Original Research Article

Content Analysis of Knowledge and Adoption of Climate-Resilient Cotton Production Practices among Dryland Farmers

UNDER PEER REVIEW

ABSTRACT

Cotton is a vital crop for smallholder farmers in India, particularly in the rainfed regions of Andhra Pradesh. The dryland farming is vulnerable to climate change, water scarcity, and soil degradation, leading to reduced crop yields and decreased livelihood security. Critical interventions like conservation agriculture, micro irrigation, and integrated nutrient management are essential to address these challenges. Despite their importance, the adoption of these interventions among dryland farmers remains limited. This study aimed to assess the knowledge and adoption of critical interventions among dryland farmers in cotton cultivation. The results showed that 75-100% of farmers had knowledge about basic practices like sowing time, seed rate, and spacing, while 50-75% knew about pest and disease management practices. However, only 25-50% were aware of drought mitigating measures, and 0-25% knew about advanced practices like micro irrigation and anti-transpirants. The adoption of critical interventions was also low, with 75-100% adoption of basic practices, 50-75% adoption of pest and disease management practices, and 25-50% adoption of drought mitigating measures. The study highlights the need for awareness and training programs to improve the knowledge and adoption of critical interventions among dryland farmers. The findings suggest that there is a significant knowledge and adoption gap among dryland farmers, particularly regarding advanced practices. Addressing this gap is crucial to enhancing the livelihoods of dryland farmers and promoting sustainable cotton production in the region.

Keywords: cotton, micro irrigation, anti-transpirants, critical interventions, training

1. INTRODUCTION

The pursuit of sustainable agriculture in the face of climate change has become a pressing global imperative. The Food and Agriculture Organization (FAO) defines drylands as areas with a length of growing period (LGP) of 1-179 days (FAO, 2000), which includes regions classified as arid, semi-arid, and dry sub-humid. According to the FAO Global Agro-Ecological Zones (GAEZ) modelling system (FAO, 2020), drylands cover 43.20% of the total global area in 2020 and are predicted to increase to 44.20% by 2050. In India, rainfed agro-ecosystems play a significant role, covering 80 M ha in arid, semi-arid, and sub-humid climatic zones, which constitutes nearly 57% of the net cultivated area (Rao *et al.*, 2016). These

areas support 40% of the human population and 60% of the livestock population, and the livelihoods of 70% of the rural population depend on the success or failure of crops (Rao *et al*., 2016). Climate change can exacerbate tensions related to natural resource access and use by pushing already fragile ecosystems and local communities beyond their coping capacity (IPCC, 2019). The productivity of rainfed agriculture remains low due to multiple risks and constraints related to biophysical and socio-economic issues (Rao et al., 2016). Adopting moisture conservation technologies and efficient farming practices can improve dryland crop productivity, farm income, and livelihoods (Kaur et al, 2022). In India, cotton is a crucial crop for smallholder farmers, particularly in the dryland regions of Andhra Pradesh, where it is a primary source of income and livelihood security. However, dryland farming is increasingly vulnerable to climate-related stresses, including drought, soil degradation, and water scarcity, which can lead to reduced crop yields, decreased livelihood security, and exacerbated poverty [10]. To mitigate these impacts, the adoption of climate-resilient practices, such as conservation agriculture, micro irrigation, and integrated nutrient management, is essential. Yet, the uptake of these interventions among dryland farmers remains limited, hindered by knowledge gaps, lack of awareness, and other constraints. This study seeks to address this critical knowledge gap by investigating the current state of knowledge and adoption of critical interventions among dryland cotton farmers in Andhra Pradesh. By identifying the key constraints and barriers to adoption, this research aims to inform the development of targeted strategies and interventions to enhance climate resilience in dryland cotton farming, ultimately contributing to the sustainability of agricultural livelihoods and the well-being of rural communities.

2. METHODOLOGY

This study employed a survey research design to assess the knowledge and adoption of critical interventions among dryland farmers in cotton cultivation. The survey was conducted in the Prakasam district of Andhra Pradesh, India by utilizing an *Ex-post facto* research design. Multi stage sampling technique was used to select 120 dryland farmers from five villages. Knowledge test to assess level of knowledge and structured interview schedule for extent of adoption was designed to collect data from the selected farmers. The knowledge section assessed farmers' awareness of various interventions, while the adoption section evaluated their implementation of these practices. Data quality control measures were implemented to ensure the accuracy and reliability of the data. Frequency and percentage analysis were used to determine the level of knowledge and adoption of critical interventions among the farmers. The data was analyzed using SPSS (Statistical Package for Social Sciences) software version 20.

