
Total	354	100.00			

Results presented in Table 4.17 reveals that 77.4% of the respondents had medium ICTs access, 13.28% had low ICTs access and the lowest 9.32% had high ICTs access. An overwhelming majority (90.68%) of the coastal farmers had low to medium access to ICTs. Adnan (2016) found similar result that majority (88.2%) of the farmers had medium access to ICTs.

However, access to ICTs had negative relationship with knowledge (r = -0.116, significant at 0.05 level) but no relationship with attitude and practice of the farmers on CSA. This means that, more access to ICTs tends to decrease knowledge on CSA and does not influence coastal farmers' attitude and practice regarding CSA. Uddin (2007), Islam (2005), Anisuzzaman (1995) and Nuruzzaman (2003) found a contradictory result that the agricultural knowledge of the respondent that had positive significant relationship with their use of communication media (ICT). Hossain (1996) and Huque (1982) found similar result that there was no relationship between farmers' attitude towards agricultural technologies and access to ICTs. On the other hand, Nira (2006) found contradictory result that access to ICTs had positive significant relationship with their practice of roof gardening.

Farmers in the coastal areas becomes aware of any upcoming climatic calamity quickly through using ICTs and take measures accordingly. Therefore, considering the importance of ICTs, its access should be available for the farmer to cope up with the climatic challenges in coastal areas.

4.2.12 Decision making ability

Decision making ability scores of the farmers ranged from 11 to 17 against the possible range of 6 to 18, the mean being 13.76, standard deviation of 1.77 and co-efficient of variation 12.86%. Based on the decision-making ability scores, the farmers were classified into three categories (Mean ± SD) as low decision-making ability, medium decision-making ability and high decision-making ability. The distribution of the respondents according to their decision-making ability is presented in the Table 4.18.

Table 4.18 Distribution of the respondents based on their decision-making ability

Categories	Number	Percent	Mean	SD	CV
Low decision making (<12)	39	11.02	13.76	1.77	12.86
Medium decision making (12 to 15)	246	69.49			
High decision making (>15)	69	19.49			
Total	354	100.00			

Results presented in Table 4.18 indicate that majority (69.49%) of the respondents had medium decision-making ability, while 19.49% and 11.02% had high and low decision-making ability respectively. The data also reveal that an overwhelming majority (80.51%) of the respondent farmers had low to medium decision-making ability. Hossain (2017) found almost similar result that majority (62.9%) of the respondents had medium decision making ability.

However, decision making ability of the farmers had positive significant relationship with knowledge (r = 0.498, significant at 0.01 level), but no relationship with attitude and practice regarding CSA. That means that, farmers having high decision-making ability tends to have high knowledge on CSA. On the other hand, farmers attitude and practice regarding CSA are not influenced by their decision-making ability. Ali (2004) found similar result in his study that decision making ability of farmers had no significant relationship with practice of agricultural technology.

4.2.13 Benefits obtained from CSA

Benefits obtained from CSA score of the farmers was found to range from 34 to 55 against the possible range of Zero (0) to 60 with mean, standard deviation and co-efficient of variation of 45.91, 5.09 and 11.09% respectively. On the basis of benefits obtained from CSA, the respondent farmers were classified into three categories (Mean ± SD) as 'low benefit obtained', 'medium benefit obtained' and 'high benefit obtained' from CSA. The distribution of the respondents according to their benefit obtained from CSA is presented in Table 4.19.

Table 4.19 Distribution of the respondents based on benefit obtained from CSA

Categories	Number	Percent	Mean	SD	CV
Low benefit obtained (< 40)	33	9.32	45.91	5.09	11.09
Medium benefit obtained (40 - 51)	267	75.42			
High benefit obtained (> 51)	54	15.26			
Total	354	100.00			

Results presented in Table 4.19 indicate that the highest proportion (75.42%) of the farmers belonged to medium benefits obtained from CSA, while 9.32% and 15.26% had low and high benefits obtained from CSA group respectively. Thus, majority (84.74%) of the farmers obtained low to medium benefits from CSA.

However, benefit obtained from CSA of the respondent farmers was positively related with their knowledge (r=0.472, significant at 0.01 level), attitude (r= 0.425, significant at 0.01 level) and practice (r= 0.317, significant at 0.01 level) regarding CSA. That means, farmers who get more benefits from CSA tends to have higher knowledge on it, have favourable attitude towards it and do more practice of it. It is well known that all the extension service are provided to the farmers in order to benefit them. Whenever a farmer gets any benefit from any practice, he becomes inspired to know about it, form favourable attitude towards it and try to practice it. No literature was found related to relationship of benefit obtained from CSA and knowledge, attitude and practice.

4.2.14 Problems faced in CSA

The observed range of the farmers problem faced in practicing CSA ranged from 32 to 56 against the possible range of 0 to 66. The mean, standard deviation and coefficient of variation were 46.04, 5.33 and 11.58 respectively. Based on this score, the farmers were classified into three categories which is presented in Table 4.20.

Table 4.20 Distribution of the respondent based on their problems faced in CSA

Categories of problem	Number	Percent	Mean	SD	CV
Low (<42)	53	14.97	46.04	5.33	11.58
Medium (42-52)	273	77.12			
High (>52)	28	7.91			
Total	354	100.00			

Results presented in Table 4.20 reveal that a great majority (77.12%) of the farmers belonged to medium problem faced in practicing CSA followed by low problem faced (14.97%) and high problem faced (7.91%) in practicing CSA.

However, problem faced in practicing CSA of the respondent farmers was positively related with their attitude (r =0.151, significant at 0.01 level) and not related with their knowledge and practice regarding CSA. Anu (2016), Raha (2007) and Islam (2001) found similar result that problem faced had no significant relationship with their knowledge. Muttaleb *et al.* (1998) and Karim *et al.* (1997) reported that problems of the farmers had a significant relationship with their attitude. Anu (2016) and Rahman (2001) found no relationship between farmers practice and problem faced in cultivation.

4.3 The inter-correlation among farmers' knowledge, attitude and practice regarding CSA

Co-efficient of correlation was computed in order to explore the inter-correlation among the focus variables of the study. The inter-correlation among farmers' knowledge, attitude and practice regarding CSA has been presented in Table 4.21.

Table 4.21 The value of inter-correlation co-efficient (r) among farmers' knowledge, attitude and practice regarding CSA

	Knowledge on CSA	Attitude towards CSA	Practice of CSA
Knowledge on CSA	1		
Attitude towards CSA	0.491**	1	
Practice of CSA	0.439**	0.661**	1

** Correlation is significant at the 0.01 level (2 tailed)

4.3.1 Relationship between the knowledge of farmers and their attitude towards CSA

Results presented in Table 4.21 show that the co-efficient of correlation 'r' is 0.491 ($p < 0.01$) between the concerned variables. This led to the following observations regarding the relationship between the two variables under consideration:

- There is a strong positive significant relationship between knowledge and attitude of the coastal farmer regarding climate smart agriculture.
- The null hypothesis was rejected.
- Therefore, if the knowledge on climate smart agriculture of the farmers can be increased, their attitude towards climate smart agriculture will be more favourable.

Hossain (2017), Mondal (2014) and Rahman (2015) observed in their respective studies and found similar results that knowledge and attitudes of the farmers were positively correlated.

4.3.2 Relationship between the knowledge of farmers and their practice of CSA

Results presented in Table 4.21 show that the co-efficient of correlation 'r' is 0.439 ($p < 0.01$) between the concerned variables. This led to the following observations regarding the relationship between the two variables under consideration:

- There is a strong positive significant relationship between knowledge and practice of the coastal farmer regarding CSA.
- The null hypothesis was rejected.
- Therefore, if the knowledge on CSA of the farmers can be increased, the farmers will use more CSA practices with great extent.

Hossain (2017), Mondal (2014) and Rahman (2015) observed in their respective studies and found similar results that knowledge and practice of the farmers were positively correlated.

4.3.3 Relationship between the attitudes of farmers and their practices of CSA

Results presented in Table 4.21 show that the co-efficient of correlation 'r' is 0.661 ($p < 0.01$) between the concerned variables. This led to the following observations regarding the relationship between the two variables under consideration-

- There is a strong positive significant relationship between attitude and practice of the coastal farmer regarding CSA.
- The null hypothesis was rejected.
- Therefore, if the attitude towards CSA of the farmers becomes more favourable, the farmers will use more CSA practices with great extent.

Hossain (2017), Mondal (2014) and Rahman (2015) observed in their respective studies and found similar results that attitudes and practice of the farmers were positively correlated.

Finally, it is observed that the term knowledge, attitude and practice are positively interrelated. With the increase or decrease of any one variable will increase or decrease of the others variables. That means, if the knowledge of a farmer is increased then his attitude towards CSA as well as practice of CSA will be increased significantly. Similarly, if the attitude of the coastal farmer towards CSA can be more favourable, they will use more CSA practices.

4.4 Contribution of the Selected Characteristics of the Farmers to Their Knowledge on CSA

For measuring contribution of the selected characteristics of the coastal farmers to their knowledge on CSA, 14 characteristics were considered which includes age (X_1), education (X_2), farm size (X_3), annual agricultural income (X_4), farming experience (X_5), extension contact (X_6), training exposure (X_7), innovativeness (X_8), credit availability (X_9), access to market (X_{10}), access to ICTs (X_{11}), decision making ability (X_{12}), benefit obtained from CSA (X_{13}), problem faced in CSA (X_{14}). Knowledge on CSA (Y_1) was dependent variable in this case.

Initially, Pearson's Product Moment correlation was run to find out the relationship between the selected characteristics of the coastal farmers and their knowledge on CSA. The results of correlation matrix containing inter-correlation among the variables are shown in Appendix-VII. However, the results of correlation co-efficient of each of the selected characteristics of the respondent farmers with their knowledge on CSA are shown in Table 4.22.

Table 4.22 Correlation co-efficient of each of the selected characteristics of the respondent farmer with their knowledge on CSA

Dependent Variables	Farmers characteristics (Independent Variables)	Co-efficient of Correlation (r)
Knowledge on climate smart agriculture	Age	-0.049 ^{NS}
	Education	0.275**
	Farm size	0.292**
	Annual family income	0.158**
	Farming experience	-0.211**
	Extension contact	0.402**
	Training exposure	0.167*
	Innovativeness	0.232**
	Credit availability	0.016 ^{NS}
	Access to market	0.265**
	Access to ICTs	-0.116*
	Decision making ability	0.498**
	Benefit obtained from CSA	0.472**
	Problem faced in CSA	0.048 ^{NS}

^{NS} Not significant, *Significant at 0.05 Level, **Significant at 0.01 Level

Results of correlation co-efficient contained in Table 4.22 reveal that-

- Out of 14 selected characteristics of the respondent farmers, 9 characteristics had significant positive relationship with their knowledge on CSA. These characteristics were: education, farm size, annual family income, extension contact, training exposure, innovativeness, access to market, decision making ability and benefit obtained from CSA.
- Two characteristics of the farmers namely- farming experience and access to ICTs had significant negative relationship with their knowledge.
- Age, credit availability and problem faced in CSA had no significant relationship with their knowledge.

The independent variables in isolation would not give a comprehensive picture of the contribution of independent variables to the knowledge on CSA (Y_1). The different characteristics of the respondents may interact together to make a combined contribution to the knowledge on CSA. Keeping this fact in view, linear multiple regression analysis was used to assess the contribution of the independent variables to knowledge on CSA.

Prior to the estimation of the model parameters, it is crucial to look into the problem of multicollinearity or association among the potential variables. To this end, the variance inflation factor (VIF) and tolerance analysis were used to test the degree of multicollinearity among the variables. VIF analysis minimizes the variance of the regression coefficients by identifying multi-collinearity within the selected independent variables. The VIF values are all well below 10 and the tolerance statistics all well above 0.2; therefore, it can be concluded that there was no collinearity within the data. The VIF and tolerance analysis values for all explanatory variables are shown in Appendix-VI.

Then full model regression analysis was also run with selected 14 independent variables where dependent variable was knowledge on CSA. Results presented in Table 4.23 show the summarized results of full model multiple regression analysis with 14 independent variables on the farmers' knowledge on CSA. It is observed that out of 14 variables 6 independent variables namely education (X_2), annual agricultural income (X_4), extension contact (X_6), decision making ability (X_{12}), benefit obtained from CSA (X_{13}) and problem faced in practicing CSA (X_{14}) were entered into the regression equation. Other 8 variables were not entered into regression equation.

Table 4.23 Contribution of selected characteristics of the farmers to their knowledge on CSA

				Std.

