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***RESEARCH ARTICLE***

# DIVERGENCE IN THE UTILIZATION AND ADOPTION MAGNITUDE OF DIFFERENT INDIGENOUS TECHNICAL KNOWLEDGES (ITKs) IN DIFFERENT UPAZILAS OF BANGLADESH

**Sumana Sarkar, Md. Aminul Khan, Md. Matiul Islam*, Chanchal Biswas, Mohammad Bashir Ahmed**

***Agrotechnology Discipline, Life Science School, Khulna University, Khulna-9208, Bangladesh.***
****Corresponding Author Email: matiul@at.ku.ac.bd, matiul_rubel@yahoo.com***



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**ABSTRACT**

The primary objective of this research was to compare the utilization of ITKs across five specific upazila (Chitalmari of Bagerhat district, Paikgacha of Khulna district, Kotalipara of Gopalganj district, Shyamnagar of Satkhira district and Jashore Sadar of Jashore district). Data were collected through personal interviews conducted with a total of 500 (100 respondents per upazila) respondents, encompassing four distinct categories (crop, fisheries, livestock and weather related ITKs). Results revealed that crop related ITKs were used most by the respondents at an average of 67.8%, while fisheries related ITKs obtained the lowest level of usage. Among the five upazila, Jashore Sadar exhibited the highest (67.8%) utilization of crop related ITKs whereas Kotalipara showed the least (50.8%) usage. In terms of fisheries related ITKs, Shyamnagar upazila exhibited the highest utilization rate (41.7%), while the lowest (21.3%) usage was found in Kotalipara. Respondents of Chitalmari upazila found the maximum (42%) usage of livestock related ITKs contrasting with Kotalipara, which showed the minimum (36.7%) usage. Additionally, weather-related ITKs were utilized in Jashore Sadar upazila was maximum (75.3%), while least (47%) usage obtained in Chitalmari. Significant disparities were observed among the upazila concerning the categorization of adapters. Among five upazila, there had been a notable prevalence of a high rate of Early Adopters, while exclusively in Jashore, the dominance laid in the high rate of the Early Majority. This research sketches a clear finding that many respondents were primarily clustered within the medium-use category of ITKs, closely followed by those in the low-use category.

**KEYWORDS**

Adoption, indigenous technical knowledge (ITK), personal interviews, Early Adopters, Early Majority.

## 1. INTRODUCTION

Modern agriculture has certainly increased food production but it has also brought about several ecological and cultural challenges. It is typified by technical developments, extensive automation, and the use of agrochemicals (Pretty et al., 2018). This method uses synthetic inputs, genetically modified organisms (GMOs), and monoculture to increase food production efficiency and productivity. There are concerns over the long-term sustainability of modern agricultural techniques due to the extensive use of chemicals and machines, which has resulted in problems including soil erosion, water pollution, and diminished biodiversity (Kremen and Miles, 2012). In recent years, there has been a renewed interest in traditional or indigenous farming methods which are based on the knowledge and practices passed down from previous generations. These methods are often well-adapted to the local environment and can be more sustainable and resilient than modern and industrial farming techniques (Altieri, 1993).

Grenier specified indigenous technical knowledges (ITKs) as "the unique, historic, local knowledge existing within and developed around the specific condition of women and men indigenous to a particular geographic area" (Grenier, 1998). It is intricately linked to a community's cultural identity and these methods preserve cultural heritage since they are frequently passed down through the years along with tales, customs, and a feeling of community. ITKs in agricultural methods are usually adaptive and appropriate to the many climates and ecosystems in the area. They provide coping mechanisms for various environmental disturbances, such as floods, droughts, and unpredictable weather patterns. This also helps in maintaining genetic diversity, resilience against pests and diseases, and ensures food security in changing climatic conditions. It has been acknowledged as a crucial component of sustainable development through balanced resource management since the turn of the century (Chowdhooree, 2019).

ITKs can be used as climate smart agriculture (CSA) technology. It has significant benefits if explored, they are alternatives that can be widely adapted, simpler, safer, and less expensive to adopt than those of modern technology, they are a safer alternative to harmful chemicals and they are environmentally friendly and play a momentous role in sustainable development (Kanak et al., 2015). Numerous factors, such as ecological settings, climatic circumstances, and geographical variety have a significant impact on the utilization patterns of ITKs in various locations of Bangladesh. Thus the utilization and adoption of these ITKs in agriculture exhibit remarkable divergence across different locations and agro-ecological zones (AEZ) reflecting a mosaic of regional variations and influences. To fully understand the variation in ITKs usage in agriculture, it was crucial to consult with local stakeholders, including farmers and, community leaders. However, none of the previous studies investigated

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the divergence of ITKs usage in southwestern region as the research gap. In light of the above statement, this paper aims to fill this gap and clarify the complex subtleties of the extent to which different ITKs are used and adopted in distinct locations of southwestern Bangladesh. The following objectives were formulated for giving proper direction to the study:

i. To determine the magnitude of ITKs used in different locations of southwestern Bangladesh

ii. To evaluate the variation in adoption levels of different ITKs among different locations of southwestern Bangladesh

iii. To compare use frequency of different ITKs in different locations of southwestern Bangladesh

## 2. METHODOLOGY

### 2.1 Locale of the Study

The study was carried out in several villages in the Chitalmari upazila of Bagerhat district; Paikgacha upazila of Khulna district, Kotalipara upazila of Gopalganj district, Shyamnagar upazila of Satkhira district and Jashore Sadar upazila of Jashore district.

Farmers in the Chitalmari upazila were engaged in crop cultivation, fisheries and livestock rearing. Chitalmari upazila has a total area of 192 square kilometers (sq. km) (figure 1).

