IMPACT OF DISTRICT AGRO-METEOROLOGICAL UNIT (DAMU) ON CROP PLANNING AND MANAGEMENT IN SELECTED DISTRICTS OF WEST BENGAL

Thesis
Submitted to the
UTTAR BANGA KRISHI VISWAVIDYALAYA
In partial fulfillment of the requirements for the Degree of
MASTER OF SCIENCE (AGRICULTURE)

In

Agricultural Extension

By
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[A-2020-011-M]

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APPROVAL OF EXAMINERS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (AGRICULTURE) IN AGRICULTURAL EXTENSION

We, the undersigned, having been satisfied with the performance of Mr. Krishnendu Mondal (Reg. No. A-2020-011-M), in the *Viva voce* associated with Final Evaluation of thesis, conducted today, 19th September of 2022, recommend that the thesis be accepted for the award of the degree of Master of Science (Agriculture) in Agricultural Extension.

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This is to certify that the work recorded in the thesis entitled, "**Impact of District Agro-meteorological Unit on Crop Planning and Management in Selected Districts of West Bengal**" submitted by **Krishnendu Mondal (Reg. No. A-2020-011-M)** in partial fulfillment of the requirements for the **Master of Science (Agriculture)** in Agricultural Extension of **Uttar Banga Krishi Viswavidyalaya,** is a faithful and bonafide research work carried out under my personal supervision and guidance. The results of the investigation reported in the thesis have not so far been submitted for any other Degree or Diploma. The assistance and help received during the course of investigation have been duly acknowledged.

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ABSTRACT

Title of the Thesis: Impact of District Agro-meteorological unit on Crop Planning and Management (DAMU) in Selected Districts of West Bengal.

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Climate change has become an important area of concern for India to ensure food and nutritional for growing population. The impacts of climate change are global but countries like India are vulnerable in view of the high population depending upon agriculture. Government of India has entrusted upon the India Meteorological Department (IMD) the task of establishing weather observing system and development of Gramin Krishi Mausam Sewa (GKMS) in the country. Under GKMS scheme, IMD proposed to establish DAMU in 530 districts, in addition to already operating 130 AMFUs. In GKMS scheme, the DAMU at KVKs prepare and disseminate sub-district level agro-met advisory bulletins after receiving weather forecast from IMD. Automatic Weather Station have been installed at KVKs to record agromet observations and generate agrometeorological information for crop, pest and diseases, soil, livestock etc. Objectives of the present study-Based on the previous discussion, the present study undertook the following objectives to address. 1)To study the socio-economic characteristics of respondents 2) To study the extent of use of agro-advisory services generated from different sources by the respondents. 3) To study the opinion regarding farm planning and management based on advisory of DAMU 4) To study the change in crop acreage and productivity after introduction of DAMU. The study was conducted in two villages of Birbhum and two villages of Malda in West Bengal. 40 respondents who are the beneficiaries from DAMU and other 40 respondents are non-beneficiaries. There is a significant difference between the beneficiaries under DAMU and

non-beneficiaries, as the t value is significant in educational status of respondents, personal media contact, mass media contact, household status, total land holding status, cultivable land and income. The result shows that the beneficiaries of DAMU are mainly in higher educational and social status. The result also shows the opinion regarding impact of DAMU in farm condition and farm decision making after introduction of DAMU.

Key Words: *Climate change, DAMU, KVK, IMD, GKMS, Advisory service.*

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ABBREVIATIONS

AAB – Agro Advisory Bulletin

AAS- Agro Advisory Services

ATMA- Agricultural Technology Management Agency

DAMU – District Agro-Meteorological Unit

IMD- India Meteorological Department

GKMS- Gramin Krishi Mausam Sewa

KVK- Krishi Vigyan Kendra

CHAPTER-I

INTRODUCTION

Approximately 58% of India's population relies mostly on agriculture for their livelihood. India's food, nutrition, and livelihood security depend heavily on agriculture. Although Indian agriculture has historically made great development, there are now many obstacles in its way. The main issues facing Indian agriculture are stagnating net sown area, plateauing yield levels, declining soil quality, decreasing per capita land availability, and the negative impact of climate change. On the other side, the growing population is placing pressure on the agricultural industry to improve food production. The endeavour is extremely difficult because 60% of the net cultivated land is rainfed and subject to biotic and abiotic pressures brought on by climatic variability and climate change. More than 80% of Indian farmers are marginal, small, and have weak coping skills. Additionally, Indian farmers are disorganised and diverse. By placing pressure on agriculture and compromising its sustainability, climate change and variability are likely to make the issue of future food security worse. Crops, soils, animals, and pests are all significantly impacted by climate change.

Due to the fact that 2/3 of India's agricultural land is rainfed and even the irrigated system is reliant on monsoon rain, Indian agriculture is particularly vulnerable to the hazards associated with climate change, especially to drought. In many areas of the country, particularly in the east where flooding is a common occurrence, flooding is also a significant problem. Additionally, cyclones on the eastern coast, heat waves in the middle and northern regions, and frost in the north-west all cause devastation. The increased atmospheric temperature has increased the frequency of severe climatic extremes in recent years, increasing the danger of significant losses in agricultural productivity. Indirect and direct impacts of climate change on crops, soils, livestock, and pests all have an impact on agriculture. Increasing atmospheric carbon dioxide fertilises crops that use the C3 photosynthetic pathway, fostering their development and yield. An increase in temperature can affect many aspects of crop growth, including crop duration, respiration rates, and photosynthesis. It can also affect pest population survival and distribution, which can lead to the development of new pest-crop equilibriums. It can also speed up the mineralization of nutrients in soils, reduce fertiliser use efficiency, and increase evapo-transpiration. Due to the availability of irrigation water, the frequency and severity of inter- and intra-seasonal droughts and floods, the transformation of soil organic

matter, soil erosion, changes in pest profiles, the loss of arable land due to the submergence of coastal land, and the availability of energy, climate change also has a significant indirect impact on the use of agricultural land in India.

In the event of climate change, the agriculture sector would confront the following significant challenges:

i. the availability of water as a result of altered rainfall patterns, stream flow, and rising crop water demands
ii. seawater intrusion causing water quality to deteriorate, over-exploitation of aquifers causing salts to be transported from deeper soil layers, and improper irrigation techniques
iii. Increased frequency and severity of extreme weather events including droughts, floods, and cyclones, which would have a greater influence on output levels than the effects of mean climate change.
iv. heat stress caused by an increase in temperature during a crucial period of crop growth
v. Pest and disease loads might change suddenly.

IMD has established a network of over 130 Agro-Meteorological Field Units (AMFUS) throughout the nation. These interdisciplinary units are in charge of creating and disseminating district and sub-district agromet advisories. These AMFUS can be found at ICAR centres, state agricultural universities, and other organizations. Each AMFU employs the pertinent output products, such as weather data from conventional/automatic weather stations (AWS) provided by IMD and ICAR, to produce and distribute to the farming community specific advisories for agricultural management for the respective districts of Agro-climatic Zones identified under its jurisdiction. The Gramin Krishi Mausam Sewa (GKMS) scheme recommends that the IMD create District Agro Met Units (DAMU) in 530 districts in addition to the 130 AMFUs that are now in operation. The goal of establishing DAMU is expected to be accomplished by 2021–2022, and it is now complete at 189 locations inside the grounds of KVK under GKMS. All of the established DAMUs have begun to prepare block level AAB for each district's blocks. Every Tuesday and Friday, 690 district level AABs in operational mode and around 2200 blocks on a pilot basis are prepared. In addition to its other duties, DAMU will use the weather

forecast provided by IMD to create and distribute agromet advisory bulletins for sub-district levels.

Through the All-India Co-ordinate Research Project on Agro-Meteorology (AICRPAM), ICAR is conducting research and development on agro-meteorology through a network of 35 centres spread throughout the nation near SAUS in order to improve weather-based advisories and increase the reach of advisory bulletins to farmers. Through strategic research and technology, the Indian Council of Agricultural Research's (ICAR) Central Research Institute for Dry Land Agriculture (CRIDA) and National Innovation on Climate Resilient Agriculture (NICRA) projects seek to increase the resilience of Indian agriculture to climate change and climate variability. Moreover, it offers agricultural advisories to the CRIDA website's weather outlook and directs the Ministry of Agriculture's emergency preparation during the crop season.

District Agro-Met Unit (DAMU)-

The management and production of agriculture depends heavily on knowledge about the weather and climate. India Meteorological Department (IMD) and ICAR started the Gramin Krishi Mausam Seva (GKMS) scheme to establish District Agro-Met Units (DAMU) at each district throughout India in order to give the weather information and agro-advisories required for the block/taluka level agricultural community.

IMD is producing and disseminating quantitative District/Block level weather forecasts up to 5 days in advance for agriculture under the GKMS scheme. Quantitative forecasts for the main meteorological variables, including rainfall, maximum and lowest temperatures, wind direction and speed, relative humidity, and cloudiness, are included in the products. The AMFUs / DAMUs use these products to create district / block level agromet advisories twice a week, on Tuesday and Friday, and distribute them to the agricultural community to assist them in making informed decisions for day-to-day farm operations.

Objectives of DAMU-

i. To prepare and issue in time, crop specific, weather-based District / Block level Agromet Advisory for next 5 days by AMFUs and DAMUs

ii. To collect and organize climate/weather, soil and crop information and to amalgamate them to prepare database for value addition of advisory
iii. To extend the weather based advisory service to the allied areas like livestock, grazing of farm feed etc.
iv. Real time verification of the forecast and reporting of weather events
v. To enhance the outreach and dissemination of services
vi. Collection of feedback and improve the services

Agro-Advisory Service

Under the Gramin Krishi Mausam Sewa (GKMS) programme, the India Meteorological Department (IMD), Ministry of Earth Sciences (MoES), provides agrometeorological advisory services (AAS) as a means of contributing to weather information-based crop and livestock management strategies and operations aimed at boosting crop production and food security.

AAS offer a highly unique type of input to the farmer in the form of advisories that can significantly improve agriculture production by maximising the positive effects of favourable weather and minimising the negative effects of unfavourable weather. AAS defines the demands of the farming community by determining the information needs of various end-user groups. It has become clear that a location-specific, quantitative weather forecast is the farmer's top priority.

Farm decisions are made in reaction to past, present, and future weather changes through the use of agro-advisory services. It covers input, water, pest, and disease management, as well as agronomic management. Crops, their phases, and farm operations that are weather-sensitive should all be considered when creating weather-based agro-advisories.

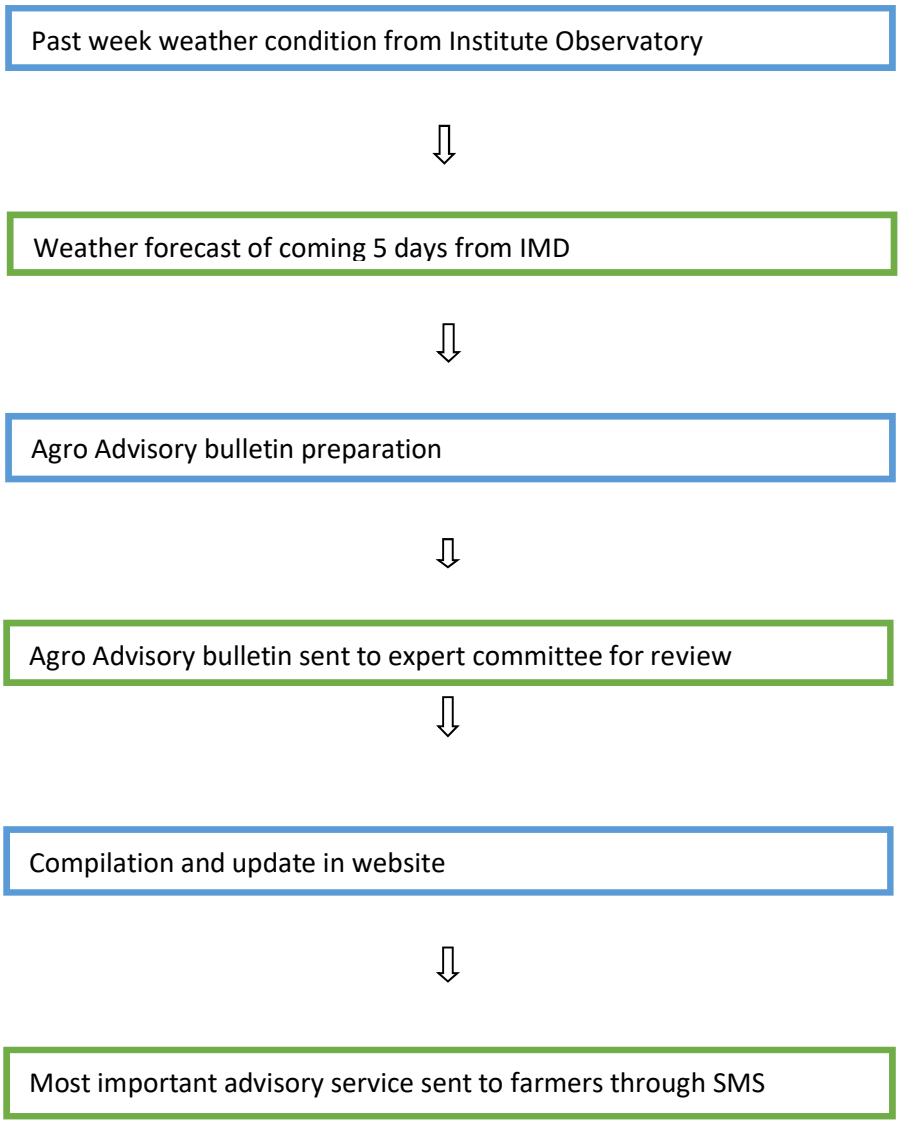
What is the use of Agro-advisory services?

