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IDENTIFICATION AND DOCUMENTATION OF FARMER'S TECHNOLOGICAL NEED AND PROBLEMS DUE TO CLIMATE CHANGE STRESS: A STUDY IN FLOOD AND INTERMITTENT DROUGHT AFFECTED AREAS OF ASSAM INDIA

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ABSTRACT

Agriculture is highly vulnerable to climate change imposing serious impact on livelihood security of farmers. Farmers have to face various problems and challenges during farming activities due to various climate stress conditions such as flood, intermittent drought etc. So, there is a need to study and document these problems in order to disseminate appropriate technology based on their varying technological need. The study was carried out in twelve villages, i.e. 6 villages in Golaghat district (Intermittent drought affected area) and 6 other villages (six) in Sivsagar district (Flood affected area) of Assam in which 'RESILIENCE' project was implemented since 2019. A purposive cum random sampling design was followed for selection of district, villages and respondents. A purposive random sampling method was used for selecting 384 farmers as respondents from 6 RESILIENCE project villages and 6 adjacent control villages of Golaghat and Sivsagar districts. The sample respondents included 192 from Golaghat and 192 from Sivsagar. All total 29 problems of farmer's due to climate change stress such as flood and intermittent drought has been identified under the present study which were collected with the level of intensity of the problem. The problem Ranked as I with weighted mean score of 1.91 is "Cost of Production increases during water shortage period" i.e in intermittent drought conditions. The problem Ranked as I with weighted mean score of 1.93 is "Prolonged water logged condition in crop areas caused due to lack of drainage and heavy rainfall along with continous water stress conditions which harm crop lead to crop loss or lodging. Majority of the respondents responded that the technology "Mostly needed" were 'Knowledge on pesticides, insecticides, fertillizer for various crops' (85.20%), 'Livestock disease management'(81.00%), 'Disease management of Kharif and Rabi crops'(85.20%). Government should redirect extension agencies to put forward their strategic effort to make farmers aware of climate change and benefits of practicing climate smart agricultural practices in order to strengthen their livelihood security and make them ready to combat the problems due to climate change stress. Documentation of farmer's problems and their technological need is very crucial for proper utilization of government fund towards dissemination of appropriate climate smart agricultural technologies in order to combat various climate stress conditions such as flood and intermittent drought in Assam. Government and non-government organizations should put sincere strategic efforts towards appropriate technology need for varying situations in order to minimize the adverse impacts of climate change on the farming community.

Keywords **:** Climate change, Flood, Intermittent drought.

Introduction

Global climate change is the most challenging and threatening issue of the current century (Anon, 2014a). The global phenomenon "climate change" has been defined by United Nations Framework Convention on Climate Change as an attribute influenced by anthropogenic events that have changed the global atmospheric composition, affecting the variability and

pace of natural climate change regionally and over time (Anon, 2010). Although climate change is a global phenomenon, it is now well understood that developing countries will experience a far more detrimental effect of climate change in comparison to developed countries due to the fact that the developing countries have relatively lower capacity to respond to such changes. The poor are the most unstable to respond to climatic stimuli (Srivastava, 2015). Agriculture sector has been proved to be one of the most sensitive sectors to climate change as an extent of climate change significantly impacts the agriculture and the processes related to it (Tao, 2011). Extreme weather events in the form of heat, droughts, floods, and variable rainfall patterns will have a significant negative impact on agriculture production (Pachauri and Meyer, 2014). Climate variability and change is one of the major sources of risk for farmers who depend on crop production (De and Bodosa. 2015; Nath and Deka 2010). Thus, any variations in climatic parameters like rainfall, humidity, temperature etc have significant influence in sustainable development of agriculture thereby leading to important changes in ecology as well.

Assam, a north-eastern state of India is highly vulnerable to climate change (Anon., 2015a). Agriculture plays a vital role in the economy of Assam as 4174023 hectares area is under cropping representing 56.84% of the geographical area of the state (Anon, 2014b). The major impacts have been on the agriculture sectors of eastern and north-eastern states of India. Climate change projections for Assam indicate that mean average temperature is likely to rise by +1.7-2.2 C by mid-century with respect to 1971-2000 (Anon., 2015a). Assam is one of the most flood prone states in India. The State faces acute flood problem in the flood plains of the river Brahmaputra and Barak and other smaller river sub-basins (Anon., 2022b). Historical analysis of the last ten years shows the problem of flood and its impact on the population every year shown in Fig. 1.

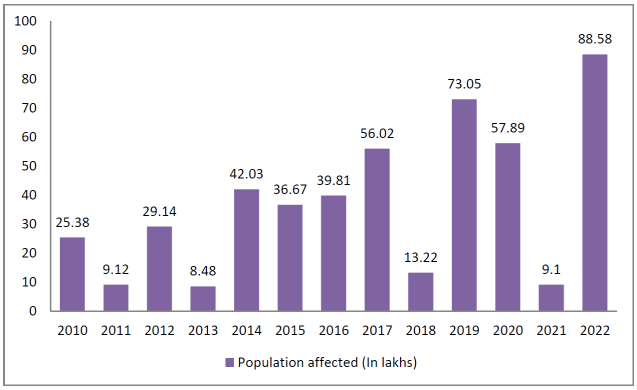


Fig. 1: Population affected by Flood from 2010-2022 (Source: Flood Memorandum Assam, 2022, GoA)

Table 1 states the year wise incidents of flood damage including Submergent crop area, Crop area damaged and Total farm families affected due to flood in Assam from 2007 to 2015. The table reflected that the highest damage in terms of monetary value had occurred during 2016 causing a loss of Rs 10339.66 crores while the highest human and livestock lives were lost during 2022 (179 no of human lives) and 2012 (11408 no of livestock).

Table 1 : Year wise incidence of flood damage in Assam (2012-2022)

Year	Crop Area Affected (Lakh Ha)	Human Lives Lost (No)	Livestock Lost (No)	Total Damage Value (In crores)
2012	3.28	144	11408	3591.81
2013	0.71	NA	NA	NA
2014	3.67	90	28	2534.88
2015	3.38	66	212	1523.79
2016	2.35	64	5580	10339.66
2017	3.98	160	449	4358.81
2018	0.31	53	556	2491.59
2019	2.15	101	250	3237.75
2020	1.88	150	702	2642.99
2021	0.65	3	13	NA
2022	1.08	179	2700	10,000

(Source: Flood Memorandum, Revenue and Disaster Management Department, 2022)

Since 2010, Assam has witnessed drought like situation twice, affecting large number of districts. 14 districts of Assam witnessed drought like situation in 2014, and again in 2019, 20 districts experienced less rain and drought like situation. Table 2 depicts the projected changes under various climate parameters from 2021-2050. The rising temperature may increase by 1.7-2.0^{o}C with respect to baseline. Only the western

part of the State will experience slight decrease in rainfall but the rest of Assam is projected to have increase in rainfall. Droughts weeks are going to rise, with Southern districts showing marginal reduction in drought weeks but rest of the district show an increase by more than 75% with respect to baseline.

