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Doddabasayya
M.sc Scholar, Department of Agricultural Extension Education, College of Agriculture, Raichur, Karnataka, India

Sidram BY
Assistant Professor, Department of Agricultural Extension Education, College of Agriculture, Bheemarayanagudi, Karnataka, India

KN Doddamani
Professor, Department of Agricultural Extension Education, College of Agriculture, Kalaburgi, Karnataka, India

Ravi M Sambrani
Associate Professor, Department of Agricultural Extension Education, College of Agriculture, Raichur, Karnataka, India

Vijayachandra Reddy
Assistant Professor, Department of Agricultural Economics, College of Agriculture, Raichur, Karnataka, India

Corresponding Author:
Doddabasayya
M.sc Scholar, Department of Agricultural Extension Education, College of Agriculture, Raichur, Karnataka, India

A study on profile characteristics of *Bt*-cotton growers for adaptability to rainfall variability in Karnataka

Doddabasayya, Sidram BY, KN Doddamani, Ravi M Sambrani and Vijayachandra Reddy

Abstract
The present study was conducted in Raichur, Manvi, Sirwar and Devadurga taluks of Raichur district of Karnataka during the year 2022-23 with a sample size of 120 *Bt*-cotton growers. The data was elicited through personal interview method with the help of structured interview schedule and ex-post facto design was employed for the study. The collected was analysed using suitable appropriate statistical tools. The characteristics profile of *Bt*-cotton growers revealed that, majority of the respondents (55.83%) accounted to the middle age group, having education upto higher secondary education (29.16%). Majority of the respondents (40.83%) have low level of farming experience, medium sized families (54.17%), medium annual income (49.17%), semi-medium land holding (35.84%), low risk orientation (45.00%), high scientific orientation (47.50%), medium economic motivation (44.17%), medium extension contact (41.67%), low extension participation (45.83%) and high media exposure (46.67%).

Keywords: Characteristics, *Bt*-cotton growers, adaptability, rainfall variability

Introduction
Water is the essence of life, an irreplaceable resource that lies at the very core of human existence. From sustaining biological functions to supporting agriculture, industry, and daily activities, the significance of water in human life is immeasurable. Its role extends far beyond mere hydration, encompassing ecological balance, health maintenance, and economic growth. As a fundamental element, water's presence shapes landscapes, dictates climatic patterns, and influences cultures across the globe. In this exploration of the importance of water, we delve into the multifaceted ways in which this precious liquid sustains and enriches human life, underscoring the urgent need for its responsible management and conservation (Bakker *et al*., 2012) [3]. Water is the most important natural resource available to all mankind. It is a resource which needs the most efficient way of harnessing and utilizing it. Anything is created from water and it doesn't support anything there. It is very obvious with every passing time that water is gaining more importance than any other resource around the globe. While there is an abundance of this specific natural resource on this planet, it is becoming scarce for human use, in agriculture and other sectors as well (Cosgrove *et al*., 2015) [6].

India has 4% of the world water resources and 18% of the world population. Only handful of countries in the globe can boast of such an extensive river network that our country has. The mighty Indus-Ganga-Brahmaputra in the North, the Narmada-Tapi Mahanadi in the Central region and Godavari-Krishna-Cauvery in the South have been symbols of existence and growth of our country right from its inception. Yet, the availability of water resources in India has its unique complexities (Anonymous, 2017) [1].

The role of rainfall in agriculture, particularly in a country as diverse and agrarian as India, cannot be overstated. Rainfall is the lifeline of Indian agriculture, serving as a primary source of water for crops that feed a vast population and contribute significantly to the nation's economy. The monsoon season, which typically occurs from June to September, is of paramount importance, as it brings the majority of India's annual rainfall.

In India, where a substantial portion of the population relies on agriculture for their livelihoods, rainfall patterns directly influence crop yields and food production. Adequate and timely rainfall ensures proper soil moisture, which is crucial for germination, growth, and development of crops. Insufficient rainfall or untimely distribution can lead to droughts, crop failures, and even famine, affecting both rural communities and the larger economy.