It aids farmers in making weather-sensitive decisions on crop seeding and transplanting, pesticide and fertiliser application, irrigation timing, timely crop harvesting, and animal vaccination.

How Agro-advisory services are disseminated?

Every Tuesday and Friday, agro advisory bulletins are created, and they are distributed to farmers the same day through the websites of the Institute and KVK, WhatsApp messaging, and Facebook.

How Agro Advisory Service will function?



Source: ICAR: Central Coastal Agricultural Research Institute

Agromet Advisory Bulletin:

The following information will be included in every Tuesday and Friday district/block level bulletin produced by AMFU/DAMU-

- Past Weather: Observed weather information of last five days in tabular format
- Quantitative medium range weather forecast for next five days. Based on forecast values weather summary for next 5 days also be kept in the bulletin.
- Based on weather forecast, abiotic weather-related stress for crops livestock, poultry of the district/block need to be formulated. Crop specific advisory should take care of the phenological phases of the crop and their relation with the weather variables based on which weather forecast based agromet advisories are formulated.
- Category rainfall forecast for the outlook of succeeding week (i.e., 6th to 12th days) to be included in bulletin.

SMS advisory:

The SMS Bulletin should include the highlights of the Agromet Bulletin issued by AMFU / DAMU to assist farmers in the decision-making process related to agronomic action in field. Message length should be restricted to 262 characters.

Meghdoot:

Meghdoot is a cooperative project of the Indian Meteorological Department (IMD) and Indian Council for Agriculture Research (ICAR) that aims to provide farmers with vernacular versions of high-resolution weather forecast-based agro warnings. Every Tuesday and Friday, the Agro-Met Field Units (AMFU) publish contextualised district- and crop-specific advisories. Farmers and other interested people can easily obtain these alerts with the Meghdoot App. Where possible, the advisories are also released in the local language. In addition to the crop advisory, the app provides weather observations and forecasts.

Damini

IITM-Pune and ESSO work together to create the Damini Lightning apps. The apps keep track of every lightning occurrence that occurs precisely in India. and send you a GPS notification if lightning is approaching your location between 20 and 40 km. While in a lightning-prone location, applications provide detailed instructions and safety advice. When lightning strikes close to you, it is imperative that you closely go by the dos and don'ts for each situation for your own protection.

Objectives of the present study

Based on the previous discussion, the present study undertook the following objectives to address.

1) To study the socio-economic characteristics of respondents
2) To study the extent of use of agro-advisory services generated from different sources by the respondents.
3) To study the opinion regarding farm planning and management based on advisory of DAMU
4) To study the change in crop acreage and productivity after introduction of DAMU.

Limitations of the study

One came from the fact that it is a study of Social Science and used the social and psychological scale and measurements – which have inherent limitations of precision; and so, generalization based on the result of the present study is limited to the extent of faithfulness of response from the respondents.

CHAPTER-II

REVIEW OF LITERATURE

A systematic review on the topic of research provides the perspectives which have already covered by the previous authors on the topic and show the direction of research to be followed. Research on DAMU is quite meager and so review on the related topic has also mentioned in this chapter based on the objectives of the study.

Socio-personal characteristics of respondents

Ogunsumi *et al.*, (2007) study comparing sustained users and abandoned users of agricultural technologies found that sustained users were older and had larger farms. The study also discovered that both sustained users and abandoned users typically produced comparable crops, employed family-owned or inherited property, and heavily relied on hired labour and family members as their primary sources of farm labour. Farmers would gear up and arrange themselves so as to profit from such programmes, in order to increase their well-being, once they were aware of the focused efforts oriented towards complete adoption and sustaining adopted technologies.

Alamn *et al.*, (2010) concluded that young people are less interested in agriculture and are moving toward SME and industrial sectors as a result of decreasing agricultural profitability. Therefore, farmers are an older, less productive demographic. The majority of farmers have large families and no other sources of income outside farming. In addition, because there is typically just one earner per family, dependency rates are extremely high. The majority of farmers have some level of education, yet even those with advanced degrees find farming unattractive due to its low profitability relative to off-farm wages. The majority of farmers have their own homes and at least one vehicle per household. The farmers' fields are likewise not far from their residence.

Mohammad (2011) reported that the main factors preventing the respondents from adopting the new agricultural technology were their low literacy rates, small land holdings, low incomes, and large families.

The psychological makeup of a person is determined by their socioeconomic characteristics, which in turn affect how they make decisions about any course of action. Understanding the farmers' socioeconomic situation will speed up the efficient transmission of technology because it has a significant impact on adoption. Additionally, it suggests that socioeconomic factors influence adoption behavior. Before making any technology available for adoption, the highly correlated socioeconomic variable must be taken into account, and technology should be produced in such a way that it harmonizes with the intended people's current socioeconomic level (Roy *et al.*, 2013).

Disssanayake *et al.*, (2013) revealed that the proportion of people under 50 years old in these locations was larger under the categories of "potential" and farmers who own immature holdings than farmers who own mature holdings, indicating the younger generation's inclination for rubber farming. In traditional rubber-growing regions, the percentage of smallholder farmers under 40 was around 17%, which was quite low when compared to nontraditional rubber-growing regions. More than half of the farmers had only completed elementary school. Therefore, it is necessary to take education into account as a barrier to raising the level of awareness among rubber farmers in non-traditional rubber growing regions. In order to ensure the correct use of public funds, the higher number of people with monthly incomes of less than Rs. 10,000 should also be seen as a barrier to the adoption of the advised technologies. Appropriate monitoring procedures must be used in the distribution of subsidies. In the non-traditional rubber, the farmers did not just depend on rubber as a source of revenue; they also planted other crops.

Vijayasarathy and Ashok (2015) revealed that the likelihood of adopting climate resilient technologies rises with education level, whereas adoption rates are negatively impacted by household and farm size. The adoption of the system of rice intensification, drip irrigation, digging new bore wells, and mixed farming had a positive and significant impact on the household's farm income. The study had indicated that the system of rice intensification (SRI), change in cropping pattern, summer ploughing, mixed farming, and drilling of new bore-wells are much more likely to be used when precipitation is decreasing. Crop production was found to be more technically efficient for technology adopters than for non-adopters.

Biswajit (2015) revealed that the lifestyle of the villagers and economic sector of the Mouza were always influenced by the components of physical environment. Lack of some infrastructural facilities is to some extent a hindrance to economic progress.

Prajapati *et al.*, (2016) reported that most livestock farmers who responded to the survey were in their middle years (56.33%), had at least a secondary education (50.67%), belonged to another backward category (59.67%), had small families (59.33%), and belonged to nuclear families (79.33%). 31.33 percent of respondents were marginal farmers, and 66% of respondents practiced mixed farming, in which agriculture and dairying were the main sources of income. Most of the respondents had herds of less than five animals (49.67)

Osarenren *et al.*, (2016) observed that Males who were still in their productive years produced the majority of the cocoa. The study area's cocoa production was very profitable and commercially feasible, as evidenced by the profitability analysis provided by Gross Margin, Net Farm Income value, Benefit Cost Ratio, Expense Structure Ratio, and Rate of Returns.

Masudkar *et al.*, (2017) observed that Most of the farmers in the adopted village were middle-aged (65.34%), and 40.0% of the respondents had large families (more than 7 people). 73.33 percent of the respondents belonged to the open caste category. Regarding schooling, over half of respondents from adopted villages had marginal land ownership (40.00%), nearly half and above respondents from adopted villages (81.37%) had a medium level of annual income. Of respondents from adopted villages, 48.00% had up to middle school education. 76.33% of respondents from the adopted village had a medium degree of economic drive, while 76.00% of respondents from the adopted village had a moderate level of scientific orientation. 60% of responders from the adopted village preferred a medium degree of risk. In terms of socioeconomic status, 70.67% of respondents in the adopted community had middle socioeconomic status, followed by 20.00% of respondents with high socioeconomic status and 9.33% of respondents with poor socioeconomic status.

Sanjeev *et al.*, (2018) concluded that Farmers in the fisheries community of block Musafirkhana, district Amethi, Uttar Pradesh, produce fish at a rate that is somewhat lower than the state average. Farmers came from a variety of age groups, castes, communities, educational backgrounds, and levels of experience. When it comes to feeding and raising

various fish species, farmers are proven to be more inventive. The Uttar Pradesh fisheries department also offers instruction and knowledge about breeding new species.

Bharati *et al.*, (2018) reported that Traditional farming practices are used by farmers, but they don't generate enough cash to support them. The farmer needs affordable technology to lower the cost of farming. The marketing channel also lacks an ordered structure. The issue of unemployment can be resolved if the government offers farmers fair crop sale prices and low-cost input technology. Sugarcane's net profit showed that this crop is valuable in terms of generating revenue and enhancing quality of life. With such a large area under cultivation and sugarcane not being a staple crop, it is clear that farmers in the Nawalparasi district value sugarcane's potential, importance, and status.

Subrata (2018) concluded that the people who live in the study region are still in poverty and are dependent on the agriculture industry to survive. The study area's educational situation is extremely poor, with a high level of illiteracy. Only a small percentage of the population has higher education. Although the electrification of the aforementioned neighbourhood is fairly good, the sanitation facilities are pretty subpar. The residents work primarily in agriculture, which contributes to their poor economic situation. Nearly 60% of the population is considered to be poor. Only a small percentage of farmers possess their own land. They are unable to use the contemporary facilities because of their extremely bad socioeconomic situation. There need a number of measures to the overall socioeconomic development of the farmers.

Pise *et al.*, (2018) observed that the majority of beneficiaries had medium levels of economic motivation, the majority of beneficiaries had marginal land holdings with medium annual incomes, and the majority of beneficiaries had medium extension contacts. The majority of beneficiaries also had illiterate education and medium farming experience and about half of the beneficiaries had medium knowledge about DAMU project, more than half of the beneficiaries had medium level of innovativeness.

Climate resilient technologies

Rathod *et al.*, (2013) revealed when technology efficacy was quite high, the majority of farmers used it. Low adoption was seen as a result of technology's unavailability, low quality, and physical characteristics.

Singh *et al.*, (2013) observed that the line department continues to dominate the dissemination of agricultural technology today. The greatest barrier to the adoption of contemporary horticultural technology in Bihar is the limited number of land holdings and the fragmented nature of the land, which are economic and physiographic considerations. On small and medium farms, a fairly high level of adoption of modern varieties of major crops was seen during the analysis.

Anil *et al.*, (2015) concluded that the majority of respondents knew a fair amount about watershed technologies. The respondents' varying attitudes about the watershed programme, education and training, a lack of engaged workers, and a lack of transportation options exhibited a significant positive link with their degree of understanding. These were thus recognized as the key factors that can be used to estimate how much people know about watershed technologies.

Archana *et al.*, (2017) concluded that the majority of NICRA respondents had high climate ready, compared to the majority of farmers in non-NICRA who had medium readiness.

Because they attended more trainings, participated in more extension activities, and carried out more community-based natural resource management activities than non-NICRA farmers, NICRA farmers were highly motivated to be climate ready to tackle the drought. Farmers in the local community must take the required steps to become more drought-resistant.

Tajpara *et al.*, (2018) revealed that Most farmers have a high level of livestock and agricultural production adaptation in relation to climate resilient technology. A medium level of adaptation was identified for NRM and institutional intervention technologies. The lack of technical know-how to use and repair instruments, a lack of funds to borrow instruments, or

challenges in moving heavy machinery may be the cause of medium level of adaptation in the case of bespoke hiring. In order to enhance farmer interest in climate-related technologies on NRM and institutional intervention, there is specific emphasis and a series of training programmes.

Mahadi *et al.*, (2018) concluded that Due to water shortages, particularly during the boro seasons when AWD practice is not fully followed, the adoption level in the research area was satisfactory. The adopter farmers may therefore have had a hazy understanding of the practice in the study area and felt the risk of a new technology or the possibility of structural issues with the irrigation systems.

Anseera and Alex (2019) observed that with the altered environment, there is always a need to adapt or pursue mitigation strategies in line with climate change. The study concentrated on farmers' awareness of and adherence to climate practices. It is crucial that the farming community is scientifically oriented towards developing climate resilient agriculture, given the positive and significant association between awareness of climate change and the adoption of resilient techniques. The findings will aid in determining the best locations for reducing climate change and fostering system resilience by incorporating locally appropriate resilient techniques into agricultural growth.