Variable entered	'b' Value	Value of 't' (with probability level)	Std. Error	coefficient (Beta)
Age (X_1)	0.003	0.123 (0.902)	0.026	0.008
**Education (X_2)	0.177	3.240 (0.001)	0.055	0.161
Farm size (X_3)	0.091	0.294 (0.769)	0.310	0.017
*Annual agricultural income (X_4)	0.244	1.977 (0.049)	0.124	0.117
Farming Experience (X_5)	-0.024	-0.840 (0.401)	0.028	-0.061
*Extension contact (X_6)	0.112	2.685 (0.008)	0.042	0.132
Training exposure (x_7)	0.123	1.126 (0.261)	0.109	0.048
Innovativeness (x_8)	-0.160	-0.891 (0.374)	0.180	-0.040
Credit availability (x_9)	-0.001	-0.073 (0.942)	0.007	-0.003
Access to market (x_{10})	0.120	1.279 (0.202)	0.093	0.055
Access to ICTs (X_{11})	0.092	0.814 (0.416)	0.113	0.037
**Decision making ability(X_{12})	0.817	7.063 (0.000)	0.116	0.374
**Benefit obtained from CSA (X_{13})	0.278	7.325 (0.000)	0.038	0.367
**Problem faced in CSA (X_{14})	-0.108	-3.111 (0.002)	0.035	-0.148
Multiple R = 0.703 R-square = 0.494 Adjusted R-square = 0.473 F-ratio = 23.663 at 0.000 level of significance Standard error of estimate = 2.803 Constant = 0.010				

** significant at 0.001 level, * significant at 0.05 level

Results presented in Table 4.23 indicates that the multiple *R*, R^2 and adjusted R^2 in the full model multiple regression analysis were 0.703, 0.494 and 0.473 respectively, and the corresponding *F*-ratio of 23.663 was significant at 0.000 level. *R* is the values of the multiple correlation coefficient between the predictors and the outcome. Therefore, large values (0.703) of the multiple *R* represent a large correlation between the predicted and observed values of the outcome (knowledge on CSA). The value of R^2 is a measure of how much of the variability in the outcome is accounted for by the predictors. In this model its value is 0.494, which means that all of the 14 variables account for 49.4% of the variation in knowledge on CSA. The adjusted R^2 gives us some idea of how well our model generalizes and ideally we would like its value to be the same, or very close to, the value of R^2 (Field, 2009). In this model the difference for the final model is small (0.494 − 0.473 = 0.021, i.e., 0.21%). This shrinkage means that if the model was derived from the population rather than a sample it would account for approximately 0.21% less variance in the outcome (knowledge on CSA). Again, significance of a variable that is being considered for entrance into the regression equation is measured by the *F*-statistic. Here, *F* is greater (*F*=23.663) and significant at 0.1% level. The regression equation so obtained is presented below-

$\mathbf{Y_1 = b_0 + b_2X_2 + b_4X_4 + b_6X_6 + b_{12}X_{12} + b_{13}X_{13} - b_{14}X_{14} + E}$

Or, $Y_1 = 0.01 + 0.177X_2 + 0.244X_4 + 0.112X_6 + 0.817X_{12} + 0.278X_{13} - 0.108X_{14}$

i.e., Knowledge = 0.01+ 0.177 (education) + 0.244 (annual agricultural income) + 0.112 (extension contact) + 0.817 (decision making ability) + 0.278 (benefit obtained from CSA) – 0.108 (problem faced in CSA)

The remaining variables i.e., age (X_1), farm size (X_3), farming experience (X_5), training exposure (X_7), innovativeness (X_8), credit availability (X_9), access to market (X_{10}) and access to ICTs (X_{11}) were not entered into the regression equation because their contribution is not significant. But since the unstandardized regression coefficients of 6 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 6 variables.

Education (b = 0.177): This value indicates that as level of education increased by one unit, knowledge increased by 0.177 units. Education was measured by years of schooling and knowledge was measured in score obtained from a set of asked questions. Therefore, for every one year of passing in schooling, an extra 0.177 knowledge score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having comparatively higher education tended to be characterized by greater farm size, higher annual agricultural income, low farming experience, high training exposure, high innovativeness, high access to ICTs, high benefit obtained from CSA, high knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, if the level of education can be increased, their knowledge will be increased.

Annual agricultural income (b=0.244): This value indicates that as annual agricultural income increased by one unit, knowledge increased by 0.244 units. Annual agricultural income was measured in scores (1 score = Tk.50000 per year) and knowledge was measured in score obtained from a set of asked questions. Therefore, for increasing annual income of every Tk.50000, an extra 0.244 knowledge score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having comparatively high annual agricultural income tended to be characterized by higher education, greater farm size, low farming experience, high training exposure, high innovativeness, high access to ICTs, low decision-making ability, high benefit obtained from CSA, high level of knowledge, favourable attitude towards CSA and more practice of CSA. Therefore, if the annual agriculture income can be increased, their knowledge will be increased.

Extension contact (b=0.112): This value indicates that as extension contact increased by one unit, knowledge increased by 0.112 units. Both the extension contact and knowledge were measured in scores. Therefore, for increasing every one score of extension contact, an extra 0.112 knowledge score was obtained. The more the number of extension media and frequency of contact is used by the respondents, the more they will obtain knowledge score. This interpretation is true only if the effects of all other independent variables are held constant. Mondal (2014) found that extension contact had 1.3% of the total variation on knowledge of strawberry cultivation.

It is found from correlation matrix (Appendix-VII) that farmers having high extension contact tended to be characterized by older, greater farm size, high innovativeness, higher credit availability, high access to market, less access to ICTs, high decision-making ability, high benefit obtained from CSA, high level of knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, if the type and frequency of extension contact can be increased, their knowledge will be increased.

Decision making ability (b = 0.817): This value indicates that as decision making ability increased by one unit, knowledge increased by 0.817 units. Both the decision-making ability and knowledge were measured in scores. Therefore, for increasing every one score of decision-making ability, an extra 0.817 knowledge score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having higher decision-making ability tended to be characterized by older, greater farm size, low annual agricultural income, high extension contact, high innovativeness, high access to market, less access to ICTs, high benefit obtained from CSA and high level of knowledge on CSA. Therefore, if the decision-making ability can be increased, their knowledge will be increased.

Benefit obtained from CSA (b = 0.278): This value indicates that as benefit obtained from CSA increased by one unit, knowledge increased by 0.278 units. Both the benefit obtained from CSA and knowledge were measured in scores. Therefore, for increasing every one score of benefit obtained from CSA, an extra 0.278 knowledge score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers obtained high benefit from CSA tended to be characterized by higher education, greater farm size, high annual agricultural income, low farming experience, high extension contact, high training exposure, high innovativeness, high credit availability, high access to market, less access to ICTs, higher decision-making ability, high problem faced in CSA, high level knowledge on CSA, more favourable attitude towards CSA and more practice of CSA. Therefore, if the decision-making ability can be increased, their knowledge will be increased.

Problem faced in practicing CSA (b = –0.108): This value indicates that as problem faced in practicing CSA increased by one unit, knowledge decreased by 0.108 units. Both the problem faced in practicing CSA and knowledge were measured in scores. Therefore, for increasing every one score of problem faced in practicing CSA, a score of 0.108 knowledge score was decreased. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers facing higher problems in CSA tended to be characterized by high credit availability, less access to market, less access to ICTs, high benefit obtained from CSA and more favourable attitude towards CSA. Therefore, if the problem faced in CSA can be decreased, their knowledge will be increased.

4.5 Contribution of Each of the Selected Characteristics of the Farmers to Their Attitudes towards CSA

For measuring contribution of the selected characteristics of the coastal farmers to their attitude towards CSA, 14 characteristics were considered which includes age (X_1), education (X_2), farm size (X_3), annual agricultural income (X_4), farming experience (X_5), extension contact (X_6), training exposure (X_7), innovativeness (X_8), credit availability (X_9), access to market (X_{10}), access to ICTs (X_{11}), decision making ability (X_{12}), benefit obtained from CSA (X_{13}) and problem faced in CSA (X_{14}). Attitude towards CSA (Y_2) was dependent variable in this case.

Initially, Pearson's Product Moment correlation was run to find out the relationship between the selected characteristics of the coastal farmers and their attitude towards CSA. The results of correlation matrix containing inter-correlation among the variables are shown in Appendix-VII. However, the results of correlation co-efficient of each of the selected characteristics of the respondent farmers with their attitudes towards CSA are shown in Table 4.24.

Table 4.24 Correlation co-efficients of each of the selected characteristics of the respondent farmer with their attitude towards CSA

Dependent Variables	Farmers characteristics (Independent Variables)	Co-efficient of Correlation (r)
Attitudes towards climate smart agriculture	Age (X_1)	-0.036 ^{NS}
	Education (X_2)	0.259**
	Farm size (X_3)	0.116*
	Annual family income (X_4)	0.205**
	Farming experience (X_5)	-0.104 ^{NS}
	Extension contact (X_6)	0.177**
	Training exposure (X_7)	0.249**
	Innovativeness (X_8)	0.127*
	Credit availability (X_9)	0.133*
	Access to market (X_{10})	0.151**
	Access to ICTs (X_{11})	0.103 ^{NS}
	Decision making ability (X_{12})	0.024 ^{NS}
	Benefit obtained from CSA (X_{13})	0.425**
	Problem faced in CSA (X_{14})	0.150**

^{NS} Not significant, *Significant at 0.05 Level, **Significant at 0.01 Level

Results of correlation co-efficient contained in the Table 4.24 reveal that-

- Out of 14 selected characteristics of the respondent farmers, 10 characteristics had significant positive relationship with their attitude towards CSA. These characteristics were: education, farm size, annual family income, extension contact, training exposure, innovativeness, credit availability, access to market, benefit obtained from CSA and problem faced in practicing CSA.
- Age, farming experience, access to ICTs, and decision-making ability had no significant relationship with their attitude towards CSA.

The independent variables in isolation would not give a comprehensive picture of the contribution of independent variables to the attitudes towards CSA (Y_2). The different characteristics of the respondents may interact together to make a combined contribution to the attitudes towards CSA. Keeping this fact in view, linear multiple regression analysis was used to assess the contribution of the independent variables to attitudes towards CSA.

Prior to the estimation of the model parameters, it is crucial to look into the problem of multicollinearity or association among the potential variables. To this end, the variance inflation factor (VIF) and tolerance analysis were used to test the degree of multicollinearity among the variables. VIF analysis minimizes the variance of the regression coefficients by identifying multi-collinearity within the selected independent variables. The VIF values are all well below 10 and the tolerance statistics all well above 0.2; therefore, it can be concluded that there was no collinearity within the data. The VIF and tolerance analysis values for all explanatory variables are shown in Appendix-VI.

Then full model regression analysis was also run with selected 14 independent variables where dependent variable was attitude towards CSA. Table 4.25 shows the summarized results of full model multiple regression analysis with 14 independent variables on the farmers' attitudes towards CSA. It was observed that out of 14 variables 7 independent variables namely education (X_2), farm size (X_3), annual agricultural income (X_4), extension contact (X_6), training exposure (X_7), access to market (X_{10}), and benefit obtained from CSA (X_{13}) were entered into the regression equation. Other 7 variables were not entered into regression equation.

Table 4.25 Contribution of selected characteristics of the farmers to their attitudes towards CSA

Variable entered	'b' Value	Value of 't' (with probability level)	Std. Error	Std. coefficient (Beta)
Age (X_1)	-0.004	-0.101 (0.919)	0.042	-0.008
**Education (X_2)	0.264	2.975 (0.003)	0.089	0.173
**Farm size (X_3)	-1.445	-2.876 (0.004)	0.503	-0.197
**Annual agricultural income (X_4)	0.573	2.858 (0.005)	0.201	0.198
Farming Experience (X_5)	0.036	0.787 (0.434)	0.046	0.067
*Extension contact (X_6)	0.172	2.538 (0.012)	0.068	0.146
*Training exposure (x_7)	0.401	2.261 (0.024)	0.177	0.114
Innovativeness (x_8)	0.186	0.637 (0.525)	0.292	0.034
Credit availability (x_9)	0.004	0.387 (0.699)	0.011	0.019
*Access to market (x_{10})	0.311	2.051 (0.041)	0.152	0.104
Access to ICTs (X_{11})	0.302	1.652 (0.100)	0.183	0.089
Decision making ability (X_{12})	-0.247	-1.457 (0.146)	0.188	-0.090
**Benefit obtained from CSA (X_{13})	0.430	6.972 (0.000)	0.062	0.408
Problem faced in CSA (X_{14})	-0.043	-0.761 (0.447)	0.056	-0.043
Multiple R = 0.554 R-square = 0.307 Adjusted R-square = 0.278 F-ratio = 10.724 at 0.000 level of significance Standard error of estimate = 4.549 Constant = 24.030				

*Significant at 0.05 Level, **Significant at 0.001 Level

Results presented in Table 4.25 indicates that the multiple *R*, R^2 and adjusted R^2 in the full model multiple regression analysis were 0.564, 0.307 and 0.278 respectively, and the corresponding F-ratio of 10.724 was significant at 0.000 level. *R* is the values of the multiple correlation coefficient between the predictors and the outcome. Therefore, large values (0.554) of the multiple *R* represent a large correlation between the predicted and observed values of the outcome (attitude towards CSA). The value of R^2 is a measure of how much of the variability in the outcome is accounted for by the predictors. In this model its value is 0.307, which means that all of the 14 variables account for 30.7% of the variation in attitude towards CSA. The adjusted R^2 gives us some idea of how well our model generalizes and ideally we would like its value to be the same, or very close to, the value of R^2 (Field, 2009). In this model the difference for the final model is small (0.307 − 0.278 = 0.029, i.e., 0.29%). This shrinkage means that if the model was derived from the population rather than a sample it would account for approximately 0.29% less variance in the outcome (attitude towards CSA). Again, significance of a variable that is being considered for entrance into the regression equation is measured by the *F*-statistic.

Here, F is greater (F=10.724) and significant at 0.1% level. The regression equation so obtained is presented below-

$$\mathbf{Y_2 = b_0 + b_2X_2 - b_3X_3 + b_4X_4 + b_6X_6 + b_7X_7 + b_{10}X_{10} + b_{13}X_{13} + E}$$

Or, $Y_2 = 24.030 + 0.264X_2 - 1.445X_3 + 0.573X_4 + 0.172X_6 + 0.401X_7 + 0.311X_{10} + 0.430X_{13}$

i.e., Attitude = 24.518 + 0.264 (education) - 1.445 (farm size) + 0.573 (annual agricultural income) + 0.172 (extension contact) + 0.401 (training exposure) + 0.311 (access to market) + 0.430 (benefit obtained from CSA)

The remaining variables i.e., age (X_1), farming experience (X_5), innovativeness (X_8), credit availability (X_9), access to ICTs (X_{11}), decision making ability (X_{12}) and problem faced in practicing CSA (X_{14}) were not entered into the regression equation because their contribution to attitude towards CSA was not significant. But since the unstandardized regression coefficients (b) of 7 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 7 variables.

Education (b = 0.264): This value indicates that as education increased by one unit, attitude increased by 0.264 units. Education was measured by years of schooling and attitude was measured in score. Therefore, for every one year of passing in schooling, an extra 0.264 attitude score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having comparatively higher education tended to be characterized by greater farm size, high annual agricultural income, low farming experience, high training exposure, high innovativeness, high access to ICTs, high benefit obtained from CSA, high level knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, if the education can be increased, their attitudes will be increased. Mondal (2014) found that education had 1.9% of the total variation on attitude towards strawberry cultivation.

