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Knowledge and adoption of farmers towards turmeric cultivation technology

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Abstract

The present study was carried out in the Washim and Wardha districts of Maharashtra's Vidarbha region to assess knowledge and adoption of turmeric grower towards the turmeric cultivation technologies. A total of 120 farmers were purposively selected from four tehsils known for significant turmeric cultivation. An exploratory research design was used to evaluate their responses. Results indicated that a majority of the turmeric grower (89.16%) had a medium level of knowledge regarding turmeric cultivation practices as mostly turmeric growing farmers are progressive growers. High awareness was observed in practices such as preparatory tillage (100%), proper soil selection (91.66%), and time of planting of rhizome (91.66%). Despite this, limited understanding was found for certain aspects like recommended fertilizer application for turmeric crop such as basal dose of NPK recommendation. In terms of adoption, 62.50% of respondents were categorized under the medium adoption category. Practices such as field preparation which is deep ploughing and harrowing, soil selection as well as method of sowing which is Ridge and furrow or Broad Bed Furrow (BBF), harvesting and some post harvesting methods showed high levels of adoption, while the use of specific weight of rhizome for sowing, plant protection measures such as pest and disease control, and recommended fertilizer application had relatively lower adoption rates although adequate knowledge among farmers.

So, the awareness and practical application highlights the need for more targeted extension services. Strengthening farmer training, supplying the post-harvest management equipment, demonstration programs, and hands-on experience can enhance the actual implementation of recommended practices, thereby improving turmeric technology and productivity in the region.

Keywords: Knowledge, Adoption, Turmeric cultivation, Turmeric grower

Introduction

Turmeric (*Curcuma longa* L.) is called as Golden Spice of India and also called as "Indian Saffron". It is mainly kharif season crop in India. It is an essential spice produced in India since ancient times is known as, "Golden spice". India is renowned as "The land of spices and flavors". This subcontinent possesses the glory of Indian spices and throughout the world these spices are known for their flavor and aroma in domestic market as well as in the global markets. To improve the flavour and taste of foods and beverages, spices have, however evolved into an essential part of the culinary skill of cooking. Due to their antibacterial qualities, spices were initially used in cuisine to preserve meat. The western world's need for spices as a preservation lessened with the invention of refrigeration. There are huge medicinal benefits of spices too. Different spices were used for their medicinal properties from ancient times. India dominates the world production scenario contributing 80% followed by China (8%), Myanmar (4%), Nigeria (3%) and Bangladesh (3%). In 2023-24, India had exported 1.62 lakh tonnes of turmeric compared to 1.70 lakh tonnes in the previous year. India is the largest producer, consumer, and exporter of turmeric in the world. Indian turmeric is considered to be of the best quality due to its high curcumin content, making it increasingly popular in medicinal and cosmetic applications.

Objectives

To study Knowledge and adoption of turmeric cultivation by the turmeric growers.

Methodology

The study was conducted in Washim and Wardha district in Vidarbha region of Maharashtra state, all four tehsils were selected purposively as there were more number of turmeric growers in the talukas. An exploratory research design was used to analyze the data. The list of beneficiaries was obtained from the Agricultural Technology Information

Centre (ATIC) cell, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Among these a total of 120 turmeric growing farmers were selected. Thus, the study included a total of 120 beneficiary farmers for data collection and analysis.

Results and Discussion

Table 1: Distribution of respondents according to their practice wise knowledge about recommended practices of cultivation