Agro-Advisory Services-

Orivaldo Brunini *et al.* (2000) studied that, It is an operational framework that gives farmers and extension services agrometeorological information about soil type, crop development, agricultural practise, pest management, irrigation needs, climatic risks (freeze, drought, dry spell), stored water in the soil, water balance, crop yield, and weather forecast.

Based on meteorological data acquired in 116 locations, the Integrated Center of Agrometeorological Information (CIIAGRO) is now creating a systematic technique for the evaluation of the SPI for the entire state of Sao Paulo. In order to lessen the harmful effects of these irregularities and their implications on society, society must adapt and develop techniques and strategies to overcome these climatic, meteorological, and agronomical adversities.

Weiss *et al.* (2000) reported that, Agrometeorological data, which is utilized to inform decisions, is one end of a continuum; scientific knowledge and understanding are the other. When information is shared in a way that allows end users to benefit the most from using it, such information has value. The collection and transfer of information will heavily rely on the Internet. Multi-Purpose Community Tele Centers (MCTs) will act as the informational equivalent of a supermarket in poor nations. Rural communities can receive information from MCTs via radio. Although agrometeorological information has improved thanks to modern technology, as has the number of end users, further advancements are required to ensure that the information's substance is sufficient to meet community needs.

Rathore *et al.* (2001) reported that with the primary goal of developing medium range weather prediction models for weather systems in the Indian region and for agrometeorological advisory services for the farming community in India, the National Centre for Medium Range Weather Forecasting (NCMRWF) was founded and dedicated to the nation. Every Tuesday, 7 Agrometeorological Advisory Service (AAS) Units located at State Agricultural Universities (SAUs) and other field stations of these SAUs receive location-specific agrometeorological forecasts of rainfall, cloud amount, wind, maximum and minimum temperatures valid for the next 72 hours (viz. Telefax, VSAT, Telephone). Furthermore, these forecasts are provided twice weekly to 29 AAS units (i.e., on Friday also). The ASS units use this data to create an agro-advisory bulletin for the relevant agroclimatic zone. These bulletins include crop-specific advisories for the coming week as well as current and forecasted weather for the next 72 hours. These are communicated to a restricted group of progressive farmers via telephone or personal contact as well as through the media. The realised weather and farmers' reactions to the service are regularly fed back to NCMRWF by AAS units. In addition to English, the majority of the advisory bulletins are written in regional tongues including Marathi, Hindi, Punjabi, Malayalam, Gujarati, Telugu, and Bengali.

Murthy and Stigter (2002) reported that, Stigter created a conceptual and diagnostic framework that depicts the creation and transmission of agrometeorological data from the support systems already in place to its modification, dissemination, and education at the farm level. Agrometeorology must develop on-farm agrometeorological services, according to a diagnosis of present practices. It has been determined that agrometeorological in-service training for extension intermediaries is crucial for training farmers in field classes, boosting

their revenue, and preventing damage to the environment that supports agricultural productivity. In the end, this manifests as practical and direct agrometeorological services in clearly defined farming systems.

Rathore *et al.* (2004) reported that, Weather forecasting can aid in the creation of an agricultural system that is both sustainable and economically viable. Land use management can also increase agricultural production, decrease losses and risks, lower input costs, improve production and yield quality, increase efficiency in the use of water, labour, and energy, protect natural resources, and reduce pollution by using agricultural chemicals or other agents that don't contribute to the degradation of the environment. Although beneficial for some applications, the short-term prognosis is insufficient for planning. agricultural methods that depend on the weather since it takes longer to adopt the needed precautions. For current farming operations to be as effective as possible, forecast information should be available three to ten days in advance.

Chauhan *et al.* (2008) reported that, because there isn't consensus on the definition of a scale of forecasting goodness, the topic of verifying weather predictions has generated debate among meteorologists and others. Results revealed that rainfall forecast accuracy was above average for the post-monsoon and entire year, and exceptional for the pre-monsoon and winter seasons. However, as indicated by the poor HK score, the post-monsoon season's forecasting accuracy was questioned. Except during monsoon season, the accuracy of the rainfall forecast was over 90%. (75 per cent accuracy). In the pre-monsoon, post-monsoon, and winter seasons, the forecast of cumulative weekly rainfall was outstanding; during the monsoon season, it was ordinary. Performance was above average for the entire year. In all the seasons, the accuracy of the wind speed was greater than 95%. Forecast of temperature (maximum and minimum) and wind direction was average (>60 per cent accuracy) in all the seasons and need additional improvements.

Indira Devi and Prasad Rao (2008) reported that, Weather-based agro-meteorological advisory services and farm level economic efficiency research examines whether farms covered by agro-advisory series include management recommendations on efficient input use levels while taking into account the farm's unique physical efficiency and cost of inputs and output. As a result, AAS might be improved to incorporate all facets of farm management.

Prasad Rao (2008) stated that, Agro Advisory Bulletin is composed of three parts structurally. The weather reports for the next five days are included in the first section of the agro advisory bulletin. These weather predictions are made to inform farmers of the maximum and minimum temperatures, average wind speed, amount of precipitation, and cloud cover. The second section of AAB provides accurate information on the different types of crops, their growth stages, agricultural practices, and crop pests and diseases. The bulletin's third section contains information on the agro advisory.

Rathore *et al.* (2009) reported that, the role of the agrometeorologist is to use all pertinent meteorological knowledge to support the farmer in making the best use of his physical surroundings. with the main objective of raising both the amount and quality of agricultural production. Only insofar as motivating the farmer to organize and engage their own resources in order to gain access to expert advice can the agriculture meteorologist be of assistance. Since the monsoon of 2008, the India Meteorological Department, Ministry of Earth Science, has created the Integrated Agrometeorological Advisory Service (IAAS) to assist the farming community in reducing weather- and climate-induced hazards in the agricultural sector. The scheme's primary goals are to create need-based agromet advisories on weather-smart agricultural management and give district level weather forecast in a quantitative format. Roles and duties for each tier of the project's organization have been established.

Choudhary *et al.* (2010) reported that, Comparisons were made between the rainfall, temperature, and cloud cover values predicted at a medium-range level (3-5 days) and observed from 1997 to 2006. In contrast to prior seasons, when rainfall was predicted to range from 67.38% and above, only 49.1% of the monsoon period's rainfall actually occurred. In comparison to the sample of farmers who weren't using AAS, the projections were determined to be positive and beneficial from an economic standpoint.

Rao *et al.* (2010) reported that, the correct forecast from the weathermen is always anticipated by farming community planners and line department personnel for the decision-making process in the event of a natural disruption. IMD's medium range forecast (3–10 days)-based district level agricultural warnings are good yet extensive. While the majority of stations have favorable skill scores for rainfall forecasting, the majority of stations are exhibiting good correlation for maximum and lowest temperatures and relative humidity.

Saha *et al.* (2010) reported that, when a farmer uses agro meteorological advice services, his farm's productivity rises and input losses are decreased.

Cecilia (2012) reported that, The Indian government hopes to quadruple the number of farmers who can receive weather and crop forecasting through their mobile phones from three million to ten million by the end of 2012. This is because the rainy season in India is becoming more turbulent. The importance of this information to the Indian economy, as provided by the Agromet Advisory Service. Every two weeks, the IMD creates a weather package for farmers in each of India's 600 districts and distributes it via SMS text messages. A five-day prediction, a weekly outlook, maximum and lowest temperatures, predicted precipitation, cloud cover, and surface wind humidity are all included in these packages. This information is used by farmers to plan when to sow, water, fertilize, harvest, and increase agricultural yields. One of several effective models of a climate information system that could possibly be tried and expanded in other nations, especially those in sub-Saharan Africa, is India's unique initiative. In order to reduce climate vulnerability and risk, we need the upcoming climate negotiations and the following global climate agreement to have certain measures for promoting research and investment in information systems that can aid decision makers in making plans for the near and long term.

Manjappa and Yeledalli (2012) reported that, the impact of agro advisories issued based on the medium-range weather forecast provided by the National Centre for Medium Range Weather Forecast (NCMRWF) on several weather factors. With the exception of wind direction, which was less than 50% in most years, the utility of other projected weather components was greater than 70% in most years. According to the economic impact assessments, farmers that followed the recommendations offered by the Agromet Advisory Service (AAS) Unit reaped significant benefits.

Palmer (2012) reported that, The Indian government hopes to quadruple the number of farmers who can receive weather and crop forecasting through their mobile phones from three million to ten million by the end of 2012. This is because the rainy season in India is becoming more turbulent. More farmers signing up for the service will likely increase the value of this information, which is offered through the Agromet Advisory Service, to the Indian economy, which has been estimated at more than US$10 billion. Only about 10% to 15% of farmers currently use mobile phone services, and only approximately 24% of farmers

are aware of them. However, India's National Council of Applied Economic Research (NCAER) has calculated that the economic benefit of these services is Rs. 50,000 per year, or about US$10 billion. If all of the nation's farmers used this resource, the total would more than double to Rs. 211,000 crores.

Krishna Reddy *et al.* (2012) reported that, through around 130 agro Meteorological Field Units, the India Meteorological Department (IMD) provides agromet advising bulletins, which include potential weather-related risk mitigation strategies, to farmers and other stakeholders (AMFUs). Using information about the current crop state and weather forecast, the AMFUs create district-level agromet bulletins. An ICT-enabled agrometeorological advisory system is the eAgromet. By utilizing advancements in both agriculture and information technology, eAgromet aims to increase the effectiveness of the process of creating and disseminating agromet advisory bulletins. In this essay, we describe the history, fundamental concepts, structural elements, and operational features of the eAgromet prototype.

Mahadevaiah *et al.* (2012) reported that, through roughly 130 Agro Meteorological Field Units (AFMUs) dispersed throughout India, the Indian Meteorological Department (IMD) offers the Agro-Meteorological Advisory Service (AAS) to the country's farming population. The AAS bulletins are created and sent by AMFUs twice a week throughout the year based on weather forecasts. The possible risk mitigation measures for all weather-sensitive agricultural operations for the crops grown in the area/region of AMFU are contained in the AAS bulletins. The IMD is doing research to enhance the caliber of agromet bulletins; we provide the framework for content development. To enhance the quality of agromet bulletins, the suggested content development framework enables the development of content linked to location-specific weather-sensitive crop activities.

Deore (2012) observed that, many stations are not keeping the information from the Agromet Advisory Bulletin that was provided. The weather-based content of AAB was therefore relatively low in percentage, with the weather element-based advice percent being the lowest. Some AMFU stations were not in a position to supply AAB data for a few years as a result.

The finest vehicle for disseminating innovative inventions, agricultural techniques, and other suggestions made by SAUs to the farming community or end consumers is the AAB issued by all AMFUs the distinct column, however, allows for highlighting unfavorable weather conditions that result in crop losses. such as the Alert massage included in AAB sent by AMFUs.

Ankit Ranjan *et al.* (2013) reported that, since 2007, the India Meteorological Department (IMD) has been issuing agromet advice bulletins, which are based on medium-range weather forecast. In addition to weather-based risk mitigation strategies for crop cultivation and livestock production, agromet advisory bulletins are agricultural guidance bulletins distributed to the farming community for a specific region on weather-sensitive agricultural operations. It is generated by taking into account data on weather forecasts and current crop/livestock conditions. The agricultural community, including farmers and other stakeholders, can benefit greatly from the agromet guidance information.

Kalpana Palkhiwala (2013) reported that, The India Meteorological Department has taken significant steps to implement cutting-edge technologies that are necessary to address the aforementioned weather and climate issues on Indian agriculture, as well as to realize the country's current needs of its farmers and to satisfy the demands of the poorer section of the population. For the benefit of farmers, the country's Integrated Agro-Meteorological Advisory Service (IAAS) was launched by the India Meteorological Department (IMD). The provision of real-time crop- and location-specific agromet services with outreach to the village level by IMD, Ministry of Earth Sciences, is an innovative approach to contribute to weather information-based crop/livestock management plans and activities focused to boosting crop yield. Indeed, this has the potential to alter India's outlook on food security and the reduction of poverty. As an advice bulletin, the IAAS offers the farmer a particularly unique form of input. By utilizing favourable weather conditions and reducing the negative effects of unfavourable weather, it has significantly improved agricultural production.

Krishna Reddy *et al.* (2014) found that, IMD provides Integrated Agromet Advisory Service in the form of agromet advisory bulletins to the nation's farmers. For the main crops and livestock, the agromet advice bulletins include potential risk mitigation strategies. At AMFU, a group of transdisciplinary scientists and agromet scientists generate district-level agromet advice bulletins based on the weather forecast. The farmers and other interested

parties in the relevant district are provided these newsletters. A project to create the IT-based agrometeorological advisory system known as e-Agromet has begun in order to simplify the process of creating agromet bulletins.