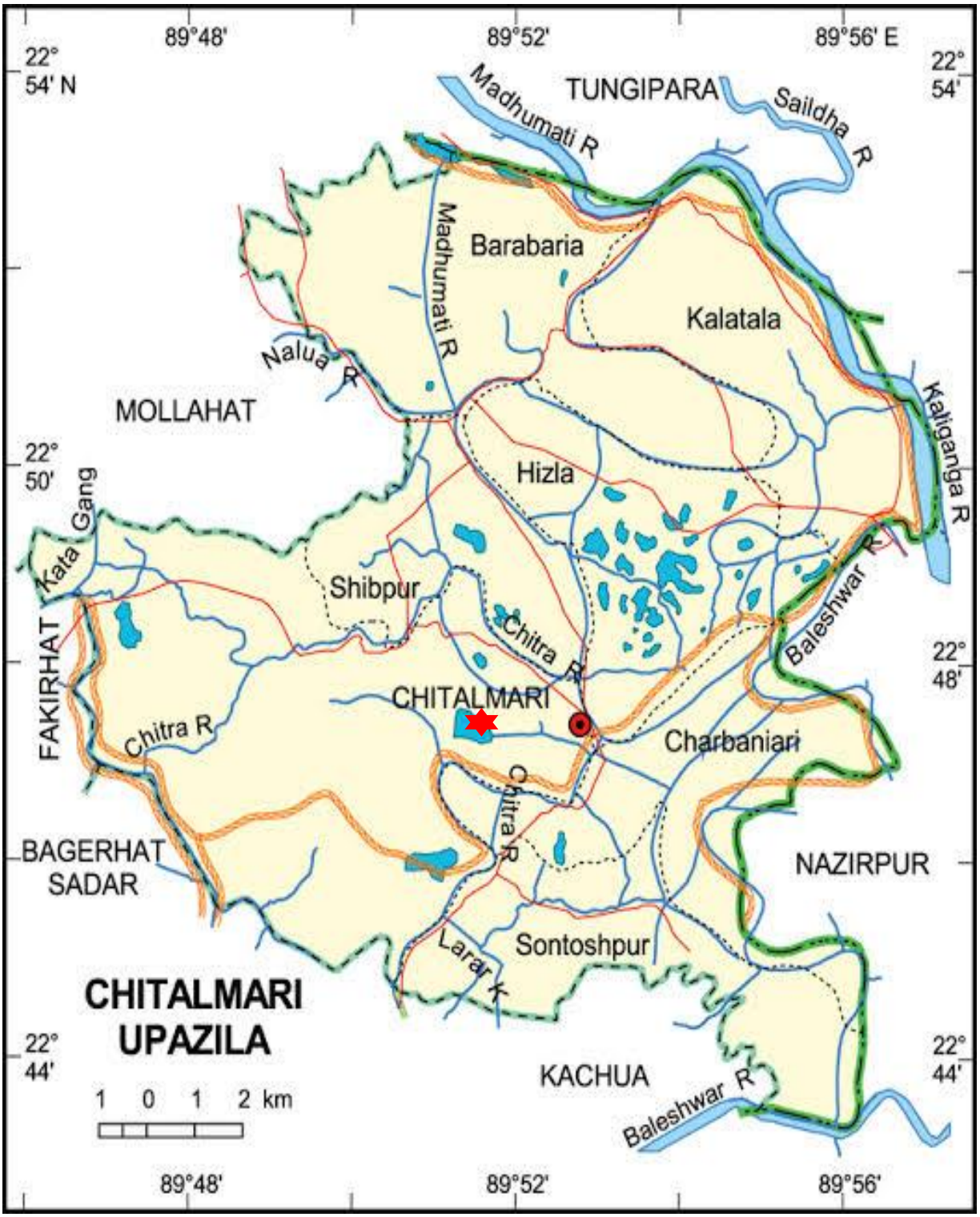



**Figure 1:** Chitalmari upazila of Bagerhat district

Crop cultivation, fishing, and livestock farming were the activities of farmers in the Shyamnagar upazila. Shyamnagar upazila (Satkhira district) is the largest upazila in Bangladesh and the area is 1968.24 sq. km, located in between 21°36' and 22°24' north latitudes and in between 89°00' and 89°19' east longitudes (figure 2).

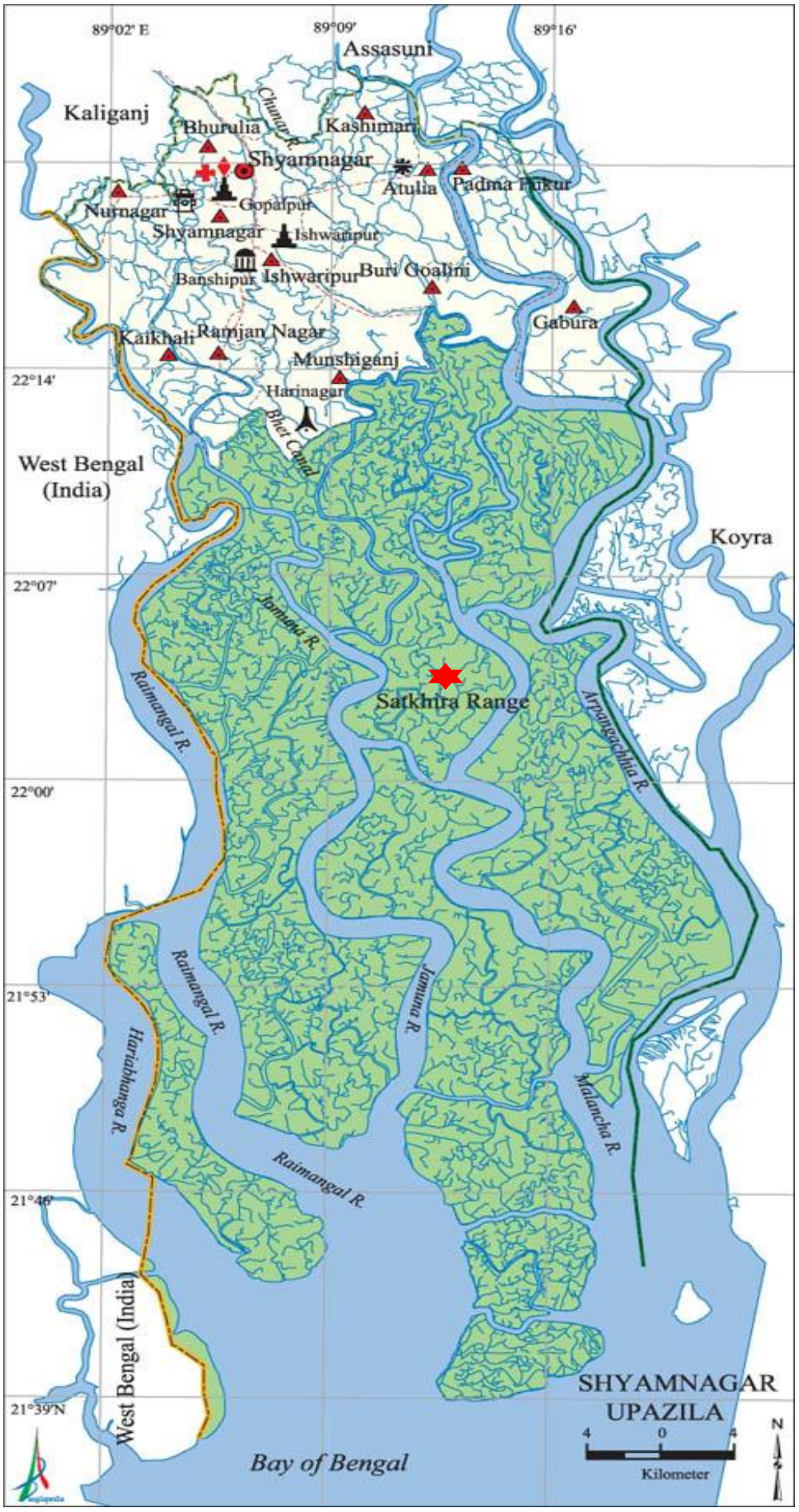



**Figure 2:** Shyamnagar upazila of Satkhira district

Paikgacha upazila (Khulna district) area 411.19 sq. km, located in between 22°28' and 22°43' north latitudes and in between 89°14' and 89°28' east longitudes (figure 3). Farmers in this region engaged in raising animals, growing crops, and fishing.


**Figure 3:** Paikgacha upazila of Khulna district

Kotalipara upazila (Gopalganj district), area 355.90 sq. km, located in between 22°52' and 23°08' north latitudes and in between 89°55' and 89°08' east longitudes (figure 4). Fishing, farming, and livestock keeping were the activities of farmers in this region.


**Figure 4:** Kotalipara upazila of Gopalganj district

Jashore Sadar upazila (Jashore district), area 435.22 sq. km, located in between 23°04' and 23°20' north latitudes and in between 89°06' and 84°06' east longitudes (figure 5). Farmers in this area were engaged in crop cultivation, fisheries and livestock rearing. But most of the people are engaged in crop cultivation rather than fishing.


**Figure 5.** Jashore Sadar upazila of Jashore district

### 2.2 Population and Sampling

The population of the study was consisted of all the rural farmers, women, local leaders, and the stakeholders of the mentioned upazila. One hundred of them were purposefully selected to make up the study samples from each upazila.

### 2.3 Preparation of Interview Schedule

An interview schedule was prepared to collect relevant information from the respondents. The interview schedule was carefully designed with a view to meeting the requirements of the objectives of the study. Both open and close-ended questions were contained in the interview schedule and all the questions were in a direct and simple form.

### 2.4 Data Collection

Data were collected by the researcher through the face-to-face interview of the respondents in the chosen area using the interview schedule. All possible efforts were made to explain the purpose of the study to the respondents to get valid and reliable information. In addition, the opinions of a few key informants were used to supplement and validate some of the data gathered through the interview program. The respondents' information was collected between March 9 and March 18, 2023, in Chitalmari upazila of Bagerhat district; on 17 September in Shyamnagar upazila of Satkhira district; on 18 September in Paikgacha upazila of Khulna district; on 6 November in Kotalipara upazila of Gopalganj district and on 7 November in Jashore Sadar upazila of Jashore district.

### 2.5 ITKs Related Focus Issues

Fifty-one ITKs were selected from available literature, articles, relevant books, proceedings, reports, publications, web sites and farmer's experience for the completion of the study.

The diversity of the ITKs was observed in terms use of their use in agricultural subsector including:

i. Crop
ii. Fisheries
iii. Livestock
iv. Weather

Inquiring with farmers from each upazila, the information was sought regarding their utilization and non-utilization of information ITKs. Their responses enabled the identification of the magnitude of ITKs employed, forming the basis of our assessment. Through questioning farmers in each upazila, we gathered data pertaining to the specific ITKs they incorporate into their practices and those they abstain from, thus establishing a comprehensive understanding of the ITKs landscape within these regions.

### 2.6 Adopter categories

Respondents were categorized into five groups based on their time required to adopt selected ITKs. Finally they were assigned to different adopter categories on the basis of the statements of Table 1.

