Biological Forum – An International Journal **15(4): 740-746(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Index to Assess the Impact of Weather based Agro-Advisory Services among the Cotton Growers of Telangana and Andhra Pradesh States

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(Received: 06 February 2023; Revised: 16 March 2023; Accepted: 20 March 2023; Published: 20 April 2023)
(Published by Research Trend)

ABSTRACT: Weather plays a major role in determining the success and failure of crop production. Meanwhile, weather based agro-advisory services facilitates the farmers to plan and perform well in advance by providing accurate weather information. Thus, these services had significant impact in improving the livelihood of farmers by averting or minimizing the crop loss due to aberrant weather. As the farmers have to combat with climate change, in addition to several other production, technical and marketing constraints, provision of timely weather based agro-advisory services enable them to reduce yield losses. To understand this, the present study provides empirical evidence of the impact index for weather based agro-advisory services among its beneficiary cotton growers in Telangana and Andhra Pradesh. The study helps Government and Non-government institutions, policy makers, agricultural scientists, agricultural officers and State Department of Agriculture and Universities to understand the cotton growers' attitude towards weather based agro-advisory services and its impact. The result of the present study helps the above-mentioned stakeholders to plan and formulate policy implications in the future for the farmer's welfare. However, lack of standard index to assess the impact of weather based agro-advisory is a major hindrance in understanding the efficient utilization of agro advisories. Seventy-five statements were collected from available literatures, then edited and subjected to judges' opinion. Based on which, 60 statements were selected to analyses the extent of differentiation between high and low group. Based on the highest 't' value, a total of 50 statements were selected finally to develop the impact index. The reliability (0.862) and the validity of the scale was assessed to represent its precision and consistency. Thus, the developed impact index can be used to measure the impact of weather based agro-advisory services among the farmers beyond the study area with suitable modifications.

Keywords: Impact, Weather based agro-advisory services, Cotton growers, Scale construction, Agro-advisory services, Weather, Climate smart agriculture.

INTRODUCTION

In an agrarian country like India, Weather plays a vital role in determining the success and failure of crop production. The weather parameters like temperature, rainfall, relative humidity, hail, wind speed and wind direction determine the crop productivity. Weather is the day-to-day condition (short-term) and climate is the weather prevailing for a longer time. Thus, the weather parameter influences the quality and quantity of crop production. India Meteorological Department (IMD) has set up in the country a network of 130 Agro-Meteorological Field Units (AMFUs) which are multidisciplinary units responsible for preparation and dissemination of district agromet advisories during XIIth FYP. Under Gramin Krishi Mausam Sewa (GKMS), IMD jointly with ICAR proposes to expand the network to cover 660 districts by establishing District Agro-Met Units (DAMUs) in additional 530 districts including 115 aspirational districts in the premise of Krishi Vigyan Kendra (KVK) of ICAR, under approved centrally sponsored scheme of MoES during 2017.

For an effective and efficient farm management, agro-advisory information like weather forecast, soil status information and agro-advisory services were important.

Based on the accurate weather forecast, the farmer could plan well in advance towards the factors like crop cultivars, time of fertilizer application, weed management, pest and disease management, drought mitigation measures etc., accordingly, in order to reduce the crop loss or the risk or crop failure. Though, the whole farm losses cannot be avoided, the losses can be minimized to some extent, based on the accurate weather forecast information. Thus, weather-based agro-advisory services predict the weather parameters and provide them to farmers to plan well in advance. In such a way, it reduces the crop or yield losses that occur to uncertain weather condition and reduce the risk of crop failure.

Meanwhile, weather based agro advisory services helps the farmers to enhance their livelihood, hence it becomes necessary to study the impact of these agro-based advisory services. In earlier times, these forecasts were sent to farmers through conventional means i.e., Newspaper, TV, Radio, etc. At the moment, weather based agro-advisory services were sent to farmers mobile twice a week with necessary information like rainfall, cloud cover, minimum and maximum temperature, wind speed and wind direction based on their location. Cotton is one of the important commercial crop and backbone of Indian textile industry, which produces 59 % of the country's total fiber production. It accounts for 34% of the country's export and fetches about Rs.50, 000 crores annually to the exchequer. Along with the industry, which it sustains, it touches the country's economy at several points including employment and export earnings. India. India ranks first in the world in cotton cultivation with 12.66 million hectares of area constituting about 38% to 41% of the world area under cotton cultivation and ranked first in production yielding 28.71 million bales production with productivity of 466 Kgs per ha (Source: Directorate of Economics & Statistics, 2019). Hence, lack of relevant impact index to understand efficient utilization of advisory services in cotton leads to the present study. Thus, the objective of the study is to develop an impact index to assess the impact of weather based agro-advisory services among the cotton growers.