Farm size (b = -1.445): This value indicates that as farm size increased by one unit, attitude decreased by 1.402 units. Farm size was measured in score obtained by a defined land area and attitude was also measured in score. Therefore, for increase of every one score of farm size, a score of 1.445 attitude was decreased. For a farmer having land area of 0.021 to 0.2 hectare, had attitude score 1.445 more than those who had land area of 0.21 to 1.0 hectare. Similarly, one who had a land area of 1.01 to 3.0 hectare had extra 1.445 attitude score than those who had land area more than 3.0 hectares. The greater the land area (farm size) the smaller the attitude score. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having comparatively greater farm size tended to be characterized by higher education, high annual agricultural income, low farming experience, high extension contact, high training exposure, high innovativeness, high decision-making ability, high benefit obtained from CSA, high knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, if the farm size can be decreased, their attitude towards CSA will be increased. This might be due to that farmers having small farm size was associated with low income for which they could realize that CSA could increase their production and income which ultimately formed favourable attitude towards CSA.

Annual agricultural income (b = 0.573): This value indicates that as annual agricultural income increased by one unit, attitude increased by 0.573 units. Both annual agricultural income and attitude were measured in scores (1 score of annual agricultural income = Tk. 50000 per year). Therefore, for increasing annual income of every Tk. 50000, an extra 0.573 attitude score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having comparatively high annual agricultural income tended to be characterized by higher education, greater farm size, low farming experience, high training exposure, high innovativeness, high access to ICTs, low decision-making ability, high benefit obtained from CSA, high level of knowledge, favourable attitude towards CSA and more practice of CSA. Therefore, if the annual agriculture income can be increased, their attitudes towards CSA will be increased. More agricultural income might inspire them forming favourable attitude towards CSA. Mondal (2014) found that income from strawberry cultivation had 1.4% of the total variation on attitude towards strawberry cultivation.

Extension contact (b = 0.172): This value indicates that as extension contact increased by one unit, attitude increased by 0.172 units. Both the extension contact and attitude were measured in scores. Therefore, for increasing every one score of extension contact, an extra 0.172 attitude score was obtained. If any farmer uses more extension media with higher frequency, he will obtain higher attitude score. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having high extension contact tended to be characterized by older, greater farm size, high innovativeness, credit availability, high access to market, less access to ICTs, high decision-making ability, high benefit obtained from CSA, high level of knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, if the type and frequency of extension contact can be increased, their attitudes towards CSA will be increased.

Training exposure (b = 0.401): This value indicates that as training exposure increased by one unit, attitude increased by 0.401 units. The training exposure was measured in number days and attitude was measured in scores. Therefore, for increasing every one day of training exposure, a score of 0.401 of attitude was increased. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having high training exposure tended to be characterized by higher education, greater farm size, high annual agricultural income, higher credit availability, high access to market, high benefit obtained from CSA, high knowledge on CSA, favourable attitudes toward CSA and more practice of CSA. Therefore, if the training exposure of the farmers can be increased, their attitudes towards CSA will be decreased.

Access to market (b = 0.311): This value indicates that as access to market increased by one unit, attitude increased by 0.311 units. Both access to market and attitude were measured in scores. Therefore, for increasing every one score of access to market of a farmer, an attitude score of 0.311 was increased. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having high access to market tended to be characterized by high extension contact, high training exposure, high credit availability, less access to ICTs, high decision making ability, high benefit obtained from CSA, less problem faced in CSA, high level of knowledge and favourable attitude towards CSA. Therefore, if the access to market can be increased, their attitudes towards CSA will be increased.

Benefit obtained from CSA (b = 0.43): This value indicates that as benefit obtained from CSA increased by one unit, attitude increased by 0.43 units. Both the benefit obtained from CSA and attitude were measured in scores. Therefore, for increasing every one score of benefit obtained from CSA, an extra 0.43 attitude score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers obtained higher benefit from CSA tended to be characterized by higher education, greater farm size, high annual agricultural income, low farming experience, high extension contact, high training exposure, high innovativeness, high credit availability, high access to market, less access to ICTs, high decision-making ability, high problem faced in CSA, high knowledge on CSA, more favourable attitude towards CSA and more practice of CSA. Therefore, if the farmers get more benefit from CSA, their attitudes towards CSA will be increased.

4.6 Contribution of Each of the Selected Characteristics of the Farmers to Their Practice of CSA

For measuring contribution of the selected characteristics of the coastal farmers to their practice of CSA, 14 characteristics were considered which includes age (X_1), education (X_2), farm size (X_3), annual agricultural income (X_4), farming experience (X_5), extension contact (X_6), training exposure (X_7), innovativeness (X_8), credit availability (X_9), access to market (X_{10}), access to ICTs (X_{11}), decision making ability (X_{12}), benefit obtained from CSA (X_{13}) and problem faced in CSA (X_{14}). Practice of CSA (Y_3) was dependent variable in this case.

Initially, Pearson's Product Moment correlation was run to find out the relationship between the selected characteristics of the coastal farmers and their practice of CSA. The results of correlation matrix containing inter-correlation among the variables are shown in Appendix-VII. However, the results of correlation co-efficient of each of the selected characteristics of the respondent farmers with their practice of CSA are shown in the 4.26.

Table 4.26 Correlation co-efficient of each of the selected characteristics of the respondent farmer with their practice of CSA

Dependent Variables	Farmers characteristics (Independent Variables)	Co-efficient of Correlation (r)
Practice of climate smart agriculture	Age (X_1)	-0.134*
	Education (X_2)	0.304**
	Farm size (X_3)	0.228**
	Annual family income (X_4)	0.295**
	Farming experience (X_5)	-0.204**
	Extension contact (X_6)	0.249**
	Training exposure (X_7)	0.266**
	Innovativeness (X_8)	0.129*
	Credit availability (X_9)	0.077 NS
	Access to market (X_{10})	0.058 NS
	Access to ICTs (X_{11})	0.094 NS
	Decision making ability (X_{12})	0.047 NS
	Benefit obtained from CSA (X_{13})	0.317**
	Problem faced in CSA (X_{14})	0.050 NS

NS Not significant, *Significant at 0.05 Level, **Significant at 0.01 Level

Results of correlation co-efficient contained in Table 4.26 reveal that-

- Education, farm size, annual family income, extension contact, training exposure, innovativeness and benefit obtained from CSA had positive significant relationship with their practice of CSA.
- Age and farming experience had significant negative relationship with their practice of CSA.
- Credit availability, access to market, access to ICTs, decision making ability and problem faced in practicing CSA had no significant relationship with their practice of CSA.

The independent variables in isolation would not give a comprehensive picture of the contribution of independent variables to the practice of CSA (Y_3). The different characteristics of the respondents may interact together to make a combined contribution to the practice of CSA. Keeping this fact in view, linear multiple regression analysis was used to assess the contribution of the independent variables to practice on CSA.

Prior to the estimation of the model parameters, it is crucial to look into the problem of multicollinearity or association among the potential variables. To this end, the variance inflation factor (VIF) and tolerance analysis were used to test the degree of multicollinearity among the variables. VIF analysis minimizes the variance of the regression coefficients by identifying multi-collinearity within the selected independent variables. The VIF values are all well below 10 and the tolerance statistics all well above 0.2; therefore, it can be concluded that there was no collinearity within the data. The VIF and tolerance analysis values for all explanatory variables are shown in Appendix-VI.

Then full model regression analysis was also run with selected 14 independent variables where dependent variable was practice of CSA. Table 4.27 shows the summarized results of full model multiple regression analysis with 14 independent variables on the farmers' practice of CSA. It was observed that out of 14 variables 5 independent variables namely education (X_2), annual agricultural income (X_4), extension contact (X_6), training exposure (X_7), and benefit obtained from CSA (X_{13}) were entered into the regression equation. Other 9 variables were not entered into regression equation.

Table 4.27 Contribution of selected characteristics of the farmers to their practice of CSA

Variable entered	'b' value	Value of 't' (with probability level)	Std. Error	Standardized coefficient (Beta)
Age (X_1)	-0.048	-1.168 (0.243)	0.041	-0.091
*Education (X_2)	0.200	2.327 (0.021)	0.086	0.135
Farm size (X_3)	-0.902	-1.848 (0.066)	0.488	-0.127
**Annual agricultural income (X_4)	0.874	4.485 (0.000)	0.195	0.311
Farming Experience (X_5)	-0.008	-0.186 (0.853)	0.045	-0.016
**Extension contact (X_6)	0.331	5.024 (0.000)	0.066	0.290

**Training exposure (x_7)	0.590	3.425 (0.001)	0.172	0.172
Innovativeness (x_8)	- 0.344	-1.211 (0.227)	0.284	-0.064
Credit availability (x_9)	-0.012	-1.084 (0.279)	0.011	-0.054
Access to market (x_{10})	-0.129	-0.876 (0.382)	0.147	-0.044
Access to ICTs (X_{11})	0.041	0.233 (0.816)	0.177	0.013
Decision making ability(X_{12})	-0.130	-0.711 (0.478)	0.182	-0.044
**Benefit obtained from CSA (X_{13})	0.280	4.673 (0.000)	0.060	0.274
Problem faced in CSA (X_{14})	-0.098	-1.798 (0.073)	0.054	-0.101
Multiple R = 0.551 R-square = 0.304 Adjusted R-square = 0.275 F-ratio = 10.575 at 0.000 level of significance Standard error of estimate = 4.418 Constant = 17.216				

*Significant at 0.05 Level, **Significant at 0.001 Level

Results presented in Table 4.27 indicates that the multiple *R*, R^2 and adjusted R^2 in the full model multiple regression analysis were 0.551, 0.304 and 0.275 respectively, and the corresponding *F*-ratio of 10.575 was significant at 0.000 level. *R* is the values of the multiple correlation coefficient between the predictors and the outcome. Therefore, large values (0.551) of the multiple *R* represent a large correlation between the predicted and observed values of the outcome (practice of CSA). The value of R^2 is a measure of how much of the variability in the outcome is accounted for by the predictors. In this model its value is 0.304, which means that all of the 14 variables account for 30.4% of the variation in practice of CSA. The adjusted R^2 gives us some idea of how well our model generalizes and ideally we would like its value to be the same, or very close to, the value of R^2 (Field, 2009). In this model the difference for the final model is small (0.304 − 0.275 = 0.029, i.e., 0.29%). This shrinkage means that if the model was derived from the population rather than a sample it would account for approximately 0.29% less variance in the outcome (practice of CSA). Again, significance of a variable that is being considered for entrance into the regression equation is measured by the *F*-statistic. Here, *F* is greater (*F*=10.575) and significant at 0.1% level. The regression equation so obtained is presented below-

$$\mathbf{Y_3 = b_0 + b_2X_2 + b_4X_4 + b_6X_6 + b_7X_7 + b_{13}X_{13} + E}$$

Or, $Y_3 = 17.216 + 0.200X_2 + 0.874X_4 + 0.331X_6 + 0.590X_7 + 0.280X_{13}$

i.e., Practice = 17.216 + 0.200 (education) + 0.874 (annual agricultural income) + 0.331 (extension contact) + 0.590 (training exposure) + 0.280 (benefit obtained from CSA)

The remaining variables i.e., age (X_1), farm size (X_3), farming experience (X_5), innovativeness (X_8), credit availability (X_9), access to market (X_{10}), access to ICTs (X_{11}), decision making ability (X_{12}) and problem faced in practicing CSA (X_{14}) were not entered into the regression equation. Because their contribution was not significant. But since the unstandardized regression coefficients (Beta weight) of 5 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 5 variables.

Education (b = 0.200): This value indicates that as education increased by one unit, practice increased by 0.200 units. Education was measured by years of schooling and practice was measured in score. Therefore, for every one year of passing in schooling, an extra 0.200 practice score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having comparatively higher education tended to be characterized by young, greater farm size, high annual agricultural income, low farming experience, high training exposure, high innovativeness, high access to ICTs, high benefit obtained from CSA, high knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, if the education can be increased, their practice of CSA will be increased.

Annual agricultural income (b = 0.874): This value indicates that as annual agricultural income increased by one unit, practice increased by 0.874 units. Both annual agricultural income and practice were measured in scores, where 1 score of annual agricultural income equals to Tk. 50000 per year. Therefore, for increasing annual income of every Tk. 50000, an extra 0.874 practice score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having comparatively higher annual agricultural income tended to be characterized by higher education, greater farm size, low farming experience, high training exposure, high innovativeness, high access to ICTs, low decision-making ability, high benefit obtained from CSA, high level of knowledge, favourable attitude towards CSA and more practice of CSA. Therefore, if the annual agriculture income can be increased, their practice of CSA will be increased.

Extension contact (b = 0.331): This value indicates that as extension contact increased by one unit, practice increased by 0.331 units. Both the extension contact and practice were measured in scores. Therefore, for increasing every one score of extension contact, an extra 0.331 practice score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having higher extension contact tended to be characterized by older, great farm size, high innovativeness, high credit availability, high access to market, less access to ICTs, high decision-making ability, high benefit obtained from CSA, high level of knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, the more the number of extension media and frequency of contact is increased by the respondents, the more they will use CSA practices.

Training exposure (b = 0.590): This value indicates that as training exposure increased by one unit, practice increased by 0.590 units. Training exposure was measured in number of days and practice was measured in scores. Therefore, for increasing every one day of training, a score of 0.590 of practice was increased. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that farmers having higher training exposure tended to be characterized by higher education, greater farm size, high annual agricultural income, high credit availability, high access to market, high benefit obtained from CSA, high level of knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, if the training exposure of the farmers can be increased, their practice of CSA will be increased. Ali (2008) found that training exposure explained 1% of total variation in adoption of ecological agriculture.