**Table 1:** Adopter categories of respondents

| Categories | Score | Statements |
|---|---|---|
| Innovators | 1 | Adopt ITKs quickly |
| Early Adopters | 2 | Creates opinions before adoption of ITKs which propel trends. |
| Early Majority | 3 | Adopt ITKs after a varying degree of time |
| Late Majority | 4 | Adopt ITKs after the majority member of the society |
| Laggards | 5 | Traditionalists and the last to adopt ITKs |

Source: Rogers, 1995

### 2.7 Extent of adoption of ITKs

The percentage of each adopter categories **(**Innovators, Early Adopters, Early Majority, Late Majority, and Laggards) of selected ITKs were calculated by the following formula

$$(\%)\ \text{Innovators} = \frac{\text{Total numer of innovators in crop related ITKs}}{\text{Total numer of respondents adopted crop related ITKs}} \times 100$$

The percentage of each adopter categories in case of fisheries, livestock and weather forecasting related ITKs were calculated using the same formula.

After calculating all the percentages of each adopter categories, a graph had been formed using Microsoft excel to show the extent of adoption of ITKs by the farmers.

### 2.8 ITKs' use

ITKs' use of the respondents indicates the total score of the respondents according to how frequently they use the 51 selected ITKs. For each ITKs, the highest score is 3 and the lowest score was 0. The minimum and maximum score of a respondent ranged 0 to 153. The respondents were classified into the following categories according to their use of ITKs Table 2.

**Table 2:** Distribution of respondents based on their ITKs use

| Categories | Score |
|---|---|
| Low use of ITKs | ≤51 |
| Medium use of ITKs | 52-102 |
| High use of ITKs | 103-153 |

### 2.9 Adoption index of ITKs

Farmers were interviewed to collect data on whether they adopted each of the selected ITKs or not. The extent of adopting ITKs was determined based on the adoption index.

The adoption score (AS) was determined by using the following formula,

$AS = N_1 \times 3 + N_2 \times 2 + N_3 \times 1 + N_4 \times 0$

Where,

AS= Adoption score

$N_1$= Number of respondents who did the practice regularly

$N_2$= Number of respondents who did the practice occasionally

$N_3$= Number of respondents who did the practice rarely

$N_4$= Number of respondents who did the practice not at all

The possible range of practice scores was 0 to 300.

After determining of AS, the adoption index was determined by the following formula (%)

$$\text{Adoption Index (\%)} = \frac{\text{Observe adaption score}}{\text{Possible highest adoption score}} \times 100$$

### 2.10 Data Processing and Analysis

All the information in the interview schedule was edited after the data had been collected. For interpretation and discussion, all personal characteristics were categorized and arranged in simple tables. When applicable, local units were converted into standard units and qualitative data were converted into quantitative ones by means of suitable scoring. Statistical package for Social Science (SPSS) and Microsoft Excel software were used on a microcomputer to analyze data. Descriptive data were interpreted using basic statistics including frequency counts, percentages, means and standard deviations.

## 3. RESULTS

### 3.1 Magnitude of ITKs (crop, fisheries, livestock, and weather) used in different locations

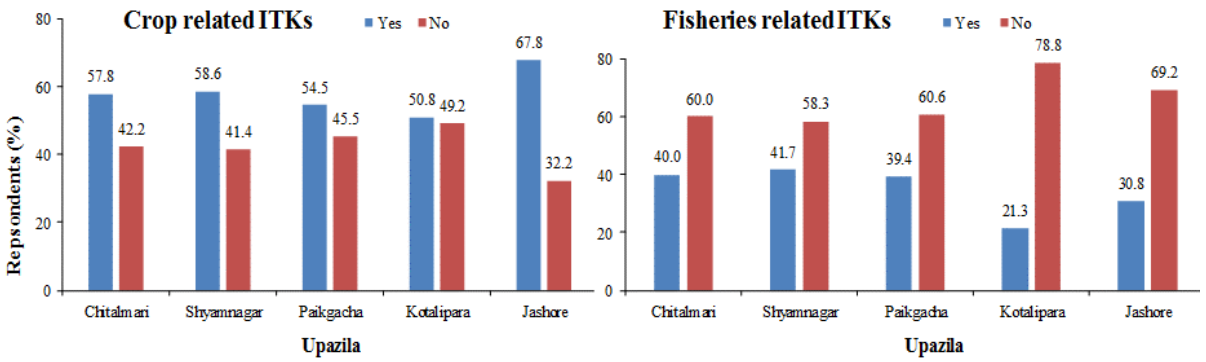
The respondent's (%) using crop-related ITKs, fisheries-related ITKs, livestock-related ITKs, and weather-related ITKs among farmers in five distinct upazila in the southwest region of Bangladesh presented in figure 6. Moreover, it also highlighted the proportion of farmers who did not use these ITKs in each respective upazila.

Respondent's (%) using crop related ITKs was observed highest (67.8%) in Jashore Sadar upazila followed by Shyamnagar (58.6%), Chitalmari (57.8%), Paikgacha (54.5%) and lowest (50.8%) was recorded in Kotalipara upazila. Thus, the respondent's (%) not using crop related ITKs was obtained highest (49.2%) in Kotalipara, followed by Paikgacha (45.5%), Chitalmari (42.2%), Shyamnagar (41.4%) and the lowest (32.2%) was found in Jashore Sadar upazila.

In case of fisheries related ITKs, maximum (41.7%) respondents were found in Shyamnagar upazila followed by Chitalmari (40%), Paikgacha (39.4%), Jashore Sadar (30.8%) and minimum (21.3%) was recorded in Kotalipara upazila. Automatically, the respondent's (%) not using fisheries related ITKs was obtained highest (78.8%) in Kotalipara, followed by Jashore Sadar (69.2%), Paikgacha (60.6%), Chitalmari (60%) and the lowest (58.3%) was found in Shyamnagar upazila.

At the same time, respondent's (%) using livestock related ITKs was observed maximum (42%) in Chitalmari upazila followed by Jashore Sadar (41.2%), Paikgacha (37.2%), Shyamnagar (36.9%) and minimum (36.7%) was recorded in Kotalipara upazila. Based on this, the respondent's (%) not using livestock related ITKs was obtained highest (63.3%) in Kotalipara, followed by Shyamnagar (63.1%), Paikgacha (63.3%), Jashore Sadar (58.8%) and the lowest (58%) was found in Chitalmari upazila.

Respondent's (%) using weather related ITKs was found highest (75.3%) in Jashore Sadar upazila followed by Paikgacha (64%), Shyamnagar (61.3%), Kotalipara (59.3%) and minimum (47%) was recorded in Chitalmari. Automatically, the respondent's (%) not using weather related ITKs was obtained highest (53%) in Chitalmari upazila followed by Kotalipara (40.8%), Shyamnagar (38.8%), Paikgacha (36%) and the lowest (24.8%) was found in Jashore Sadar upazila



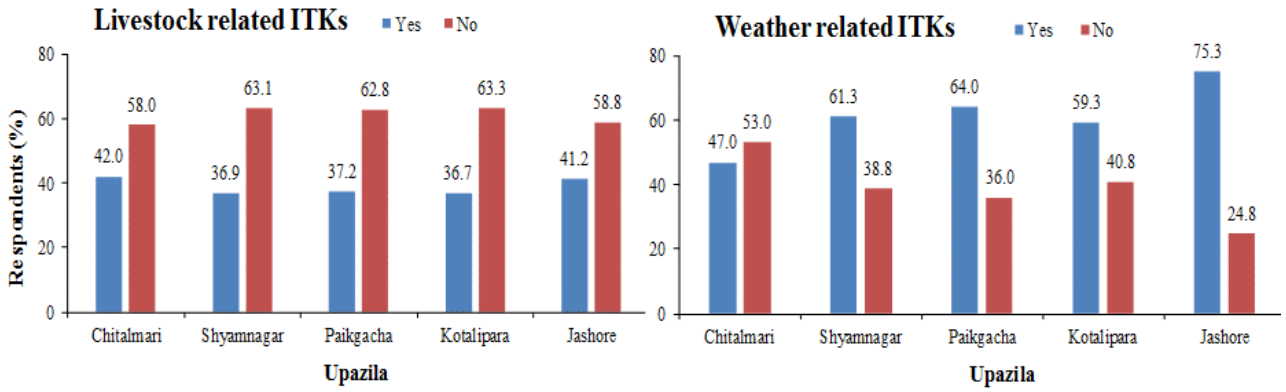



Figure 6: Magnitude of ITKs (crops, fisheries, livestock, and weather) used in different locations

### 3.2 Diversity of the use of ITKs in the study area

The highest utilization of ITKs in agriculture among the four specific sub-sectors (crop, fisheries, livestock, and weather) illustrated in figure 7.