Based on the findings, it could be observed that weather based agro-advisory services had high impact on yield and package of practices; medium impact on input usage, income and social aspects while considering the other dimensions. While, weather based agro-advisory services had equal percentage of low and high impact in economical aspects and institutional aspects because of the beneficiaries having high frequency of the extension contact and participation in institutional programmes had high level of impact and others had low level of impact. Beneficiary cotton growers those who adopted weather based agro-advisory services were able to plan farming operations in prior, which helps them to avoid yield loss, do farming operations as per plan, able to sow, harvest and market produce as per market value, use recommended level of inputs, helps to conserve natural resources by optimum use of inputs. Further, the beneficiary cotton growers had timely technical assistance from agro-advisories, helps to avoid yield loss and provide market information to sell in nearby markets, able to gain social and institutional contacts through extension participation.

Nattu and Deshmukh (2019) analyzed the impact of mobile based agro-advisory services in Marathwada region and mentioned that less than two-third of the farmers utilizing mobile based agro-advisory services had medium level of impact (63.33%), followed by low (20%) and high (16.67%) level of overall impact.

Renuka (2020) studied the impact of weather based agro-advisory services in Madhya Pradesh and revealed that beneficiaries and non-beneficiaries cultivate soyabean, maize, sorghum, mung and arhar in Kharif; wheat, gram, barley and pea in Rabi and all types of crop in Zayad. Among the 60 beneficiaries, 25 had medium level of impact in change in cropping pattern, 20 had low level and remaining 15 had high level of impact in change in cropping pattern. Regarding the non-beneficiaries, 26 non-beneficiaries had low level of impact, 23 non-beneficiaries had medium level and 11 non-beneficiaries had high level of impact in change in cropping pattern.

Sakthivel *et al*. (2022) assessed the effectiveness of whatsapp agro-advisory service in Cauvery Delta Zone and reported that more than three-fourth of the farmers had agriculture as their primary occupation (79.20%) and remaining 20.80 per cent of the farmers had agriculture as their secondary occupation.

Shanmuka *et al*. (2022) analyzed the effectiveness of social media based agro-advisory services in Andhra Pradesh and reported that nearly two-fifth of the farmers had medium effectiveness of social media based agro-advisory services to farmers (39.7%), followed by low effectiveness (33.3%) and high effectiveness (27%) of social media based agro-advisory services to farmers.

To measure the impact of weather based agro-advisory among the cotton growers, a scale was developed as suggested by Likert (1932); Edwards (1957). The methodology used in the development of impact index was given as follows.

Collection and Editing of Items. To assess the impact of weather based agro-advisory services among cotton farmers, seventy-five statements were collected based on the previous studies, available literature and suggestions from the specialists in the field of Agro-meteorology and Extension. Those statements were edited and fine-tuned based on the fourteen criteria given by Thrustone and Chave (1928); Likert (1932); Edwards (1957). From the 75 statements, after editing;60 unambiguous and non-factual statements were retained.

Relevancy test. The retained 60 statements were sent for judge's opinion to120 members who were experts in the field of Agronomy, Agro-meteorology and Extension and to senior faculty members of State Agricultural Universities, Programme coordinator, Subject Matter Specialists of KVK, ICAR scientists and scientists related to this domain. They were asked to mention their responses for each statement as 'Most Relevant', 'Relevant' and 'Not relevant' with the scores

of 3, 2 and 1 respectively. They were also requested to include statements if it was left. Hence, a total of 65 members were responded to the index. Based on the responses received, for each statement, the relevancy weightage, relevancy percentage and mean relevancy score was calculated by using the following formula;

Relevancy weightage. Indicates the relevancy of the statement to the impact index.

$$RW = \frac{MRR*3 + RR*2 + NRR*1}{MOS\,(3*65 = 195)}$$

Where,
RW = Relevancy Weightage
MRR = Most Relevant Response
RR = Relevant Response
NRR = Not Relevant Response
MOS = Maximum Obtainable Score