Benefit obtained from CSA (b = 0.280): This value indicates that as benefit obtained from CSA increased by one unit, practice increased by 0.280 units. Both the benefit obtained from CSA and practice were measured in scores. Therefore, for increasing every one score of benefit obtained from CSA, an extra 0.280 practice score was obtained. This interpretation is true only if the effects of all other independent variables are held constant.

It is found from correlation matrix (Appendix-VII) that the farmers obtained high benefit from CSA tended to be characterized by higher education, greater farm size, high annual agricultural income, low farming experience, high extension contact, high training exposure, high innovativeness, high credit availability, high access to market, less access to ICTs, high decision-making ability, high problem faced in CSA, high knowledge on CSA, favourable attitude towards CSA and more practice of CSA. Therefore, if the farmers get more benefit from CSA, their practice of CSA will be increased.

4.7 Direct and Indirect Effects of the Selected Characteristics of the Farmers

In the present study Pearson Product Moment correlation test and full model linear multiple regression were conducted. It is not possible to find out the direct effects and indirect effects separately by these tests. But, in path analysis, it is possible to get direct effects and indirect effects separately.

Path coefficient is simply a standardized partial regression coefficient and as such measures the direct influence of one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effects (Dewey and Lu, 1959). This allows the reflection of direct effect of an independent variable and its indirect effect through other variables on the dependent variable (Sasmal and Chakrabarty, 1978).

Direct effect of an independent variable on the dependent variable is the standardized beta co-efficient (value of 'b' of regression analysis) of the respective independent variable. Whereas indirect effect of an independent variable through a channeled variable is measured by the following formula-

$e = \Sigma\, b \times r$

Where, e = Total indirect effect of an independent variable

b = Direct effect of the variable through which indirect effect is channeled

r = Correlation co-efficient between respective independent variable and variables through which indirect effect is channeled.

Path coefficient analysis was employed in order to obtain clear understanding of the direct and indirect effects of selected independent variables. Path analysis was done involving the significant variables of full model multiple regression analysis.

4.7.1 Direct and indirect effects of the selected characteristics of the farmers on knowledge of CSA

Path coefficients showing the direct and indirect effects of significant 6 independent variables of full model multiple regression analysis on the farmers' knowledge on CSA have been presented in the Table 4.28. Analysis of data furnished in Table 4.28 indicated that among the independent variables, decision making ability (X_{12}) had the highest direct effect (0.817) in the positive direction followed by benefit obtained from CSA (X_{13}), annual agricultural income (X_4), education (X_2) and extension contact (X_6) in the positive direction on farmers' knowledge and their direct effect were 0.278, 0.244, 0.177 and 0.112 respectively. Again, problem faced in CSA (X_{14}) had direct effect in the negative direction on farmers' Knowledge on CSA and its direct effect was -0.108.

Here, it may be mentioned that without path co-efficient analysis it is not possible to know the indirect effects of an independent variable through other variables on the dependent variable. Therefore, emphasis has been given on the indirect effects which have been obtained from path co-efficient analysis (Table 4.28).

The variable extension contact (X_6) had the highest (0.478) total positive indirect effect followed by benefit obtained from CSA (X_{13}), decision making ability (X_{12}) and education (X_2). Annual agricultural income (X_4) and problem faced in CSA (X_{14}) had negative total indirect effects on knowledge on CSA.

Table 4.28 Direct and indirect effects of significant independent variables of full model multiple regression analysis on the coastal farmers’ knowledge on CSA

Independent variables	Variables through which indirect effects are channeled	Indirect effects	Total indirect effect	Direct effect

Independent variables	Variables through which indirect effects are channeled	Indirect effects	Total indirect effect	Direct effect
Education (X_2)	Annual agricultural income (X_4)	0.073	0.078	0.177
	Extension contact (X_6)	0.006		
	Decision making ability (X_{12})	-0.04		
	Benefit obtained from CSA (X_{13})	0.038		
	Problem faced in CSA (X_{14})	0.001		
Annual agricultural income (X_4)	Education (X_2)	0.053	-0.057	0.244
	Extension contact (X_6)	-0.006		
	Decision making ability (X_{12})	-0.129		
	Benefit obtained from CSA (X_{13})	0.031		
	Problem faced in CSA (X_{14})	-0.006		
Extension contact (X_6)	Education (X_2)	0.009	0.478	0.112
	Annual agricultural income (X_4)	-0.018		
	Decision making ability (X_{12})	0.423		
	Benefit obtained from CSA (X_{13})	0.065		
	Problem faced in CSA (X_{14})	-0.001		
Decision making ability (X_{12})	Education (X_2)	-0.009	0.078	0.817
	Annual agricultural income (X_4)	-0.039		
	Extension contact (X_6)	0.058		
	Benefit obtained from CSA (X_{13})	0.071		
	Problem faced in CSA (X_{14})	-0.003		
Benefit obtained from CSA (X_{13})	Education (X_2)	0.024	0.297	0.278
	Annual agricultural income (X_4)	0.027		
	Extension contact (X_6)	0.026		
	Decision making ability (X_{12})	0.211		
	Problem faced in CSA (X_{14})	-0.055		
Problem faced in CSA (X_{14})	Education (X_2)	-0.001	-0.022	-0.108
	Annual agricultural income (X_4)	0.014		
	Extension contact (X_6)	0.001		
	Decision making ability (X_{12})	0.019		
	Benefit obtained from CSA (X_{13})	-0.055		

On the basis of path analysis, the independent variables having indirect effects on knowledge on CSA of the coastal farmers have been presented and discussed below in descending order.

Extension contact (X_6)

Path analysis shows that extension contact (X_6) had the highest total indirect effect (0.478) and a positive direct effect of 0.112 (Table 4.28) on knowledge on CSA of the coastal farmers. The indirect effect was channeled positively through education (X_2), decision making ability (X_{12}) and benefit obtained from CSA (X_{13}) and a slight negatively through annual agricultural income (X_4) and problem faced in CSA (X_{14}). It may be inferred that other variables remaining constant, extension contact (X_6) was a determinant of the farmers' knowledge on CSA.

Benefit obtained from CSA (X_{13})

Path analysis shows that benefit obtained from CSA (X_{13}) had the 2nd highest total indirect effect (0.297) and a direct effect of 0.278 (Table 4.28) on knowledge on CSA of the coastal farmers. Both the indirect and direct effects are positive in directions. The indirect effect was channeled positively through education (X_2), annual agricultural income (X_4), extension contact (X_6) and decision-making ability (X_{12}) and negatively through problem faced in CSA (X_{14}). It may be inferred that other variables remaining constant, benefit obtained from CSA was a determinant of the coastal farmers' knowledge on CSA.

Education (X_2)

Path analysis shows that education had the 3rd total indirect effect of 0.078 and a direct effect of 0.177 (Table 4.28) on knowledge of CSA. Both the indirect and direct effects were positive in direction. The indirect effect was channeled positively through annual agricultural income (X_4), extension contact (X_6), benefit obtained from CSA (X_{13}) and problem faced in CSA (X_{14}) and negatively through decision-making ability (X_{12}). It may be inferred that other variables remaining constant, education was a determinant of the coastal farmers' knowledge on CSA.

Decision making ability (X_{12})

Path analysis shows that decision making ability had also the 3rd total positive indirect effect (0.078) and a direct effect of 0.817 (Table 4.28) on knowledge of CSA. The indirect effect was channeled positively through extension contact (X_6) and benefit obtained from CSA (X_{13}) and negatively through education (X_2), annual agricultural income (X_4) and problem faced in CSA (X_{14}). It may be inferred that other variables remaining constant, decision-making ability (X_{12}) was a determinant of the coastal farmers' knowledge on CSA.

Annual agricultural income (X_4)

Path analysis shows that annual agricultural income had the 4^{th} total negative indirect effect (-0.057) and a direct positive effect of 0.244 (Table 4.28) on knowledge of CSA. The indirect effect was channeled positively through education (X_2) and benefit obtained from CSA (X_{13}) and negatively through extension contact (X_6), decision making ability (X_{12}) and problem faced in CSA (X_{14}). It may be inferred that other variables remaining constant, annual agricultural income was a determinant of the coastal farmers' knowledge on CSA.

Problem faced in CSA (X_{14})

Path analysis shows that problem faced in CSA (X_{14}) had the 5^{th} total negative indirect effect (-0.022) and a negative direct effect of -0.108 (Table 4.28) on knowledge of CSA. The indirect effect was channeled positively through annual agricultural income (X_4), extension contact (X_6) and decision-making ability (X_{12}) and negatively through education (X_2) and benefit obtained from CSA (X_{13}). It may be inferred that other variables remaining constant, problem faced in CSA was a determinant of the coastal farmers' knowledge on CSA.

4.7.2 Direct and indirect effects of the selected characteristics of the farmers on attitude towards CSA

Path coefficients showing the direct and indirect effects of significant 7 independent variables of full model multiple regression analysis on the farmers' attitude towards CSA have been presented in the Table 4.29. Analysis of data furnished in Table 4.29 indicated that among the independent variables, annual agricultural income (X_4) had the highest direct effect (0.573) in the positive direction followed by benefit obtained from CSA (X_{13}), training exposure (X_7), access to market (X_{10}), education (X_2) and extension contact (X_6)) in the positive direction on farmers' attitude towards CSA and their direct effect were 0.430, 0.401, 0.311, 0.264 and 0.172 respectively. On the other hand, farm size (X_3) had direct effect in the negative direction on farmers' attitude towards CSA and its direct effect was -1.445.

Here, it may be mentioned that without path co-efficient analysis it is not possible to know the indirect effects of an independent variable through other variables on the dependent variable. Therefore, emphasis has been given on the indirect effects which have been obtained from path co-efficient analysis (Table 4.29).

The farm size (X_3) of the coastal farmers had the highest (0.670) total positive indirect effect followed by access to market (X_{10}), training exposure (X_7), and extension contact (X_6). On the other hand, annual agricultural income (X_4), education (X_2) and benefit obtained from CSA (X_{13}) had total indirect effects on attitude towards CSA in negative direction.

Table 4.29 Direct and indirect effects of significant independent variables of full model multiple regression analysis on the coastal farmers' attitude towards CSA

Independent Variables	Variables through which indirect effects are channeled	Indirect Effects	Total indirect effect	Direct effect
Education (X_2)	Farm size (X_3)	-0.416	-0.107	0.264
	Annual agricultural income (X_4)	0.172		
	Extension contact (X_6)	0.009		
	Training exposure (X_7)	0.072		
	Access to market (X_{10})	-0.002		
	Benefit obtained from CSA (X_{13})	0.058		
Farm size (X_3)	Education (X_2)	0.076	0.670	-1.445
	Annual agricultural income (X_4)	0.393		
	Extension contact (X_6)	0.031		
	Training exposure (X_7)	0.067		
	Access to market (X_{10})	0.019		
	Benefit obtained from CSA (X_{13})	0.084		
Annual agricultural income (X_4)	Education (X_2)	0.014	-0.859	0.573
	Farm size (X_3)	-0.989		
	Extension contact (X_6)	-0.012		
	Training exposure (X_7)	0.074		
	Access to market (X_{10})	0.006		
	Benefit obtained from CSA (X_{13})	0.048		
Extension contact (X_6)	Education (X_2)	0.014	0.017	0.172
	Farm size (X_3)	-0.264		
	Annual agricultural income (X_4)	0.105		
	Training exposure (X_7)	0.016		
	Access to market (X_{10})	0.045		
	Benefit obtained from CSA (X_{13})	0.101		
Training exposure (X_7)	Education (X_2)	0.047	0.034	0.401
	Farm size (X_3)	-0.239		
	Annual agricultural income (X_4)	0.106		
	Extension contact (X_6)	0.007		
	Access to market (X_{10})	0.042		
	Benefit obtained from CSA (X_{13})	0.071		
	Education (X_2)	-0.002		

Independent Variables	Variables through which indirect effects are channeled	Indirect Effects	Total indirect effect	Direct effect
Access to market (X_{10})	Farm size (X_{3})	-0.087	0.073	0.311
	Annual agricultural income (X_4)	0.011		
	Extension contact (X_6)	0.025		
	Training exposure (X_7)	0.054		
	Benefit obtained from CSA (X_{13})	0.072		
Benefit obtained from CSA (X_{13})	Education (X_2)	0.036	-0.023	0.430
	Farm size (X_{3})	-0.282		
	Annual agricultural income (X_4)	0.064		
	Extension contact (X_6)	0.040		
	Training exposure (X_7)	0.067		
	Access to market (X_{10})	0.052		

The independent variables having indirect effects on coastal farmers' attitudes towards CSA have been presented and discussed below in descending order.

Annual agricultural income (X_4)

Path analysis shows that annual agricultural income had the highest total negative indirect effect of -0.859 and a direct positive effect of 0.573 (Table 4.29) on coastal farmers' attitude towards CSA. The indirect effect was channeled positively through education (X_2), training exposure (X_7), access to market (X_{10}) and benefit obtained from CSA (X_{13}) and negatively through farm size (X_3) and extension contact (X_6). It may be inferred that other variables remaining constant, annual agricultural income was a determinant of the coastal farmers' attitudes towards CSA.

Farm size (X_3)

Path analysis shows that farm size (X_3) had the 2nd highest total indirect effect of 0.670 and a negative direct effect of -1.445 (Table 4.29) on attitudes towards CSA. The indirect effect was channeled positively through education (X_2), annual agricultural income (X_4), extension contact (X_6), training exposure (X_7), access to market (X_{10}) and benefit obtained from CSA (X_{13}). It may be inferred that other variables remaining constant, farm size was a determinant of the coastal farmers' attitudes towards CSA.

Education (X_2)

Path analysis shows that education (X_2) had the 3rd highest total indirect effect of -0.107 and a positive direct effect of 0.264 (Table 4.29) on attitudes towards CSA. The indirect effect was channeled positively through annual agricultural income (X_4), extension contact (X_6), training exposure (X_7) and benefit obtained from CSA (X_{13}) and negatively through farm size (X_3) and access to market (X_{10}). It may be inferred that other variables remaining constant, education was a determinant of the coastal farmers' attitudes towards CSA.