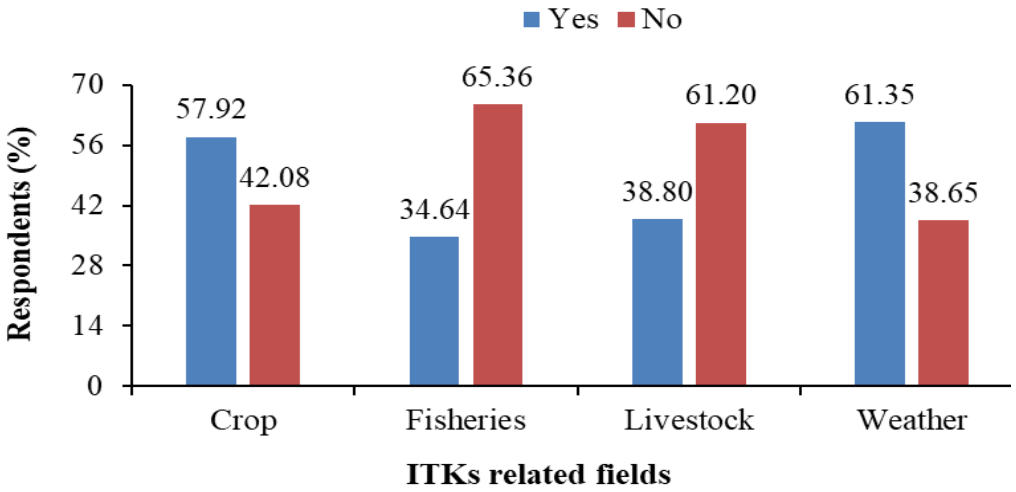
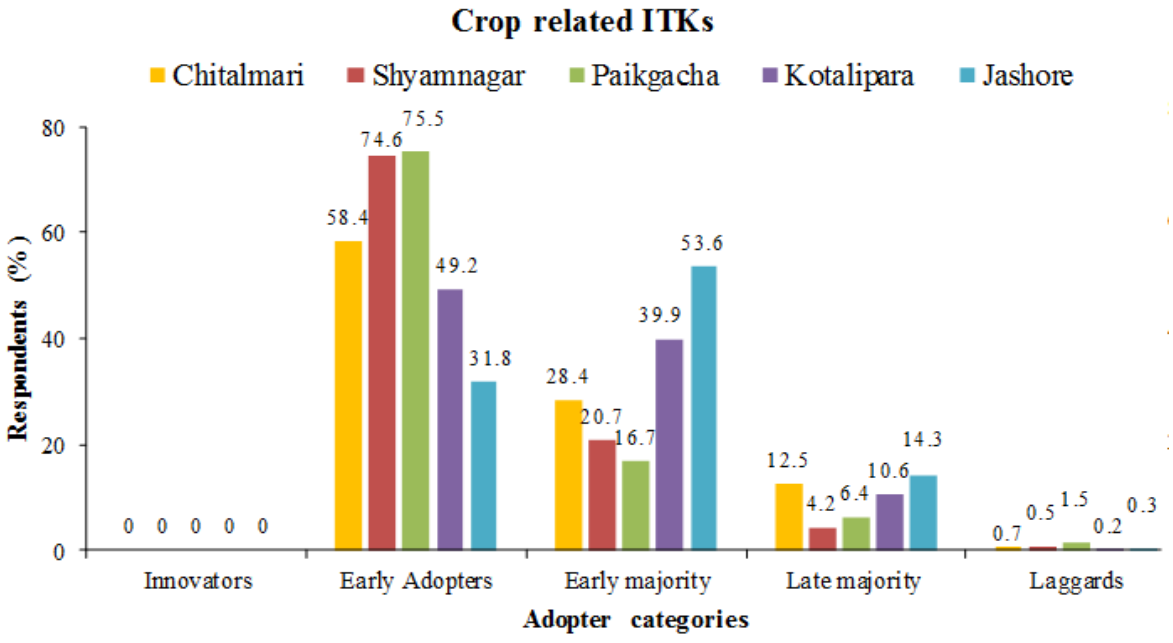



**Figure 7:** Diversity of the use of ITKs in the study area

The maximum diversity was observed in weather related ITKs (61.65%) while it was minimum in fisheries related ITKs sector (34.64%) while crop related ITKs emerged as second position, occupying 57.92% of the standings and the livestock sector occupied the third position, contributing 38.80%.

### 3.3 Magnitude of adoption of ITKs and comparison among adapter categories in different locations of southwestern Bangladesh

Adopters are categorized based on their innovativeness into five divisions and presented in figure 8. The category of innovators consistently observed 0% across all examined upazila in respect of those four specific sub-sectors (crop, fisheries, livestock, and weather related ITKs).



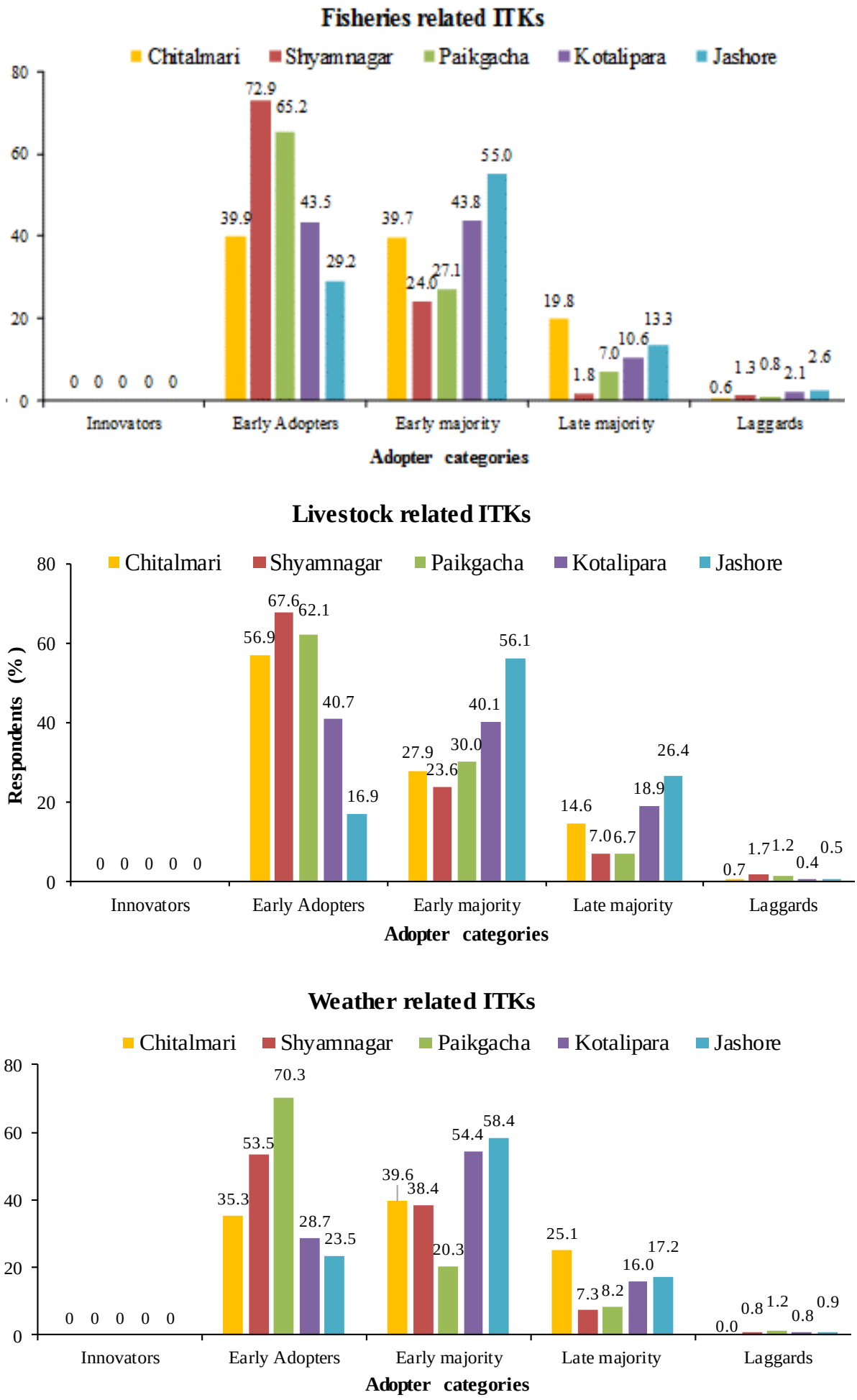



**Figure 8:** Comparison of different technologies in different categories of adopters in respects of crop, fisheries, livestock, and weather related ITKs

During the study, it was established that the utilization of these ITKs among farmers predominantly occurred through ancestral knowledge, learning from neighbors, or other traditional means, attributing to the absence of information within the innovator category. In case of crop related ITKs, Chitalmari initially recorded 58.4% Early Adopters, followed by an increase to 74.6% in Shyamnagar and a slight rise to 75.5% in Paikgacha. However, Kotalipara and Jashore demonstrated declines to 49.2% and 31.8%, respectively marking lower counts of Early Adopters in these areas compared to the Early Majority. In terms of Early Majority, Chitalmari started at 28.4%, while Shyamnagar began with 20.7%, followed by a decrease to 16.7% in Paikgacha.