The spatial and temporal distribution of rainfall is highly variable across India due to its diverse geographical features, including mountains, plateaus, and coastal areas. This variability has led to the classification of the country into different agricultural regions, each with its own cropping patterns and water management strategies. For example, the northwestern parts of India, including states like Punjab and Haryana, heavily depend on the monsoon for their staple crops such as wheat and rice. In contrast, the southern states, like Tamil Nadu and Karnataka, receive more diverse and evenly distributed rainfall patterns, allowing for cultivation of various crops throughout the year.

Rainfall variability in India exerts a profound and often unpredictable impact on its agriculture, influencing crop yields, livelihoods, and food security. The Indian agricultural landscape, heavily reliant on the monsoon season for water supply, is particularly vulnerable to fluctuations in rainfall patterns. Erratic monsoons, characterized by inconsistent timing, intensity, and duration, can lead to a series of challenges for farmers. Prolonged dry spells during critical growth stages can hinder germination, stunt crop development, and reduce overall yields. Conversely, excessive rainfall, especially in concentrated bursts, can result in waterlogging, soil erosion, and damage to standing crops. Such variability disrupts planting and harvesting schedules, affects the availability of water for irrigation, and introduces uncertainties that can jeopardize agricultural productivity. The consequences extend beyond individual farms, impacting rural economies, food prices, and the nation's overall food security. The rainfall variability effects the production of commercial crop like *bt*-cotton which leads to huge economic loss to farmers.

The soil and climatic condition of Raichur district is most suitable for *Bt* cotton cultivation. The production and productivity is good in this region. Data also reveals that majority of the farmers are cultivating *Bt*-cotton in the villages of Raichur district. Keeping the above fact in the view, the present study entitled “A study on adaptability to rainfall variability by *Bt*-cotton growers” was undertaken with the following specific objectives.

Methodology

The research study on adaptability to rainfall variability of *Bt*-Cotton growers in Raichur district of Karnataka during the academic year of 2021-2022. An “Ex-post-facto design” was used as research design. Raichur district comprises of six taluks out of which four were selected *viz*, Raichur, Manvi, Devadurga and Siriwar. Four talukas of Raichur district were selected for the study. From the selected taluks, the three villages having maximum area under *Bt*-Cotton cultivation were selected for the study. Ten farmers from each selected village were selected by simple random sampling method to make the total sample size of 120. A list of *Bt*-cotton farmers from each village was prepared in consultation with the Assistant Agricultural Officers, Agricultural Officers, and KVK officials of UAS, Raichur. By following the simple random sampling procedure, 10 farmers from each village were drawn as respondents. A total 120 *Bt*-cotton farmers constituted the sample for the study.

Result and Discussion

Age

Results put forward in Table clearly displayed that the majority of the respondents (55.83%) accounted to the middle age group, followed by the young age group (26.67%) and the lowest category among these respondents are old age group (17.50%).

This inferred that the middle age category farmers were more involved in adopting the adaptability practices to rainfall variability. The probable reason might be that, middle age group farmers were highly enthusiastic, have energy to work more efficiently, have free hand in financial affairs with which they can take up an independent decision to implement their ideas and also, they were also socially active in comparison with groups of other ages. Further, youth counterparts lacked experience and are most likely relocating to towns and cities for higher education and better career possibilities while those belonged to old age do not have required energy to work and were reluctant to take risk.

The results were in line with Priyadarshini *et al*. (2022) [16]; Waghmare (2020) [22]; Kumar *et al*. (2019) [8]; Prashanth and Reddy (2018) [15]; Kumar (2015) [9] whose study showed that majority of respondents belonged to middle age group.