Access to market (X_{10})

Path analysis shows that access to market (X_{10}) had the 4th highest total indirect effect of 0.073 and direct effect of 0.311 (Table 4.29) on attitudes towards CSA. The indirect effect was channeled positively through annual agricultural income (X_4), extension contact (X_6), training exposure (X_7) and benefit obtained from CSA (X_{13}) as well as negatively through education (X_2) farm size (X_3). It may be inferred that other variables remaining constant, access to market was a determinant of the coastal farmers' attitudes towards CSA.

Training exposure (X_7)

Path analysis shows that training exposure (X_7) had the 5th total indirect effect of 0.034 and a direct effect of 0.401 (Table 4.29) on attitudes towards CSA. The indirect effect was channeled positively through education (X_2), annual agricultural income (X_4), extension contact (X_6), access to market (X_{10}) and benefit obtained from CSA (X_{13}) as well as negatively through farm size (X_3). It may be inferred that other variables remaining constant, training exposure was a determinant of the coastal farmers' attitudes towards CSA.

Benefit obtained from CSA (X_{13})

Path analysis shows that benefit obtained from CSA (X_{13}) had the 6th highest total indirect effect of -0.023 and a positive direct effect of 0.430 (Table 4.29) on attitudes towards CSA. The indirect effect was channeled positively through education (X_2), annual agricultural income (X_4), extension contact (X_6), training exposure (X_7) and access to market (X_{10}) as well as negatively through and farm size (X_3). It may be inferred that other variables remaining constant, benefit obtained from CSA was a determinant of the coastal farmers' attitudes towards CSA.

Extension contact (X_6)

Path analysis shows that extension contact (X_6) had the lowest total indirect effect of 0.017 and a direct effect of 0.172 (Table 4.29) on attitudes towards CSA. The indirect effect was channeled positively through education (X_2), annual agricultural income (X_4), training exposure (X_7), access to market (x_{10}) and benefit obtained from CSA (X_{13}) as well as negatively through farm size (X_3). It may be inferred that other variables remaining constant, extension contact was a determinant of the coastal farmers' attitudes towards CSA.

4.7.3 Direct and indirect effects of the selected characteristics of the farmers on the practice of CSA

Path coefficients showing the direct and indirect effects of significant 5 independent variables of full model multiple regression analysis on the farmers' practice of CSA have been presented in Table 4.30. Analysis of data furnished in Table 4.30 indicated that among the independent variables, annual agricultural income (X_4) had the highest direct effect of 0.874 in the positive direction followed by training exposure (X_7), extension contact (X_6), benefit obtained from CSA (X_{13}) and education (X_2) on farmers' practice of CSA and their direct effect were 0.590, 0.331, 0.280 and 0.200 respectively.

Here, it may be mentioned that without path co-efficient analysis it is not possible to know the indirect effects of an independent variable through other variables on the dependent variable. Therefore, emphasis has been given on the indirect effects which have been obtained from path co-efficient analysis (Table 4.30).

The education (X_2) of the coastal farmers had the highest (0.416) total positive indirect effect followed by training exposure (X_7), benefit obtained from CSA (X_{13}), annual agricultural income (X_4) and extension contact (X_6).

Table 4.30 Direct and indirect effects of significant independent variables of full model multiple regression analysis on the coastal farmers' practice of CSA

Independent variables	Variables through which indirect effects are channeled	Indirect effects	Total indirect effect	Direct effect
Education (X_2)	Annual agricultural income (X_4)	0.255	0.416	0.200
	Extension contact (X_6)	0.017		
	Training exposure (X_7)	0.106		
	Benefit obtained from CSA (X_{13})	0.038		
	Education (X_2)	0.060		

Independent variables	Variables through which indirect effects are channeled	Indirect effects	Total indirect effect	Direct effect
Annual agricultural income (X_4)	Extension contact (X_6)	-0.023	0.177	0.874
	Training exposure (X_7)	0.109		
	Benefit obtained from CSA (X_{13})	0.031		
Extension contact (X_6)	Education (X_2)	0.010	0.039	0.331
	Annual agricultural income (X_4)	-0.061		
	Training exposure (X_7)	0.024		
	Benefit obtained from CSA (X_{13})	0.066		
Training exposure (X_7)	Education (X_2)	0.036	0.253	0.590
	Annual agricultural income (X_4)	0.157		
	Extension contact (X_6)	0.014		
	Benefit obtained from CSA (X_{13})	0.046		
Benefit obtained from CSA (X_{13})	Education (X_2)	0.027	0.244	0.280
	Annual agricultural income (X_4)	0.094		
	Extension contact (X_6)	0.077		
	Training exposure (X_7)	0.046		

On the basis of path analysis, the independent variables having indirect effects on practice of CSA of the coastal farmers have been presented and discussed below in descending order.

Education (X_2)

Path analysis shows that education (X_2) of the farmers had the highest total positive indirect effect of 0.416 and a direct positive effect of 0.200 (Table 4.30) on the practice of CSA. The indirect effect was channeled positively through annual agricultural income (X_4), extension contact (X_6), training exposure (X_7) and benefit obtained from CSA (X_{13}). It may be inferred that other variables remaining constant, education was a determinant of the coastal farmers' practice of CSA.

Training exposure (X_7)

Path analysis shows that training exposure (X_7) had the 2nd highest total positive indirect effect of 0.253 and a direct effect of 0.590 (Table 4.30) on the practice of CSA. The indirect effect was channeled positively through education (X_2), annual agricultural income (X_4), extension contact (X_6) and benefit obtained from CSA (X_{13}). It may be inferred that other variables remaining constant, training exposure was a determinant of the coastal farmers' practice of CSA.

Benefit obtained from CSA (X_{13})

Path analysis shows that benefit obtained from CSA (X_{13}) had the 3rd highest total positive indirect effect of 0.244 and a direct positive effect of 0.280 (Table 4.30) on the practice of CSA. The indirect effect was channeled positively through education (X_2), annual agricultural income (X_4), extension contact (X_6) and training exposure (X_7). It may be inferred that other variables remaining constant, benefit obtained from CSA was a determinant of the coastal farmers' practice of CSA.

Annual agricultural income (X_4)

Path analysis shows that annual agricultural income (X_4) had the 4th highest total positive indirect effect of 0.177 and a direct positive effect of 0.874 (Table 4.30) on the practice of CSA. The indirect effect was channeled positively through education (X_2), training exposure (X_7) and benefit obtained from CSA (X_{13}) and negatively through extension contact (X_6). It may be inferred that other variables remaining constant, annual agricultural income was a determinant of the coastal farmers' practice of CSA.

Extension contact (X_6)

Path analysis shows that extension contact (X_6) had the lowest total positive indirect effect of 0.039 and a direct positive effect of 0.331 (Table 4.30) on the practice of CSA. The indirect effect was channeled positively through education (X_2), training exposure (X_7) and benefit obtained from CSA (X_{13}) and negatively through annual agricultural income (X_4). It may be inferred that other variables remaining constant, extension contact was a determinant of the coastal farmers' practice of CSA.

4.8 Identification and Comparison of the Problems Faced by the Farmers in Practicing CSA

In order to compare the problems faced by the farmers in practicing CSA, a Problem Faced Index (PFI) was developed by summing up the weights following the formula as described in the Chapter 3.

The respondents were asked to put their opinion about the extent of problem they have been facing in practicing CSA technologies. It was observed that the respondents faced various problems having different magnitudes. An attempt was made in this section to identify the major problems faced by the respondents with their magnitude. Each problem faced by the respondents was rated against a 4-point rating scale: Severe problem (score =3), moderate problem (score =2), less problem (score =1) and no problem (score =0).

PFI (Problem Faced Index) of a problem indicated the extent of seriousness of a problem faced by the respondents. The higher the value of PFI of a problem, the greater was the magnitude of the problem. On the basis of PFI obtained, rank order was prepared and shown in Table 4.31**.**

PFI was computed for each problem by using the following formula-

$$PFI = P_s \times 3 + P_m \times 2 + P_l \times 1 + P_n \times 0$$

Where,

PFI = Problem Faced Index

P_s = Number of respondents faced severe problem

P_m = Number of respondents faced moderate problem

P_l = Number of respondents faced less problem

P_n = Number of respondents faced no problem

PFI for each problem could range from 0 to 1062 (354×3), where 0 indicating lowest extent of problem and 1062 indicating highest extent of Problem. Table 4.31 represents the severity of the problems.

Table 4.31 Comparison of the problems according to the PFI

Problems	*Sp	Mp	Lp	Np	PFI	Rank
Higher cost of inputs (seed, vermicompost, etc.)	255	55	37	7	912	1
Lower price of produced crops	210	119	25	0	893	2
Poor and inadequate roads for transportation	220	89	45	0	883	3
Low production	211	98	45	0	874	4
Need excess labour	210	98	46	0	872	5
Difficult to move to a distance place	205	105	38	6	863	6

Lack of proper transport	201	108	43	2	862	7
Lack of storage facilities	175	140	35	4	840	8
Difficult to maintain crop rotation	172	139	37	6	831	9
Poor adoption of CSA by maximum farmers	129	192	33	0	804	10
Lack of appropriate crop/variety (salt, flood and drought tolerant)	180	61	101	12	763	11
Lack of information and publicity	125	146	81	2	748	12
Technologies (USG, AWD, etc.) are unavailable	143	123	68	20	743	13
Difficult to prepare and maintain technologies	85	217	43	9	732	14
Lack of proper organization	84	185	84	1	706	15
Poor extension service	119	120	98	17	695	16
Difficult to collect equipment/components to prepare any technology	93	163	88	10	693	17
Uncertainty of pest control in case of severe attack	73	204	61	16	688	18
Undesirable involvement of middle men	119	103	70	62	633	19
Criticism from family members	41	95	136	82	449	20
Criticism from relatives and neighbouring farmers	35	97	147	75	446	21
Criticism from fertilizer and pesticide dealers	43	36	167	108	368	22

*Sp= Severe problem (3), Mp= Moderate problem (2), Lp= Less problem (1), Np= No problem (0)

It is observed from Table 4.31 that the topmost problems coastal farmers were facing was an economic problem; 'Higher cost of inputs' ranked 1st and 'Lower price of produced crops' ranked 2nd. It is miserable that farmers are getting less income despite investing more money from farming. On the other hand, at the bottom of the ranking laid 'criticism from dealers, neighbour and family members. It indicated that psychological problems were minimum to the coastal farmers.

An attempt was also made to identify which type of problems were major to the respondents. For doing this all the problems were previously categorized into 6 types. As the number of problems were not same in each category, an average score was calculated for each type of problem and then ranking was done based on the scores. Ranking based on the types problem is shown in Table 4.32.

Table 4.32 Comparison of the types of problems according to the PFI

Types of problem	Total Score	No. of problems	Average score	Rank
Economic problem	3551	4	887.75	1
Marketing problem	4081	5	816.2	2
Technical problem	4450	6	741.67	3

Social problem	2953	4	738.25	4
Psychological problem	1263	3	421	5

It is observed from the Table 4.32 and the pie chart below that economic problem ranked first followed by marketing problem, technical problem, social problem and psychological problem.

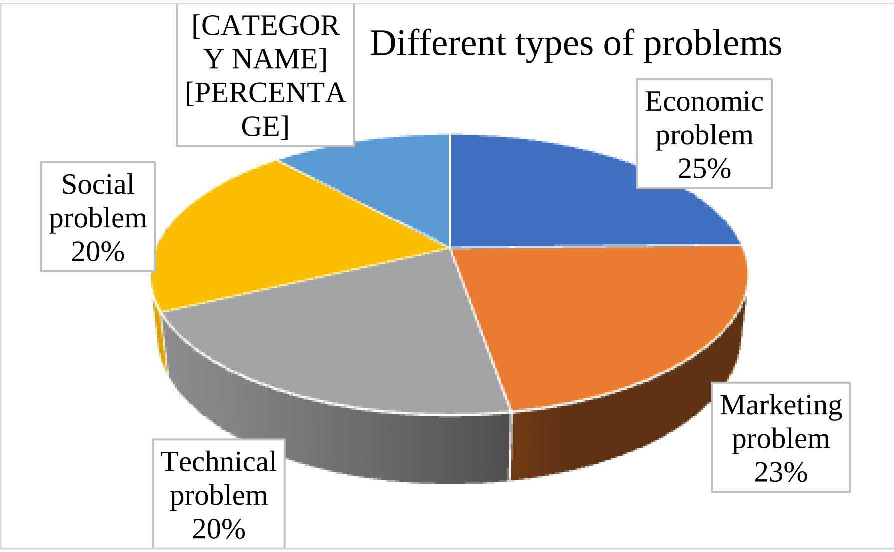


Figure 4.3 Type and degree of problems faced by the coastal farmers in practicing CSA

The economic problems were-

i) higher cost of inputs (seed, fertilizer, etc.)

ii) low production

iii) need excess labour and

iv) low price of produced crops

It is remarkable that their input cost was high and production was less due to adverse climatic factors against their low earning due to low price of the products. Easily perishable properties of agricultural products, no or less availability of preservation facilities and low access of market in selling goods might create this economic problem.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Major Findings

The major findings of the study are summarized below-

5.1.1 Extent of knowledge, attitude and practice regarding climate smart agriculture

Knowledge on CSA: A great majority of (75.14%) of the farmers had medium-level knowledge, and the remaining two categories of the farmers (14.13% poor knowledge and 10.73% high level knowledge) collectively became one-third (24.86%) of the majority group based on knowledge on CSA.

Attitude towards CSA: The highest proportion (61.01%) of the farmer had medium favourable attitude towards CSA as compared to 18.65% and 20.34% having low and high favourable attitude towards CSA respectively.

Practice of CSA: About 57.91% of the coastal farmers had medium practice followed by 22.88% high and 19.21% low practice of CSA. Among the 19 identified CSA practices "using of thread pipe/plastic pipe for irrigation" ranked first and indicated highest extent of use by the coastal farmers. The 2nd, 3rd and 4th position in the rank order were "cultivation of salinity resistant and high yielding crop varieties," "mulching" and "ridge planting (Bank of pond/gher/in ails)" respectively.