This number surged to 39.9% in Kotalipara and further escalated to 53.6% in Jashore, surpassing the count of Early Adopters. Respondents (%) belonged to Late Majority category was found 12.5% in Chitalmari, and then decreased to 4.2% in Shyamnagar, jumped to 6.4% in Paikgacha, ascended to 10.6% in Kotalipara, and peaked at 14.3% in Jashore. At last Laggards, displaying the lowest percentages, were notably minimal across all upazila. Paikgacha revealed the highest count at 1.5%, followed by Chitalmari 0.7%, Shyamnagar 0.5%, Jashore 0.3%, and Kotalipara at the lowest count of 0.2%.

On the other hand, Early Adopters in fisheries related ITKs initiated with 39.9% in Chitalmari and recorded maximum in Shyamnagar (72.9%) which gradually decreased following the order 65.2% in Paikgacha, 43.5% in Kotalipara and minimum (29.2%) was found in Jashore. Regarding Early Majority in fisheries related ITKs, Chitalmari commenced at 39.7%, Shyamnagar at 24%, Paikgacha at 27.1%, increasing in Kotalipara to 43.8%, and escalating in Jashore to 55%. Late Majority in fisheries related ITKs fluctuated, with Chitalmari starting at 19.8%, declining in Shyamnagar to 1.8% then gradually rising in subsequent upazila to 7%, 10.6%, and 13.3%, respectively. Laggards in fisheries related ITKs varied among upazila, peaking at 1.3% in Shyamnagar, followed by 0.8% in Paikgacha, and 2.6% in both Kotalipara and Jashore, while Chitalmari demonstrated the lowest count at 0.6%.

In terms of livestock related ITKs, Chitalmari initiated with 56.9% Early Adopters which slightly increased to 67.6% in Shyamnagar, then declined in Paikgacha, Kotalipara, and Jashore to 62.1%, 40.7%, and 16.9%, respectively. The count of Early Majority in livestock related ITKs began at 27.9% in Chitalmari that decreased to 23.6% in Shyamnagar, followed by gradual increase in Paikgacha, Kotalipara, and Jashore, reaching 30%, 40.1%, and 56.1%, respectively, showing the highest count in Jashore Sadar upazila. The Late Majority (%) in Livestock Related ITKs varied starting at 14.6% in Chitalmari which decreased to Shyamnagar and Paikgacha to approximately 7% while increased to 18.9% in Kotalipara and found 26.4% in Jashore. Laggards in Livestock Related ITKs demonstrated variations across upazila, obtaining 1.7% in Chitalmari, followed by 1.2% in Paikgacha, and lower counts followed by Jashore, Shyamnagar, and Kotalipara at 0.7%, 0.5%, and 0.4%, respectively.

Finally, Early Adopters in weather related ITKs was found 35.3% in Chitalmari upazila, which then increased to 53.5% in Shyamnagar and slightly further to 70.3% in Paikgacha. However, this percentage decreased to 28.7% in Kotalipara and dropped further to 23.5% in Jashore Sadar. The Early Majority comprised 39.6% in Chitalmari, which decreased to 38.4% in Shyamnagar and further decreased to 20.3% in Paikgacha. Subsequently, these numbers rose to 54.4% in Kotalipara and peaked at 58.4% in Jashore. The subsequent category was the Late Majority, which commenced at 25.1% in Chitalmari that decreased to 7.3% in Shyamnagar, increased to 8.2% in Paikgacha, and continued to rise. It reached 16% in Kotalipara, ultimately climbing to 17.2% in Jashore Sadar. Laggards, the final category, displayed notably small percentages. Paikgacha demonstrated the highest at 1.2%, while Shyamnagar 0.8%, Jashore 0.9%, Kotalipara 0.8% and the lowest was in Chitalmari upazila at 0%.

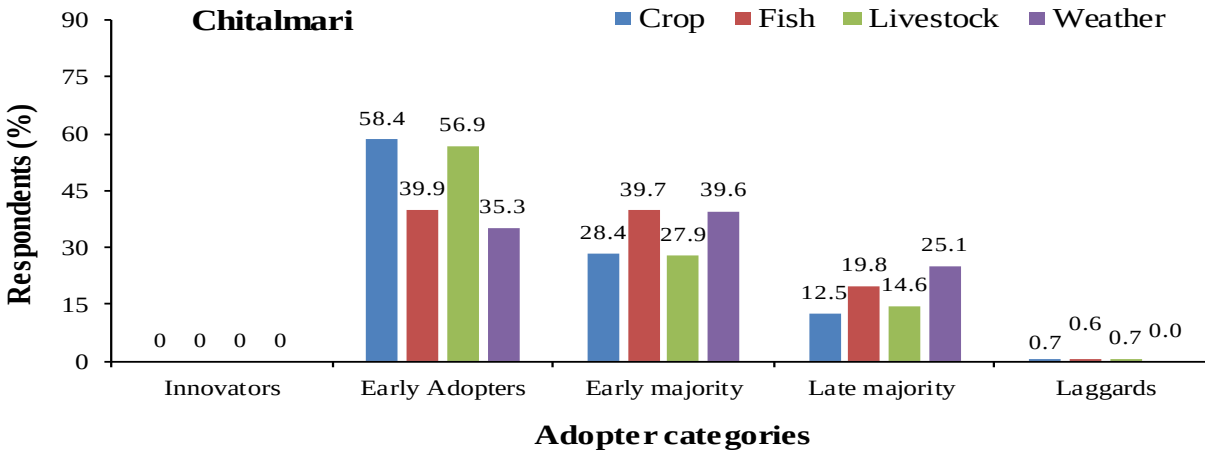
### 3.4 Comparative Analysis of Adopter Categories Based on Magnitude of Adoption

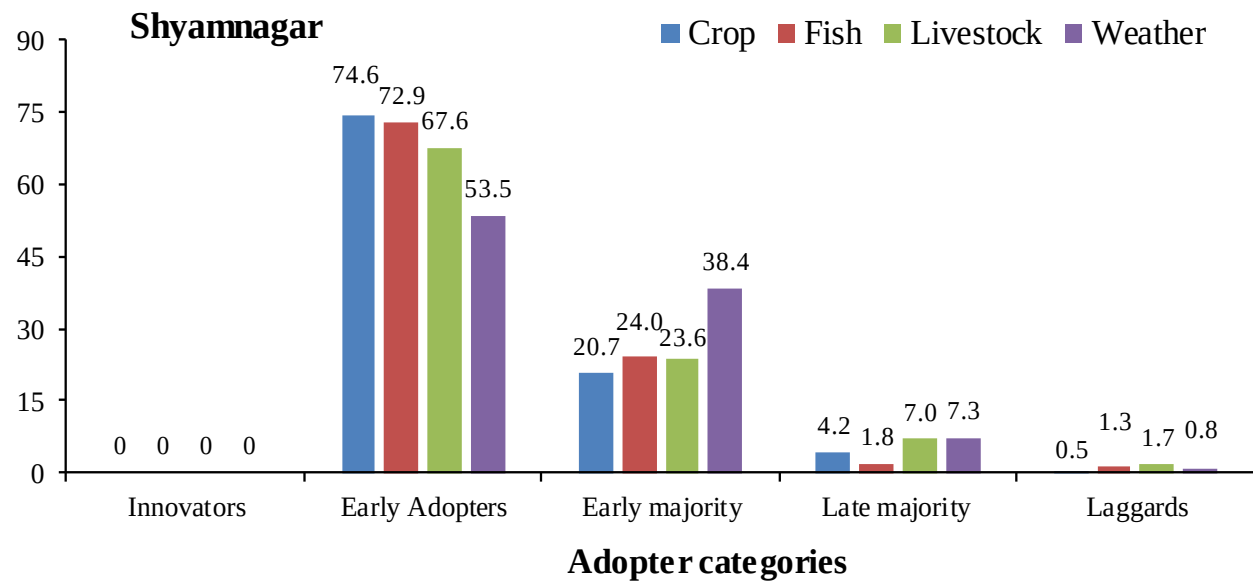
A comparison was made here how different groups in Chitalmari, Shyamnagar, Paikgacha, Kotalipara, and Jashore Sadar upazila adopt and use ITKs (figure 9). In the Chitalmari upazila, it was found that many individuals were Early Adopters, accounting for 58.4% of respondents in crop related ITKs. Following closely behind were the Early Majority, constituting 28.4%, while the Late Majority comprised 12.5%. The number of Laggards was notably minimal, standing at a mere 0.7%. Regarding fish related ITKs, nearly an equal distribution between the Early Adopters and the Early Majority was observed, which exhibited 39.9% and 39.6%, respectively. The subsequent category was the Late Majority, representing 19.8%, while the Laggards accounted for a negligible 0.6%. In terms of livestock related ITKs, the Early Adopters took the lead with 56.9%, followed by the Early Majority 27.9%. The Late Majority made up 14.6% of the respondents, while the Laggards constituted a minimal 0.7%. Weather-related ITKs revealed that the highest proportion belonged to the Early Majority, accounting for 39.6%, closely trailed by the early adopters at 35.3%. The Late Majority stood at 25.1%, marking the highest among the four variables (crop-related, fisheries related, livestock related, and weather related). Notably, no Laggards were recorded in this category.