Table 2 : Projected changes in climate of Assam from 2021-2050

Climate Indicators	2050 Projection *wrt* to Baseline 2021	Remarks
Mean Temperature	1.7 ^{o}C -2.0^{o}C	All Across Assam
Annual Rainfall	-5to 10%	North Western district of Assam
	5-10%	North Eastern Districts of Assam
	10-25%	Central And South Eastern district of Assam
Drought weeks	-25%to >75%	Southern district show marginal reduction but others show an increase of more than 75% wrt to Baseline

(Source: Assam SAPCC 2015-2020).

Flood and intermittent drought situations which are the results of climate change stress conditions significantly hampering the crop production and creating hindrance in various farming activities along with other challenges in Assam. Thus, this study would help in learning and documenting varying problems faced by the farmers belonging to various climate stress conditions in Assam i.e. flood and intermittent drought respectively. Along with proper documentation of farmer's problems. Along with documentation of problems, there is an utmost need to identify the technological needs of farmers facing different climate stress conditions because with varying situations their technological need might vary as well. The study is very crucial for proper utilization of government fund towards dissemination of appropriate climate smart agricultural technologies in order to combat these climatic stress conditions such as flood and intermittent drought in Assam.

Materials and Methods

The study was conducted in Golaghat and Sivsagar districts of Upper Brahmaputra valley zone of Assam. A purposive random sampling method was used for selecting 384 farmers as respondents from 6 RESILIENCE project villages and 6 adjacent control villages of Golaghat and Sivsagar districts. The sample respondents included 192 from Golaghat and 192 from Sivsagar district of Assam. Among 384 respondents 192 respondents were project farmers of Ujoni Bhorolua, Gotonga, Thekeratol and 3 No Gomariguri, Amgurichukh, Rupkolia project villages of Sivsagar and Golaghat district respectively. The other 192 respondents were non project farmers of Krishnasiga, Moglow, Gowal Gaon and Rampur, Merachukh, Naujanchukh non project villages of Sivsagar and Golaghat district respectively. Selected respondents were interviewed personally with the help of specially structured schedule.

In the present study. Problems are the difficulties faced by a respondent due to various climate stress situations occurring due to climate change such as intermittent drought condition and flood. In this study, "Problems faced by farmers due to Climate Change Stress" was considered as a descriptive variable and were studied as per objectives of the study. An open ended questionnaire was constructed to identify the problems. After collecting details about problems faced by the respondents due to intermittent drought and flood and the intensity of the problem, they were properly worded, categorized and presented. The responses regarding intensity of problem were measures in three continum as "High Problem", "Moderate Problem", "Less Problem". Frequency and Percentage Distribution of use of coping mechanisms were also calculated. The collected data were tabulated and analyzed with the help of MS Excel and SPSS software programes. Appropriate statistical methods like Frequency Distribution, Percentage, Mean, Standard Deviation, Weighted Mean Score were used for analysis and interpretation of data with a score of 2,1 and 0 respectively. Ranking has been done according to the Weighted mean Score.

To assess farmer's technology need a structured schedule was constructed that contains statements regarding specific technology need of farmers for their situation. The responses were collected from the study area and were presented according to project and non-project farmer and cumulative opinion in respective frequency distribution table. The scoring procedure for the statements was as follows:

Categories	Score
Mostly Needed	3
Somewhat Needed	2
Less Needed	1

Along with Cumulative respondents farmer's various types of training needs, the ranking is done among project and non-project farmer as well.

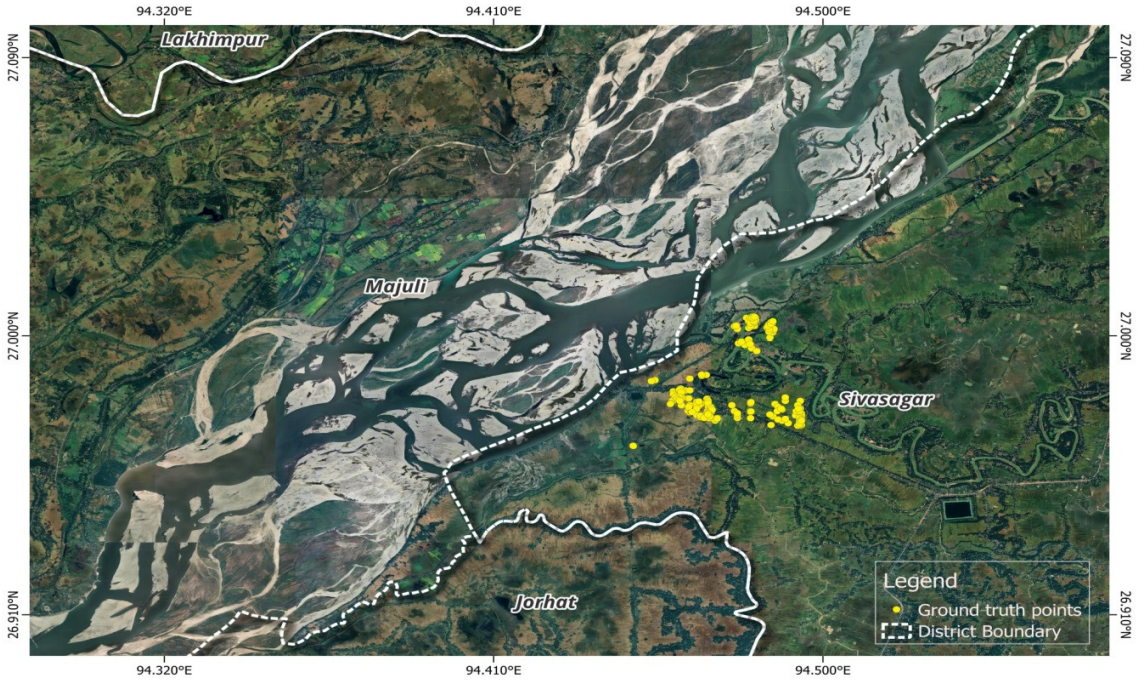
Weighted mean Score has been calculated using the formula as follows:

$$\text{WMS} = \frac{\text{Sum of product of frequency and score assigned}}{\text{Total number of respondents}}$$

Where WMS = Weighted Mean Score

A pretested research schedule was used for collection of data. Appropriate statistical tools such as frequency, percentage, mean, standard deviation, weighted mean score were used for analysis of data.