3. RESULTS AND DISCUSSION

3.1 Content Analysis of Level of Knowledge

Table 1 Content analysis of level of knowledge on critical interventions of cotton

(**n=120)**

UNDER PEER REVIEW

S. No.	Critical Intervention*	Level of knowledge				Rank
		Correct		Incorrect		
		f	%	f	%	
1.	Formation of ridges and furrows before sowing	79	65.83	41	34.17	14
2.	Sowing across the slope	54	45.00	66	55.00	21
3.	Opening of broad bed furrows during early season drought	46	38.33	74	61.67	22
4.	Prefer early varieties of American/desi cotton if monsoon is delayed by 4 weeks	66	55.00	54	45.00	18
5.	Sowing time for cotton crop	118	98.33	2	1.67	1
6.	Recommended spacing for cotton	102	85.00	18	15.00	7
7.	Hand dibbling method in rainfed areas	114	95.00	6	5.00	4
8.	Cotton + Pigeon pea intercropping system	96	80.00	24	20.00	10
9.	Following sorghum + cow pea intercropping system during normal onset of monsoon	101	84.17	19	15.83	8
10.	Entire N, P, K apply as basal for rainfed cotton	60	50.00	60	50.00	20
11.	Complex fertilizers should not be used for top dressing in cotton	37	30.83	83	69.17	26
12.	Avoid applying fertilizers till sufficient moisture is available in soil during early season drought	62	51.67	48	48.33	19
13.	Adopt 20-25% more seed rate than recommended seed rate and reduce fertilizer dose by 25% for cotton if rainfall is delayed by 4 weeks	4	3.33	116	96.67	34
14.	Quizalofop-ethyl @ 50g/ha will be sprayed as a post emergence herbicide in cotton	17	14.17	103	85.83	30
15.	Deep ploughing is done in cotton to control root rot disease	68	56.67	52	43.33	17
16.	Deep summer ploughing is Integrated pest and disease Management	80	66.67	40	33.33	13
17.	Egg parasitoids Trichograma sp. @ 1.5 lakh per ha for pest control	34	28.33	86	71.67	27

UNDER PEER REVIEW

18.	Harvest at physiological maturity stage during terminal drought situation	9	7.50	111	92.50	33
19.	The other methods of sowing in cotton	106	88.33	14	11.67	6
20.	Recommended chemical used for seed treatment in cotton	45	37.50	75	62.50	23
21.	Intercropping system for normal onset of monsoon	78	65.00	42	35.00	15
22.	Pre emergence herbicide used in cotton	44	36.67	76	63.33	24
23.	Critical growth stages in cotton	70	58.33	50	41.67	16
24.	N requirement for rainfed cotton	38	31.67	82	68.33	25
25.	Avoid top dressing of fertilizers until receipts of rainfall during	18	15.00	102	85.00	29
26.	Trap crops used in cotton crop	86	71.67	34	28.33	12
27.	Sowing depth for cotton	117	97.50	3	2.50	2
28.	Optimum seed rate for cotton	116	96.67	4	3.33	3
29.	Recommended other intercropping systems in cotton	92	76.67	28	23.33	11
30.	Inter cultivation, dust mulching to conserve soil moisture	14	11.67	106	88.33	31
31.	Mechanical weed control methods	110	91.67	10	8.33	5
32.	Time of supplemental irrigation in cotton	100	83.34	20	16.66	9
33.	Percentage of water save through drip irrigation system	32	26.67	88	73.33	28
34.	Percentage of KNo_3 required in cotton for foliar spray	10	8.33	110	91.67	32
35.	Trade names of anti-transpirants used in cotton	3	2.50	117	97.50	35

f: Frequency, **%**: Percentage *Multiple response format

Results furnished in the Table 1 revealed that the 75 to 100 per cent of the dryland farmers had knowledge on critical interventions in cotton in percentage rank order of their decreasing importance are, sowing time for cotton crop (98.33%), sowing depth for cotton (97.50%), optimum seed rate for cotton (96.67%), hand dibbling in rainfed areas (95.00%), mechanical weed control methods (91.67%), other methods of sowing in cotton (88.33%), recommended spacing for cotton (85.00%), following sorghum + cow pea intercropping system during normal onset of monsoon (84.17%), time of supplemental irrigation in cotton (83.34%), cotton + pigeon pea intercropping system (80.00%) and recommended other intercropping systems in cotton (76.67%) .