Overall, the study showed a prevailing trend of Early Adopters leading in the adoption of ITKs across various agricultural domains in the past. The Early Majority frequently followed suit, demonstrating a substantial acceptance and implementation of innovative techniques. Late Majority groups also participated, albeit to a lesser extent, while Laggards represented a significantly minimal fraction across all sectors, indicating a widespread uptake of technological advancements within the Chitalmari upazila. In Shyamnagar upazila, the study highlighted that concerning ITKs related to crop cultivation, a significant number of participants were categorized as Early Adopters, comprising a substantial 74.6%.

The subsequent group was the Early Majority, making up 20.7%, followed by the Late Majority, which constituted 4.2%. A minimal 0.5% was classified as Laggards, indicating a relatively low resistance towards embracing these technological advancements. Regarding ITKs associated with fisheries, a noteworthy percentage of respondents (72.9%) were found as Early Adopters, while the Early Majority accounted for 24%. Interestingly, the Late Majority comprised only 1.8%, a notably lower proportion compared to the data observed in Chitalmari upazila. Laggards represented a modest 1.3% within this category.

In the domain of ITKs related to livestock, many participants were classified as Early Adopters, amounting to 67.6%, with the Early Majority following at 23.6%. The Late Majority made up 7% of the respondents, while Laggards constituted a minor 1.7%. In terms of weather-related ITKs, the highest proportion of respondents belonged to the Early Adopters, accounting for 53.5%. Following closely were the Early Majority at 38.4%, which marked the highest percentage among all categories. The Late Majority accounted for 7.3%, the highest among the four variables (crop-related, fish, livestock, and weather), while Laggards comprised 0.8%.




Shyamnagar
Crop
Fish
Livestock
Weather
90
75
60
45
30
15
0
74.6
72.9
67.6
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24.0
23.6
38.4
4.2
1.8
7.0
7.3
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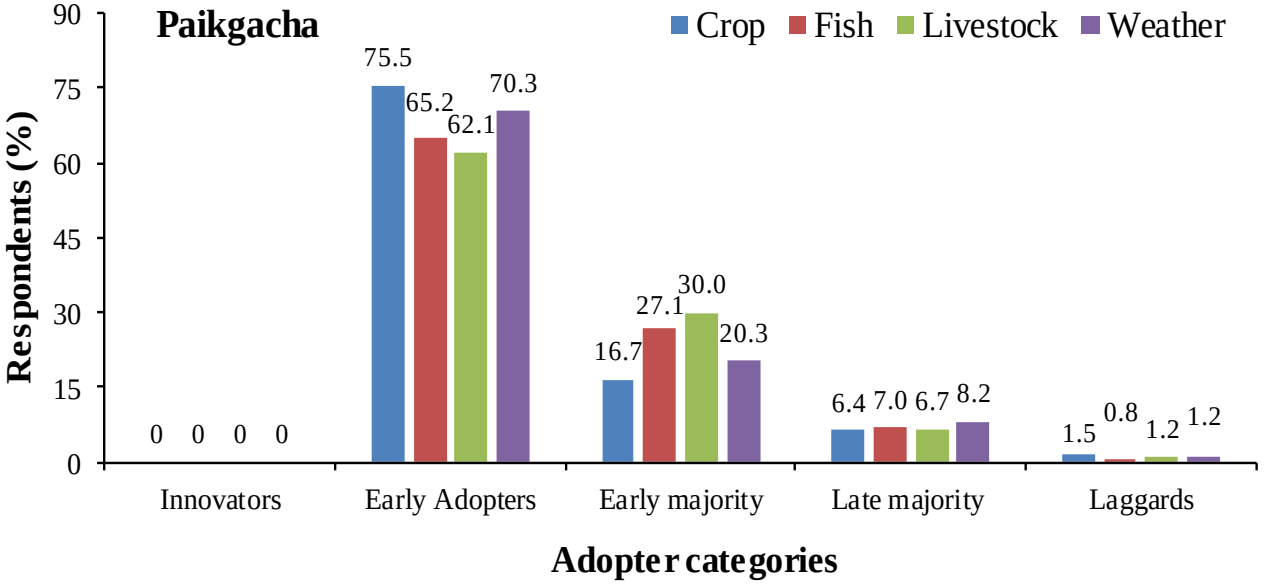
0 0 0 0
Innovators
Early Adopters
Early majority
Late majority
Laggards
Adopter categories


Paikgacha
Crop
Fish
Livestock
Weather
Respondents (%)
90
75
60
45
30
15
0
75.5
65.2
62.1
70.3
16.7
27.1
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20.3
6.4
7.0
6.7
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0.8
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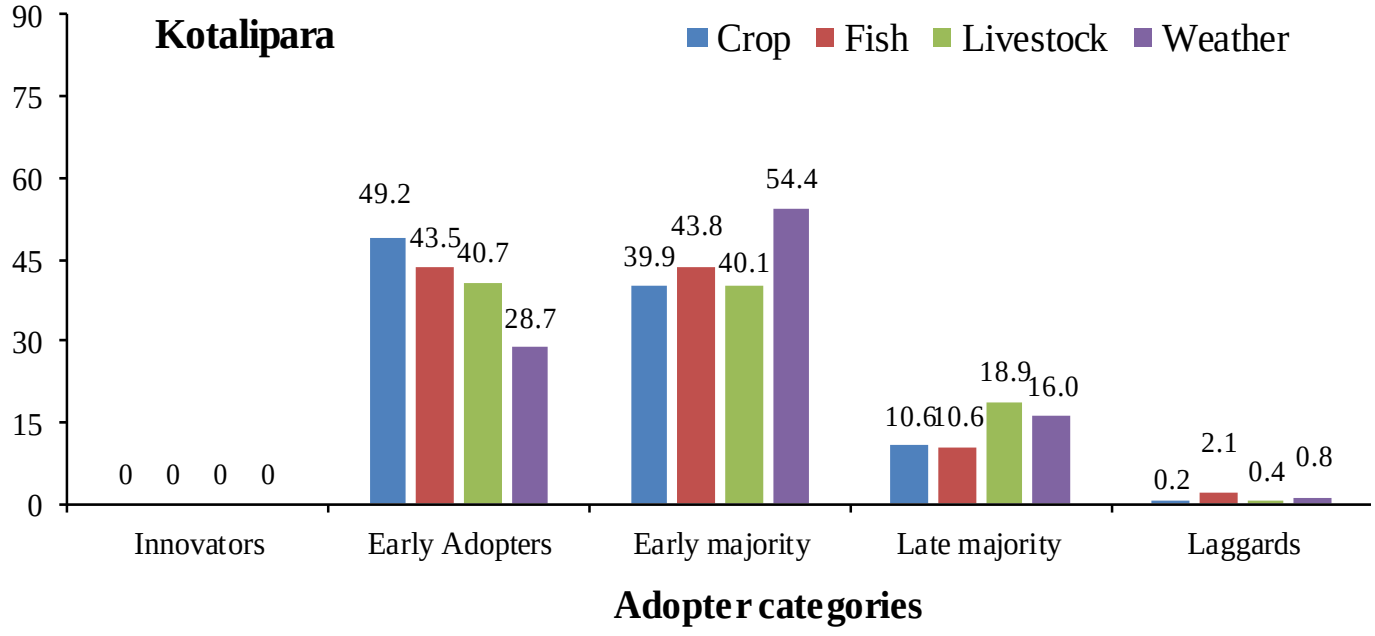
0 0 0 0
Innovators
Early Adopters
Early majority
Late majority
Laggards
Adopter categories