(a) Sivsagar, Assam (Flood affected area)



(Prepared by Author using QGIS software)

Fig 2. : Map with GPS locations of the respondents of Sivsagar district (Marked with yellow)

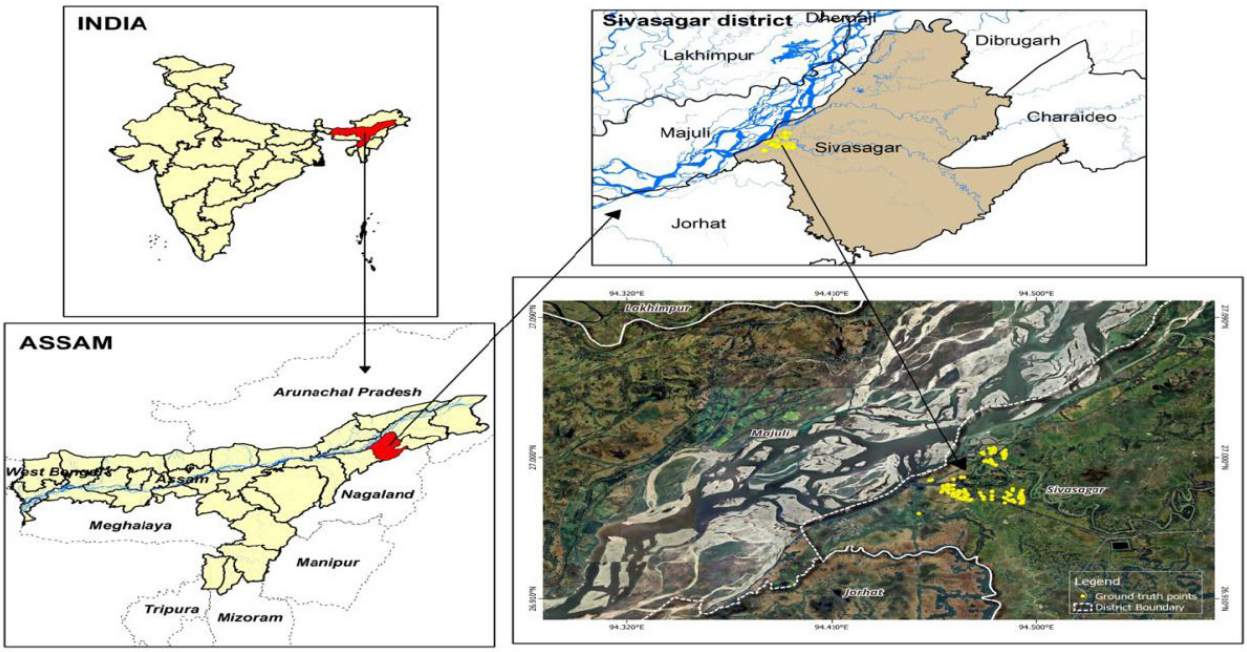
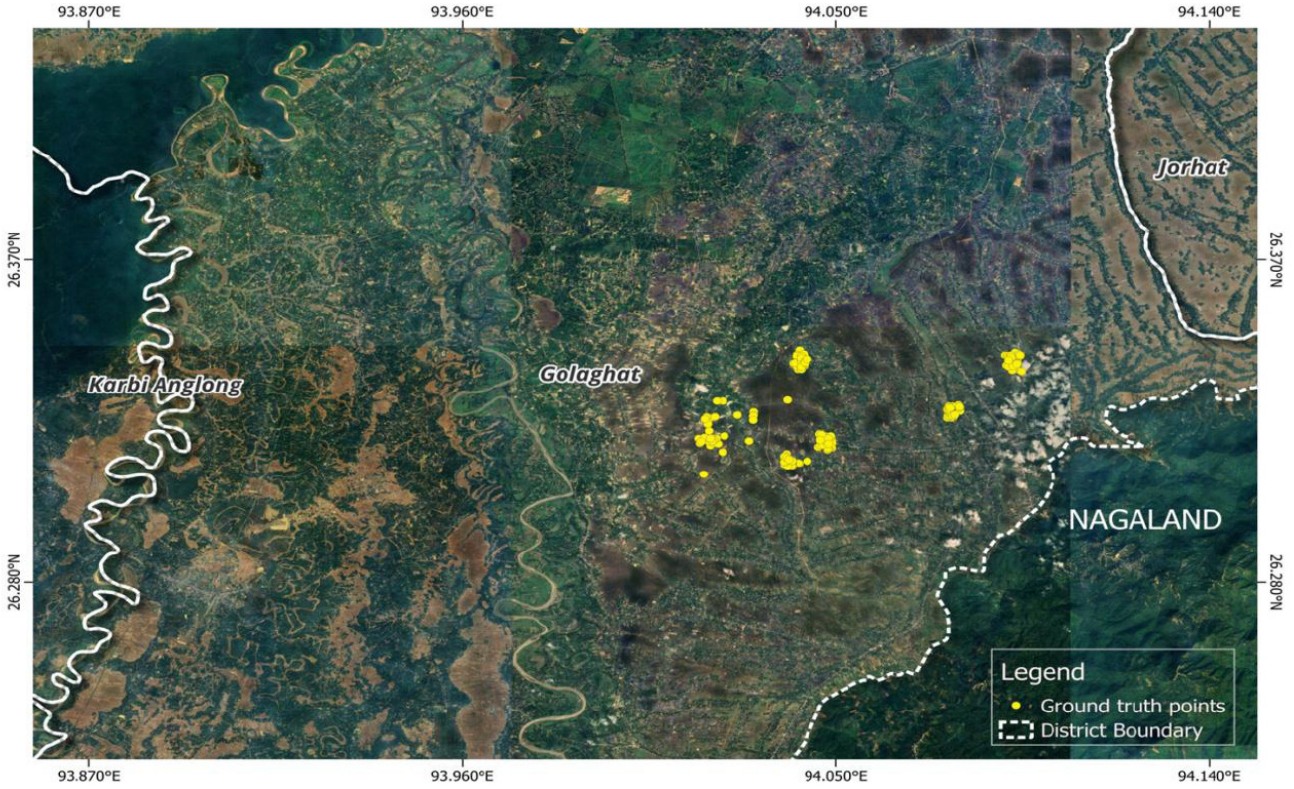


Fig. 3 : Map of Study District (Sivsagar District)

(b) Golaghat, Assam (Intermittent drought affected area)



(Prepared by Author using QGIS software)

Fig. 4 : Map with GPS locations of the respondents of Golaghat district (Marked with yellow)