UNDER PEER REVIEW

This can be inferred that 75 to 100 per cent of the dryland farmers had knowledge about sowing time for cotton crop, sowing depth for cotton, optimum seed rate for cotton, hand dibbling in rainfed areas, mechanical weed control methods, recommended spacing for cotton, following sorghum + cow pea intercropping system during normal onset of monsoon, time of supplemental irrigation in cotton, cotton + pigeon pea intercropping system, recommended other intercropping systems in cotton. The probable reason might be due to these practices were easy to understand and very basic practices need to be understood by the farmers.

An overview of the table 1 also revealed that 50 to 75 per cent of the dryland farmers had knowledge about critical interventions in cotton in percentage rank order of their decreasing importance are, trap crops used in cotton crop (71.67%), deep summer ploughing is integrated pest and disease management (66.67%), formation of ridges and furrows before sowing (65.83%) , other intercropping system to be followed during normal onset of monsoon (65.00%), critical growth stages in cotton (58.33%), deep ploughing is done in cotton to control root rot disease (56.67%) , prefer early varieties of American/desi cotton if monsoon is delayed by 4 weeks (55.00%), avoid applying fertilizers till sufficient moisture is available in soil during early season drought (51.67%) and entire N, P, K apply as basal for rainfed cotton (50.00%) .

This can be inferred that 50 to 75 per cent of the dryland farmers had knowledge about trap crops used in cotton crop, deep summer ploughing is integrated pest and disease management, formation of ridges and furrows before sowing, other intercropping systems to be followed during normal onset of monsoon, deep ploughing is done in cotton to control root rot disease, prefer early varieties of American/desi cotton if monsoon is delayed by 4 weeks, avoid applying fertilizers till sufficient moisture is available in soil during early season drought, entire N, P, K apply as basal for rainfed cotton. The probable reason might be due to these pest and disease management practices like integrated pest and disease management, deep summer ploughing to control root rot were very important practices needs to know to minimize economic losses that will occur due to pest and disease attack in this commercial crop and also need to know critical growth stages to give supplemental irrigation to protect from crop failure during moisture stress stages.

An overview of the table 1 also revealed that 25 to 50 per cent of the dryland farmers had knowledge about critical interventions in cotton in percentage rank order of their decreasing importance are, sowing across the slope (45.00%), opening of broad bed furrows during early season drought (38.33%), recommended chemical used for seed treatment in cotton (37.50%), pre-emergence herbicide used in cotton (36.67%), nitrogen requirement for rainfed cotton (31.67%), complex fertilizers should not be used for top dressing in cotton (30.83%), egg parasitoids Trichograma sp. @ 1.5 lakh per ha for pest control (28.33%) and percentage of water save through drip irrigation system (26.67%).

This can be inferred that only 25 to 50 per cent of the dryland farmers had knowledge about sowing across the slope, opening of broad bed furrows during early season drought, recommended chemical used for seed treatment in cotton, pre-emergence herbicide used in cotton, nitrogen requirement for rainfed cotton, complex fertilizers should not be used for top dressing in cotton, egg

UNDER PEER REVIEW

parasitoids Trichograma sp. @ 1.5 lakh per ha for pest control, percentage of water save through drip irrigation system. The probable reason might be due to the fact that lack of awareness about in-situ moisture conservation practices, herbicides used in cotton due to low extension contact and information seeking behaviour.

An overview of the table 1 also revealed that 0 to 25 per cent of the dryland farmers had knowledge about critical interventions in cotton in percentage rank order of their decreasing importance are, avoid top dressing of fertilizers until receipts of rainfall during (15.00%) Quizalofop-ethyl @ 50g/ha will be sprayed as a post emergence herbicide in cotton (14.17%), inter cultivation, dust mulching to conserve soil moisture (11.67%), percentage of KNo_3 required in cotton for foliar spray (8.33%), harvest at physiological maturity stage during terminal drought situation (7.50%), adopt 20-25% more seed rate than recommended seed rate and reduce fertilizer dose by 25% for cotton if rainfall is delayed by 4 weeks (3.33%) and trade names of anti-transpirants used in cotton (2.50%).