Kotalipara
Crop
Fish
Livestock
Weather
90
75
60
45
30
15
0
49.2
43.5
40.7
28.7
39.9
43.8
40.1
54.4
10.6
10.6
18.9
16.0
0.2
2.1
0.4
0.8
0 0 0 0
Innovators
Early Adopters
Early majority
Late majority
Laggards
Adopter categories

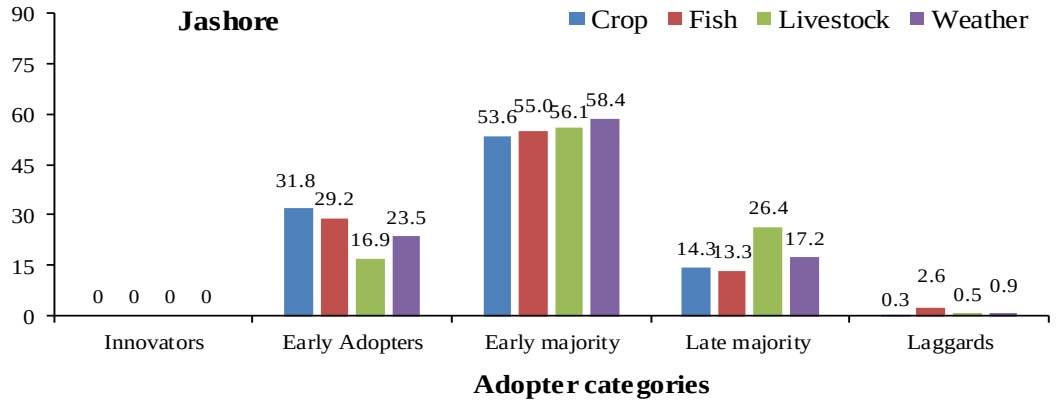



**Figure 9:** Adopter categories (Magnitude of adoption) comparison among Chitalmari, Shyamnagar, Paikgacha, Kotalipara and Jashore Sadar upazila in respects of crop, fisheries, livestock, and weather related ITKs

Overall, the study reflected a prevalent trend of Early Adopters leading in the adoption of ITKs across various sectors within Shyamnagar upazila in the past. The Early Majority also demonstrated significant acceptance and implementation of innovative techniques. Late Majority groups participated to a lesser extent, while Laggards remained a relatively minimal fraction across all sectors, indicating a general acceptance and adoption of technological advancements within the region.

Paikgacha upazila unveiled a predominant adoption pattern across diverse sectors notably observing a substantial 75.5% representing the Early Adopters in the realm of crop related ITKs, followed sequentially by the Early Majority at 16.7% and the Late Majority at 6.4%. Laggards, signaling minimal hesitance, constituted merely 1.5% in embracing these technological innovations. In the context of fisheries related ITKs, a noteworthy 65.2% were categorized as Early Adopters, succeeded by the Early Majority at 27.1%, while the Late Majority and Laggards represented 7% and 0.8%, respectively. Similarly, within the livestock related ITKs domain, a majority of 62.1% comprised Early Adopters, trailed by the Early Majority at 30% and the Late Majority at 6.7%, with a modest 1.2% classified as Laggards. Weather-related ITKs revealed a high proportion of Early Adopters at 70.3%, followed by the Early Majority at 20.3%, and the Late Majority at 8.2% while Laggards were low at 1.2% within this category.

The data showed a prevalent acceptance and uptake of technological innovations, particularly in the domain of crop related ITKs, where Early Adopters were notably dominant. This pattern was observed in varying degrees across fisheries, livestock, and weather-related ITKs, with Early Adopters consistently leading the adoption, followed by subsequent categories with decreasing percentages, reflecting a generally positive attitude towards embracing technological advancements in this region.

In Kotalipara, in terms of crop related ITK, the highest proportion was attributed to the Early Adopters, standing at 49.2%, followed by a slightly lower percentage of 39.9% for the Early Majority. Subsequently, the Late Majority comprised 10.6% while Laggards represented 0.2%. Analyzing fish related ITKs in the same upazila, both the Early Adopters and the Early Majority held nearly equivalent positions accounting for 43.5% and 43.8% respectively. However, the Late Majority found considerably lower 10.6%. Laggards decreased further to 2.1%. Notably, among all the variables of fish related ITKs exhibited a higher proportion of Laggards. Concerning livestock related ITKs, there were no innovators observed. The Early Adopters and the Early Majority occupied similar positions with the Early Adopters at 40.7% and the Early Majority slightly behind at 40.1%. The Late Majority held the highest percentage among all variables within this upazila with a figure of 18.9% while Laggards represented 0.4%. Weather-related ITKs displayed the Early Majority at the highest position accounting for 54.4%. Following closely were the Early Adopters at 28.7%. The Late Majority represented 16% while Laggards accounted for 0.8% within this category in the upazila.

In Jashore Sadar upazila, the proportion of Early Adopters was consistently lower than that of the Early Majority. Specifically, concerning crop related ITKs, Early Adopters accounted for only 31.8%, while the Early Majority was at 53%. The Late Majority dropped to a mere 14.3%, and Laggards constituted a minimal 0.3%. Shifting focus to fish related ITKs, Early Adopters were recorded at 29.2%, significantly less than the Early Majority at 55%. The Late Majority trailed behind the Early Adopters, representing 13.3%, while Laggards slightly increased to 2.6%. In the context of livestock related ITKs, Early Adopters accounted for 16.9%, while the Early Majority had a higher percentage at 56.1%. The Late Majority comprised 26.4% and Laggards were observed at the lowest percentage of 0.5%. Examining weather-related ITKs, the Early Majority held the highest percentage at 58.4% surpassing all other categories. Early Adopters followed at 23.5%. The Late Majority decreased to 17.2% and Laggards further diminished to 0.9% within this category.

### 3.5 Distribution of respondents according to their ITKs use

Distinguishable patterns emerged in low and medium levels of ITKs usage across the different regions (figure 10). Specifically, Chitalmari upazila reported a low ITKs usage of 46.4%, complemented by a corresponding medium usage of 53.6%. Shyamnagar upazila displayed a low usage of 30% marking the highest medium usage at 70% among all the upazila. Similarly, Paikgacha upazila depicted a low of 58% alongside a medium usage of 42%. Further, Kotalipara upazila as exhibiting the highest proportion of low usage at 96%, paired with the lowest representation in the medium usage category at 4% among the five upazila. Finally, in Jashore Sadar upazila, the registered low usage stood at 77% while the medium usage was 23%.

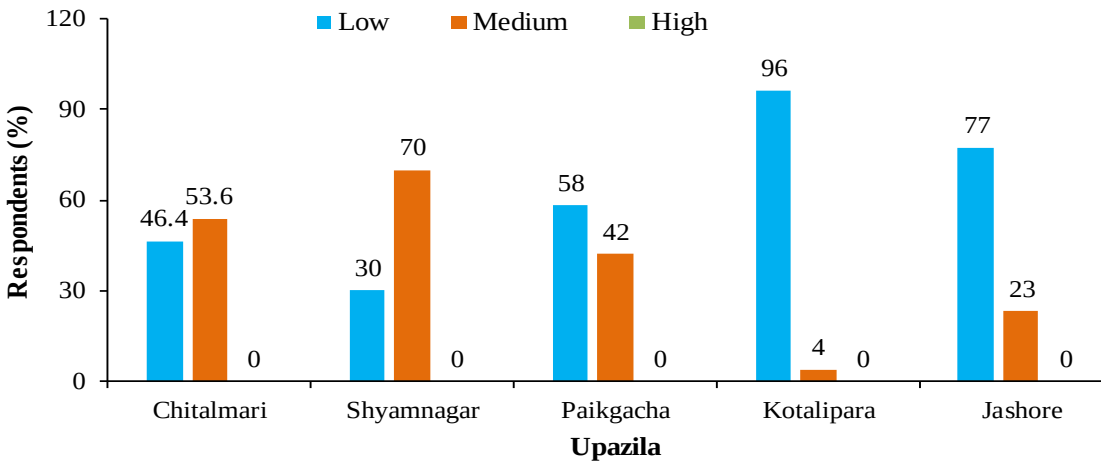



**Figure 10:** Distribution of respondents according to their ITKs use among different locations of southwestern Bangladesh

### 3.6 Variability among Respondents in ITKs usage across Southwestern Bangladesh

The fluctuations, disparities, and prevalence levels of ITKs practices within these locations, aiming to discern the differences in reliance on traditional knowledge systems were presented in figure 11.