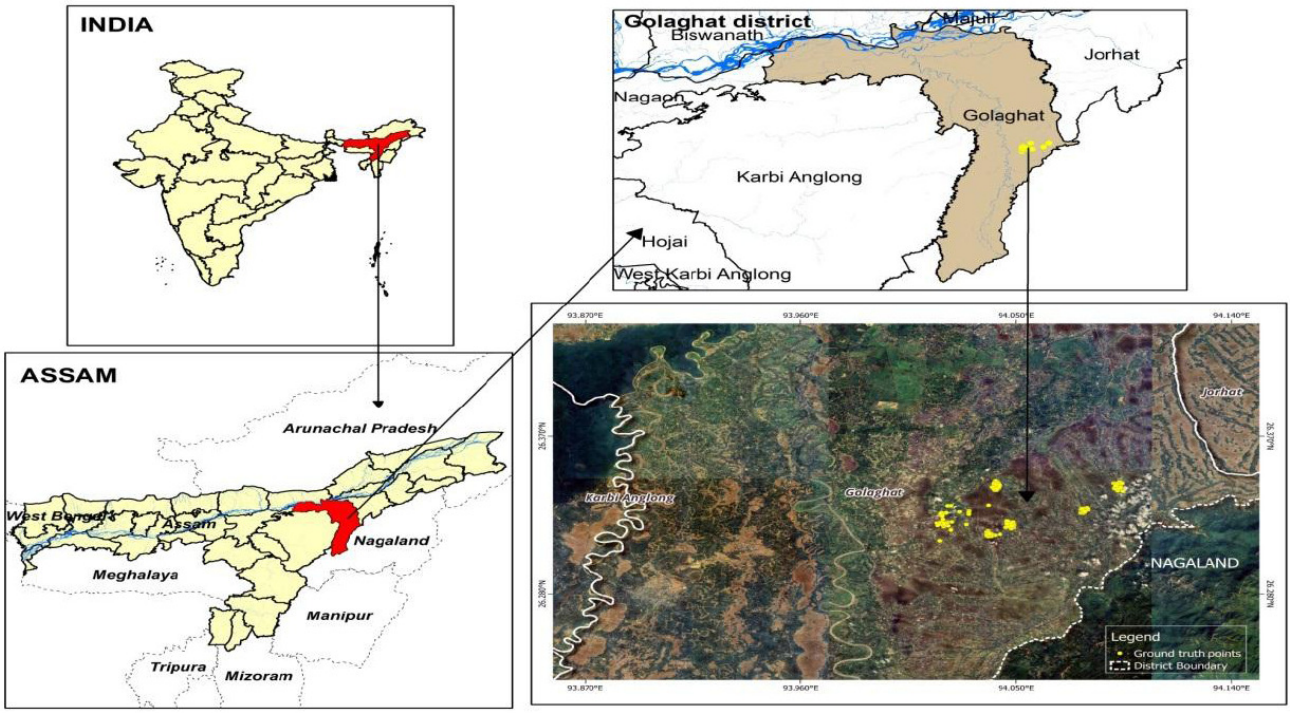


Fig. 5 : Map of Study District (Golaghat District)

Result and Discussion

(a) Problems faced by farmer in intermittent drought affected area (Golaghat, Assam)

All total 29 problems of farmer's due to climate change stress such as flood and intermittent drought has been identified under the present study which were collected with the level of intensity of the problem. The collected problems due to adverse effect of climate change were worded properly and arranged in accordance according to two different situations i.e 'Problems faced by farmer in Intermittent drought affected area' and 'Problems faced by farmer in flood affected area'. In Intermittent drought area, 14 no of problems has been identified while in flood affected area 15 no of problems has been identified along with probable causes behind the problem.

Thus, total two different climate change stressed situations were identified as follows:

(i) 'Problems faced by farmer in intermittent drought affected area'

(ii) 'Problems faced by farmer in flood affected area'

All total 14 no of problems are document under this study in intermittent drought affected area (Golaghat district). The details of the problem along with the probable causes behind the problem and level of Intensity of the problem are presented in Table 3. The table 3 also depicted the ranking of the problems according to their weighted mean score.

The problem ranked as I with weighted mean score of 1.91 is "cost of production increases during water shortage period" i.e. in intermittent drought conditions during cultivation season water scarcity occurs in field conditions which affect the crop growth hence water availability to fields need to be continuously ensured, hence electric motors are used by the farmers sue to its quick efficiency. Thus, due to usage of 1HP electric motor (3hrs/0.13 ha) to draw water during water shortage (2 times/1 season), the cost of production increases. This put an additional weightage on farmer in terms of unavoidable expenses. The problem ranked at II with weighted mean score of 1.88 is "weed Problem is a serious issue" because it also demands a great expense in terms of farmer's cultivation cost. Moreover, the cost involvement in weed management is very high as high rates of weedicides in market. At rank III with a weightage score of 1.80, "high Incidence of tomato blight for *rabi* crops sown during *rabi* Season (last week of November)" create problematic situations for the farmers because of continuous sprinkle of water in warm and dry condition create a warm and wet situation which is convenient for the fungus to grow and spread causing the faster spread of the disease in a very short time affecting the crop growth and sometime causing total crop loss.

The problem ranked as IV with weighted mean score of 1.78 is "sali rice cultivating farmers find it difficult to capture the vegetable market" because farmers of Char areas cultivate *rabi* crops earlier than them and prioritize rabi cultivation more than *sali* rice cultivation while famers from the intermittent drought area are mostly dependent on rice cultivations, so they have to wait until last week of November. The problem ranked at V with weighted mean score of 1.41 is "paddy seedlings damaged during pre-monsoon period" due to vulnerable nature of seedlings, they get easily damaged in water scarcity conditions. With climate changing conditions the monsoon arrival timings fluctuate which ultimate create water scarcity conditions on the nursery and crop field, thus damaging the vulnerable paddy seedlings. The problem ranked at VI with weighted mean score of 1.39 is "access to government irrigation schemes is low" which is due to lack of information and knowledge regarding various opportunities and schemes of government. They also faced difficulties in interacting with government officials also their reluctancy increases with certain government formalities, procedures and waiting period. The problem ranked at VII with weighted mean score of 1.21 is "minimum market linkage" due to lack of knowledge about market information.

The problem ranked at VIII with weighted mean score of 1.16 is "crop loss due to water scarcity" because scanty rainfall leaves the fields, pond and streams dry and the crops could not survived the harsh situation. The problem ranked at IX with weighted mean score of 1.06 is "unavailability of labour is an issue" which leads to excess cost involvement to avail labour from other parts of the state. The problem ranked at X with weighted mean score of 0.97 is "unavailability of good quality seeds for rice cultivation" which is due to lack of knowledge about research stations, seed banks etc.

The problem ranked at XI with weighted mean score of 0.92 is "Sun scalding in tomato is common in these areas" due to scorching sunlight during summers which basically burns the light skin of tomato. The problem ranked at XII with weighted mean score of 0.72 is "migration to other income generating activities other than farming" because the farmers are disinterested because of excess hard work involving in farming activities and their unability to afford proper

mechanization like tractors, and good market profit etc. The problem ranked at XIII with weighted mean score of 0.60 is "farm Income get minimized due to yield loss", although total yield loss is not that common however in rare conditions crop loss occurs due to water shortage, disease or pest attack etc. The problem ranked at XIV with weighted mean score of 0.57 is "storm and hail storm pose threat to crops", although it's a rare event however in some days the wind pressure and hail size leads to damage and lodging of crops leading to yield loss.

The problems identified in intermittent drought areas are categorized on the basis of the level of intensity of the problem mentioned in Table 3. The problems which the respondents found to be as a "high intensity problem" are "cost of production increases during water shortage period"(91.15%) , "high Incidence of tomato blight for rabi crops sown during rabi season i.e. last week of Nov"(83,33%), "weed problem is a serious issue" (88.54%), "sali rice Cultivating farmers find it difficult to capture the vegetable market"(84.90%), "access to government irrigation schemes is low"(59.90%), "paddy seedlings damaged during pre-monsoon period" (56.77%) and "Minimum Market linkage" (43.23%). The problems which the respondents found to be as a "medium intensity problem" are "Unavailabilty of labour is an issue"(88.02%), "crop loss due to water scarcity"(80.21%), "Unavailabilty of good quality seeds for rice cultivation" (78.65%),"sun scalding in tomato is common in these areas" (63.54%) and "farm Income get minimized due to yield loss" (59.90%). The problems which the respondents found to be as a "low intensity problem" are "migration to other income generating activities other than farming" (61.98%) and "storm and hail storm pose threat to crops" (50.00%).