Relevancy percentage. Indicates the relevant percentage of the statement to the impact index.

$$RP = \frac{OS}{MOS\,(3*65 = 195)} \times 100$$

Where,
RP = Relevancy Percentage
OS = Obtained Score
MOS = Maximum Obtainable Score

Mean relevancy score. Indicates the mean relevancy score of each statement to the impact index.

$$MRS = \frac{MRR*3 + RR*2 + NRR*1}{No.of\ Judges\,(65)}$$

Where,
MRS = Mean Relevancy Score
MRR = Most Relevant Response
RR = Relevant Response
NRR = Not Relevant Response

RESULTS AND DISCUSSION

The impact of weather based agro-advisory on beneficiary cotton growers was assessed under ten different dimensions as impact on cotton crops, input usage, package of practices, yield, income, conservation of natural resources, social aspects, economic aspects, technical aspects and institutional aspects, analyzed using percentage analysis.

Based on these three criteria, the statements/items were subjected to relevancy. Eventually, the statements with a relevancy weightage of more than 0.66, relevancy percentage of more than 66 and mean relevancy score of more than 2 were selected as relevant statements to assess the impact. Thus, a total of 55 statements were selected to develop the index. The relevancy weightage, relevancy percentage and mean relevancy score of the items in index was presented in Table 1.

Table 1: Relevancy weightage, relevancy percentage and mean relevancy score of the items in index.

Sr. No.	Statements	RW	RP	MRS
I	**IMPACT ON COTTON CROPS**			
1.	WBAS helps to determine the cropping pattern	0.744	74.36	2.23
2.	Effective pest and disease management practices occurs as a result of WBAS	0.677	67.69	2.03
3.	Weather based agro-advisory services facilitates better seasonal crop management	0.713	71.28	2.14
4.	WBAS helps to plan sowing and harvesting well in advance	0.728	72.82	2.18
5.	WBAS provides technical assistance on cotton cultivation	0.667	66.67	2.00
6.	WBAS facilitates the cultivation of cotton in easy way	0.682	68.21	2.05
II	**IMPACT ON INPUT USAGE**			
1.	WBAS guides farmers to use critical inputs optimally	0.703	70.26	2.11
2.	WBAS provides the prices of agricultural inputs	0.744	74.36	2.23
3.*	**WBAS suggests inputs that are difficult to purchase**	**0.651**	**65.13**	**1.95**
4.	WBAS suggests agricultural inputs based on their availability	0.682	68.21	2.05
5.	Inputs suggested by WBAS are not effective	0.672	67.18	2.02
6.	WBAS helps the farmers to purchase inputs at better quality	0.728	72.82	2.18
III	**IMPACT ON PACKAGE OF PRACTICES**			
1.	WBAS provide technical guidance to farmers towards various farming operations like sowing, harvesting, marketing, etc.	0.703	70.26	2.11
2.	Crop management practices were improved as a result of introduction of WBAS	0.697	69.74	2.09
3.	WBAS facilitates timely pest and disease management practices	0.672	67.18	2.02
4.*	**WBAS provides package of practices using technical terms which are difficult to understand**	**0.621**	**62.05**	**1.86**
5.	Modern farm implements and tools can be used with proper guidance	0.779	77.95	2.34
6.	Proper irrigation management reduces the economic issues of farmers	0.682	68.21	2.05
IV	**IMPACT ON YIELD**			
1.	Weather advisory delivered through mobile can avert crop loss	0.682	68.21	2.05
2.	WBAS provides technical guidance to increase the crop yield	0.677	67.69	2.03
3.	WBAS suggests location and crop specific information that aids in increasing of yield	0.697	69.74	2.09
4.	WBAS advices the proper harvesting method and time, to get increased yield	0.708	70.77	2.12
5.	WBAS suggests new and high yielding varieties	0.703	70.77	2.12
6.	WBAS advises on pest and diseases management practices that affect yield	0.677	67.69	2.03
V	**IMPACT ON INCOME**			
1	WBAS enables the farmers to get good returns through price forecasting	0.718	71.79	2.15
2.*	**WBAS helps in prior planning to cultivate crops, which helps farmers to assured income**	**0.646**	**64.62**	**1.94**
3.	WBAS facilitates farmers to get reasonable price for their produce, by providing market prices	0.697	69.74	2.09
4.	WBAS strengthens the farmers to negotiate the price of the produce with the trader	0.677	67.69	2.03
5.	Proper input management reduces economic losses of the farmers	0.672	67.18	2.02
6.	WBAS decreased the cost of production	0.733	73.33	2.20
VI	**IMPACT ON CONSERVATION OF NATURAL RESOURCES**			
1.*	**WBAS encourage farmers towards natural and organic way of farming**	**0.662**	**66.15**	**1.98**