Education

The deep observation of Table 1 indicated that the majority of the respondents (29.16%) had completed higher secondary school education, followed by less than one fourth proportion (24.16%) had completed primary school education. A smaller proportion of respondents (17.50%) were illiterate while an even smaller proportion (16.67%) had obtained a degree or higher level of education, the lowest proportion of respondents (12.50%) had completed PUC.

The results depicted that majority of the respondents were belonged to higher secondary education category because of the fact that affordability and accessibility up to higher secondary school education at village level and they did not go for further education due to lack of awareness and they were involved in the agricultural activities to earn the bread for their families, followed by smaller proportion of the respondents ended up their education right there in the primary school because they might face barriers to access higher education such as financial constraints and lack of educational opportunities at village level. It is a known fact that in rural area’s people won’t give much importance to the education because of their poor socio-economic conditions, and practicing agriculture right from the young age might be the reason for above results.

The results were in line with Jambule *et al*. (2023) [7]; Kumar *et al*. (2019) [8]; Shridevi and Halakatti (2018) [19]; Badekhan and Devi (2018) [2]; Kumar (2015) [9] and Reddy *et al*. (2014) [18] whose study revealed that the majority of the respondents belong to higher secondary school education. The findings were in contradiction with Nagtilak (2017) [12]; and Priyadarshini *et al*. (2022) [16] in which the majority of the respondents belong to middle school education.

Farming experience

The results of Table depicted that most of the respondents (40.83%) have low level of farming experience, followed by 34.17 percent with a high level of farming experience and 25.00 percent with a medium level of farming experience, respectively.

It is observed in the study area that after their higher secondary school, intermediate and graduation level education they start farming. And high level of farming experience is due to the fact that respondents were started farming at their young age.

The results were in contradiction with jambule *et al*. (2023) [7]; Prasad (2021) [14]; Shridevi and Halakatti (2019) [19]; Prashanth and Reddy (2018) [15]; Nagtilak (2017) [12]; and Reddy *et al*. (2014) [18] whose research found that the majority of the respondents belong to medium level of farming experience.

Family size

A glance from the Table shows that, more than half (54.17%) of the farmers were having the medium sized family which comprises of 5-6 members. Whereas, 32.50 percent of the farmers belonged to small sized family and 13.33 percent of the respondents were belonged to large sized family.

Increased living costs and the benefits of reduced expenditure and comfortable living which even attracted the rural areas, motivated them to convert into medium sized families. It also provides a balance of labour and support for farming activities. While some the families in the study area were still living together by believing that unity is strength in which their grandparents who were still alive, might not have allowed their younger generation to live separately, this might be the reason for above results.

The results were parallel with Priyadarshini *et al*. (2022) [16]; and Kumar *et al*. (2019) [8] the results revealed that majority of the respondents belonged to medium sized families.

Annual income

From the recorded data of Table, nearly half (49.17%) of the farmers were having medium level of annual income, followed by 30.83 percent with a low level of annual income, and 20.00 percent with the high level of annual income.

More than half of the respondents were dry land farmers, whose crop yield is dependent on the prevailing weather conditions specifically on rainfall. Also, lack of access to credit from institutional sources, the fluctuations in the price of the produce and these might be the reasons for a greater number of farmers fall under medium to low level of income category. The farmers with a sizeable number of livestock and diversification in cropping were able to generate additional revenue, thus falling under the high-income group.

The findings were in line with jambule *et al*. (2023) [7]; Kumar *et al*. (2019) [8]; Shridevi and Halakatti (2019) [19]; Kumar (2015) [9]; and Vinayak (2014) [20] which indicated that the majority of the farmers belonged to medium level of annual income. The results presented here were in contradictory with Priyadarshini *et al*. (2022) [16]; and Vysali *et al*. (2020) [21] which concluded that majority of the farmers belonged to low level of annual income category.

Land holding

From Table 1, the results clearly depicted that majority of the farmers (35.84%) had semi-medium land holdings and nearly one third (31.67%) of the respondents had small sized land holdings, less than one fifth (16.67%) of them had marginal sized farms. While, some of them (8.33%) had medium sized land holdings and few of them (7.50%) were belonged to large land holders.