Table 3 : Ranking of the problems and along with distribution of respondent according to intensity of the problems faced by farmers in intermittent drought affected areas

Sl. No	Problems	Probable causes behind the problem	Intermittent Drought affected Areas (N=192)			WS	WMS	RANK
			High Problem	Moderate Problem	Low Problem			
1	High Incidence of Tomato Blight for *Rabi* crops sown during Rabi Season (last week of Nov)	Due to continuous sprinkle of water in warm and dry condition create a warm and wet situation which is convenient for the fungus to grow and spread	160 (83.33)	25 (13.02)	7 (3.65)	345	1.80	III
2	Storm and Hail storm pose threat to crops	The wind pressure and hail size leads to damaging and lodging of crops leading to yield loss	13 (6.77)	83 (43.23)	96 (50.00)	109	0.57	XIV
3	Cost of Production increases during water shortage period	Due to usage of 1HP electric motor (3hrs/0.13 ha) to draw water during water shortage (2 times/1 season)	175 (91.15)	17 (8.85)	0 (0.00)	367	1.91	I
4	Weed Problem is serious issue	As cost involvement in weed management is high	170 (88.54)	20 (10.42)	2 (1.04)	360	1.88	II
5	*Sali* Rice Cultivating farmers find it difficult to capture the vegetable market	Because farmers of Char areas cultivate Rabi Crops earlier than them and prioritize Rabi cultivation more than Sali rice cultivation	163 (84.90)	16 (8.33)	13 (6.77)	342	1.78	IV
6	Crop loss due to water scarcity	Scanty rainfall leaves the fields, pond and streams dry	34 (17.71)	154 (80.21)	4 (2.08)	222	1.16	VIII
7	Unavailabilty of good quality seeds for rice cultivation	Due to lack of knowledge about research stations, seed banks etc	18 (9.38)	151 (78.65)	23 (11.98)	187	0.97	X
8	Migration to other income generating activities other than farming	They are disinterested because of excess hardwork involving in farming activities and their unability to afford proper mechanization like tractors etc.	65 (33.85)	8 (4.17)	119 (61.98)	138	0.72	XII
9	Unavailabilty of Labour is an issue	It leads to excess cost involvement	17 (8.85)	169 (88.02)	6 (3.13)	203	1.06	IX
10	Farm Income get minimized due to yield loss	Crop loss due to water shortage	0 (0.00)	115 (59.90)	77 (40.10)	115	0.60	XIII
11	Minimum Market linkage	Lack of knowledge about market information.	83 (43.23)	67 (34.90)	42 (21.88)	233	1.21	VII
12	Sun scalding in tomato is common in these areas	Due to scorching sunlight during summers	27 (14.06)	122 (63.54)	43 (22.40)	176	0.92	XI
13	Paddy seedlings damaged during pre-monsoon period	Due to vulnerable nature of seedlings, they get easily damaged in water scarcity conditions	109 (56.77)	52 (27.08)	31 (16.15)	270	1..41	V
14	Access to government irrigation schemes is low	Lack of information and knowledge	115 (59.90)	36 (18.75)	41 (21.38)	266	1.39	VI

(b) Problems faced by farmer in flood affected area (Sivsagar, Assam)

All total 15 no of problems are document under this study in flood affected area (Sivsagar district). The details of the problem along with the probable causes behind the problem and level of intensity of the problem are presented in Table 4 The table 4 also depicted the ranking of the problems according to their weighted mean score.

The problem ranked as I with weighted mean score of 1.93 is "prolonged water logged condition in crop areas caused due to lack of drainage and heavy rainfall along with continous water stress conditions which harm crop lead to crop loss or lodging. The problem ranked as II with weighted mean score of 1.91 is "Bao rice cultivators cannot go for dual cropping in the same land" because Bao rice duration is 180 days long duration rice crop. The problem ranked as III with weighted mean score of 1.84 is "Capsicum cultivation are highly affected in these areas" because capsicum has delicate roots and with heavy fruiting the whole plant gets uprooted by flood easily causing total yield loss. The problem ranked as IV with weighted mean score of 1.82 is "nursery beds are highly damaged" because they are highly vulnerable to water logging condition during flood. The problem ranked as V with weighted mean score of 1.78 is "weed problem is a serious issue" because it also demands a great expense in terms of farmer's cultivation cost. Moreover, the cost involvement in weed management is very high as high rates of weedicides in market.

The problem ranked as VI with weighted mean score of 1.76 is "farm Income get minimized" due to yield loss and livestock loss during flood. The problem ranked as VII with weighted mean score of 1.19 is "low availability of livestock fodder" because flood damages the fodder stocks and grazing fields. The problem ranked as VIII with weighted mean score of 1.16 is "grain storage gets affected" due to excessive moisture during flood. The problem ranked as IX with weighted mean score of 1.11 is "high incidence of livestock diseases like Diarrhea etc" because during flood condition water contamination increases leading to such diseases. The problem ranked as X with weighted mean score of 1.09 is "high fish mortality rate" due to overflowing of water of pond.

The problem ranked as XI with weighted mean score of 1.07 is "market linkage is hampered" because lack of communication during flood and also due to lack of knowledge about market information. The problem ranked as XII with weighted mean score of 1.01 is "unavailabilty of good quality seeds for rice cultivation" due to lack of knowledge about research stations, seed banks etc. The problem ranked as XIII with weighted mean score of 0.97 is "Unavailabilty of Labour is an issue" which leads to excess cost involvement to avail labour from other parts of the state. The problem ranked as XIV with weighted mean score of 0.42 is "communication get hindered to flood affected areas" due to road blockages and disrupted communications during flood and the problem ranked as XV with weighted mean score of 0.38 is "migration of youth to other areas" because of lack of income generating activities during flood time.

The problems identified in flood affected areas are categorized on the basis of the level of intensity of the problem mentioned in Table 4. The problems which the respondents found to be as a "high intensity problem" are "prolonged water logged condition in crop areas" (93.23%), "Bao rice cultivators cannot go for dual cropping in the same land." (91.15%), "Capsicum cultivation are highly affected in these areas"(85.94%),"nursery beds are highly damaged" (82.29%), "weed problem is an issue"(78.13%), "farm Income get minimized" (78.13%), and "market linkage is hampered" (44.27%).The problems which the respondents found to be as a "medium intensity problem" are "Unavailabilty of good quality seeds for rice cultivation" (99.48%),"grain storage gets affected" (82.81%), "low availability of livestock fodder" (81.25%), "Unavailabilty of labour is an issue" (79.17%), "high Incidence of livestock diseases like Diarrhea etc." (79.17%), and "high fish mortality rate" (68.75%)". The problems which the respondents found to be as a "low intensity problem" are communication get hindered to flood affected areas "migration of youth to other areas" (70.83%) and "communication get hindered to flood affected areas" (73.44%).

Table 4 : Ranking of the problems and along with distribution of respondent according to intensity of the problems faced by farmers in flood affected areas.