2.	WBAS helps farmers in effective farm management	0.708	70.77	2.12
3.	WBAS promotes use of organic inputs	0.692	69.23	2.08
4.	WBAS promotes integrated pest and disease management	0.723	72.31	2.17
5.	WBAS facilitates restoring of soil fertility	0.677	67.69	2.03
6.	WBAS promotes use of natural enemies to protect crop from pest and diseases	0.677	67.69	2.03
VII	**IMPACT ON SOCIAL ASPECTS**			
1.	Adoption of WBAS increased the social status among farmers	0.703	70.26	2.11
2.	WBAS increased the farmer's involvement towards social activities	0.733	73.33	2.20
3.*	**By utilizing WBAS, a farmer become as an innovative farmer**	**0.656**	**65.64**	**1.97**
4.	WBAS increases the social participation of the farmer by increasing their knowledge	0.677	67.69	2.03
5.	Usage of WBAS affects the social behaviour of the farmers	0.708	70.77	2.12
6.	WBAS reduced the dependence of farmers towards extension agents	0.728	72.82	2.18
VIII	**IMPACT ON ECONOMICAL ASPECTS**			
1.	WBAS encourages the credit orientation of the farmers	0.687	68.72	2.06
2.	WBAS increases the living standard of farmer	0.672	67.18	2.02
3.	WBAS facilitates the farmers to get better returns	0.692	69.23	2.08
4.	Proper technical guidance through WBAS reduced the economic burden of farmers	0.703	70.26	2.11
5.	WBAS improves the decision-making power of the farmers regarding various agricultural practices	0.718	71.79	2.15
6.	WBAS improves the risk-taking ability of the farmers	0.687	68.78	2.06
IX	**IMPACT ON TECHNICAL ASPECTS**			
1.	WBAS promotes farm mechanization	0.682	68.21	2.05
2.	Timely forecast helps in proper crop protection measures	0.62	69.23	2.08
3.	Technical guidance was given to farmers to increase their yield	0.687	68.72	2.06
4.	WBAS provide agro-advisory services using technical terms which are difficult to understand	0.682	68.21	2.05
5.	WBAS provides information on location specific weather parameters	0.677	67.69	2.03
6.	WBAS provides information on crop specific weather parameters	0.692	69.23	2.08
X	**IMPACT ON INSTITUTIONAL ASPECTS**			
1.	WBAS increased the awareness towards the malpractices in market yard	0.718	71.79	2.15
2.	WBAS facilitates proper management of transportation of farm produce for distant market	0.697	69.74	2.09
3.	WBAS increased awareness among the farmers towards insurance facilities	0.697	69.74	2.09
4.	Farmers were encouraged to visit various institutions for new innovations	0.677	67.69	2.03
5.	WBAS provides information on post-harvest management institutions	0.687	68.72	2.06
6.	WBAS increased farmer's awareness towards storage and transport facilities	0.697	69.74	2.09

(*- Statements rejected because of low relevancy weightage, low relevancy percentage and less mean relevancy scores)

Calculation of 't' value (Item analysis). The relevant 55 statements were subjected to item analysis to assess the statements based on their ability to differentiate the respondent with high impact and low impact (extent to differentiate) towards weather based agro-advisory services. For this purpose, the selected 55 statements were sent to 60 farmers in non-sample area. The farmers were requested to indicate their response on a five-point continuum ranging from 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree' with the scores of 5,4,3,2 and 1 respectively for positive statements and vice versa for negative statements. Based on the responses obtained from the farmers, they were arranged in descending order according to their total scores. As suggested by Edwards (1957), the high group (top 25 per cent of farmers) and the low group (lowest 25 per cent of farmers) were identified to evaluate the individual statements. Finally, out of 60 farmers, the 15 farmers with highest and lowest scores were used as criterion groups to evaluate the individual statements.