CHAPTER-II

RESEARCH METHODOLOGY

In this chapter, the methods and procedure of investigation is used in the study are presented under following points,

A. Conceptual framework of the study
B. Design of research
C. Selection of the area and respondents
D. Data collection tool and procedures
E. Variables and scales for measurements
F. Data processing and analysis

Conceptual framework of the study

In social science research, the concepts used are not always are essentially quantitative, rather most of the concepts are qualitative in nature. So, a concept should be defined in an operational way by which it can be measured. The present study used different concepts which are defined as per standard meaning and also defined operationally.

Impact: A marked effect or influence of an activity. The present study measured impact based on the changes on acreage and productivity of crops in a farm as well as changes in different aspects in household level, farm level as well as societal level in respect of DAMU.

Crop Productivity: It is the crop yield per unit area. In the present study the popular unit of land was taken as the unit and productivity measured in the unit Quintal per Bigha of land. One bigha equals to 0.33 acre in the study area.

Crop area: Amount of land on which a crop is grown.

Agro advisory services: Advisory services means that the directives and advises given by the State agricultural department, KVK, NGO, electronic media or any other such organization in respect of enhancing production and productivity of an agricultural system.

Crop planning in farm level: It is the number of crops, acreage under each crop according to season in the farm level, scheduling of irrigation, plant protection etc.

Crop management: It is the decision to schedule crop planting, irrigation, plant protection and other practices to grow a crop.

Design of research

In a study of evaluation of impact of any project research requires informal study design like before-after control; after with control or before-after with control designs. Due to the time constraints, the present study adopted both before-after without control and after with control research design whenever necessary. However, the present study relied on the memory of respondents when collected information regarding time period before intervention of DAMU project in selected area.

Selection of the area and respondents

The study area was conducted in Birbhum and Malda district of West Bengal. Both for state and district selection was done purposively. Two KVKs were selected purposively from two districts which are implementing DAMU projects. Two blocks from each district were selected purposively, Illambazar and Sriniketan CD block from Birbhum and Ratua-I and Ratua-II CD block from Malda were selected. From each block, two villages were also selected purposively. The respondents are categorized into two groups—beneficiary and non-beneficiary; and 5 beneficiaries and 5 non-beneficiaries were selected from each block randomly. Total 20 beneficiaries and 20 non-beneficiaries from each district is selected and the total number of respondents were 80.

Description of the study area

The Birbhum District

It is located between 88° 1′ 40″ and 87° 5′ 25″ east longitude and 23° 32′ 30″ and 24° 35′ 0″ north latitude. It has the appearance of an isosceles triangle. The river Ajay forms the triangle's foundation, and the apex is located at its northernmost point not far south of where the Ganges and the Santhal Paraganas' hills start to divide. Santhal Paraganas, the districts of Murshidabad and Burdwan, the districts of Burdwan, and the Ajay River form the northern, western, eastern, and southern boundaries of Birbhum, respectively. The district covers 4545 square kilometres of land.

The district comprises three subdivisions: Suri Sadar, Bolpur and Rampurhat. Suri is the district headquarters. There are 19 development blocks, 6 municipalities and 167 gram panchayats in this district.

Climate, Soil and Agriculture of the district

The summers are dry and hot in Birbhum, with temperatures frequently going above average.The temperature in the summertime often exceeds 40°C (104°F). In Birbhum, the summer months typically begin in the middle of March and extend through the middle of June. The start of the monsoon season in Birbhum coincides with the month of June. The region boasts a high annual rainfall average. However, it has been noted that the western part of the Birbhum district has more rainfall than the eastern part. An illustration of this is the variation in annual rainfall between Rajnagar (1,405 millimetres) and Nanoor (1,212 millimetres). In Birbhum, the monsoon season lasts until the middle of October.

Birbhum experiences nice and comfortable winters, with temperatures dropping to around 10°C (50°F). While the temperature during the day is pleasantly comfortable, when dusk approaches, it drops much lower, making the nights chilly and freezing. Winter season begins in December and lasts through the month of February. The study area is mainly undulating, with hills and valleys, and it shows varying grades of laterization in the development of soil. The soil is typically well-drained, prone to erosion from rapid external drainage or runoff, acidic in ridges and nearly neutral in valleys, saturated with bases, and

rich in organic carbon. Phosphorus matter and potash are notably low at ridge but rise down the slope, especially at valley.

Agriculture of the region is mostly rain dependent. Ground water is not easily and economically harvestable. Prevalence of moisture stress on standing Kharif crops during the late monsoon period is very common. Paddy is the major crop of this district which covers an area of 94% of the total cultivated area of the district during kharif. Other major crops are Oilseeds, Wheat & pulses, vegetables.

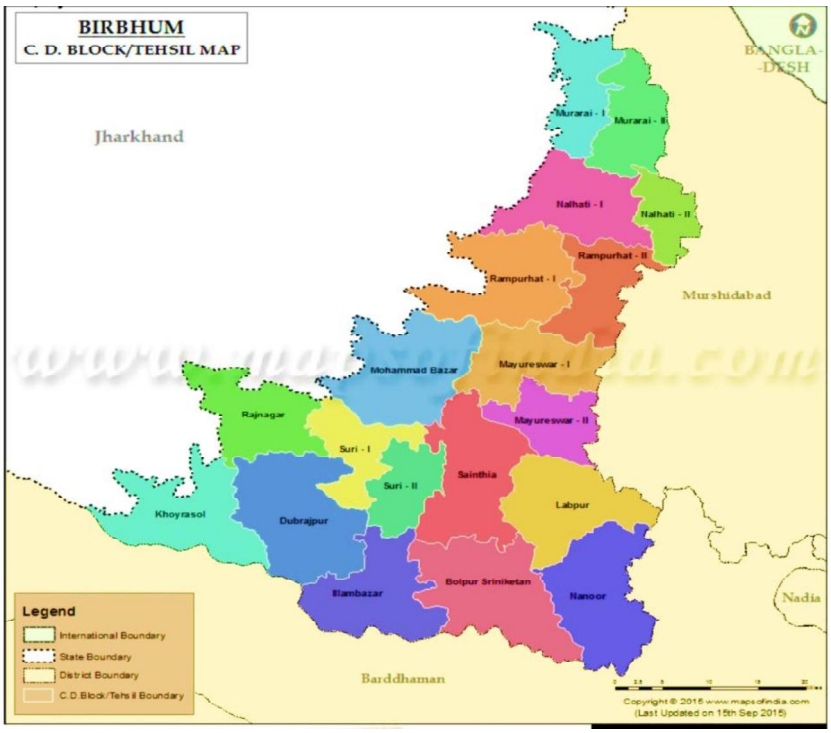


Plate 3.1 Map of Birbhum District

Description of Sriniketan CD block

Geography

Sriniketan is located at 23°40′33″N 87°39′37″E. The Suri-Bolpur Plain, one of Birbhum district's four sub-micro physiographic zones, includes Bolpur Sriniketan CD Block. In the district's southeast, it covers the interfluves of the Mayurakshi and Ajay rivers. The geography in this area is relatively highland and slopes from the north-west to the south-east.

Sainthia and Labpur CD Block, Nanoor CD Block, Ausgram II CD Block in Purba Bardhaman district, across the Ajay, and Ilambazar CD Block are the CD Blocks that border Bolpur Sriniketan to the north, east, south, and west, respectively. With 334.58 km2, Bolpur Sriniketan CD Block is relatively large.

According to official statistics, there are 159 inhabited villages, 170 mouzas, 9 gramme panchayats, 99 gramme sansads, and 1 panchayat samity in this area., as per District Statistical Handbook Birbhum 2008.

Demography

According to the 2011 Indian Census, there were 202,553 people living in the Bolpur Sriniketan CD Block, of which 190,393 lived in rural areas and 12,160 in urban ones. There were 99,831 (49%) females and 102,722 (51%) males. There were 23,160 people under the age of six. The highest percentages of Scheduled Castes and Scheduled Tribes among all CD Blocks in the district were 61,960 (30.59%) and 38,615 (19.06%) respectively.

According to the 2001 census, there were 175,490 people living in Bolpur Sriniketan block, with 89,581 men and 85,909 women. Population growth in the Bolpur Sriniketan block was 15.42% between 1991 and 2001. The district of Birbhum experienced decadal growth of 17.88%. West Bengal saw a 17.84% decadal growth. Census Town in Bolpur Sriniketan CD Block is (2011 census figures in brackets): Surul (12,160).

Large villages (with 4,000+ population) in Bolpur Sriniketan CD Block are (2011 census figures in brackets): Mehidipur (4,080), Bahiri (5,222), Sansat (4,551), Singi (5,723) and Ruppur (3,803),

Other villages in Bolpur Sriniketan CD Block include (2011 census figures in brackets): Kasba (2,611), Panchsoa (1,851), Shian (2,106), Muluk (3,361), Supur (1,803), Raipur (2,320) and Sarpalehana (1,109).

Literacy

According to the 2011 Census, there were 126,779 literates overall in the Bolpur Sriniketan CD Block (70.67% of the population over the age of 6), of which there were

70,323 men (77.29% of the male population over the age of 6), and 56,456 women (63.86% of the female population over the age of 6). The gender gap (difference between the literacy rates of men and women) was 13.42%.

The villages selected from Bolpur Sriniketan CD block are Surul and Ruppur. The agroclimatic, demographic and socio-economic characteristics of those villages are similar as the block.

Description Illambazar block

Geography

Geographically, the Birbhum district is a part of the former Rarh area. The Chota Nagpur Plateau mainly extends into the western part of the district. Most of the soil in the area is loose, reddish lateritic, and low fertility. The major rivers including the Ajay, Bakreshwar, Mayurakshi, and Brahmani have soft alluvial soil in their flood plains in the east. 3.5% of the district is only covered in forest. Despite the district's coal reserves and the 1050 MW Bakreshwar Thermal Power Station, agriculture still accounts for the majority of Birbhum's economic activity. In West Bengal, significant land reforms started in 1977. Peasants were given access to land that was obtained over the land ceiling.

In Birbhum district, 19,968 hectares of vested agricultural land has been distributed amongst 161,515 beneficiaries, till 2011. However, more than 38% of the operational land holding is marginal or less than 1 acre. The proportion of agricultural labourers amongst total workers in Birbhum district is 45.9%, the highest amongst all districts of West Bengal. Ilambazar is located at 23°38′N 87°32′E.

The Suri-Bolpur Plain, one of Birbhum district's four sub-micro physiographic areas, includes the Ilambazar CD Block. In the district's southeast, it covers the interfluves of the Mayurakshi and Ajay rivers. The geography in this area is relatively highland and slopes from the north-west to the south-east. Suri II CD Block, Bolpur Sriniketan CD Block, Kanksa and Faridpur Durgapur CD Blocks in Paschim Bardhaman district, across the Ajay on the south, and Dubrajpur CD Block on the west are the boundaries of Ilambazar CD Block.

Ilambazar CD Block has an area of 261.54 km2. It has 1 panchayat samity, 9-gram panchayats, 86-gram sansads (village councils), 134 mouzas and 128 inhabited villages, as per District Statistical Handbook Birbhum 2008. Ilambazar police station serves this block. Headquarters of this CD Block is at Ilambazar.

Gram panchayats of Ilambazar block/panchayat samiti are: Batikar, Bilati, Dharampur, Gurisha, Illambazar, Jaydev Kenduli, Mongaldihi, Nanasole and Sirsha.

Demography

Population

Ilambazar CD Block had a total population of 168,709 as per the 2011 Indian Census, of which 161,584 lived in rural areas and 7,125 in urban ones.

There were 82,021 women and 86,688 men, or 51 percent each. 21,097 people were under the age of six. The number of Scheduled Castes was 39,866 (23.63%), and the number of Scheduled Tribes was 15,087 (8.94%). Ilambazar block had a total population of 144,490 as of the 2001 census, of which 74,366 men and 70,124 women. The population of Ilambazar block increased by 19.52 percent between 1991 and 2001. The district of Birbhum experienced decadal growth of 17.88%. West Bengal saw a 17.84% decadal growth. Ilambazar is the Census Town in the Ilambazar CD Block (2011 census data in brackets) (7,125).

Large villages (with 4,000+ population) in Ilambazar CD Block are (2011 census figures in brackets): Sahapur (4,369), Shripur (4,134) and Chaupahari Jangal (4,445).

Other villages in Ilambazar CD Block include (2011 census figures in brackets): Jaydev Kenduli (3,280), Batikor (3,086), Nanasol (265), Mangaldidhi (2,668), Dharampur (1,127), Shirsha (2,319), Bilati (749) and Makra (1480).

Literacy

According to the 2011 Census, there were 109,023 literates overall in the Ilambazar CD Block (74.27% of the population over the age of 6), of which 60,663 were men (80.40%

of the male population over the age of 6), and 48,360 were women (67.78% of the female population over the age of 6). The gender gap (difference between the literacy rates of men and women) was 12.62%.

The villages selected from Illambazar CD block are Sahapur and Shripur. The agroclimatic, demographic and socio-economic characteristics of those villages are similar as the block.