This is due to the respondents in the study area belong to medium sized families and most of the farmers are mostly dependent on farming and do not possess many subsidiary occupations, so they maintain a substantial 5 to 10 acres of land. Whereas nearly one third of the farmers being small land holders which might be due to land fragmentation which brought on by rising populations across generations. The distribution of land from their ancestors lead to marginal sized farms. Only few of them were belonged to the category of large land holders due to large family size who were still living with their parents and not divided their lands in their families.

The data presented here were contradictory with Jambule *et al*. (2023) [7]; Kumar *et al*. (2019) [8]; and Kumar (2015) [9] whose results revealed that majority of the respondents belong to medium sized land holdings. While Priyadarshini *et al*. (2022) [16]; Vysali *et al*. (2020) [21]; and Vinayak (2014) [20] which found in line and reported that the majority of the respondents were small farmers.

Risk orientation

It could be observed from Table 1, the majority (45.00%) of the respondents had the low risk orientation, followed by 40.83 and 14.17 percent belonged to high and medium risk orientation categories, respectively.

The annual income of the farmers is medium to low income due to this, farmers were not able take the risks and the high school and primary level education does not prepare them for taking up the higher risks. The lower farming experience among the respondents made them less courageous and confident. Those who were highly educated and had high scientific orientation fall under high risk orientation category.

The results were in contradiction with Jambule *et al*. (2023) [7]; Kumar (2021) [10]; Vysali *et al*. (2020) [21]; Kumar *et al*. (2019) [8]; Baramagoudar *et al*. (2019); and Nagtilak (2017) [12] indicated that majority of the Bt- cotton growers had medium risk orientation.

Scientific orientation

A perusal of Table 1 indicated that, less than half (47.50%) of the Bt- cotton growers belonged to high scientific orientation category, followed by low (38.33%) and medium (14.17%) scientific orientation categories, respectively.

About more than eighty percent of the farmers had undergone formal education which enables them to incubate the scientific approach in their farm and also due to high mass media utilization pattern might be the reason for the above findings.

The findings were contradictory with Kumar *et al*. (2019) [8]; Baramagoudar *et al*. (2019); Nagtilak (2017) [12]; and Vinayak (2014) [20] revealed that majority of the cotton growers had medium level of scientific orientation.

Economic motivation

Regarding results in Table 1 denoted that, more than two fifth (44.17%) of the Bt-cotton growers had been appertained to medium level of economic motivation whereas, 32.50 and 23.33 percent of the respondents had low and high level of economic motivation.

The respondents in the study area were medium to low annual income category and also the farmer's poor socio-economic condition, semi-medium to small land holding and low productivity might be the reason for the above findings.

The data presented here were in line with Prasad *et al*. (2021) [14]; Vysali *et al*. (2020) [21]; Kumar *et al*. (2019) [8] Nagtilak (2017) [12]; and Kumar (2021) [10] mentioned that majority of the Bt- cotton growers belong to medium level of economic motivation category.

Extension contact

from the Table 1 it is evident that, more than two fifth (41.67%) of the respondents had medium level of extension contact while 30.83 and 27.50 percent of the respondents appertained to low and high levels of extension contact categories, respectively.

The reasons for the above findings might be that majority of respondents in the study area visit or contact the extension worker only when the problem arises in their field and the extension agents visit the farmers field occasionally, this have resulted the farmers to fall under the medium level of extension contact category.

The results were parallel with Jambule *et al*. (2023) [7]; Prasad (2021) [14]; Mahesh *et al*. (2020) [11]; Kumar *et al*. (2019) [8]; Kumar (2021) [10]; and Reddy *et al*. (2014) [18] lamented that majority of the farmers belong to medium level of extension participation category.

Extension participation

The results from the Table 1 depicted that, majority (45.83%) of the Bt-cotton farmers had low extension participation whereas, 37.50 and 16.67 percent of them had medium and high level of participation, respectively.