As suggested by Edwards (1957), the 't' value is calculated by using the following formula,

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

Where,

$(X_H - \bar{X}_H)^2 = X_H^2 - (X_X)^2$

$(X_L - \bar{X}_L)^2 = X_L^2 - (X_L)^2$

X_H = The mean score on given statement of the high group

X_L = The mean score on given statement of the low group

X_H^2 = Sum of square of the individual score on a given statement for high group

X_L^2 = Sum of square of the individual score on a given statement for low group

X_H = Summation of scores on given statement for high group

X_L = Summation of scores on given statement for low group

n = Number of respondents in each group

$\sum$ = Summation

Selection of statements for final scale. According to the calculated 't' value for the 60 statements, the statements with highest 't' value were selection for inclusion in scale. The list of statements with their 't' values were shown in table.2.

Reliability

Test-retest method. The final 50 statements which represents the impact of weather based agro-advisory services among cotton farmers were administered on a five-point continuum scale to 30 farmers in non-sample area. After a time period of 15 days, the scale was again administered to the same respondents and thus there were two set of scores obtained. For both sets of scores, the correlation co-efficient was calculated and the 'r' value was 0.844 which represents significant at 1 per cent level of probability. Thus, it indicates the impact index was highly suitable to assess the impact of

weather based agro-advisory services among cotton farmers. The index was stable and dependable in its measurement.

Validity

Content validity. Content validity refers to the sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. This method was adopted to determine the content validity of the developed index. As the content of the impact examines the weather based agro-advisory services, it was assumed that the present scale satisfies the content validity. As the scale value differs for each of the statement with a high discriminating value, this scale is said to be a valid measure of the impact.

Table 2: List of statements with their't' values.

Sr. No.	Statements	Response					t-value
		SA	A	UD	DA	SDA	
I	**IMPACT ON COTTON CROPS**						
1.	WBAS helps to determine the cropping pattern						1.865
2.	Effective pest and disease management practices occurs as a result of WBAS						5.622
3.	Weather based agro-advisory services facilitates better seasonal crop management						3.027
4.	**WBAS provides technical assistance on cotton cultivation**						**-2.162**
5.	WBAS helps to plan sowing and harvesting well in advance						5.189
6	WBAS facilitates the cultivation of cotton in easy way						3.460
II	**IMPACT ON INPUT USAGE**						
1.	WBAS guides farmers to use critical inputs optimally						1.297
2.	WBAS provides the prices of agricultural inputs						3.460
3.	WBAS suggests agricultural inputs based on their availability						1.297
4.	Inputs suggested by WBAS are not effective						2.430
5.	WBAS helps the farmers to purchase inputs at better quality						5.190
III	**IMPACT ON PACKAGE OF PRACTICES**						
1.	WBAS provide technical guidance to farmers towards various farming operations like sowing, harvesting, marketing, etc.						4.757
2.	Crop management practices were improved as a result of introduction of WBAS						1.730
3.	WBAS facilitates timely pest and disease management practices						2.590
4.	Modern farm implements and tools can be used with proper guidance						3.025
5.	Proper irrigation management reduces the economic issues of farmers						5.190
IV	**IMPACT ON YIELD**						
1.	Weather advisory delivered through mobile can avert crop loss						3.027
2.	**WBAS advises on pest and diseases management practices that affect yield**						**-0.865**
3.	WBAS provides technical guidance to increase the crop yield						6.055
4.	WBAS suggests location and crop specific information that aids in increasing of yield						9.082
5.	WBAS advices the proper harvesting method and time, to get increased yield						6.054
6.	WBAS suggests new and high yielding varieties						5.190
V	**IMPACT ON INCOME**						
1.	WBAS enables the farmers to get good returns through price forecasting						3.460
2.	WBAS facilitates farmers to get reasonable price for their produce, by providing market prices						3.892
3.	WBAS strengthens the farmers to negotiate the price of the produce with the trader						1.730
4.	Proper input management reduces economic losses of the farmers						6.487
5.	WBAS decreased the cost of production						3.460
VI	**IMPACT ON CONSERVATION OF NATURAL RESOURCES**						
1	WBAS helps farmers in effective farm management						6.055
2.	WBAS promotes use of organic inputs						6.920
3.	WBAS promotes integrated pest and disease management						2.162
4.	WBAS facilitates restoring of soil fertility						3.027
5.	WBAS promotes use of natural enemies to protect crop from pest and diseases						1.730
VII	**IMPACT ON SOCIAL ASPECTS**						
1.	Adoption of WBAS increased the social status among farmers						4.325
2.	WBAS increased the farmer's involvement towards social activities						3.892
3.	WBAS increases the social participation of the farmer by increasing their knowledge						4.320
4.	Usage of WBAS affects the social behaviour of the farmers						6.890
5.	WBAS reduced the dependence of farmers towards extension agents						2.162
VIII	**IMPACT ON ECONOMICAL ASPECTS**						
1.	WBAS increases the living standard of farmer						3.460
2.	WBAS facilitates the farmers to get better returns						2.162
3.	Proper technical guidance through WBAS reduced the economic burden of farmers						1.723
4.	**WBAS encourages the credit orientation of the farmers**						0.000
5.	WBAS improves the decision making power of the farmers regarding various agricultural practices						8.217
6.	WBAS improves the risk taking ability of the farmers						8.649
IX	**IMPACT ON TECHNICAL ASPECTS**						
1.	WBAS promotes farm mechanization						3.459
2.	Timely forecast helps in proper crop protection measures						3.892
3.	Technical guidance were given to farmers to increase their yield						7.352
4.	WBAS provides information on location specific weather parameters						6.487
5.	**WBAS provide agro-advisory services using technical terms which are difficult to**						**0.864**