The Malda District

The range of latitudes is 24°40'20" to 25°32'08" and the range of longitudes is 87°45'50" to 88°28'10". The area of the district is 3,733.66 square kilometres (1,441.6 sq mi). In accordance with the 2001 Census, there were 3,290,160 people living there. The gateway to North Bengal is Malda.

With its 3,733 square kilometres (1,441 square miles) of area divided into Tal, Diara, and Barind, it was originally the centre of Gour-Banga. Murshidabad District lies in the south, and North Dinajpur and South Dinajpur Districts are in the north. The international border with Bangladesh is located to the east. Jharkhand's Santhal Parganas and Bihar's Purnea are to the west.

The district comprises two subdivisions: Chanchal and Malda Sadar. Chanchal consists of six community development blocks: Chanchal–I, Chanchal–II, Ratua–I, Ratua–II, Harishchandrapur–I and Harishchandrapur–II. Malda Sadar subdivision consists of Old Malda municipality, English Bazar municipality and nine community development blocks: English Bazar, Gazole, Habibpur, Kaliachak–I, Kaliachak–II, Kaliachak–III, Manickchak, Old Malda and Bamangola. English Bazar is the district headquarters. There are 15 development blocks, 2 municipalities, 146 gram panchayats and 3,701 villages in this district.

Climate, Soil and Agriculture of the district

Malda typically experiences highly humid tropical weather. In May and June, daytime highs can reach 42 °C (108 °F), while overnight lows in December and January can reach 8 °C (46 °F). The average yearly temperature in Malda is 26.4 °C (79.5 °F). 1,554 mm of

precipitation fall annually on average. The month of December is the driest. In December, there is 4.3 mm (0.17 in) of precipitation. The month of July experiences the most precipitation, averaging 352 mm.

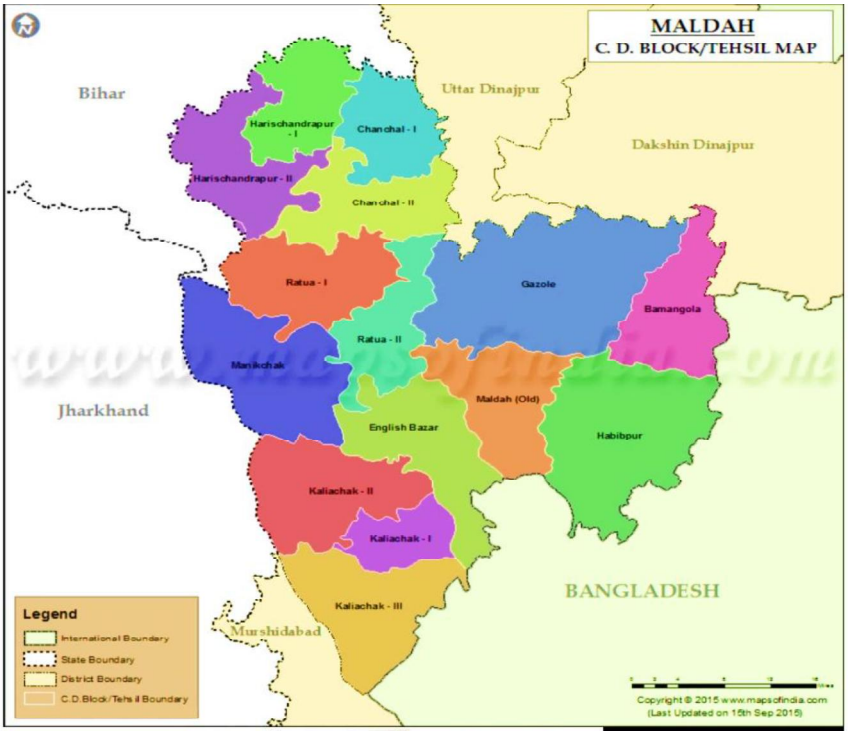


Plate 3.2 Map of Malda district

The district of Malda has three different kinds of soils i.e., i) Old alluvium soils covering 77700 hectares, ii) Vindhyan alluvial soil covering 17130 hectare and iii) Ganga alluvial soils spreading over 243540 hectares of the district. The entire area of research is mainly covered by alluvium.

Agriculture: Mango, Litchi Orchards and Sericulture form the backbone of the economy of the district. Paddy, wheat, maize, mustard and potato are the major field crops. Other crops cultivated in the district are jute, mulberry and sugarcane.

Description of Ratua-I Block

Geography

Location of Ratua is 25°12′N 87°56′E. One of the district's three physiographic sub-regions, the Tal, includes Ratua I CD Block.

The sub-region primarily remains submerged during the monsoons and during the dry season vast areas of it convert into mud banks with several shallow marshes dispersed about. "The Tal region progressively slopes down towards the south-west and joins with the Diara sub-region."

River's meander through the area with virtually any grade. The CD Block is bordered by the Kalindri River. In the Ratua I CD Block, the gramme panchayats of Debipur, Mahanandatola, Bilaimari, Kahala, and Baharal may sustain damage from flooding from the neighboring Fulahar, Koshi, and Kalindri rivers.

Ratua I CD Block is bordered on the north by the CD Blocks of Harishchandrapur II and Chanchal II, on the east by the CD Block of Ratua II, on the south by the CD Block of Manikchak, and on the west by the CD Block of Amdabad in the Bihar district of Katihar. Ratua I CD Block is 225.17 km2 in size. It has 95 inhabited villages, 101 mouzas, 10 gramme panchayats, 166 gramme sansads, and 1 panchayat samity. This block is serviced by the Ratua police station. This CD Block's administrative centre is in Ratua. Gram panchayats of Ratua I block/ panchayat samiti are: Debipur, Mahanandatola, Bilaimari, Kahala, Ratua, Baharal, Bhado, Samsi, Chadmoni I and Chandmoni II.

Demography

Population

There were 275,388 people living in Ratua I CD Block overall, all of them were rural, according to the 2011 Indian Census. There were 133,205 women and 142,183 men, or 52 percent each. Population under the age of six: 45,676. 30,538 Scheduled Castes (11.09%) and 23,458 Scheduled Tribes (8.52%) were recorded.

Large villages (with 4,000+ population) in Ratua I CD Block were (2011 population in brackets): Gadai Maharajpur (15,023), Kamalpur (6,802), Maniknagar (8,877), Balupur (10,808), Durgapur (5,366), Debipur (4,070), Jannagar (4,140), Austola (4,880), Ratua (5,498), Rukundipur (7,260), Karbana (4,046), Bihari (4,183), Bahirkap (4,549), Bhado (17,190), Kankot (6,491), Parakaram (6,386), Okhra Chandpara (5,196), Chhabilpara (6,479),

Andhirampara (5,041), Bijrabhita (5,513), Lakshmipur (4,170), Santapur (5,322), Talparanpur (4,618), Dakshin Durgapur (4,219) and Sahapur (5,005).

Other villages in Ratua I CD Block included (2011 population in brackets): Samsi (2,686) and Baharai (2,775).

Literacy

According to the 2011 Census, there were 138,137 literates overall in Ratua I CD Block (60.13% of the population over the age of 6), of whom 76,280 (64.17% of the male population over the age of 6 years) and 61,857 (55.81% of the female population over the age of 6 years) were female. The gender gap (difference in literacy rates between men and women) was 8.36%.

The villages selected from Ratua-I CD block are Ratua and Rukundipur. The agroclimatic, demographic and socio-economic characteristics of those villages are similar as the block.

Description of Ratua-II Block

Geography

Ratua II is located at 25°08′05″N 88°02′11″E. One of the three physiographic sub-regions of the district, the Tal, includes the Ratua II CD Block. "The Tal region progressively slopes down towards the south-west and merges with the Diara sub-region... (it) is studded with numerous marshes, bils, and oxbow lakes," says the district. During the monsoons, the sub-region is largely submerged, and during the dry season, vast portions of it are covered in mud banks and shallow marshes. River's meander through the area with virtually any grade. The Mara Mahananda River runs through the CD Block, the Mahananda River forms its eastern boundary, and the Kalindri River skirts its southern limits.

Ratua II is bordered to the north by Chanchal II CD Block, to the east by Gazole CD Block and Old Malda CD Block, to the east by English Bazar CD Block, to the south by Manikchak CD Block, and to the west by Ratua I CD Block and Chanchal II CD Block. The Ratua II CD Block covers 101.29 km2. It has 48 inhabited villages, 51 mouzas, 8 gramme

panchayats, and 124 gramme sansads (village councils). This CD Block's administrative centre is at Pukhuria.

Over the last three decades of the previous century, the left bank erosion of the Ganges upstream of the Farakka Barrage has caused over 4.5 lakh people to become homeless in the Manikchak, Kaliachak I, II, and III, and Ratua blocks. Between Bhutnidiara and Panchanandapore in the Kaliachak II block is where the damage is the worst. The Manikchak and Kalichak regions lost 750 km2 of land in 30 years, claims the Ganga Bhangan Pratirodh Action Nagarik Committee. Sripur I, Sripur II, Maharajpur, Sambalpur, Paranpur, Araidanga, Pukhuria, and Pirganj are the gramme panchayats of Ratua II block/panchayat samiti.

Demography

Population

As per 2011 Census of India, Ratua II CD Block had a total population of 202,080, all of which were rural. There were 102,962 (51%) males and 99.118 (49%) females. Population below 6 years was 31,373. Scheduled Castes numbered 12,880 (6.37%) and Scheduled Tribes numbered 1,954 (0.97%).

Large villages (with 4,000+ population) in Ratua II CD Block were (2011 population in brackets): Laskarpur (4,043), Magura (4,561), Magura Khod (5,844), Barail (7,031), Sambalpur (9,250), Kumarganj (6,131), Raninagar (6,422), Maharajpur (8,978), Rajapur (6,143), Rangamatia (4,858), Shibnagar (8,298), Kadamtali (6,323), Nijgan Paranpur (8,523), Chandpur (6,183), Naoda (5,017), Nij Ganaraidanga (4,765), Betahaek Barna (4,335), Sultanpur (6,778), Koklamari (5,923), Pukhuria (22,550), Nasipur (6,404) and Satmara (5,224). Other villages in Ratua II CD Block included (2011 population in brackets): Shripur (2,687).

Literacy

According to the 2011 Census, there were 95,915 literates in the Ratua II CD Block (56.19% of the population over the age of 6), of which 50,738 (58.31% of the male

population over the age of 6), and 45,177 (54.03% of the female population over the age of 6), were female. The gender gap (difference between the literacy rates of men and women) was 4.28%.

The villages selected from Ratua-II CD block are Chandpur and Sultanpur. The agroclimatic, demographic and socio-economic characteristics of those villages are similar as the block.

Data collection tool and procedures

The primary data was collected by using household interviews with the help of interview schedule. The interview has information on two villages from each selected blocks from each district with 5 number of beneficiaries and 5 number of non-beneficiaries thereby total number of 80 respondents. Information was collected on socio-economic variables such as age, religion, caste, educational status, household status, farming experience, mass media contact, personal media contact, total land holding, cultivated land and total income. Other variables are crop acreage, crop productivity, use of agro-advisory services and use of Damini and Meghdoot aap.

Variables and scales for measurements

Age- Direct number value taken as variables.

Family information – Family information collected on total number of members, their education status, caste, religion. Direct numerical values were taken in each case with their corresponding scale.

Farming Experience- Years of practical contact with farming. Direct number value taken as variables.

Personal media contact- Sum of scores on frequency of communication with particular personnel like progressive farmers, agents of farmers' club, agents of KVK, line department etc.

Mass media contact- Sum of scores on frequency of contact with mass media channels like radio, TV, internet, newspaper etc.

Household Status- Sum total of scores obtained from quality of house, Sanitation, electricity and possession of household appliances.

Land holding- Possession of total land in Bigha (0.33 ac)

Total income- Yearly income from all sources in Rs.

Crop acreage- Direct numerical value taken as variables in local unit (1acre= 1.613 bigha)

Crop productivity- Crop yield/ Bigha

Use of agro advisory services- The scale composed with the use of agro advisory services released from DAMU and other sources (Never=0, Sometimes=1, Frequently=2)

Use of 'Damini' and 'Meghdoot' App- The scale composed with the use of those mobile apps by the respondents. (Never=0, Sometimes=1, Frequently=2)

Opinion regarding impact of DAMU- The scale composed with opinion of respondents regarding DAMU [Strongly disagree (1), Disagree (2), Undecided (3), Agree (4), Strongly agree (5)]

Statistical methods used

The statistical methods used in the study include mean, percentage, Paired t-test, standard deviation.

Mean

The mean is the average of the values in the given set. We must first add up (sum) all of the data values (x) in order to determine the arithmetic mean of a set of data, and then

divide the result by the total number of values (n). Since the symbol for summarizing values is (see Sigma Notation), we arrive at the formula shown below for the mean (x):

$$\bar{x}=\sum x/n$$

Where, X- Represents items to be averaged

n- Represents the number of items.