Sl. No	Problems	Causes behind the problem	Flood Affected Areas (N=192)			WS	WMS	RANK
			High Problem	Moderate Problem	Low Problem			
1	Weed Problem is a serious issue.	As cost involvement in weed management is high	150 (78.13)	42 (21.88)	0 (0.00)	342	1.78	V
2	Unavailabilty of good quality seeds for rice cultivation	Due to lack of knowledge about research stations, seed banks etc.	1 (0.52)	191 (99.48)	0 (0.00)	193	1.01	XII

3	Migration of youth to other areas	Lack of income generating activities during flood time	17 (8.85)	39 (20.31)	136 (70.83)	73	0.38	XV
4	Unavailabilty of Labour is an issue	It leads to excess cost involvement	17 (8.85)	152 (79.17)	23 (11.98)	186	0.97	XIII
5	Bao rice cultivators cannot go for dual cropping in the same land.	Bao rice duration is 180 days long.	175 (91.15)	16 (8.33)	1 (0.52)	366	1.91	II
6	Capsicum cultivation are highly affected in these areas	Flood uproot the whole plant causing total yield loss	165 (85.94)	23 (11.98)	4 (2.08)	353	1.84	III
7	Nursery Beds are highly damaged	They are highly vulnerable to water logging condition during flood	158 (82.29)	34 (17.71)	0 (0.00)	350	1.82	IV
8	High Incidence of Livestock Diseases like Diarrhea etc.	During flood condition water contamination leads to such diseases	31 (16.15)	152 (79.17)	9 (4.69)	214	1.11	IX
9	Low availability of Livestock Fodder	Flood damages the fodder stocks and grazing fields	36 (18.75)	156 (81.25)	0 (0.00)	228	1.19	VII
10	Communication get hindered to flood affected areas	Road blockages during flood leads to it	29 (15.10)	22 (11.46)	141 (73.44)	80	0.42	XIV
11	Farm Income get minimized	Due to yield loss and livestock loss during flood	150 (78.13)	37 (19.27)	5 (2.60)	337	1.76	VI
12	Grain storage gets affected	Due to excessive moisture	32 (16.67)	159 (82.81)	1 (0.52)	223	1.16	VIII
13	Prolonged water logged condition in crop areas	Caused due to prolonged water stress conditions and lack of drainage	179 (93.23)	13 (6.77)	0 (0.00)	371	1.93	I
14	High fish mortality rate	Due to overflowing of water of pond	39 (20.31)	132 (68.75)	21 (10.93)	210	1.09	X
15	Market Linkage is hampered	Disrupted communication during flood and lack of knowledge about market information.	85 (44.27)	35 (18.23)	72 (37.50)	205	1.07	XI

Technology Need

The data presented in the Table 5 and Fig 6 represents that the technology "mostly needed" by the respondents were 'knowledge on pesticides, insecticides, fertillizer for various crops' (85.20%), 'livestock disease management'(81.00%), 'disease management of *kharif* and *rabi* crops'(85.20%), while technologies like 'knowledge of newly improved crop varieties'(24.20%),'disease management on horticultural crops' (54.40%) falls under "somewhat needed" category. This indicate that farmers who rear livestock for commercial purpose are affected due to frequent incidence of livestock diseases due to various reason like flood, lack of proper nutrition etc. So, these farmers are highly interested in any kind of technological knowledge or methods to tackle such problems. Commercial kharif and rabi crop farmers are also highly interested in acquiring any technological benefit regarding proper doses and recommendations of pesticides, insecticides and fertilizers. Moreover, the technologies which are less popular among respondent's interest fall under "less needed" category such as 'commercial vermicompost production' (74..70%), 'farm machinery maintenance'(62.00%), 'nursery bed preparation' (58.90%), 'fish production technology' (56.50%), 'irrigation management techniques' (53.10%), 'seed treatment and seed quality maintenance (50.50%), 'value addition for valuable crops' (44.80%), 'disease management of fishes' (44.50%), 'improved paddy cultivation technique' (42.40%), 'post harvest management' (37.00%).

The data presented in the Table 5 and Fig 7 indicates that the respondents considered "disease management of kharif and rabi crops" as their top technical need with Rank I having a weighted mean score of 2.83, followed by "knowledge on pesticide, insecticides, fertilizer for various crops", "livestock disease management", "disease management of fishes" and "post-harvest management" at second (2.81), third (2.75), fourth (1.98) and fifth (1.93) rank with given weighted mean score respectively. The other important technical needs are "disease management of horticulture crops" with 6th rank (weighted mean score: 1.89), "improved paddy cultivation techniques" with 7th rank (weighted mean score: 1.85), "value addition for horticulture crops" with 8th rank (weighted mean score: 1.84), "irrigation management techniques" with 9th rank (weighted mean score: 1.73), "knowledge of newly improved crop varieties with 10th rank (weighted mean score:1.70). The technical needs which have a little less interest of respondents in terms of knowledge and training are "seed treatment and seed quality maintenance" with 11th rank (weighted mean score: 1.69), "fish production technology" with 12th rank (weighted mean score: 1.67), "farm machinery maintenance" with 13th rank (weighted mean score: 1.61), "nursery bed preparation" with 14th rank (weighted mean score: 1.59), "commercial vermicompost production" with 15th rank (weighted mean score:1.38).

Table 5 : Distribution of respondents on the basis of their Technology Need and ranked on the basis of Weighted mean score.

Technology Need	Cumulative (N=384)			WS	WMS	RANK
	Mostly Needed	Somewhat Needed	Less Needed			
Knowledge of Newly Improved crop varieties	87 (22.70)	93 (24.20)	204 (53.10)	651	1.70	X
Knowledge on Pesticide, Insecticides, Fertilizer for various crops	327 (85.20)	41 (10.70)	16 (4.10)	1079	2.81	II
Post-Harvest management	115 (29.90)	127 (33.10)	142 (37.00)	741	1.93	V
Value addition for Horticulture crops	109 (28.40)	103 (26.80)	172 (44.80)	705	1.84	VIII
Fish production technology	91 (23.70)	76 (19.80)	217 (56.50)	642	1.67	XII
Disease management of fishes	163 (42.40)	50 (13.00)	171 (44.50)	760	1.98	IV
Livestock Disease management	311 (81.00)	50 (13.00)	23 (6.00)	1056	2.75	III
Farm Machinery maintenance	89 (23.20)	57 (14.80)	238 (62.00)	619	1.61	XIII
Improved Paddy cultivation techniques	106 (27.60)	115 (29.90)	163 (42.40)	711	1.85	VII
Irrigation management techniques	99 (25.80)	81 (21.1)	204 (53.1)	663	1.73	IX
Nursery bed Preparation	70 (18.20)	88 (22.90)	226 (58.90)	612	1.59	XIV
Commercial Vermicompost Production	48 (12.50)	49 (12.80)	287 (74.70)	529	1.38	XV
Disease management of Kharif and Rabi crops	327 (85.20)	47 (12.20)	10 (2.60)	1085	2.83	I
Disease management of Horticulture crops	66 (17.20)	209 (54.40)	109 (28.40)	725	1.89	VI
Seed Treatment and Seed quality maintenance.	73 (19.00)	117 (30.50)	194 (50.50)	647	1.69	XI