Sr. No	Recommended cultivation practices of turmeric crop	Respondents (n = 120)			
		Yes	Percentage	No	Percentage
1.	Medium land, well aeration and drainage required (pH 6-6.5)	110	91.66	10	8.34
2.	Method of sowing (Ridge and furrow) or Broad bed furrow (BBF)	120	100.00	00	00.00
3.	**Field preparation:** Ploughing and Harrowing	120	100.00	00	00
	FYM: 20-25 bullock carts/ha of well rotten FYM/ compost 2 weeks before sowing	110	91.66	10	08.34
4.	**Planting** a. Spacing (distance between ridges and furrows) 30 X 15 cm	100	83.34	20	16.66
	b. Rhizome selection (PDKV-Waigaon, Salem variety), free from Pest & Diseases	100	83.34	20	16.66
	c. Time of planting • May/June - February/ March (for salem variety) • May/June - November/December (in case of PDKV-Waigaon variety)	110	91.66	10	08.33
	d. Seed Treatment **Inorganic**-(Bavistin 3g / litre water, Mancozeb 75% WP 3gm per lit of water)	69	57.50	51	42.50
	Organic - Pseudomonas fluorescens (10g/kg), Trichoderma viride (4g/kg).	78	65.00	42	35.00
	e. Weight of rhizome (25 - 35g approx.)	80	66.66	40	33.34
5.	**Mulching:** (Dried grasses, leaves or green leaves) (or) Silver black plastic mulch	70	58.34	50	41.66
6.	**Irrigation Management:** Critical stages of irrigation 1. 1st critical stage of irrigation in first week after sowing	120	100.00	00	00.00
	2. 2nd critical stage of irrigation at Rhizome development	100	83.34	20	16.66
	3. 3rd critical stage of irrigation at vegetative growth	83	69.16	37	30.84
	4. 4th critical stage of irrigation at maturity stage	79	65.84	41	34.16
7.	**Weed management:** 1st weeding - 3 weeks after planting	98	81.66	22	18.34
	Total - 5 to 6 Weeding- for organic farming	95	79.16	25	20.84
8.	**Weed management:** Pendimethalin (pre-emergence) 4 DAP - for inorganic farming	65	54.16	55	45.84
	Earthing up 1st - 45 to 60 DAP	94	78.34	26	21.66
	2nd - 90 to 105 DAP	84	70.00	36	30.00
	3rd - 120 to 135 DAP	70	58.34	50	41.66
9.	Fertilizer management 200:100:100 NPK Kg/ha	91	75.84	29	24.16
	Application of N by splitting it into 3 doses 1st dose - 1/3 N, full P and K, @40-50 DAP	80	66.66	40	33.34
	2nd dose - 1/3 N application @ 80-90 DAP	76	63.34	44	36.66
	3rd dose - 1/3 N application @ 115 - 120 DAP	74	61.66	46	38.34
	Application of micro-nutrient (ZnSo4 & Borax in 5g/lit of water (2 splash in 20-30 days difference).	61	50.84	59	49.16
	Application of organic matter	94	78.34	26	21.66
10.	**Plant protection** A. For control of Rhizome borer (Humni pest) Spray malathion 0.1% at 30 days interval during July to October	83	69.16	37	30.84
	B. Rhizome scale insect / Maggot Apply poultry manure in 2 splits followed by drenching Dimethoate 30 EC @ 2ml.	84	70.00	36	30.00
	C. Thrips Spray insecticide quinalphos 0.025% or Phosalone 0.07%	65	54.16	55	45.84
11.	**Plant protection for Disease management** D. Leaf blight / blotch Spray mancozeb 0.25% or COC 0.25% immediately appearance of symptom at 15 days interval	71	59.16	49	40.84
	E. Leaf spot (Karpa) Spray carbendazim 500g/ha or Mancozeb 1kg/ha or COC 1.25 kg/ha.	85	70.84	35	29.16
12.	**Harvesting period** PDKV-Waigaon variety- 6 to 7 months	87	72.50	33	27.50
	Salem variety - 8 to 9 months	76	63.34	44	36.66
13.	**Harvesting** Yellowing of leaves followed by drying @ 50% is the major indication of harvesting stage in turmeric	120	100.00	00	00.00
	Harvesting is done by digging	89	74.16	31	25.84
	With turmeric harvester.	64	53.34	56	46.66
14.	**Post - Harvest management**	115	95.84	05	04.16