Percentage

Percentage is used for making simple comparison. For calculating percentage, the frequency of a particular cell is divided by the total frequency and then the result was multiplied by 100 to obtain the percentage. The mathematical expression is follows:

$$\text{Percentage} = (\text{Frequency})/N * 100$$

Where, N = number of respondents

Frequency

Frequency is the statistical measure to represent the number of respondents in a particular category.

Standard deviation

The standard deviation is a measurement of how much a group of values vary or are dispersed. While a high standard deviation suggests that the values are dispersed throughout a wider range, a low standard deviation suggests that the values tend to be close to the established mean. For frequency distribution, Standard Deviation (S.D.) is measured as follows:

$$\sigma =\sqrt{(1/N)} \sum fi\ (Xi-\bar{x})^2$$

Where, σ = standard deviation

N = Total number of observations

X= Value of observation of a particular cell

f = Frequency of observation in the corresponding cell

$\overline{x}$= Mean of the observation

i = any number (e.g., 1, 2, 3.....) denoting position

Paired t- test-

The paired t-test gives a hypothesis examination of the difference between population means for a set of random samples whose variations are almost normally distributed. Subjects are often tested in a before-after situation or with subjects as alike as possible. The paired t-test is a test that the differences between the two observations are zero.

Let us assume two paired sets, such as Xi and Yi for i = 1, 2, …, n such that their paired difference is independent which are identically and normally distributed. Then the paired t-test concludes whether they notably vary from each other.

Formula- Where, Σd is the sum of the differences.

$$t = \frac{\sum d}{\sqrt{\frac{n(\sum d^2) - (\sum d)^2}{n-1}}}$$

Data processing and analysis-

The data of the present investigation were processed by Microsoft Excel and analyzed with support of SPSS statistical software.

The statistical methods such as percentage, mean, t-test, standard deviation used as per the characteristics of data analysis

CHAPTER-IV

RESULTS AND DISCUSSION

The chapter systematically presents the results of the study and presented with discussion as per the objectives.

Socio-economic and personal characteristics of the respondent

Table 4.1 to 4.12 represents the socio-economic and personal characteristics of the respondents and also compared among beneficiary and non-beneficiary farmers.

Table- 4.1 Age distribution of respondents

Age				
Years	Non-beneficiary	Percentage	Beneficiary	Percentage
<39	9	22.50	4	10.00
39 to 53	26	65.00	27	67.50
>53	5	12.50	9	22.50

Among the non-beneficiary respondents, the age of 22.50 percent of respondents are less than 39 years old followed by 65.00 percent respondents are under the age group of 39 to 53 years and 12.50 percent respondents are above 53 years whereas in case of DAMU beneficiary 10.00 percent respondents are less than 39 years old followed by 67.50 percent respondents are under the age group of 39 to 53 years and 22.50 percent respondents are above 53 years respectively.

Table- 4.2 Caste distribution of respondents

Caste				
Caste	Non beneficiary	Percentage	Beneficiary	Percentage
ST	5	12.50	2	5.00
SC	15	37.50	16	40.00

OBC	9	22.50	10	25.00
General	11	27.50	12	30.00

Caste distribution shows that 12.50 percent respondents from non-beneficiary are ST, 37.50 percent are SC, 22.50 percent are from OBC and 27.50 percent are under general caste whereas 5.00 percent ST, 40.00 percent SC, 25 percent OBC and 30.00 percent general caste are from DAMU beneficiary.

Table- 4.3 Religion distribution of respondents

Religion				
Religion	Non beneficiary	Percentage	Beneficiary	Percentage
Hindu	28	70.00	32	80.00
Muslim	12	30.00	7	17.50
Cristian	0	0	1	2.50

From the non-beneficiary, 70 percent respondents are Hindu and 30 percent respondents are Muslim whereas Hindu religion respondents are more among DAMU beneficiaries that is 80 percent. 17.5 percent respondents are Muslim and 2.5 percent Cristian among DAMU beneficiaries.

Table- 4.4 Education distribution of respondents

Educational Status				
Status	Non beneficiary	Percentage	Beneficiary	Percentage
Illiterate	2	5.00	0	0
Primary	9	22.50	0	0
Secondary	16	40.00	5	12.50
Higher Secondary	13	32.50	14	35.00
Graduation and above	0	0	21	52.50

In case of Educational Status, it is found that 5 percent respondents from non-beneficiaries are illiterate, followed by 22.5 with primary education, 40 percent with

secondary education and 32.5 percent are having higher secondary education, whereas in case of DAMU beneficiary's 12.5 percent respondents having secondary education, 35 percent having higher secondary education and 52.5 percent respondents are holding graduation and above educational status.

Table- 4.5 Distribution of respondents according to personal media contact

Personal Media contact				
Status	Non beneficiary	Percentage	Beneficiary	Percentage
Low	10	25.00	3	7.50
Medium	30	75.00	27	67.50
High	0	0	10	25.00

In case of personal media contact results shows that the 25 percent of respondents from non-beneficiary reported to have low score followed by 75 percent have medium score, whereas in DAMU beneficiary 7.5 percent respondents are reported to have low level of personal media contact, 67.5 percent medium level and 25 percent of respondents have high level of personal media contact.

Table- 4.6 Distribution of respondents according to mass media contact

Mass Media contact				
Status	Non-beneficiary	Percentage	Beneficiary	Percentage
Low	17	42.50	6	15.00
Medium	21	52.50	18	45.00
High	2	5.00	16	40.00

In mass media, participation results show that the 42.5 percent of respondents reported to have low score followed by 52.5 percent have medium score and 5 percent have high score among non-beneficiary. 15 percent of respondents reported to have low score followed by 45 percent have medium score and 40 percent have high level of mass media participation among DAMU beneficiary.

Table- 4.7 Distribution of respondents according to household status

Household Status				
Status	Non-beneficiary	Percentage	Beneficiary	Percentage
Low	12	30.00	2	5.00
Medium	28	70.00	22	55.00
High	0	0.00	16	40.00

In household status results show that the 30 percent of respondents reported to have low score followed by 70 percent have medium level of household status among non-beneficiary. 5 percent of respondents reported to have low score followed by 55 percent have medium score and 40 percent have high level of mass media participation among DAMU beneficiary.

Table- 4.8 Distribution of respondents according to land holding

Total Land Holding Status (Bi)				
Status	Non beneficiary	Percentage	Beneficiary	Percentage
Low (up to 11.5)	12	30.00	0	0.00
Medium (11.5 to 23.5)	27	67.50	26	65.00
High >23.5	1	2.50	14	35.00

The result shows that majority of respondents from non-beneficiary are under land holding group of 11.5 to 23.5 bigha (67.5percent), 30 percent respondents are having up to 11.5 bigha land holding and above 23.5 bigha land holding group having 2.5 percent respondents, whereas in case of DAMU beneficiaries 11.5 to 23.5 bigha land holding group having 65 percent of respondents and 35 percent having above 23.5 bigha land holding.

Table- 4.9 Distribution of respondents according to possession of cultivated land

Cultivated land (Bi)				
Status	Non beneficiary	Percentage	Beneficiary	Percentage
Low<9.5	16	40.00	0	0
Medium	24	60.00	28	70.00

9.5 to 19				
High>19	0	0	12	30.00

The result shows that majority of respondents from non-beneficiary are under cultivable land holding group of 9.5 to 19 bigha (60 percent), 40 percent respondents are having up to 9.5 bigha cultivable land holding, whereas in case of DAMU beneficiaries 9.5 to 19 bigha cultivable land holding group having 70 percent of respondents and 30 percent having above 19 bigha cultivable land holding.

Table- 4.10 Distribution of respondents according to yearly income

Total income				
Status	Non beneficiary	Percentage	Beneficiary	Percentage
Low	6	15.00	0	0
Medium	32	80.00	31	77.50
High	2	5.00	9	22.50

It indicates that the non-beneficiary farmers having in low-income group are 15 percent, followed by medium level income group are the majority in income level with 80 percent and 5 percent respondents having high income level, whereas the beneficiary respondents of DAMU having 77.5 percent with medium income level and 22.5 percent respondents belongs in high income level.

Table – 4.11 Distribution of respondents according to year of farming experience

Farming Experience				
Status	Non beneficiary	Percentage	Beneficiary	Percentage
Low <13	9	22.50	6	15.00
Medium 13 to 27	26	65.00	28	70.00
High > 27	5	12.50	6	15.00

Among the non-beneficiary respondents, the farming experience of 22.50 percent of respondents are less than 13 years followed by 65.00 percent respondents are under the medium level of farming experience group of 13 to 27 years and 12.50 percent respondents are above 27 years of farming experience, whereas in case of DAMU beneficiary 15.00 percent respondents are less than 13 years of farming experience followed by 70 percent respondents are under the farming experience group of 13 to 27 years and 15 percent respondents are above 27 years respectively.

Table 4.12 presented a comparative analysis of beneficiary and non-beneficiary respondents. The table indicates the mean comparison between DAMU beneficiaries and non-beneficiaries' respondents according to socio economic and personal characters.

Table- 4.12 Comparative socio-economic and personal status

Comparison between beneficiary and non-beneficiary regarding Socio-economic characteristics			
Socio-economic characteristics	Mean value		t-value
	non-beneficiary	Beneficiary	
Age	48	45.43	1.56 NS
Educational Status	3	4.4	7.85 **
Farming Experience	19.58	20.67	0.72 NS
Personal media contact	5.2	7.62	8.75 **
Mass media exp.	2.8	5.82	13.51 **
Household status	15.75	20.71	10.19 **
Total Land (Bi)	13.13	21.97	9.76 **
Cultivated land	10.61	17.95	9.83 **
Total income	84665	185560	7.37 **

NS= non-Significant, *= Significant at 5% level, **= Significant at 1% level

It shows that the mean value of beneficiaries of DAMU in case of educational status, personal media contact, mass media contact, household status, total land holding, cultivable land area, total income is more than the non-beneficiaries that is 4.4, 7.62, 5.82, 20.71, 21.97, 17.95 and 185560. But in case of age the mean value of non-beneficiary is more than the beneficiary from DAMU is 48. The t value is significant in educational status of respondents, personal media contact, mass media contact, household status, total land holding status, cultivable land and income. It implies that there is a significant difference between the beneficiaries under DAMU and non-beneficiaries.

Use of Agro-advisory services by the respondents

This section presented the extent of utilisation of agro-advisory sources for betterment of farming practices.

Table- 4.13 Extent of utilisation of different agro-advisory sources

Source used by respondents for agro-advisory services					
Source	Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
State agricultural department	Never	18	45.00	0	0
	sometimes	22	55.00	40	100.00
	Frequently	0	0	0	0
Email	Never	40	100	18	45.00
	sometimes	0	0	22	55.00
	Frequently	0	0	0	0
What's app	Never	16	40.00	0	0
	sometimes	24	60.00	8	20.00
	Frequently	0	0	32	80.00
Other social media	Never	28	70.00	18	45.00
	sometimes	12	30.00	22	55.00
	Frequently	0	0	0	0
Mobile app	Never	14	35.00	0	0
	sometimes	26	65.00	0	0
	Frequently	0	0	40	100.00
Text message on registered mobile number under DAMU	Never	40	100.00	0	0
	sometimes	0	0	0	0
	Frequently	0	0	40	100.00
Text message on registered mobile	Never	22	55.00	14	35.00

number from another project					
	sometimes	18	45.00	14	35.00
	Frequently	0	0	12	30.00
Online awareness programme	Never	24	60.00	0	0
	sometimes	16	40.00	40	100.00
	Frequently	0	0	0	0
KVK websites	Never	24	60.00	0	0
	sometimes	16	40.00	14	35.00
	Frequently	0	0	26	65.00
Institute websites	Never	40	100.00	40	100.00
	sometimes	0	0	0	0
	Frequently	0	0	0	0
NGO	Never	28	70.00	27	67.50
	sometimes	12	30.00	13	32.50
	Frequently	0	0	0	0

This table indicates that non-beneficiaries never use agro-advisory services through email and institute websites and as they have not registered mobile number under DAMU, so they do not get any advisory services through text message on registered mobile number under DAMU. 55 percentage of non-beneficiary respondents use State agricultural department for agro-advisory services sometimes and 60 percent among them uses what's app sometimes for agro-advisory services. The percentage of non-beneficiaries according to the use of other social-media, Mobile app, text message on registered mobile number from another project, online awareness programme, KVK websites, NGO for agro-advisory services sometimes is 30, 65, 45, 40, 40 and 30. While 100 percent of the beneficiaries are using frequently mobile app, text message on registered mobile number under DAMU for agro-advisory services. Among beneficiaries, 80 percent uses what's app, 55 percent uses other social media and65 percent uses KVK websites frequently for agro-advisory services. 100 percent of them never use institute websites for any advisory service.

Opinion of respondents regarding impact of DAMU

Result on opinion of the beneficiaries and non-beneficiaries on different changes in farm, household and community level were studied in this section.