This can be inferred that only 0 to 25 per cent of the dryland farmers had knowledge about avoid top dressing of fertilizers until receipts of rainfall during, Quizalofop-ethyl @ 50g/ha will be sprayed as a post emergence herbicide in cotton, inter cultivation, dust mulching to conserve soil moisture, percentage of KNo_3 required in cotton for foliar spray, harvest at physiological maturity stage during terminal drought situation, adopt 20-25% more seed rate than recommended seed rate and reduce fertilizer dose by 25% for cotton if rainfall is delayed by 4 weeks, trade names of anti-transpirants used in cotton. The probable reason might be due to the fact that these drought mitigating practices recommended by Central Research Institute for Dryland Agriculture were not popular among the dryland farmers in this area. because of lack of widespread publicity about these practices among the farming community.

So, there is a need to create awareness about drought mitigating measures through extension personnel and mass media channels and conducting demonstrations, training programmes, exposure visits etc.

3.2 Content Analysis of Extent of Adoption

Table 2. Content analysis of extent of adoption of critical interventions in cotton by dryland farmers (n=120)

S. No.	Critical Intervention*	Extent of Adoption				Rank
		Adopted		Not Adopted		
		f	%	f	%	
1.	Off season and secondary tillage	118	98.33	2	1.67	1
2.	Improved/high yielding varieties	116	96.66	4	3.34	2
3.	Drought tolerant varieties	74	61.67	46	38.33	14

UNDER PEER REVIEW

4.	Seed treatment	26	21.67	94	78.33	24
5.	Ridges and furrows system	82	68.33	38	31.67	11
6.	Conservation furrows	34	28.33	86	71.67	23
7.	Trench cum bunding measures	22	18.33	98	81.67	26
8.	Broad bed furrow system	20	16.67	100	83.33	27
9.	Green manuring for *in situ* soil moisture conservation	78	65.00	42	35.00	12
10.	Sowing across the slope to conserve soil moisture	61	50.83	59	49.17	19
11.	Normal sowing window for red and black soils	115	95.83	5	4.17	3
12.	Recommended seed rate	110	91.67	10	8.33	6
13.	Recommended spacing	76	63.33	44	36.67	13
14.	Mulching	8	6.67	112	93.33	30
15.	Intercropping	62	51.67	58	48.33	18
16.	Anti-transpirants to reduce the evapo-transpiration losses	10	8.33	110	91.67	29
17.	Alternate crops in case of delayed monsoon	86	71.67	34	28.33	10
18.	Short duration varieties to avoid moisture stress	47	39.17	73	60.83	22
19.	Life saving irrigations	96	80.00	24	20.00	8
20.	Micro irrigation techniques	18	15.00	102	85.00	28
21.	Timely weed management practices	100	83.33	20	16.67	7
22.	Chemical weed control practices	48	40.00	72	60.00	21
23.	Mechanical weed control measures	114	95.00	6	5.00	4
24.	Cultural weed control measures	112	93.33	8	6.67	5
25.	Soil test based fertilizer application	25	20.83	95	79.17	25
26.	Integrated nutrient management	54	45.00	66	55.00	20
27.	Foliar application of nutrients to mitigate the crop losses during drought conditions	68	56.67	52	43.33	17
28.	Timely pest and disease management	90	75.00	30	25.00	9
29.	Integrated pest and disease management	70	58.33	50	41.67	16
30.	Avoid continuous cropping in the same field to prevent American boll worm incidence	72	60.00	48	40.00	15

f: Frequency, **%**: Percentage *****Multiple response format

UNDER PEER REVIEW

Results furnished in the Table 2 revealed the 75 to 100 per cent of the dryland farmers had extent of adoption of dryland famers on critical interventions in cotton in percentage rank order of their decreasing importance are, off season and secondary tillage (98.33%) , improved/high yielding varieties (96.66%), normal sowing window for red and black soils (95.83%), mechanical weed control measures (95.00%), cultural weed control measures (93.33%), recommended seed rate (91.67%), timely weed management practices (83.33%), life-saving irrigations (80.00%) and timely pest and disease management (75.00%).

This can be inferred that 75 to 100 per cent of the dryland farmers adopted critical interventions in cotton like off season and secondary tillage, improved/high yielding varieties, normal sowing window for red and black soils, mechanical weed control measures, cultural weed control measures, recommended seed rate, timely weed management practices, life-saving irrigations and timely pest and disease management. This might be due these are very necessary practices required for the cotton cultivation.