	understand						
6.	WBAS provides information on crop specific weather parameters						3.892
X	**IMPACT ON INSTITUTIONAL ASPECTS**						
1.	WBAS increased the awareness towards the malpractices in market yard						6.054
2.	WBAS facilitates proper management of transportation of farm produce for distant market						2.590
3.	WBAS increased awareness among the farmers towards insurance facilities						2.860
4.	Farmers were encouraged to visit various institutions for new innovations						7.352
5.	WBAS increased farmer's awareness towards storage and transport facilities						4.300
6.	**WBAS provides information on post harvest management institutions**						**-1.297**

Table 3: Final list of selected statements to develop impact index.

Sr. No.	Statement	Responses				
		SA	A	UD	DA	SDA
I.	**IMPACT ON COTTON CROPS**					
1.	WBAS helps to determine the cropping pattern					
2.	Effective pest and disease management practices occurs as a result of WBAS					
3.	Weather based agro-advisory services facilitates better seasonal crop management					
4.	WBAS helps to plan sowing and harvesting well in advance					
5.	WBAS facilitates the cultivation of cotton in easy way					
II.	**IMPACT ON INPUT USAGE**					
1.	WBAS guides farmers to use critical inputs optimally					
2.	WBAS provides the prices of agricultural inputs					
3.	WBAS suggests agricultural inputs based on their availability					
4.	Inputs suggested by WBAS are not effective					
5.	WBAS helps the farmers to purchase inputs at better quality					
III.	**IMPACT ON PACKAGE OF PRACTICES**					
1.	WBAS provide technical guidance to farmers towards various farming operations like sowing, harvesting, marketing, etc.					
2.	Crop management practices were improved as a result of introduction of WBAS					
3.	WBAS facilitates timely pest and disease management practices					
4.	Modern farm implements and tools can be used with proper guidance					
5.	Proper irrigation management reduces the economic issues of farmers					
IV.	**IMPACT ON YIELD**					
1.	Weather advisory delivered through mobile can avert crop loss					
2.	WBAS provides technical guidance to increase the crop yield					
3.	WBAS suggests location and crop specific information that aids in increasing of yield					
4.	WBAS advices the proper harvesting method and time, to get increased yield					
5.	WBAS suggests new and high yielding varieties					
V.	**IMPACT ON INCOME**					
1.	WBAS enables the farmers to get good returns through price forecasting					
2.	WBAS facilitates farmers to get reasonable price for their produce, by providing market prices					
3.	WBAS strengthens the farmers to negotiate the price of the produce with the trader					
4.	Proper input management reduces economic losses of the farmers					
5.	WBAS decreased the cost of production					
VI.	**IMPACT ON CONSERVATION OF NATURAL RESOURCES**					
1.	WBAS helps farmers in effective farm management					
2.	WBAS promotes use of organic inputs					
3.	WBAS promotes integrated pest and disease management					
4.	WBAS facilitates restoring of soil fertility					
5.	WBAS promotes use of natural enemies to protect crop from pest and diseases					
VII.	**IMPACT ON SOCIAL ASPECTS**					
1.	Adoption of WBAS increased the social status among farmers					
2.	WBAS increased the farmer's involvement towards social activities					
3.	WBAS increases the social participation of the farmer by increasing their knowledge					
4.	Usage of WBAS affects the social behaviour of the farmers					
5.	WBAS reduced the dependence of farmers towards extension agents					
VIII.	**IMPACT ON ECONOMICAL ASPECTS**					
1.	WBAS increases the living standard of farmer					
2.	WBAS facilitates the farmers to get better returns					
3.	Proper technical guidance through WBAS reduced the economic burden of farmers					
4.	WBAS improves the decision making power of the farmers regarding various agricultural practices					
5.	WBAS improves the risk taking ability of the farmers					