*() depicts the percentage

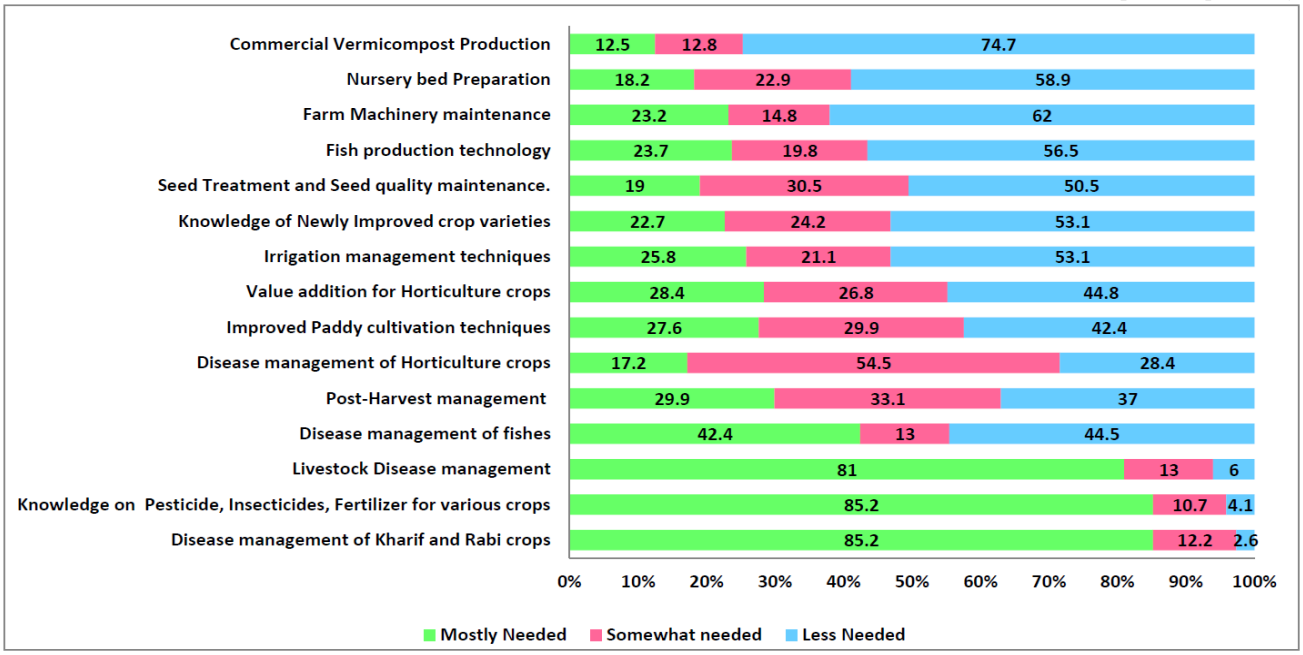


Fig. 6 : Distribution of Respondents on the Basis of Their Technology Need

Fig. 7 : Ranking According to Weighted Mean Score of Technological Need of Respondents

The data presented in Table 6 and Fig 8 is presented and arranged on the basis of the technological need of the respondents from Golaghat (intermittent drought affected area) and Sivsagar district (flood affected area). Respondents belonging to two different situations have different interests towards technologies, their need varies according to their suitability of their areas. Hence, their technological needs vary to some extent. The data presented in the table 4.1.10 represents that the top technology "mostly needed" by the respondents from Golaghat district (intermittent drought affected area) were 'knowledge on pesticides, insecticides, fertillizer for various crops' (85.94%), 'livestock disease management'(81.77%), 'disease management of kharif and rabi crops'(87.50%), 'irrigation management techniques' (51.56%). While in Sivsagar district (flood affected area), the top technology "mostly needed" by the respondents were 'knowledge on pesticides, insecticides, fertillizer for various crops' (84.38%), 'fish production technology' (35.42%), 'disease management of fishes' (72.40%), 'livestock disease management' (80.21%), 'disease management of kharif and rabi crops'(82.81%). In Golaghat district technologies like 'post-harvest management'(35.94%), 'disease management on horticultural crops'(55.21%) falls under "somewhat needed" category while in case of Sivsagar district, the technologies under "somewhat needed" category includes only 'disease management on horticultural crops' (52.60%). Respondents from Golaghat district are least interest in technologies such as 'knowledge of newly improved crop varieties' (34.38%),'commercial vermicompost production' (72..40%), 'farm machinery maintenance'(41.67%), 'nursery bed preparation'(65.10%), 'fish production technology' (81.77%), 'seed treatment and seed quality maintenance (48.96%), 'value addition for horticulture crops' (44.79%), 'disease management of fishes' (77.60%), 'improved paddy cultivation technique' (41.67%), 'commercial vermicompost production' (72.40%) falling under "less needed" category. While respondents from Sivsagar district are least interest in technologies such as 'knowledge of newly improved crop varieties' (70.83%), 'post-harvest management' (42.19%), 'value addition for horticulture crops' (44.79%), 'farm machinery maintenance'(82.29%), 'improved paddy cultivation technique' (43.23%), 'irrigation management technique'(99.48%), 'nursery bed preparation'(52.60%), 'commercial vermicompost production' (77.08%), 'seed treatment and seed quality maintenance (52.08%).

The data presented in the table 6 and Fig 8 indicates that the respondents belonging to Golaghat district (intermittent drought affected area) considered "disease management of kharif and rabi crops" as their top technical need with rank I having a weighted mean score of 2.86, followed by "knowledge on pesticide, insecticides, fertilizer for various crops", "livestock disease management", "irrigation management techniques" and "improved paddy cultivation" at second (2.82) ,third (2.77), fourth (2.45) and fifth (2.04) rank with given weighted mean score respectively. The other important technical needs are "disease management of horticulture crops" with 6th rank (weighted mean score: 2.03), "post-harvest

management" with 7th rank (weighted mean score: 2.01) , "knowledge of newly improved crop varieties with 8th rank (weighted mean score:1.98), "farm machinery maintenance" with 9th rank (weighted mean score: 1.97), "value addition for horticulture crops" with 10th rank (weighted mean score: 1.96), The technical needs which have a little less interest of respondents in terms of knowledge and training are "seed treatment and seed quality maintenance" with 11th rank (weighted mean score: 1.80), "nursery bed preparation" with 12th rank (weighted mean score: 1.47, "commercial vermicompost production" with 13th rank (weighted mean score:1.41), "disease management of fishes" with 14th rank (weighted mean score:1.35), "fish production technology" with 15th rank (weighted mean score: 1.67). Thus, we can say that technologies related to fisheries have less popularity among the respondents from Golaghat district.