Table- 4.14 Opinion of respondents regarding increased number of crops in my farm after DAMU

Increased number of crops in my farm				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	0	0
Disagree (2)	39	97.50	1	2.50
Undecided (3)	1	2.50	29	72.50
Agree (4)	0	0	10	25.00
Strongly agree (5)	0	0	0	0

This table shows that among non-beneficiaries' 97.50 percent and 2.50 percent beneficiaries are disagreed regarding this opinion and it's undecided for 72.50 percent beneficiaries, while 25 percent beneficiaries agreed with this opinion.

Table- 4.15 Opinion of respondents regarding Increased production of crops in my farm after DAMU

Increased the production of crops				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	0	0
Disagree (2)	39	97.50	0	0
Undecided (3)	1	2.50	0	0
Agree (4)	0	0	36	90.00
Strongly agree (5)	0	0	4	10.00

This tables indicates that there are no non-beneficiaries who agreed with this opinion regarding DAMU, but 90 percent of beneficiaries are agreed and 10 percent strongly agreed with this opinion regarding DAMU.

Table- 4.16 Opinion of respondents regarding decision to irrigate after DAMU

I can take decision whether to irrigate or not				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	8	20.00	0	0
Disagree (2)	31	77.50	0	0
Undecided (3)	1	2.50	0	0
Agree (4)	0	0	20	50.00
Strongly agree (5)	0	0	20	50.00

In case of this opinion, 50 percent of beneficiaries agreed and 50 percent strongly agreed with this, while 77.50 percent non-beneficiaries disagreed with it.

Table-4.17 Opinion of respondents regarding number of irrigation after DAMU

I can decide about number of irrigations				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	10	25.00	0	0
Disagree (2)	29	72.50	0	0
Undecided (3)	1	2.50	0	0
Agree (4)	0	0	29	72.50
Strongly agree (5)	0	0	11	27.50

This table shows that the 72.50 percent beneficiaries agreed and 72.50 percent of non-beneficiaries disagreed regarding this opinion, while 27.50 percent of beneficiaries strongly agreed about it.

Table-4.18 Opinion of respondents regarding change in farm after DAMU

Introduction of DAMU not at all changed anything in my farm				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	2	5.00
Disagree (2)	0	0	18	45.00
Undecided (3)	0	0	19	47.50
Agree (4)	20	50.00	1	2.50
Strongly agree (5)	20	50.00	0	0

In case of this opinion, 45 percent beneficiaries believes that introduction of DAMU results some changes in their farm so they are disagreed with this opinion and for the same

reason 5 percent beneficiaries strongly disagreed with it. But as a non-beneficiary respondents' 50 percent have to agree and strongly agree with this opinion regarding DAMU.

Table-4.19 Opinion of respondents regarding cultivation in dry season

It helps to decide the number of crops I should cultivate in dry season				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	0	0
Disagree (2)	17	42.50	0	0
Undecided (3)	22	55.00	8	20.00
Agree (4)	1	2.50	24	60.00
Strongly agree (5)	0	0	8	20.00

In case of this opinion, 60 percent agreed with this opinion and for the same reason 20 percent beneficiaries strongly agreed with it. But as a non-beneficiary respondents' 42.50 percent have to disagree with this opinion regarding DAMU. It's undecided to 55 percent of non-beneficiaries.

Table- 4.20 Opinion of respondents regarding general management of crops in farm after DAMU

Training under DAMU also taught me regarding general management practice of crops				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	0	0
Disagree (2)	16	40.00	0	0
Undecided (3)	23	57.50	15	37.50
Agree (4)	1	2.50	25	62.50
Strongly agree (5)	0	0	0	0

This table indicates that the 62.50 percent of beneficiaries agreed that the training under DAMU also taught me regarding general management practice of crops.

Table- 4.21 Opinion of respondents regarding establishment of DAMU

Establishment of DAMU is a good decision of ICAR				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	0	0
Disagree (2)	0	0	0	0
Undecided (3)	39	97.50	0	0
Agree (4)	0	0	29	72.50

Strongly agree (5)	1	2.50	11	27.50

This table shows that 72.50 percent of beneficiaries agreed and 27.50 percent of beneficiaries strongly agreed that Establishment of DAMU is a good decision of ICAR. It's undecided to 97.50 percent of non-beneficiaries.

Table- 4.22 Opinion of respondents regarding effect of weather fluctuation

DAMU helped me in reducing effect of weather fluctuation in cropping				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	0	0
Disagree (2)	0	0	00	0
Undecided (3)	39	97.50	10	25.00
Agree (4)	1	2.50	14	35.00
Strongly agree (5)	0	0	16	40.00

This table shows that 35 percent of beneficiaries agreed and 40 percent of beneficiaries strongly agreed that DAMU helped me in reducing effect of weather fluctuation in cropping.

Table- 4.23 Opinion of respondents regarding disparity among farmers

DAMU increased the disparity among the farmers				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	11	27.50	0	0
Disagree (2)	18	45.00	12	30.00
Undecided (3)	11	27.5	19	47.50
Agree (4)	0	0	9	22.50
Strongly agree (5)	0	0	0	0

This table indicates that the 27.50 percent of non-beneficiaries strongly disagreed, 45 percent disagreed regarding this opinion. But 22.50 percent beneficiaries agreed that DAMU increased the disparity among the farmers.

Table- 4.24 Opinion of respondents regarding dependency on DAMU

DAMU increased our dependency on outer agency towards crop planning				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	0	0
Disagree (2)	1	2.50	20	50.00
Undecided (3)	39	97.50	20	50.00
Agree (4)	0	0	0	0
Strongly agree (5)	0	0	0	0

According to this table, it's undecided for 97.50 percent non-beneficiaries and 50 percent of beneficiaries regarding this opinion and 50 percent beneficiaries disagreed with this.

Table-4.25 Opinion of respondents regarding empowerment on decision making

DAMU empowered us to take immediate decision during natural calamities				
Status	Non-Beneficiary	Percentage	Beneficiary	Percentage
Strongly disagree (1)	0	0	0	0
Disagree (2)	0	0	0	0
Undecided (3)	39	97.50	0	0
Agree (4)	1	2.50	30	75.00
Strongly agree (5)	0	0	10	25.00

This table indicates that 75 percent beneficiaries agreed and 25 percent of beneficiaries strongly agreed that DAMU empowered them to take immediate decision during natural calamities, as DAMU beneficiaries informed through the use of Damini and Meghdoot app, through text messages registered number under DAMU and with bulletins during extreme weather events.

Impact assessment based on physical parameters

This section assessed impact of DAMU based on increase in productivity and acreage after introduction of DAMU.

Table- 4.26 Change in area of crops after DAMU (Beneficiaries)

Pair	Crops	Mean value after intervention of DAMU	Mean value before introduction of DAMU	t-value
1	Kharif rice	12.64	12	2.23 *
2	Maize	0.95	1.50	1.80 NS
3	Jute	1	0.71	2.20 *
4	Ground nut	0.50	0.10	3.06 **
5	Rabi rice	3.5	3.2	1.19 NS
6	Wheat	3.28	2.41	1.69 NS
7	Mustard	3.75	2.98	1.72 NS
8	Potato	1.20	1.38	1.23 NS
9	Summer rice	11.18	11.00	1.06 NS
10	Green gram	1.15	0.95	1.64 NS
11	Black gram	1.20	0.85	2.58 **
12	Sesame	0.90	0.75	2.66 **

NS= non-Significant, *= Significant at 5% level, **= Significant at 1% level

Table-4.27 Change in area of crops after DAMU (non-Beneficiaries)

Pair	Crops	Mean Value after	Mean value before	t-value
1	Kharif Rice	7.5	7.3	1.54 NS
2	Maize	0.41	0.45	0.31 NS
3	Jute	0.55	0.61	1.55 NS
4	Ground nut	0.20	0.15	0.84 NS

5	Rabi Rice	3.50	2.90	1.44 NS
6	Wheat	1.39	0.75	2.18 *
7	Mustard	1.75	2.16	1.22 NS
8	Potato	0.78	1.05	1.78 NS
9	Summer Rice	6.85	6.90	0.72 NS
10	Green gram	0.22	0.25	1.20 NS
11	Sesame	0.43	0.42	0.13 NS
12	Black Gram	0.42	0.49	1.78 NS

NS= non-Significant, *= Significant at 5% level, **= Significant at 1% level

Table-4.28 Change in productivity of crops after DAMU (Beneficiaries)

Pair	Crops	Mean value after intervention of DAMU	Mean value before introduction of DAMU	t-value
1	Kharif rice	10.03	7.78	41.502 **
2	Maize	3.35	2.12	1.879 NS
3	Jute	2.81	2.31	1.340 NS
4	Ground nut	0.63	0.37	2.261 *
5	Rabi rice	7.49	5.40	1.771 NS
6	Wheat	3.96	3.72	.242 NS
7	Mustard	2.39	2.09	1.248 NS
8	Potato	43.08	41.98	1.049 NS
9	Summer rice	6.49	5.91	20.722 **
10	Green gram	0.83	0.95	1.152 NS
11	Black gram	1.31	1.05	3.396 **
12	Sesame	1.38	1.15	3.117 **

NS= non-Significant, *= Significant at 5% level, **= Significant at 1% level

Table- 4.29 Change in productivity of crops after DAMU (non-Beneficiaries)

Pair	Crops	Mean value after intervention of DAMU	Mean value before introduction of DAMU	t-value
1	Kharif rice	7.89	7.06	5.135 **
2	Maize	1.53	1.42	0.209 NS

3	Jute	1.96	1.95	0.405 NS
4	Ground nut	0.38	0.32	0.266 NS
5	Rabi rice	7.27	6.18	1.619 NS
6	Wheat	2.92	2.64	0.637 NS
7	Mustard	1.53	1.42	0.417 NS
8	Potato	43.76	40.83	1.407 NS
9	Summer rice	6.15	6.04	1.012 NS
10	Green gram	0.63	0.61	1.446 NS
11	Black gram	0.84	0.83	0.939 NS
12	Sesame	0.86	0.83	0.481 NS

NS= non-Significant, *= Significant at 5% level, **= Significant at 1% level

The present section assessed that the impact on crop acreage and productivity of crops after the implementation of DAMU. To assess this, before and after design analysis control group (non-beneficiary) has been employed. From the table, it is found that after introduction of DAMU, the beneficiaries have higher advantage through increase in acreage under crops of kharif rice, jute, ground nut, black gram and sesame. The acreage under all the crops have significantly increased. The DAMU beneficiaries by using regular advisories could plan the irrigation and could asses the rainfall status. It is also found that acreage under rainfed crops mostly increased.

In case of non-beneficiaries only wheat acreage has increased. This may due to the fact that in study area there are some other projects which promotes wheat cultivation in the area.

In case of productivity, same picture has found. The beneficiary farmers with the use of advisory service from DAMU could increase the productivity of Kharif rice, ground nut, summer rice, black gram and sesame has significantly increased, where as in case of non-beneficiaries' productivity of kharif rice has only significantly increased.

Table- 4.30 Use of Meghdoot and Damini aap

Status	Non beneficiary	Percentage	Beneficiary	Percentage
never	24	60.00	0	0
sometimes	16	40.00	11	27.50
frequently	0	0	29	72.50

This table indicates that majority of the non- beneficiaries with percentage of 60 never use Damini and Meghdoot app, where as among the beneficiary's 72.50 percent respondents uses frequently those apps and 27.50 percent beneficiaries uses sometimes.