IX.	IMPACT ON TECHNICAL ASPECTS					
1.	WBAS promotes farm mechanization					
2.	Timely forecast helps in proper crop protection measures					
3.	Technical guidance were given to farmers to increase their yield					
4.	WBAS provides information on location specific weather parameters					
5.	WBAS provides information on crop specific weather parameters					
X.	**IMPACT ON INSTITUTIONAL ASPECTS**					
1.	WBAS increased the awareness towards the malpractices in market yard					
2.	WBAS facilitates proper management of transportation of farm produce for distant market					
3.	WBAS increased awareness among the farmers towards insurance facilities					
4.	Farmers were encouraged to visit various institutions for new innovations					
5.	WBAS increased farmer's awareness towards storage and transport facilities					

Thus, a total of 50 statements with highest 't' values were selected for the construction of final scale which differentiate between highest and lowest groups. The statements with low 't' value were deleted. The final lists of selected statements were presented in Table 3.

Three-fourth of the beneficiary cotton growers strongly agrees that WBAS helps to determine the cropping pattern (60%) and WBAS facilitates effective pest and disease management practices (60%). Whereas, two-fifth of the beneficiary cotton growers strongly agrees that WBAS facilitates better seasonal crop management (40%), helps to plan sowing and harvesting well in advance (40%) and facilitates cultivation of cotton in easy way (40%).

As the weather based agro-advisory services provides prior weather parameters like rainfall, it enables the cotton growers to cultivate and harvest by planning earlier; which avoids yield loss. Further, weather forecasting helps them to plan their cropping pattern according to the weather prevails in that area.

CONCLUSIONS

Nowadays, a high pressure is exerted on the agriculture sector to increase the production for the growing population, but the challenge lies in the climate change. Despite of the various constraints faced by the farmers, climate change acts as the root cause of several other constraints. The impact index will be developed based the ten impact indicators that covers all aspects of the farming community. Based on the ten indicators the results shown that exactly three-fifth of the beneficiary cotton growers had medium level of impact of weather based agro-advisory services on beneficiary cotton growers (60%), followed by an equal percentage of them had low (20%) and high (20%) level of impact of weather based agro-advisory services on beneficiary cotton growers respectively.

FUTURE SCOPE

The farmers can tackle other constraints by themselves based on their farming experience, but to tackle the problem of climate change, they need support from Government and Non-government institutions by providing reliable weather information. As climate change leads to significant percentage of reduction in yield, carrying out agricultural activities along with the conducive weather is one of the strategies to reduce yield losses. For this purpose, the farmers should be provided with the relevant and reliable weather information in timely manner. Thus, this index will highlight the impact of weather based agro-advisory services on cotton growers based on ten impact indicators it will be helpful for the policy makers to plan and implement strategic and effective weather based agro-advisory services to cotton growers.

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How to cite this article: B. Srishailam, V. Sailaja, P. Ganesh Kumar, D. Subramanyam and Shaik Nafeez Umar (2023). Index to Assess the Impact of Weather based Agro-Advisory Services among the Cotton Growers of Telangana and Andhra Pradesh States. *Biological Forum – An International Journal*, *15*(4): 740-746.