5.1.2 Selected characteristics of the coastal farmers

Age: The majority (74.14%) of the farmers were middle-aged compared to 13.71% being young and 12.15% old. There was a negative relationship between age and practice of the farmers on CSA (r = -0.134, significant at 0.05 level).

Education: A large proportion (59.32%) of the respondents had secondary education compared to 12.71% illiterate, 20.06% had primary education, 5.37% had higher secondary education and 2.54% had tertiary education. The education had a positive relationship with knowledge (r = 0.275, significant at 0.01 level), attitude (r = 0.259, significant at 0.01 level) and practice (r = 0.304, significant at 0.01 level) regarding CSA.

Farm size: The small farm holder constituted the highest proportion (60.5%) followed by medium farm holder (22.6%). Besides, the marginal farm holder and large farm holder constituted 10.2% and 6.8% respectively. There was no landless farmer among the respondents. However, farm size had a positive relationship with knowledge (r = 0.292, significant at 0.01 level), attitude (r = 0.116, significant at 0.05 level) and practice (r = 0.228, significant at 0.01 level) regarding CSA.

Annual agricultural income: The respondents having low annual agricultural income constituted the highest proportion (50.56%); their annual agricultural income is up to Tk.150000, while the lowest proportion belongs to high income group (8.76%) and medium income category constituted the second majority having 40.68% of the respondents. Annual agricultural income had a positive relationship with knowledge (r = 0.158, significant at 0.01 level), attitude (r = 0.205, significant at 0.01 level) and practice (r = 0.295, significant at 0.01 level) regarding CSA.

Farming experience: The majority proportion (69.77%) of the farmers had medium experience compared to 18.36% of them had low experience and 11.87% of them high experience. Farming experience had a negative relationship with knowledge (r = -0.211, significant at 0.01 level) and practice (r = -0.204, significant at 0.01 level) regarding CSA.

Extension contact: Majority proportion (68.64%) of the farmers had medium extension contact compared to 17.51% of them had low extension contact and 13.85% of them had high extension contact. Extension contact had a positive relationship with knowledge (r = 0.402, significant at 0.01 level), attitude (r = 0.177, significant at 0.01 level) and practice (r = 0.249, significant at 0.01 level) regarding CSA.

Training exposure: About 73.45% of the coastal farmers did not receive any training while 20.06% received low training, 3.95% received medium training and 2.54% received high training. However, training exposure had a positive relationship with knowledge (r = 0.167, significant at 0.01 level), attitude (r = 0.249, significant at 0.01 level) and practice (r = 0.266, significant at 0.01 level) regarding CSA.

Innovativeness: The early majority group of the farmers are belonging to the highest percentage (39.54%) followed by early adopter (34.46%), late majority (12.71%), innovator (11.03%) and laggard (2.26%). However, innovativeness had a positive relationship with knowledge (r = 0.232, significant at 0.01 level), attitude (r = 0.127, significant at 0.05 level) and practice (r = 0.129, significant at 0.05 level) of the farmers regarding CSA.

Credit availability: A majority proportion (81.36%) of the coastal farmers had no need of credit compared to 12.15% of them had medium credit availability, 5.08% had low credit availability and 1.41% of them had high credit availability. However, credit availability had a positive relationship with their attitude (r = 0.133, significant at 0.05 level) towards CSA.

Access to market: A great majority (75.14%) of the coastal farmers had medium market access followed by high market access (16.67%) and low market access (8.19%). However, access to market had a positive relationship with knowledge (r = 0.265, significant at 0.01 level) and attitude (r = 0.151, significant at 0.01 level) of the farmers regarding CSA.

Access to ICTs: About 77.4% of the respondents had medium ICTs access, 13.28% had low ICTs access and the lowest 9.32% had high ICTs access. However, access to ICTs had a negative relationship with knowledge (r = -0.116, significant at 0.05 level) of the farmers on CSA.

Decision making ability: The majority (69.49%) of the respondents had medium decision-making ability, while 19.49% and 11.02% had high and low decision-making ability respectively. However, there was a strong positive relationship between decision making ability and knowledge on CSA (r = 0.498, significant at 0.01 level).

Benefit obtained from CSA: The highest proportion (75.42%) of the farmers belonged to medium benefits obtained from CSA, while 9.32% and 15.26% had low and high benefits obtained from CSA group respectively. However, benefit obtained from CSA of the respondent farmers was positively related with their knowledge (r = 0.472, significant at 0.01 level), attitude (r = 0.425, significant at 0.05 level) and practice (r = 0.317, significant at 0.01 level) regarding CSA.

Problem faced in practicing CSA: A great majority (77.12%) of the farmers belonged to medium problem faced in practicing CSA followed by low problem faced (14.97%) and high problem faced (7.91%). However, problem faced in practicing CSA of the respondent farmers was positively related with their attitude (r =0.150, significant at 0.01 level) towards CSA.

The topmost problems coastal farmers were facing was an economic problem; 'higher cost of inputs' ranked 1st and 'lower price of produced crops' ranked 2nd. On the other hand, psychological problems were minimum to the coastal farmers.

5.1.3 The inter-correlation among farmers' knowledge, attitude and practice regarding CSA

- There is a strong positive significant relationship between knowledge and attitude of the coastal farmer regarding CSA.
- There is a strong positive significant relationship between knowledge and practice of the coastal farmer regarding CSA.
- There is a strong positive significant relationship between attitude and practice of the coastal farmer regarding CSA.
- Therefore, each of the three focus variables are significantly and positively interrelated.

5.1.4 Contribution of the selected characteristics of the coastal farmers to their knowledge, attitude and practice regarding CSA

5.1.4.1 Contribution of the selected characteristics of the coastal farmers to their knowledge on CSA

It was observed that out of 14 independent variables 6 variables namely education (X_2), annual agricultural income (X_4), extension contact (X_6), decision making ability (X_{12}), benefit obtained from CSA (X_{13}) and problem faced in practicing CSA (X_{14}) were entered into the regression equation. This indicated that the whole model of 14 variables explained 49.4 percent of the total variation in knowledge on CSA of the respondents.

Education (b = 0.177): It was found that for every one year of passing in schooling, an extra 0.177 knowledge score was obtained.

Annual agricultural income (b = 0.244): For increasing annual income of every Tk.50000, an extra 0.244 knowledge score was obtained.

Extension contact (b = 0.112): For increasing every one score of extension contact, an extra 0.112 knowledge score was obtained.

Decision making ability (b = 0.817): For increasing every one score of decision-making ability, an extra 0.817 knowledge score was obtained.

Benefit obtained from CSA (b = 0.278): Therefore, for increasing every one score of benefit obtained from CSA, an extra 0.278 knowledge score was obtained.

Problem faced in practicing CSA (b = –0.108): Therefore, for increasing every one score of problem faced in practicing CSA, a score of 0.108 knowledge score was decreased.

5.1.4.2 Contribution of the selected characteristics of the coastal farmers to their attitude towards CSA

It was observed that out of 14 independent variables 7 variables namely education (X_2), farm size (X_3), annual agricultural income (X_4), extension contact (X_6), innovativeness (X_8), credit availability (X_9), and benefit obtained from CSA (X_{13}) were entered into the regression equation. Other 7 variables were not entered into regression equation. The whole model of 14 variables explained 30.7 percent of the total variation in attitude of the respondents towards CSA.

Education (b = 0.264): For every one year of passing in schooling, an extra 0.264 attitude score was obtained.

Farm size (b = -1.445): For every one score of farm size, a score of 1.445 attitude was decreased. A farmer having land area of 0.021 to 0.2 hectare, had attitude score 1.402 more than those who had land area of 0.21 to 1.0 hectare. Similarly, one who had a land area of 1.01 to 3.0 hectare had extra 1.445 attitude score than those who had land area more than 3.0 hectares.

Annual agricultural income (b = 0.573): For increasing annual income of every Tk. 50000, an extra 0.573 attitude score was obtained.

Extension contact (b = 0.172): For increasing every one score of extension contact, an extra 0.172 attitude score was obtained.

Training exposure (b = 0.401): For increasing every one day of training exposure, a score of 0.401 of attitude was increased.

Access to market (b = 0.311): For increasing every one score of access to market for a farmer, an attitude score of 0.311 was increased.

Benefit obtained from CSA (b = 0.430): For increasing every one score of benefit obtained from CSA, an extra 0.430 attitude score was obtained.

5.1.4.3 Contribution of the selected characteristics of the coastal farmers to their practice of CSA

It was observed that out of 14 variables 5 independent variables namely education (X_2), annual agricultural income (X_4), extension contact (X_6), training exposure (X_7), and benefit obtained from CSA (X_{13}) were entered into the regression equation. The whole model of 14 variables explained 30.4 percent of the total variation in the practice of CSA.

Education (b = 0.200): For every one year of passing in schooling, an extra 0.200 practice score was obtained.

Annual agricultural income (b = 0.874): For increasing annual income of every Tk.50000, an extra 0.874 practice score was obtained.

Extension contact (b = 0.331): For increasing every one score of extension contact, an extra 0.331 practice score was obtained. The more the number of extension media and frequency of contact is increase by the respondents, the more they will use CSA practices.

Training exposure (b = 0.590): For increasing every one day of training, a score of 0.590 of practice was increased.

Benefit obtained from CSA (b = 0.280): For increasing every one score of benefit obtained from CSA, an extra 0.280 practice score was obtained.

5.1.5 Direct and indirect effects of the selected characteristics of the farmers on knowledge, attitude and practice regarding CSA

5.1.5.1 Direct and indirect effects of the selected characteristics of the farmers on knowledge of CSA

Path coefficients indicated that among the independent variables, decision making ability (X_{12}) had the highest direct effect of 0.817 in the positive direction followed by benefit obtained from CSA (X_{13}), annual agricultural income (X_4), education (X_2) and extension contact (X_6) in the positive direction on farmers' knowledge and their direct effect were 0.278, 0.244, 0.177 and 0.112 respectively. Again, problem faced in CSA (X_{14}) had direct effect in the negative direction on farmers' Knowledge on CSA and its direct effect was -0.108.

The variable extension contact (X_6) had the highest (0.478) total positive indirect effect followed by benefit obtained from CSA (X_{13}), decision making ability (X_{12}) and education (X_2). Annual agricultural income (X_4) and problem faced in CSA (X_{14}) had negative total indirect effects on knowledge on CSA.

5.1.5.2 Direct and indirect effects of the selected characteristics of the farmers on attitude towards CSA

Path coefficients indicated that among the independent variables, annual agricultural income (X_4) had the highest direct effect (0.573) in the positive direction followed by benefit obtained from CSA (X_{13}), training exposure (X_7), access to market (X_{10}), education (X_2) and extension contact (X_6)) in the positive direction on farmers' attitude towards CSA and their direct effect were 0.430, 0.401, 0.311, 0.264 and 0.172 respectively. On the other hand, farm size (X_3) had direct effect in the negative direction on farmers' attitude towards CSA and its direct effect was -1.445.

The farm size (X_3) of the coastal farmers had the highest (0.670) total positive indirect effect followed by access to market (X_{10}), training exposure (X_7), and extension contact (X_6). On the other hand, annual agricultural income (X_4), education (X_2) and benefit obtained from CSA (X_{13}) had total indirect effects on attitude towards CSA in negative direction.

5.1.5.3 Direct and indirect effects of the selected characteristics of the farmers on the practice of CSA

Path coefficients indicated that among the independent variables, annual agricultural income (X_4) had the highest direct effect of 0.874 in the positive direction followed by training exposure (X_7), extension contact (X_6), benefit obtained from CSA (X_{13}) and education (X_2) on farmers' practice of CSA and their direct effect were 0.590, 0.331, 0.280 and 0.200 respectively.

The education (X_2) of the coastal farmers had the highest (0.416) total positive indirect effect followed by training exposure (X_7), benefit obtained from CSA (X_{13}), annual agricultural income (X_4) and extension contact (X_6).

5.2 Identification and Comparison of the Problems Faced by the Farmers in Practicing CSA

The topmost problems coastal farmers were facing was identified as an economic problem; ‘Higher cost of inputs’ ranked 1st and ‘Lower price of produced crops’ ranked 2nd. It is miserable that farmers were getting less income from farming despite investing more money. On the other hand, at the bottom of the ranking laid ‘criticism from dealers, neighbour and family members. It indicated that psychological problems were minimum to the coastal farmers.

5.3 Conclusion

A great majority of (75.14%) of the farmers had medium-level knowledge; farmers having high level knowledge (10.73%) became slight smaller than that of poor knowledge (14.13%) on CSA. Their knowledge on CSA can be increased by increasing education, agricultural income, extension contact, decision making ability and benefit obtained from CSA along with decreasing problem faced in CSA. On the other hand, by forming more favourable attitude towards CSA may increase their knowledge on CSA.

The highest proportion (61.01%) of the farmer had medium favourable attitude towards CSA while high favourable (20.34%) attitude possessing farmers became a little greater than that of low favourable (18.65%) towards CSA. Practice of CSA by the majority of the farmers and annual agricultural income influenced them forming favourable attitudes towards CSA. Other factors, such as, farmers' education, extension contact and benefits obtained from CSA had significant contribution in forming their attitudes favourable towards CSA. Farmers having smaller farm tended to show more favourable attitudes towards CSA than that of large farm size.

Nearly quarter portion (22.88%) of the coastal farmer was found practicing CSA at a higher extent while another majority (57.91%) having practicing CSA moderately. Among the 19 identified CSA practices, "using of thread pipe/plastic pipe for irrigation" was mostly used by the coastal farmers as this technology was available, cheap and easy to use. Additionally, water smart agricultural technologies were mostly used by the coastal farmers due to the increase of soil and water salinity and scarcity of water in dry season which hampering crop production in the coastal region of Bangladesh. Farmers' practice of CSA can be increased by increasing their education, annual agricultural income, extension contact, training exposure and benefit obtained from CSA because these factors had significant contributions to the practice of CSA.