The probable reasons for the above results might be that the extension agents conducted less number of extension activities in the villages. Another reason might be that non-awareness of farmers about extension activities that were organized by the extension workers at village level.

The results were in contradiction with the Prabhu (2017) [13]; Kumar (2015) [9]; and Birajdar (2012) [5] lamented that majority of the farmers belong to medium level of extension participation category.

Mass media utilization

The mass media utilization of the respondents was shown in Table 1, explains that majority (46.67%) of the farmers had a high followed by 30.83 percent with a low and 22.50 percent with a medium level of mass media utilization.

As large number of respondents in the study area possess the television and smart phones which made them aware about the information they needed. The majority of the farmers had obtained the high school education and have some literacy to read newspapers and farm magazine which enables them to grab latest information about farming practices.

The results were in line with the Prasad (2021) [14]; Vysali *et al*. (2020) [21]; Kumar (2015) [9]; and Reddy *et al*. (2014) [18] revealed that majority of the respondents had medium exposure to mass media.

Table 1: Socio-economic profile of Bt-Cotton growers N=120

Sl. No	Variable	Category	Frequency	Percent
1.	Age	Young (Up to 30 years)	32	26.67
		Middle (31-50 years)	67	55.83
		Old (>50 years)	21	17.50
2.	Education	Illiterate	21	17.50
		Primary school	29	24.16
		High school	35	29.16
		Pre-university	15	12.50
		Degree and above	20	16.67
3.	Farming experience	Low (Up to 15 Years)	49	40.83
		Medium (16 to 23 years)	30	25.00
		High (24 and above)	41	34.17
4.	Family size	Low (Up to 4)	39	32.50
		Medium (5-6)	65	54.17
		High (above 6)	16	13.33
5.	Annual income	Low (less than Rs.1,20,670)	37	30.83
		Medium (Rs.1,21,000-3,26,000)	59	49.17
		High (above Rs.3,27,993)	24	20.00
6.	Land holdings	Marginal farmers (Up to 2.50 acre)	20	16.67
		Small farmers (2.51 to 5.00 acre)	38	31.67
		Semi-medium farmers (5.01 to 10.00 acre)	43	35.84
		Medium farmers (10.01 to 25.00 acre)	10	8.33
		Large farmers (Above 25.00 acre)	9	7.50
7.	Risk orientation	Low	54	45.00
		Medium	17	14.17
		High	49	40.83
Mean = 16.94 S.D =1.93				
8.	Scientific orientation	Low	46	38.33
		Medium	17	14.17
		High	57	47.50
Mean = 14.09 S.D = 1.79				
9.	Economic motivation	Low	39	32.50
		Medium	53	44.17
		High	28	23.33
Mean = 16.21 S.D = 1.88				
10.	Extension contacts	Low	37	30.83
		Medium	50	41.67
		High	33	27.50

		Mean = 10.40		S.D = 3.83
11.	Extension participation	Low	55	45.83
		Medium	20	16.67
		High	45	37.50
		Mean = 3.93		S.D = 2.18
12.	Mass media utilization	Low	37	30.83
		Medium	27	22.50
		High	56	46.67
		Mean = 3.27		S.D = 1.47

Note: S.D = Standard deviation

Conclusion

The study found that more than half of the *Bt*-cotton growers educational status was in better position, hence the printed literature like pamphlets and leaflets in which the latest innovations regarding management of *Bt*-cotton crop should be included and circulated to the farmers to make them aware about the new technologies that can improve quality and yield of *Bt*-cotton to fetch the better income and rise their standard of living. The usage of social media should be increased among both farmers and extension agents, so that timely suggestions and technical guidance can be provided to the farmers to bring positive hope about future, thus avoiding effects that might be caused due to rainfall variability. The extension agents should provide the information regarding the crop related information and various schemes available from the govt to the farmers in case of any loss of crop due to rainfall variability.

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