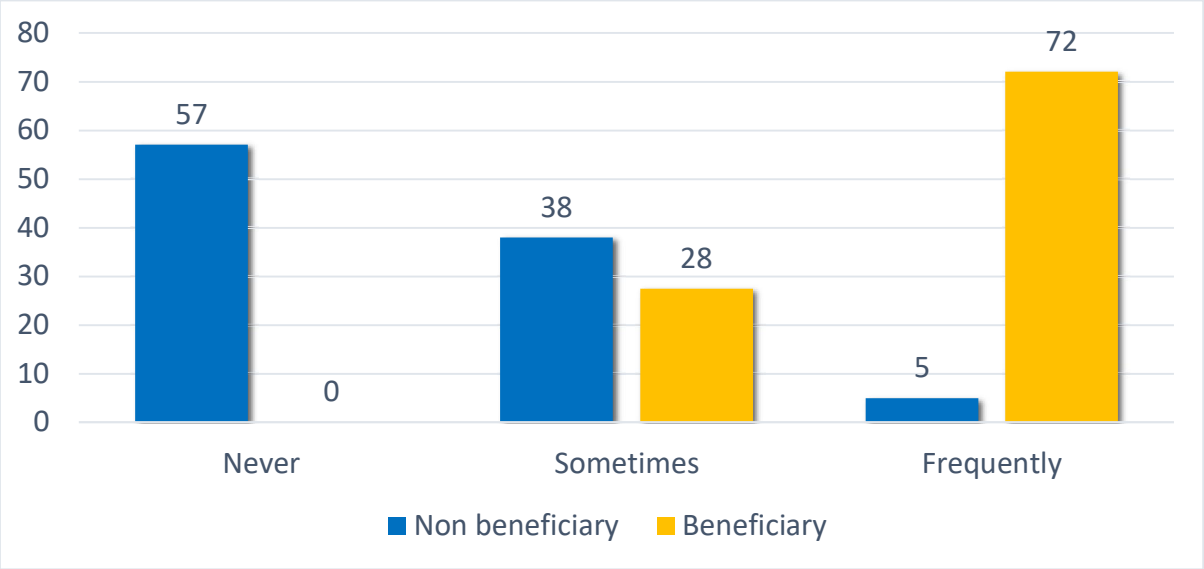


Fig: 4.1 Distribution of respondents according to the use of Meghdoot and Damini apps

CHAPTER-V

SUMMARY

The management and production of agriculture depends heavily on knowledge about the weather and climate. India Meteorological Department (IMD) and ICAR started the Gramin Krishi Mausam Seva (GKMS) scheme to establish District Agro-Met Units (DAMU) at each district throughout India in order to give the weather information and agro-advisories required for the block/taluka level agricultural community. IMD is producing and disseminating quantitative District/Block level weather forecasts up to 5 days in advance for agriculture under the GKMS scheme. Quantitative forecasts for the main meteorological variables, including rainfall, maximum and lowest temperatures, wind direction and speed, relative humidity, and cloudiness, are included in the products. The AMFUs / DAMUs use these products to create district / block level agromet advisories twice a week, on Tuesday and Friday, and distribute them to the agricultural community to assist them in making informed decisions for day-to-day farm operations. Agro Advisory Services defines the demands of the farming community by determining the information needs of various end-user groups. It has become clear that a location-specific, quantitative weather forecast is the farmer's top priority. Farm decisions are made in reaction to past, present, and future weather changes through the use of agro-advisory services.

Objectives of the present study

1) To study the socio-economic characteristics of respondents
2) To study the extent of use of agro-advisory services generated from different sources by the respondents.
3) To study the opinion regarding farm planning and management based on advisory of DAMU
4) To study the change in crop acreage and productivity after introduction of DAMU.

The primary data was collected by using household interviews with the help of interview schedule. The interview has information on two villages from each selected blocks from each district with 5 number of beneficiaries and 5 number of non-beneficiaries thereby total number of 80 respondents. Information was collected on socio-economic variables such as

age, religion, caste, educational status, household status, farming experience, mass media contact, personal media contact, total land holding, cultivated land and total income. Other variables are crop acreage, crop productivity, use of agro-advisory services and use of Damini and Meghdoot aap.

The findings of the study are summarized in the following points:

1. The mean value of beneficiaries of DAMU in case of educational status, personal media contact, mass media contact, household status, total land holding, cultivable land area, total income is more than the non-beneficiaries that is 4.4, 7.62, 5.82, 20.71, 21.97, 17.95 and 185560. But in case of age the mean value of non-beneficiary is more than the beneficiary from DAMU is 48. It indicates that there is a significant impact of DAMU on beneficiaries.
2. The SC category population is more in beneficiaries as compare to non-beneficiaries that is 40 percent. But in case of OBC category 25 percent respondents from beneficiary and 22.50 percent among the non-beneficiaries.
3. Beneficiaries are dominant by graduate and above educated respondents with a percentage of 52.50, whereas non-beneficiaries are dominated by secondary pass respondents with a percentage of 40.
4. 30 percent of non-beneficiary respondents belongs to low household status and 70 percent moderate household status, whereas beneficiaries have moderate household status with 55 percent and 40 percent with high household status.
5. Moderate personal and mass media contact for both groups of the respondents and 25 percent beneficiary respondents have high personal media contact and 40 percent beneficiary have high mass media contact.
6. Both groups of respondents have majority in medium range farming experience; among beneficiary 65 percent and among non-beneficiary 70 percent. Moderate land holding and income status in case of both beneficiaries and non-beneficiaries.
7. Regarding utilization of agro-advisory services, the beneficiaries are utilizing these more than the non-beneficiaries.
8. Assessment of impact through utilization of physical data on acreage under different major crops before and after the introduction of DAMU shows that the beneficiaries could extract more benefit by allotment of areas to the rainfed crops like kharif paddy, pulses, groundnut etc. whether, there is no significant increase in cropping areas

before and after introduction of DAMU in case of non-beneficiaries, rather there is a significant decrease in wheat area, which needs scheduled irrigation in proper time.

9. Assessment of impact through utilization of physical data on productivity of different major crops before and after the introduction of DAMU shows that the beneficiaries' productivity has significantly increased. whether, there is no significant increase in cropping productivity before and after introduction of DAMU in case of non-beneficiaries.
10. Opinion study regarding crop planning and management in farm level extracts that DAMU has positive impact on area allotment of crops, its production, crop management through irrigation scheduling and pest management during fluctuating weather. There is also a positive impact of DAMU beneficiaries to take immediate decision during extreme weather condition.
11. Beneficiary respondents utilizes more in using Damini and Meghdoot aap, while 60 percent of the respondents from non-beneficiaries never uses those apps.

Conclusion

- According to the study, Beneficiaries and non-beneficiaries both are under the medium age group and SC caste is dominant for both the respondents and Hindu religion is also dominant among them. Beneficiaries are dominant by graduate and above educated respondents, whereas non-beneficiaries are dominated by secondary pass respondents. Moderate personal and mass media contact for both groups of the respondents. Non-beneficiary respondents have low to moderate household status, whereas beneficiaries have moderate to high household status. Both groups of respondents have majority in medium range farming experience. Moderate land holding and income status in case of both beneficiaries and non-beneficiaries. DAMU beneficiaries are significantly belong to higher stratum than the non-beneficiary farmers. This may be due to the fact that that higher stratum populations are generally attached with the DAMU as the beneficiary.
- From the distribution of respondents regarding utilization of agro-advisory services, the same trend found as in case of socio-economic status; viz. the beneficiaries are utilizing these more than the non-beneficiaries.

- Assessment of impact through utilization of physical data on acreage under different major crops before and after the introduction of DAMU shows that the beneficiaries could extract more benefit by allotment of areas to the rainfed crops like kharif paddy, pulses, groundnut etc. whether, there is no significant increase in cropping areas before and after introduction of DAMU in case of non-beneficiaries.
- Assessment of impact through utilization of physical data on productivity of different major crops before and after the introduction of DAMU shows that the beneficiaries' productivity has significantly increased. whether, there is no significant increase in cropping productivity before and after introduction of DAMU in case of non-beneficiaries.
- Opinion study regarding crop planning and management in farm level extracts that DAMU has positive impact on area allotment of crops, its production, crop management through irrigation scheduling and pest management during fluctuating weather.
- Beneficiary respondents utilizes more in using Damini and Meghdoot aap.

Recommendation

Based on the analysis, it is found that there are significant impacts on crop planning and management of the beneficiaries by utilizing advisories from DAMU; and it is also seen that people with lower socio-economic status are less associated with DAMU as beneficiary. So, it is recommended that people from lower socio-economic status should also be included as the beneficiary of DAMU. They should be motivated through awareness generation programmes.

Future Scope of study

1. An impact study based on physical data may be undertaken to make the result more generalized.
2. Contribution of different agro-advisory service institutes may be assessed in comparison to DAMU towards creating different impacts on livelihood.

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BENEFICIARY / NON-BENEFICIARY

Interview schedule on Impact of District Agro meteorological Unit on crop planning and management in selected districts of West Bengal

PART-I: GENERAL INFORMATION

1. Name of the farmer:
2. Village:
3. District:
4. Block:
5. Age:
6. Caste:
7. Religion:
8. Educational qualification:
9. Farming Experience:
10. Major farming system of the district:

11. From whom you access agricultural information and how frequently?

Agent	Frequently (2)	Sometimes (1)	Never (0)
Friend, neighbor, relatives			
Progressive farmers			
My Farmer's Club/SHG/FPO/FPC			
Input dealers			
Panchayat personnel			
NGO/Voluntary Agency personnel			
Line dept. personnel			
KVK/Agril. University personnel			
News paper/Agricultural bulletin/leaflet/journal			
Krishi mela/exhibition/stall/Agricultural training			
Radio/TV			
Internet/Whatsapp/Youtube/Agril. App			
Mobile SMS/Phone call			

12. Whether you have the following (√ mark)

Housing	Kachha house (2) / Mixed house (3) / Pakka house (4)		
Sanitation	No latrine (0) / Ring Latrine (1) / Sanitary latrine 2		
Having Electricity	No (0) / Yes (1)		
Drinking water source	Dug well (1) / Tube Well (2) / Treated drinking water or Purifier (3)		
Household appliances	Bullock cart (1)	Fridge (1)	Improved plough (0.5)
	Motor cycle (2)	Computer/Tab (2)	Sprayer/ duster (0.5)
	Car/truck (3)	Television (1)	Seed drill (0.5)
	Power Tillar (3)	Mobile (1)	Thresher (1)
	Tractor (4)	Bullock (1)	LPG (2)
	Combine harvester (5)	Cot/Almirah (1)	

13. Land Holding (Bigha)

Cultivated area	
Uncultivated area	
Homestead land area	
Pond area if any	
Irrigated area	

14. Source of income

Source of income	Income/year
Agriculture	
Small business	
Farm/casual labour	
Govt employment	
Pvt employment	
Fishery	
Animal husbandry	
Poultry/duckery	
Other works	

PART-II: INFORMATION REGARDING DAMU

15. Cropping Pattern before the introduction of DAMU:

Season	Name of the crop	Rainfed Area	Irrigated area	Total area	Total production
Kharif					
Rabi					
Summer					

16. Cropping pattern after DAMU's intervention:

Season	Name of the crop	Rainfed Area	Irrigated area	Total area	Total production
Kharif					
Rabi					
Summer					

17. How do you get agro-advisory services?

State Agricultural Department	
Email	
What's App	
Other social media	
Mobile app	
Text message (SMS) on registered mobile no. under DAMU	
Text message on registered mobile no. from other project	
Online awareness programme	
KVK websites	
Institute Websites	
NGO	

18. How frequently do you use *Meghdoot* and *Damini* App? _____

19. What is your opinion regarding the introduction of DAMU

Opinion	Strongly agree (5)	Agree (4)	Undecided (3)	Disagree (2)	Strongly disagree (1)
Reduces my cost towards irrigation					
Increased number of crops in my farm					
Increased the production of crops					
I can take decision whether to irrigate or not					
I can decide about number of irrigation					

BENEFICIARY / NON-BENEFICIARY

I can decide on time of spray					
Introduction of DAMU not at all changed anything in my farm					
It helps to decide the number of crops I should cultivate in dry season					
Training under DAMU also taught me regarding general management practice of crops					
Establishment of DAMU is a good decision of ICAR					
DAMU helped me in reducing effect of weather fluctuation in cropping					
DAMU increased the disparity among the farmers					
DAMU increased our dependency on outer agency towards crop planning					
DAMU empowered us to take immediate decision during natural calamities					
DAMU cannot stop natural calamity; so, its existence cannot make us more resilient to climate vulnerabilities					

(Signature of the Investigator)

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Entire Document

1 CHAPTER-I INTRODUCTION Approximately 58% of India's population relies mostly on agriculture for their livelihood. India's food, nutrition, and livelihood security depend heavily on agriculture. Although Indian agriculture has historically made great development, there are now many obstacles in its way. The main issues facing Indian agriculture are stagnating net sown area, plateauing yield levels, declining soil quality, decreasing per capita land availability, and the negative impact of climate change. On the other side, the growing population is placing pressure on the agricultural industry to improve food production. The endeavour is extremely difficult because 60% of the net cultivated land is rainfed and subject to biotic and abiotic pressures brought on by climatic variability and climate change. More than 80% of Indian farmers are marginal, small, and have weak coping skills. Additionally, Indian farmers are disorganised and diverse. By placing pressure on agriculture and compromising its sustainability, climate change and variability are likely to make the issue of future food security worse. Crops, soils, animals, and pests are all significantly impacted by climate change. Due to the fact that 2/3 of India's agricultural land is rainfed and even the irrigated system is reliant on monsoon rain, Indian agriculture is particularly vulnerable to the hazards associated with climate change, especially to drought. In many areas of the country, particularly in the east where flooding is a common occurrence, flooding is also a significant problem. Additionally, cyclones on the eastern coast, heat waves in the middle and northern regions, and frost in the north-west all cause devastation. The increased atmospheric temperature has increased the frequency of severe climatic extremes in recent years, increasing the danger of significant losses in agricultural productivity. Indirect and direct impacts of climate change on crops, soils, livestock, and pests all have an impact on agriculture. Increasing atmospheric carbon dioxide fertilises crops that use the C3 photosynthetic pathway, fostering their development and yield. An increase in temperature can affect many aspects of crop growth, including crop duration, respiration rates, and photosynthesis. It can also affect pest population survival and distribution, which can lead to the development of new pest-crop equilibriums. It can also speed up the mineralization of nutrients in soils, reduce fertiliser use efficiency, and increase evapo-transpiration. Due to the