Coastal farmer knowledge, attitude and practice regarding CSA were positively and significantly intercorrelated. So, by increasing knowledge of CSA and make farmers' attitudes towards CSA favourable, practice of CSA can be increased considerably. Farmers need training and credit for their successful farming, but in the study area, most of the farmers (73.45%) received no training and no credit (81.36%) for farming activities with in last five years. Based on innovativeness, percentage of innovator has been increased and laggard has been decreased as compared to Rogers (1995) categorization.

This study reveals that the top most problems that the coastal farmers were facing was economic problem. In respect of annual agricultural income of the farmers, it was observed that most of the farmers were in low-income group. Additionally, their invest in farming became more than the outcome from it. Their major problems were: costly inputs (seed, fertilizer, etc.), low production, need excess labour, lower price of produced crops, etc.

5.4 Recommendations

Based on the findings and conclusions of the study, the following recommendations could be made:

5.4.1 Recommendation for policy implication

i. Since, coastal farmers' knowledge, attitude and practice regarding CSA were positively and significantly interrelated. So, by increasing knowledge of CSA and make farmers attitudes favourable towards it, practice of CSA can be increased considerably. Therefore, intervention (e.g., communication, arranging trainings, motivational campaigns, demonstrations, etc.) can be taken by the concerned authorities to increase knowledge, attitude and practice of the farmers regarding CSA.

ii. Farmers' education, annual agricultural income, extension contact and benefit obtained from CSA had significant positive contributions to their knowledge, attitude and practice regarding CSA. Therefore, to increase knowledge, attitude and practice regarding CSA, education can be increased for those who have less or no education; farmers' agricultural income needed to be increased by subsidy or other financial support; number of extension media and frequency of extension communication are to be increased for them who has less contact or who are beyond extension contact; benefit from CSA can be ensured for the farmers who are getting less or no benefit from CSA.

iii. Decision making ability had significant positive contribution to knowledge on CSA, that's why regular communication is to be needed to the farmers who had less ability to take decision. On the other hand, problems faced in CSA had significant negative contributions to knowledge on CSA, therefore, problems faced by the farmers in using CSA can be solved as early as possible and their needs can be met to increase knowledge.

iv. Coastal farmers' farm size had significant negative contribution to their attitude towards CSA. Therefore, more attention can be given to the farmers who have smaller farm than to larger farm to increase more favourable attitudes towards CSA.

v. This study area is more vulnerable to adverse climatic phenomenon and sudden climatic hazards. This may cause a huge loss of crops and lives of the people. Moreover, their top most problem was economic problem. Their annual agricultural income indicates that most of the farmers were in low-income group. Additionally, their invest in farming became more than the outcome. Nevertheless, they continued farming for their livelihood. Therefore, it is expected that the government and concern organizations can provide subsidy to their farming to keep coastal agriculture sustainable. Agricultural inputs are needed to be less costly; credit needs to be easy and available, agricultural market needs to be in such that farmers can sell their products with profit. Agriculture policy needs to be more farmers friendly and a considerable compensation can be made in case of sudden loss of crops due to natural calamities.

5.4.2 Recommendations for further study

A small and limited research cannot provide unique and universal information related to farmers' knowledge, attitude and practices regarding CSA. Further studies should be undertaken on related matters. On the basis of scope and limitations of the present study and observations made by the researcher, the following recommendations are made for further study-

i. The study was conducted on the coastal farmers of selected area of Tala upazila under Satkhira district, Dacope upazila under Khulna district, and Morrelgonj upazial under Bagerhat district. Findings of the study need verification by similar research in other parts of the country.

ii. The present study was undertaken to explore the contribution of selected characteristics of the farmers on their knowledge, attitude and practice regarding CSA. Therefore, further studies can be designed considering other agricultural and non-agricultural activities and including other characteristics of the farmers that might affect knowledge, attitude and practice regarding CSA.

iii. Age, farming experience, innovativeness, credit availability and access to ICTs had no significant contributions to their knowledge, attitude and practice regarding CSA. So, further verification is necessary.

iv. The full model regression analysis done in this study shows that the whole model of 14 variables explained 49.4 percent of the total variation in knowledge, 30.7 percent of the total variation in attitude and 30.4 percent of the total variation in practice of CSA. Therefore, there are other variables which might contribute to the knowledge, attitude and practice of the coastal farmer regarding CSA and that's why further study can be taken to know the other factors.

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APPENDIX- I

Department of Agricultural Extension and Information System
Sher-E-Bangla Agricultural University, Dhaka

An Interview schedule for collecting data for PhD research on **"Coastal Farmers' Knowledge, Attitude and Practice Regarding Climate Smart Agriculture"**

Sample No.--

Name of the respondent: ....Mobile No:……..…………..
Village:...Union:..................................
Upazila:…..District:................................

1. Age

What is your age? .... years,

2. Level of education

Please indicate your educational qualification.

(a) Cannot read and write
(b) Can sign only
(c) Studied up to .... class
(d) Passed SSC/HSC/graduation/ Post-graduation

3. Farm size: Please mention your farm size.

Sl. No.	Types of land	Area of land	
		Local unit	Hectare
1.	Homestead area		
2.	Own land under own cultivation		
3.	Own land taken from others on borga		
4.	Own land taken from others on lease		
5.	Others (fruit garden, pond etc.)		
	Total		

4. Annual agricultural income

Please mention your annual agricultural income against the appropriate sources.

Sl. No.	Sources of income	Total Price (Taka)
1.	Paddy	
2.	Wheat	
3.	Jute	
4.	Sugarcane	
5.	Pulses	
6.	Oils	
7.	Vegetables	
8.	Fruits	
9.	Cattle rearing and dairy	
10.	Poultry rearing	
11.	Fish culture	

5. Farming experience

Mention your experience in farming activities …………..year/years.

6. Extension contact

Please indicate your frequency of contact with the following media

Sl. No.	Name of the Extension media	Nature of communications			
		Frequently (3)	Occasionally (2)	Rarely (1)	Never (0)

a) Individual Contact					
1.	Model farmer/Friends/ Relatives/ Neighbours)	4 or more times/month ( )	1-3 times/ month ( )	3 times/year ( )	Never ( )
2.	Agricultural input dealer	4 or more times/month ( )	1-3 times/ month ( )	3 times/year ( )	Never ( )
3.	NGO workers	4 or more times/month ( )	1-3 times/ month ( )	3times/ year ( )	Never ( )
4.	Sub-asstt. Agri. Officer (SAAO)	4 or more times/month ( )	1-3 times/ month ( )	3 times/ year ( )	Never ( )
5.	Upazila Agriculture Officer/ Additional Agriculture Officer/ Agriculture Extension officer	At least 1 time/month ( )	At least 1 time/2 months ( )	1-5 times/ year ( )	Never ( )
6.	Other extension worker (eg-Health worker, BRDB's field officer, Imam etc.)	4 or more times/month ( )	1-3 times/ month ( )	3 times/ year ( )	Never ( )
b) Group contact					
1.	Participation in group discussion	4 or more times/year ( )	2-3 times/ year ( )	1 time/year ( )	Never ( )
2.	Participation in demonstration meeting (Result and method demonstration)	4 or more times/month ( )	1-3 times/ month ( )	3 times/year ( )	Never ( )
3.	Participation in Field day/ farmers rally	4 or more times/month ( )	1-3 times/ month ( )	3 times/year ( )	Never ( )
4.	Participation in training	3 or more times/year ( )	2 times/ year ( )	1 time/year ( )	Never ( )
(c) Mass media contact					
1.	Listening Farm Radio talk	4 times/month ( )	2-3 times/ month ( )	1 time/month ( )	Never ( )
2.	Watching agricultural program in TV	4 times/month ( )	2-3 times/ month ( )	1 time/ month ( )	Never ( )
3.	Reading agricultural magazine (Booklet/ Leaflet/Krishi Katha etc.)	5 or more times/year ( )	3-4 times/year ( )	at least 1-2 times/year ( )	Never ( )
4.	Visiting agricultural fair	3 or more times/ year ( )	2 times/year ( )	At least 1 time/year ( )	Never ( )

7. Training exposure

Did you receive any kind of agricultural/CSA training in the last 5 years?

Yes ( ) / No ( ), If yes, please furnish the following information—

SL. No.	Title of training course	Duration (days)	Conducting organization and place
1.			

2.			
3.			
4.			
5.			
Total			

8. Innovativeness

Please indicate your position from the following categories-

Sl. No	Adopter categories	Respondent's position/intension	Scores
1.	Innovator	Willing to take risk any time to adopt innovations having high financial ability.	5
2.	Early adopter	Adopt innovations immediate after a check of risk, having opinion leadership.	4
3.	Early majority	Deliberate willingness to adopt innovations having seldom leadership.	3
4.	Late majority	Do not adopt until most others have done so, little leadership.	2
5.	Laggard	Suspicious of innovations, cautious to reject the traditional and late to adopt new.	1

9. Credit availability

Have you ever been received any credit for your farming/other purpose? Yes--/No-----

If yes--i. Please indicate the source of credit ....

ii. Amount of the credit taken ....Tk.

iii. Amount of credit you needed/sought …………………………Tk.

iv. Source of credit…………………………………………………

10. Access to market

Items	Sustained access (2)	Intermittent access (1)	No access (0)
Buying			
1. Salinity/flood resistant (rice/other crops) Seeds			

Items	Sustained access (2)	Intermittent access (1)	No access (0)
2. Organic/chemical fertilizers			
3. Pesticide/weedicide/vitamins			
4. Irrigation water			
5. Agricultural equipment			
Selling			
1. Paddy/Rice			
2. Vegetables			
3. Straw			
4. Irrigation water			
5. Livestock/fishery products			

11. Access to Information and Communication Technologies (ICTs)

Sl. No.	**Technologies**	**Extent of use**			
		Regularly (3)	Occasionally (2)	Rarely (1)	Never (0)
1	Mobile phone				
2	Internet connection				
3	Television				
4	Radio				
5	Computer				

12. Decision making ability

Please mention the extent of your decision-making ability by putting tick mark (√) in appropriate column.

Items of decision making	Extent of decision making		
	Able to make self-decision (3)	Able to make decision with family members (2)	Able to make decision with outsiders of the family (1)
1. Practicing of CSA			
2. Buying of agricultural inputs			
3. Selling of agricultural products			
4. Family affairs			
5. Education of children			
6. Participation in social activities			

13. Benefit obtained from CSA

Please mention the extent of benefits obtained by you by using CSA practices

	Extent of benefit obtained

Items of benefit	High benefit (3)	Moderate benefit (2)	Less benefit (1)	No benefit (0)
Social benefits				
1. Development of knowledge and skill				
2. Development of organizational participation and extension contact				
3. Development of employment Opportunity				
4. Development of participation in meeting and Training				
5. Development of counseling ability				
Environmental benefits				
6. Decrease of air and water pollution				
7. Improve soil properties				
8. Increased biodiversity against adverse climate				
9. Decrease of crop pest				
Economic benefits				
10. Increased family income				
11. Decrease production cost				
12. Increased crop yield				
Technical benefits				
13. Increase of integrated crop Management				
14. Increase of cropping intensity				
15. Increase in the use of local resources				
16. Increased crop production and Productivity				
17. Improved capacity on new technology Implementation				
Psychological benefits				
18. Positive mental state to adopt new Technology				
19. Development of social norms and values				
20. Positive attitude towards change in food habit				

14. Problems faced in practicing CSA

Please indicate the extent of problems faced by you in ecological agriculture

	Extent of problem faced

Items of problem	Severe Problem (3)	Moderate problem (2)	Less problem (1)	No problem (0)
Social problems				
1. Lack of information and publicity				
2. Lack of proper organization				
3. Poor extension service				
4. Poor adoption of climate smart agriculture by maximum farmers				
Technical problems				
5. Difficult to collect equipment/components to prepare any technology				
6. Lack of appropriate crop/variety (salt, flood and drought tolerant)				
7. Difficult to prepare and maintain technologies (Rain water harvest, Floating bed, etc.)				
8. Difficult to maintain crop rotation				
9. Technologies (USG, AWD, etc.) are unavailable				
10. Uncertainty of pest control in case of severe attack				
Economic problems				
11. Higher cost of inputs (Seed, fertilizer, etc.)				
12. Low production				
13. Need excess labour				
14. Lower price of produced crops				
Marketing problems				
15. Poor and inadequate roads for transportation				
16. Difficult to move to a distance place				
17. Lack of proper transport				
18. Undesirable involvement of middle men				
19. Lack of storage facilities				
Psychological problems				
20. Criticism from family members				
21. Criticism from relatives and neighbouring farmers				
22. Criticism from fertilizer and pesticide dealers				

15. Knowledge on CSA technologies

Please answer the following questions

Sl. No.	Questions	Full marks	Marks obtained
Remembering			

Sl. No.	Questions	Full marks	Marks obtained
1.	Name two rice varieties that can tolerate unfavourable weather?	2	
2.	Which crops can be grown in less water/drought condition?	2	
3.	Which crop can grow in water logging condition?	2	
4.	Which crops can grow in saline soil?	2	
Understanding			
5.	What do you mean by climate change?	2	
6.	What kind of damage is caused by unfavourable weather?	2	
7.	How can you identify salinity effects/Soil salinity?	2	
8.	What are the disadvantages of cultivating same crops in a same land frequently?	2	
Applying			
9.	How can you preserve rain water for crop cultivation?	2	
10.	How can you remove salt from your land?	2	
11.	How can you protect evaporation from soil?	2	
12.	How can you prepare compost?	2	
Analyzing			
13.	Why do you use guti urea?	2	
14.	What is the benefit of using solar power irrigation?	2	
15.	Why do you use floating bed cultivation method?	2	
16.	Why do you use zero tillage cultivation?	2	
Evaluating			
17.	Why you should not use granular urea in broadcasting method?	2	
18.	What is the benefit of adjusting planting time?	2	
Creating			
19.	How can you save the misuse of irrigation water?	2	
20.	How can you save crops from bad weather?	2	

16. Attitude towards CSA

Please state your degree of agreement with the following statements

		Extent of agreement

Sl. No.	Statements	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
+1.	Cultivation of salt tolerant rice varieties is profitable					
-2.	Flood tolerant crop varieties are often damaged by flood					
+3.	Damage by bad weather can be minimized by adjusting planting time					
-4.	Crop rotation is a complex system					
+5.	Intercropping is very effective against climate change					
-6.	Applying zero tillage gives less yield					
+7.	Forestation can minimize crop loss due to climatic disaster					
-8.	Technologies/practices given from agriculture office are not effective against climate change					
+9.	Farmers should use Guti urea instead of granular urea in rice cultivation					
-10.	Ridge plantation practice is not profitable					
+11.	Farmers should preserve rain water for irrigation in dry season					
-12.	The disadvantage of solar power irrigation is more than its advantage					
+13.	Production and application of vermicompost is profitable					
-14.	Vegetable production in floating should be avoided for its higher cost and labour					
+15.	Crops can be saved from bad weather by cultivation short duration crop/ crop varieties					
-16.	Crop production in raised bed is not profitable					
+17.	In the dry season mulching must be done					
-18.	Using plastic pipe for irrigation channel is less convenient than earthen channel					

17. Practices of CSA

Please mention how frequently you use the following CSA technologies and practices in your farming activities.