The data presented in the table 6 and Fig 8 indicates that the respondents from Sivsagar district (Flood affected area) considered "knowledge on pesticide, insecticides, fertilizer for various crops" as their top technical need with rank I having a weighted mean score of 2.80, followed by "disease management of Kharif and Rabi crops", "livestock disease management", "disease management of fishes" and "fish production technology" at second (2.79) ,third (2.73), fourth (2.61) and fifth (2.04) rank with given weighted mean score respectively. The other important technical needs are "post-harvest management" with 6th rank (weighted mean score: 1.85), "disease management of horticulture crops" with 7th rank (weighted mean score: 1.73), "nursery bed preparation" with 8th rank (weighted mean score: 1.72), "value addition for horticulture crops" with 9th rank (weighted mean score: 1.71), "improved paddy cultivation techniques" with 10th rank (weighted mean score: 1.66). The technical needs which have a little less interest of respondents in terms of knowledge and training are "seed treatment and seed quality maintenance" with 11th rank (weighted mean score: 1.57), "knowledge of newly improved crop varieties with 12th rank (weighted mean score: 1.43), "commercial vermicompost production" with 13th rank (weighted mean score:1.35), "farm machinery maintenance" with 14th rank (weighted mean score: 1.26),"irrigation management techniques" with 15th rank (weighted mean score: 1.01). Hence, flood affected area have no fruitful implementation of disseminating technologies related to irrigation nor they are interested in acquiring knowledge on farm machinery maintenance due to their ignorance towards machinaries. (Details mentioned in Annexure VII).

Table 6 : Distribution of respondents on the basis of their Technology Need in Golaghat district (Intermittent drought area) and Sivsagar district (Flood Area) and ranked on the basis of Weighted mean score

Technology Need	Golaghat (Intermitent Drought) (N=192)		Sivsagar (Flood) (N=192)	
	WMS	RANK	WMS	RANK
Knowledge of Newly Improved crop varieties	1.98	VIII	1.43	XII
Knowledge on Pesticide, Insecticides, Fertilizer for various crop	2.82	II	2.80	I
Post-Harvest management	2.01	VII	1.85	VI
Value addition for Horticulture crops	1.96	X	1.71	IX
Fish production technology	1.30	XV	2.04	V
Disease management of fishes	1.35	XIV	2.61	IV
Livestock Disease management	2.77	III	2.73	III
Farm Machinery maintenance	1.97	IX	1.26	XIV
Improved Paddy cultivation techniques	2.04	V	1.66	X
Irrigation management techniques	2.45	IV	1.01	XV
Nursery bed Preparation	1.47	XII	1.72	VIII
Commercial Vermicompost Production	1.41	XIII	1.35	XIII
Disease management of Kharif and Rabi crops	2.86	I	2.79	II
Disease management of Horticulture crops	2.03	VI	1.73	VII
Seed Treatment and Seed quality maintenance.	1.80	XI	1.57	XI

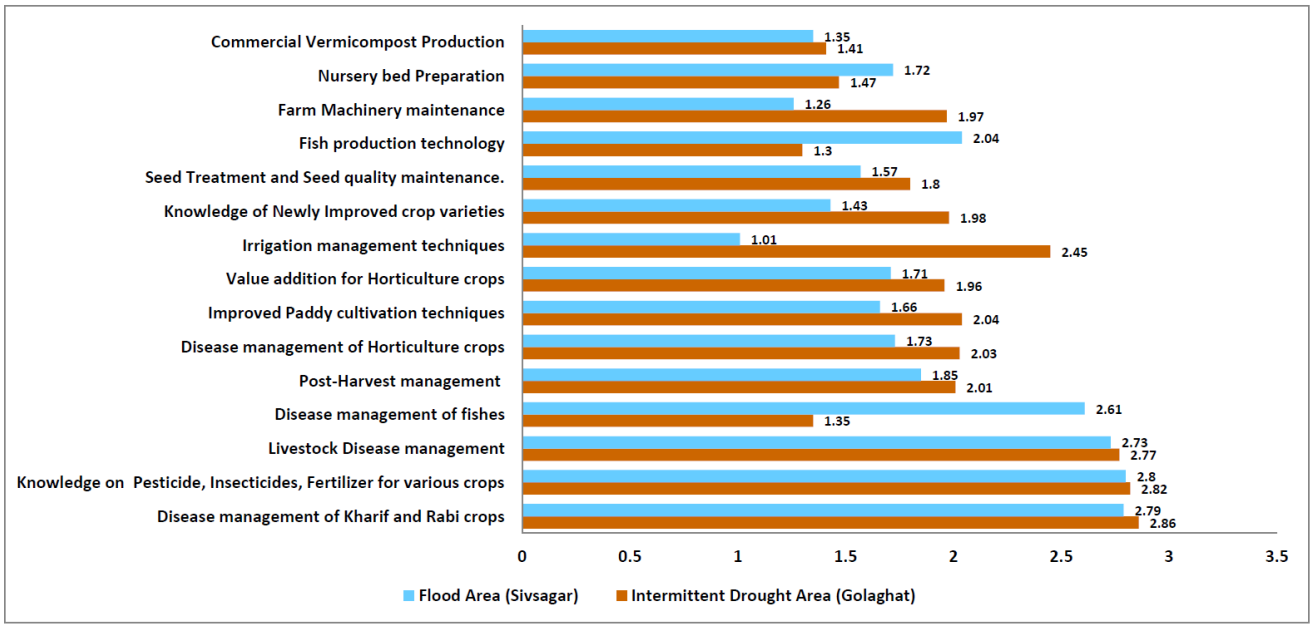


Fig. 8 : Distribution of Respondents on The Basis of Their Technology Need In Golaghat District (Intermittent Drought Area) and Sivsagar District (Flood Area)

Conclusion

Based on the findings it is evident that, farmers belonging to two distinct situation such as flood (Sivsagar) and intermittent drought affected (Golaghat) has not only different response to climate change events but also with respect to different problems faced by farmers and their technology need is unique to their individual situations.

In case of intermittent drought area, majority of the respondents found ‘“cost of production increases during water shortage period” as the major problem because in intermittent drought conditions during cultivation season water scarcity occurs in field conditions which affect the crop growth hence water availability to fields need to be continuously ensured, hence electric motors are used by the farmers sue to its quick efficiency. Thus, due to usage of 1HP electric motor (3hrs/0.13 ha) to draw water during water shortage (2 times/1 season), the cost of production increases. This put an additional weightage on farmer in terms of unavoidable expenses. Thus, government should take initiative to sort such problems by giving schemes to address such issues

In case of flood affected area, majority of the respondents found “prolonged water logged condition in crop areas” as a major problem which is caused due to lack of drainage and heavy rainfall along with continous water stress conditions which harm crop lead to crop loss or lodging. Thus, government should take initiative to sort such problems by giving schemes to address such issues.

The identification of problems faced by farmers belonging to two different situation i.e flood and drought affected area along with the different technological need based on their situations implies that Government should focused in an all-encompassing approach resulting into sustainable livelihood outcomes in terms of sustainable productivity, better resilience, mitigation and monitoring instead of only convexing the efforts into a relief centric policy. It will also be path breaking for the policy makers in formulating future climate smart agriculture policies based on Farmer’s livelihood profiles in climatically vulnerable regions. The findings suggested that before considering for future policies by the government addressing climate smart agricultural practices, government should put emphasis on a detail study of the technological needs of the farmers which is clearly shown in this study results that technological needs of farmers vary from one situation to other.

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