Results furnished in the Table 2 revealed that the 50 to 75 per cent of the dryland farmers had extent of adoption of dryland famers on critical interventions in cotton in percentage rank order of their decreasing importance are, alternate crops in case of delayed monsoon (71.67%), ridges and furrows system (68.33%), green manuring for *in situ* soil moisture conservation (65.00%), recommended spacing (63.33%), drought tolerant varieties (61.67), avoid continuous cropping in the same field to prevent American boll worm incidence (60.00%), integrated pest and disease management (58.33%), foliar application of nutrients to mitigate the crop losses during drought conditions (56.67%), intercropping (51.70%) and sowing across the slope to conserve soil moisture (50.83%).

This can be inferred that 50 to 75 per cent of the dryland farmers adopted critical interventions in cotton like alternate crops in case of delayed monsoon, ridges and furrows system, green manuring for *in situ* soil moisture conservation, recommended spacing, drought tolerant varieties, avoid continuous cropping in the same field to prevent American boll worm incidence, integrated pest and disease management, foliar application of nutrients to mitigate the crop losses during drought conditions, intercropping and sowing across the slope to conserve soil moisture.

An overview of Table 1 revealed that the 25 to 50 per cent of the dryland farmers had extent of adoption of dryland famers on critical interventions in cotton in percentage rank order of their decreasing importance are, integrated nutrient management (45.00%), chemical weed control practices (40.00%), short duration varieties to avoid moisture stress (39.17%) and conservation furrows (28.33%).

This can be inferred that 25 to 50 per cent of the dryland farmers adopted critical interventions in cotton like integrated nutrient management, chemical weed control practices, short duration varieties to avoid moisture stress and conservation furrows. The reason might be due to fact that not using the biofertilizers due to its non-availability and stigma among the farmers about chemical weed control because they felt that herbicides will affect the standing crop and it will also affect the next crop to be grown.

UNDER PEER REVIEW

An overview of Table 1 also revealed that the 0 to 25 per cent of the dryland farmers had extent of adoption of dryland famers on critical interventions in cotton in percentage rank order of their decreasing importance are, seed treatment (21.67%), soil test based fertilizer application (20.83%), trench cum bunding measures (18.33%), broad bed furrow system (16.67%), micro irrigation techniques (15.00%), anti-transpirants to reduce the evapo-transpiration losses (8.33%) and mulching (6.67%).

This can be inferred that 0 to 50 per cent of the dryland farmers adopted critical interventions in cotton seed treatment, soil test-based fertilizer application, trench cum bunding measures, broad bed furrow system, micro irrigation techniques, anti-transpirants to reduce the evapo-transpiration losses and mulching. The probable reason might be due fact that lack of awareness among the farmers about necessary *in-situ* moisture conservation interventions which leads to crop failures and poor crop yields.

4. CONCLUSION

Based on the study's findings, it can be concluded that the level of knowledge and extent of adoption of critical interventions in cotton cultivation among dryland farmers varies significantly. A high percentage (75-100%) of farmers were knowledgeable about basic agronomic practices, such as sowing time, depth, and seed rate, and commonly adopted interventions like offseason tillage and using high-yielding varieties. These practices are well-understood and implemented due to their fundamental role in ensuring successful crop establishment and management. However, only 50-75% of farmers were aware of and adopted more specialized interventions, including the use of trap crops, integrated pest management, and soil moisture conservation techniques like deep plowing and ridges. These practices are crucial for minimizing losses due to pests, diseases, and drought, indicating a need for further education and training in these areas. Conversely, a significant knowledge and adoption gap was observed for advanced drought mitigation measures and integrated nutrient management practices, with only 0-25% of farmers implementing these strategies. For example, the low awareness and adoption rates for the use of anti-transpirants, seed treatments, and micro-irrigation techniques suggest a lack of exposure to advanced agricultural practices that could enhance resilience against environmental stressors.

The findings highlight the importance of targeted extension services, training programs, and demonstration plots to enhance farmers' awareness and adoption of critical interventions. Emphasizing the importance of advanced practices, especially those recommended by research institutions like the Central Research Institute for Dryland Agriculture, could significantly improve cotton yields and sustainability in dryland farming systems. Overall, bridging the knowledge and adoption gaps through comprehensive extension and education efforts is crucial for enhancing the productivity and sustainability of cotton cultivation in dryland regions.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

UNDER PEER REVIEW

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UNDER PEER REVIEW