Sl. No.	Technologies	Extent of use			
		Regularly (3)	Occasionally (2)	Rarely (1)	Never (0)
1.	Cultivation of salinity resistant and high yielding crop varieties				
2.	Cultivation of submergence resistant and high yielding crop varieties				
3.	Cultivation of drought resistant and high yielding crop varieties				
4.	Cultivation of short duration and high yielding crop varieties				
5.	Adjusting planting time				
6.	Adoption of crop rotation				
7.	Adoption of relay cropping/ intercropping with legume				
8.	Practicing of zero tillage				
9.	Practicing of minimum tillage				
10.	Mulching				
11.	Rain water harvesting for irrigation				
12.	Using of thread pipe/plastic pipe				
13.	Adoption of raised bed planting				
14.	Applying of compost/ vermicompost				
15.	Rearing improved livestock breed				
16.	Traditional Gher farming				
17.	Practicing of 'Hari' system				
18.	Ridge planting (Bank of pond/ gher/ in ails)				
19.	Watermelon cultivation				

Thanks for your Cooperation

Signature of the interviewer

APPENDIX- II

Pre-test Items of Climate Smart Agriculture Knowledge Test

Please answer the following questions

Sl. No.	Questions	Full marks	Marks obtained
	Remembering		
1.	Mention two important CSA technologies.	2	
2.	Name 2 rice varieties that can tolerate unfavourable weather?	2	
3.	Which crop can tolerate drought?	2	
4.	Which crop can withstand water logging?	2	
5	Which crops can grow in saline soil?	2	
	Understanding		
6.	Do you mean by Climate change?	2	
7.	What kinds of damage is caused by unfavourable weather?	2	
8.	What are the characteristics of quality seed?	2	
9.	How can you identify salinity effects/Soil salinity?	2	
10.	What are the disadvantages of cultivating same crops in a same land frequently?	2	
11.	What do you mean by zero tillage?	2	
	Applying		
12.	How can you preserve rain water for crop cultivation?	2	
13.	How can you remove salt from your land?	2	
14.	How can you protect evaporation from soil?	2	
15.	How can you use Guti urea?	2	
16.	How can you prepare compost?	2	
	Analyzing		
17.	Why do you use guti urea?	2	
18.	Why do you cultivate crops in sarjan method?	2	
19.	What is the benefit of using solar power irrigation?	2	
20.	Why do you use floating bed cultivation method?	2	
21.	Why crops are cultivated in zero tillage method?	2	
	Evaluating		
22.	Why granular urea should not be applied in broadcasting method?	2	
23.	What kinds of damages in crops are caused by high temperature?	2	
24.	What benefit do you get from relay/intercropping Aman/+Kheshari?	2	
25.	What is the benefit of adjusting planting time?	2	
	Creating		
26.	How can you increase soil fertility?	2	
27.	How can you save the misuse of irrigation water?	2	
28.	How can you save crops from bad weather?	2	

APPENDIX- III

Difficulty Indices and Discrimination Indices of the 28 Items of Climate Smart Agricultural Knowledge Test

Sl. No. of Items	Frequencies of correct/partially answers given by each group of respondents (each group containing 4 farmers)						Total frequencies of (N=24)		Difficulty index (Pi)	Discrimination Index ($E^{1/3}$)
	G_1	G_2	G_3	G_4	G_5	G_6	correct/ partially correct answers	wrong answers		
1	1	1	1	0	0	0	3	21	87.5	0.25
2	3	3	2	1	1	1	11	13	54.17*	0.50
3	4	3	2	2	2	1	14	10	41.67*	0.50
4	4	4	3	2	2	1	16	8	33.33*	0.625
5	4	4	3	2	1	1	15	9	37.5*	0.75
6	4	3	3	2	1	1	14	10	41.67*	0.625
7	3	3	2	2	2	1	13	11	45.83*	0.375
8	4	4	4	3	2	1	18	6	25.0	0.625
9	3	3	2	2	1	0	11	13	54.17*	0.625
10	3	3	3	2	1	0	12	12	50.0*	0.625
11	4	4	4	4	1	0	17	7	29.17	0.875
12	4	3	2	2	2	1	14	10	41.67*	0.50
13	4	3	2	2	1	1	13	11	45.83*	0.625
14	4	4	3	2	1	1	15	9	37.5*	0.75
15	4	4	4	4	0	0	16	8	33.33	1.00
16	4	4	4	3	1	1	17	7	29.17*	0.75
17	3	3	2	2	1	0	11	13	54.17*	0.625
18	2	2	1	0	0	0	5	19	79.17	0.50
19	4	3	2	2	1	1	13	11	45.83*	0.625
20	4	4	3	3	2	1	17	7	29.17*	0.625
21	4	4	3	2	1	1	15	9	37.5*	0.75
22	4	4	3	2	2	1	16	8	33.33*	0.625
23	2	1	1	1	1	1	7	17	70.83	0.125
24	2	1	1	1	1	0	6	18	75.0	0.25
25	4	3	3	2	1	1	14	10	41.67*	0.625
26	3	2	2	1	0	0	8	16	66.67	0.625
27	4	3	3	2	1	0	13	11	45.83*	0.75
28	4	3	2	2	1	0	12	12	50.0*	0.75

* Items selected for the study

APPENDIX - IV

Critical Ratio (t-values) for Attitude towards Climate Smart Agriculture Statements

Sl.	Attitudes Statements	‘t'

No.		values
+1.	Cultivation of salt tolerant rice varieties is profitable	2.854*
-2	Cultivation of drought tolerant rice seed is very risky	0.953
+3	Pesticide spraying is not needed at all in pest resistant varieties	1.520
-4.	Flood tolerant crop varieties are often damaged by flood	2.787*
+5.	Damage by bad weather can be minimized by adjusting planting time	3.415*
-6.	Crop rotation is a complex system	1.980*
+7.	Intercropping is very effective against climate change	4.125*
-8.	Applying Zero tillage is not a profitable cropping system	3.023*
+9.	Forestation can minimize crop loss due to climatic disaster	2.341*
+10.	Land doesn't dry up quickly if minimum tillage is applied	1.342
-11.	CSA technologies given from agriculture office are not effective against climate change	2.579*
+12.	Farmers should use Guti urea instead of granular urea in rice cultivation	3.630*
-13.	Ridge plantation practice is not profitable	2.390*
-14.	Application of USG is laborious and time consuming	0.978
+15.	Farmers should preserve rain water for irrigation in dry season	5.172*
-16.	The disadvantages of solar power irrigation are more than its advantages	2.341*
+17.	HYV fodder cultivation is more profitable than cultivation of rice, jute, etc.	1.230
-18.	Vegetable production in floating should be avoided for its higher cost and labour	5.731*
+19.	Agroforestry is a profitable production system	1.206
-20.	Farmers should rear indigenous cattle instead of improved breeds	1.045
+21.	AWD method of irrigation is the most suitable method of irrigation.	0.930
+22.	Crops can be saved from bad weather by cultivation short duration crop/ crop varieties	4.433*
-23.	Single crop cultivation is more profitable than integrated farming	1.651
-24.	In the dry season mulching must be done	2.853*
+25.	Sorjon method is costly and laborious work	1.130
-26.	Farmers should transform their crop land into gher for shrimp farming	1.436
+27.	Gher farming is harmful for and soil environment	0.785
+28	Production and application of vermicompost is profitable	1.971*
-29.	Raised bed plantation is not profitable	2.053*
-30.	Using plastic pipe for irrigation channel is less convenient than earthen channel	5.310*

*Statements selected for final attitude towards ecological agriculture scale

APPENDIX - V

Critical Ratio (t-values) for Climate Smart Agriculture Practices

Sl. No.	Climate Smart Agriculture Practices	't' values

1.	Cultivation of salinity resistant and high yielding crop varieties	2.751*
2.	Cultivation of submergence resistant and high yielding crop varieties	4.251*
3.	Cultivation of drought resistant and high yielding crop varieties	5.413*
4.	Cultivation of short duration and high yielding crop varieties	2.677*
5.	Cultivation of diseases resistant and high yielding crop varieties	1.304
6.	Adjusting planting time	3.215*
7.	Adoption of crop rotation	3.417*
8.	Adoption of relay cropping/intercropping with legume	2.528*
9.	Practicing of zero tillage	3.523*
10.	Practicing of minimum tillage	1.947*
11.	Applying mulching	3.302*
12.	Irrigation by AWD method	0.879
13.	Rain water harvesting for irrigation	2.749*
14.	Adoption of Solar power irrigation	1.024
15.	Using of thread pipe/plastic pipe	5.733*
16.	Using of Urea Super Granules in rice field	1.109
17.	Adoption of Sorjan method	0.765
18.	Adoption Floating vegetable bed	1.099
19.	Adoption of raised bed planting	2.360*
20.	Adoption of Vegetable towers	0.657
21.	Applying of compost/vermicompost	3.960*
22.	Compost and biogas production	0.572
23.	Rearing improved livestock breed	2.345*
24.	Production of Fodder crop	1.409
25.	Adoption of Agroforestry practices	0.706
26.	Traditional Gher farming	4.232*
27.	Practicing of ‘Rice field fish rings’	0.823
28.	Practicing of ‘Hari’ system	1.870*
29.	Ridge planting (Bank of pond/gher/in Ails)	6.735*
30.	Watermelon cultivation	5.293*

*CSA practices selected for final data collection

APPENDIX-VI

Results of variance inflation factor (VIF) and tolerance analysis

Explanatory variables	Collinearity statistics	
	Tolerance	VIF
Age (X_1)	0.335	2.984
Education (X_2)	0.607	1.647
Farm size (X_3)	0.436	2.295
Annual agricultural income (X_4)	0.426	2.349
Farming Experience (X_5)	0.283	3.539
Extension contact (X_6)	0.615	1.627
Training exposure (x_7)	0.811	1.233
Innovativeness (x_8)	0.729	1.371
Credit availability (x_9)	0.842	1.188
Access to market (x_{10})	0.797	1.254
Access to ICTs (X_{11})	0.711	1.406
Decision making ability(X_{12})	0.533	1.875
Benefit obtained from CSA (X_{13})	0.596	1.678
Problem faced in CSA (X_{14})	0.655	1.527

APPENDIX-VII

Correlation Matrix

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	Y_1	Y_2	Y_3
X_1	1																
X_2	-0.338**	1															
X_3	0.042	0.288**	1														
X_4	-0.010	0.301**	0.685**	1													
X_5	0.787**	-0.515**	-0.112*	-0.113*	1												
X_6	0.106*	0.052	0.183**	-0.072	0.017	1											
X_7	0.023	0.179**	0.166**	0.185**	-0.034	0.041	1										
X_8	-0.039	0.205**	0.296**	0.202**	-0.094	0.391**	0.004	1									
X_9	-0.011	0.044	0.022	0.080	-0.054	0.137*	0.312**	0.037	1								
X_{10}	-0.012	-0.006	0.060	0.020	-0.092	0.145**	0.135**	-0.020	0.105*	1							
X_{11}	-0.134*	0.224**	0.069	0.220**	-0.040	-0.134*	0.090	0.050	-0.066	-0.257**	1						
X_{12}	0.119*	-0.050	0.129*	-0.158**	-0.016	0.518**	-0.027	0.286**	0.066	0.286**	-0.408**	1					
X_{13}	-0.010	0.136*	0.195**	0.111*	-0.144**	0.234**	0.166**	0.114*	0.121*	0.168**	-0.142**	0.258**	1				
X_{14}	0.045	-0.002	0.032	0.057	-0.019	0.007	0.018	-0.026	0.151**	-0.111*	-0.112*	0.024	0.508**	1			
Y_1	-0.049	0.275**	0.292**	0.158**	-0.211**	0.402**	0.167**	0.232**	0.098	0.265**	-0.116*	0.498**	0.472**	0.048	1		
Y_2	-0.036	0.259**	0.116*	0.205**	-0.104	0.177**	0.249**	0.127*	0.133*	0.151**	0.103	0.024	0.425**	0.150**	0.491**	1	
Y_3	-0.134*	0.304**	0.228**	0.295**	-0.204**	0.249**	0.266**	0.129*	0.077	0.058	0.094	0.047	0.317**	0.050	0.439**	0.661**	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

X_1= Age; X_2 = Level of education; X_3 = Farm size; X_4 = Annual agricultural income

X_5 = Farming experience; X_6 = Extension media contact; X_7= Training exposer; X_8= Innovativeness

X_9= Credit availability; X_{10}= Access to market; X_{11}= Access to ICTs; X_{12}= Decision making ability

X_{13}= Benefit obtained from CSA; X_{14}= Problem faced in practicing CSA; Y_1= Knowledge; Y_2= Attitude; Y_3= Practice