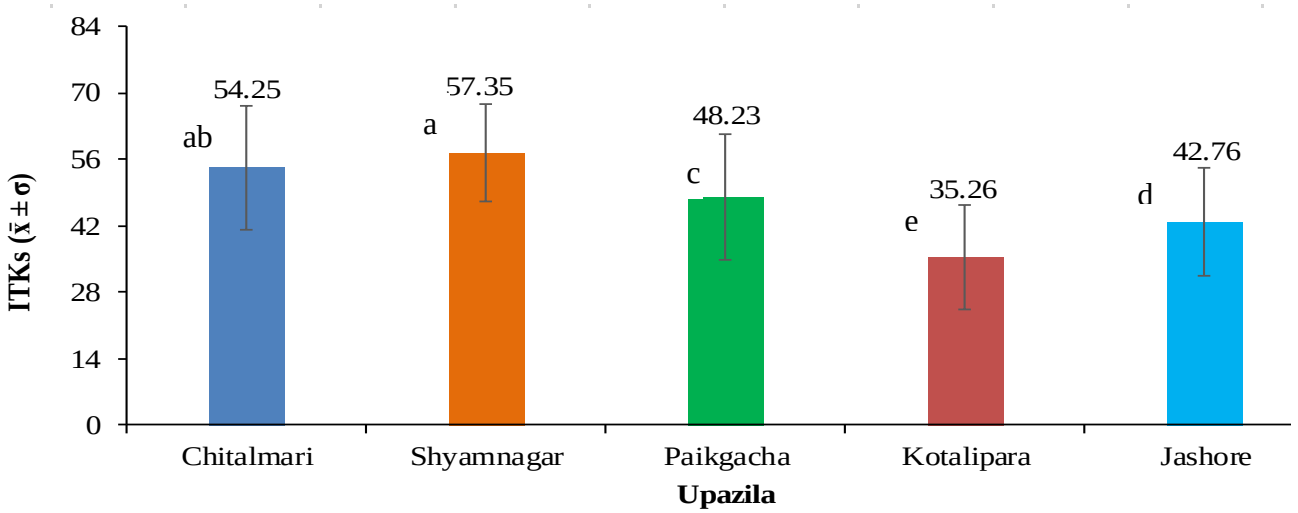



**Figure 11:** Variation in ITKs use among five upazila

Respondents in Chitalmari and Shyamnagar upazila exhibited a considerable prevalence of ITKs usage in southwestern Bangladesh. Shyamnagar upazila slightly surpassed Chitalmari upazila in ITKs usage, recording a value of 57.35%. Conversely, Chitalmari upazila reported a slightly lower but still notable ITKs usage at 54.25%. Following these upazila, Jashore and Paikgacha upazila displayed comparatively lesser utilization of ITKs. Notably, Paikgacha upazila secured the third position, showing the ITKs usage percentage of 48.23% while Jashore Sadar upazila trailed behind with a recorded ITKs usage of 42.76%. Among the surveyed regions, Kotalipara upazila registered the lowest level of ITKs usage, reporting the lowest recorded value at 35.26%.

The letter (a, ab, c, d, and e) of the figure means that the highest usage of ITKs was in Shyamnagar upazila, which is statistically similar with Chitalmari but significantly different with Paikgacha followed by Jashore and Kotalipara upazila. From this difference we could say that agriculture can be made sustainable, ecofriendly, and productive by increasing the use of ITKs where the usage of ITKs is low.

## 4. Discussion

### 4.1 Magnitude of ITKs (crop, fisheries, livestock, and weather) used in different locations

Being saline prone area Chitalmari, Shyamnagar and Paikgacha have less cultivable land and cropping pattern for this region was mainly Fallow-Fallow-T.aman that's why crop related ITKs users was less in those region. Although Kotalipara did not belongs to saline prone area but this region was surrounded by a lots of pond, canal and river and due to this, a similar trend was also observed there like previously mentioned saline area that's means less amount of cultivable land. Respondents of those regions cultivate fish and rearing livestock rather than producing crops as the land remains fallow throughout the year except T. aman season. On the other hand, a huge cultivable land was observed in Jashore Sadar upazila compared to rest of the locations mentioned above and crop related ITKs users percentage was recorded highest in this region. This area was occupied mainly by both Rabi and Kharif crop. A major portion of the respondents was found mainly involved in vegetables seedlings production. Due to insufficient water sources, ITKs related to fish cultivation was obtained lowest there while a satisfactory percent of respondents rearing of livestock was observed as people in this area. Along with crop cultivation respondents of this region involved in beef fattening. Among all the ITKs, crop related ITKs were more used than those of others. Weather related ITKs were also used a lot by people. But the use of fisheries related ITKs and livestock related ITKs was much less than the previous two.

### 4.2 Comparative Analysis of Adopter Categories Based on Magnitude of Adoption

In most of the examined upazila, the predominant trend observed was the prevalence of a higher proportion of Early Adopters compared to other categories. However, this pattern diverged in Jashore Sadar upazila, where the count of Early Adopters was notably lower than that of the majority. Conversely, the instances where the count of Early Majority surpassed that of Early Adopters were noted solely in Chitalmari, Shyamnagar, Paikgacha, and Kotalipara upazila. This phenomenon was distinctively evident in these areas. Across all studied regions, the presence of the Late Majority remained significantly low, but it was consistently greater than the count of Laggards. This trend was consistent in Chitalmari, Shyamnagar, Paikgacha, Kotalipara, and Jashore Sadar upazila. Interestingly, the contrast between the count of Early Adopters and Early Majority highlighted a unique situation solely in Jashore Sadar upazila, where the count of Early Majority surpassed that of Early Adopters. This distinctive deviation was not observed in the other examined upazila, setting Jashore Sadar apart in terms of the prevalence of Early Majority.

A group researchers found that in the case of nutrient management, the majority (83.07%) of the respondents were medium adopters (Khatri et al., 2021). The majority (67.4%) of the respondents were medium adopters in the case of ITKs of plant protection. Maximum respondents (66.77%) were medium adopters in the case of ITKs of plant storage. ITKs in animal husbandry, majority (82.04%) of the respondents had medium adoption. The majority (79.86%) of the farmers were medium adopters in the case of ITKs in weather forecasting.

### 4.3 Distribution of respondents according to their ITKs use

The results strongly indicated that none of the areas showed a notable prevalence of high ITKs usage. Instead, they predominantly leaned toward either low or medium usage. This observation underscores the need for a more comprehensive understanding of the factors influencing ITKs practices within these regions. This finding was inconsistent with Roy who found similar findings in her study that the highest proportion of the respondents fell into low to moderate user categories for practicing indigenous technical knowledge while Rahman also found the similar results that highest proportion (47.2%) of the respondents belonged to the low user as compared to 39.2% in the moderate user and 13.6% in the high user (Roy, 2009; Rahman, 2012).

These findings raise pertinent questions regarding the factors contributing to the disparity in ITKs utilization among the various upazila. Factors such as cultural influences, accessibility to information, traditional beliefs, and healthcare access might significantly impact the prevalence of ITKs usage within these communities. Understanding the reasons behind the varying levels of ITKs utilization in different regions could offer valuable insights for policymakers, healthcare providers, and researchers aiming to promote effective healthcare practices and bridge gaps in knowledge dissemination. Further studies exploring the socio-cultural, economic, and geographical facets influencing ITKs usage are essential for formulating targeted strategies to support and integrate traditional knowledge systems within broader.

## 5. Conclusions

The study conducted at a total of five upazila, each distinguished by its unique agricultural features. Among these areas, Jashore Sadar upazila stands out prominently in terms of agricultural advancements. This upazila compared to the others, demonstrates higher agricultural prowess. Positioned slightly higher in altitude than the rest, Jashore Sadar upazila also experiences less emphasis on fish farming activities, resulting in significantly fewer associated ITKs usages in this domain. Conversely, crop related ITKs are more prevalent in this region compared to other categories of ITKs. Notably, differences were discerned among the upazila concerning the distribution of adapter categories. In our analysis, it became evident that many respondents were primarily clustered within the medium-use category of ITKs, closely followed by those in the low-use category. This observation underlines the diverse utilization of ITKs among the farmers in these upazila.

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