	A. Boiling				
	B. Testing of boiled turmeric: (Includes vapour of boiling and smell and by hand pressing)	115	95.84	05	04.16
	C. Drying: Sun drying for 15 days in march to May and drying till 8-10% moisture content left	120	100.00	00	00.00
	D. Polishing: Traditional- Manual polishing (includes Abrasion or mutual rubbing)	100	83.34	20	16.66
	Scientific- Mechanical polishing (by polishing drums)	56	46.66	64	53.34
	E. Grading: According to rhizome size and separating mother rhizomes	98	81.66	22	18.34
	F. Colouring: 100 kg Polished rhizomes + 1.5-2.0 lit edible oil + 3-4 kg turmeric powder.	66	55.00	54	45.00
	G. Storing Storing in gunny bags	120	100.00	00	00.00
	Storing in iron Peb	44	36.66	76	63.34

A detail probing practice wise knowledge possessed by the turmeric grower in the table revealed that in 91.66 per cent had complete knowledge regarding soil with good drainage, it was followed by 100.00 per cent of the respondents had complete knowledge regarding field preparation such as ploughing and harrowing and 91.66 per cent of the respondents had knowledge regarding FYM compost.

With regards the knowledge about plant spacing. It was found that 83.34 per cent had knowledge about rhizome planting distance and 83.34 per cent had knowledge about rhizome selection. Majority of the turmeric growers 91.66 per cent had knowledge about time of planting.

As regards 57.50 per cent of turmeric growers had knowledge about chemical rhizome treatment if in case of inorganic cultivation, and 65.00 per cent of turmeric growers had knowledge about organic rhizome treatment for organic farming. 66.66 per cent of turmeric growers had knowledge about the weight of rhizome for planting mother rhizome. 58.34 per cent of turmeric growers had knowledge about mulching.

However, 100 per cent of turmeric growers had knowledge about the 1st critical stage of irrigation in first week after sowing and followed by 83.34 per cent for 2nd critical stage of irrigation at rhizome development, 69.16 per cent for 3rd critical stage of irrigation at vegetative growth and 65.84 per cent 4th critical stage of irrigation at maturity stage. Further, it is seen that higher percentage of turmeric growers 81.66 per cent had knowledge about 1st weeding which is 3 weeks after sowing rhizomes and followed by 79.16 per cent for hand weeding in turmeric and 54.16 per cent of turmeric growers had knowledge about the use of weedicide as a measure for control of weeds.

While, 78.34 per cent of turmeric growers had knowledge about Earthing up practices which is 1st earthing up at 60 days after planting followed by 70.00 per cent for 2nd earthing up during 105 days after planting and 58.34 per cent for 3rd earthing up during 135 days after planting.

While, studying the knowledge about fertilizer application, it was seen that, 75.84 per cent of turmeric growers had knowledge about the basal recommended NPK dose application, and the knowledge about application of N by splitting into 3 doses which is 66.66 per cent of turmeric growers had knowledge about 1st dose at 50 days after planting, and 63.34 per cent for 2nd dose of N application at 90 days after planting and 61.66 per cent for 3rd dose of N application at 120 days after planting. 50.84 per cent had knowledge about the application of micro-nutrient, and 78.34 per cent of turmeric growers had knowledge about application of organic matter such as Jeevamrut etc.

While, assessing the knowledge about important pests, it was observed that, majority of turmeric growers 69.16 per cent had knowledge about Rhizome borer, 70.00 per cent turmeric growers had knowledge about important pest of rhizome scale insect / maggots, 54.16 per cent of turmeric growers had knowledge about thrips. While, assessing the knowledge about important diseases it was observed that, majority of turmeric growers 59.16 per cent had knowledge about leaf blight/blotch, 70.84 per had knowledge about Leaf spot (Karpa) disease.

About 100.00 per cent of the turmeric growers had knowledge about the harvesting stage when the leaves of turmeric turn yellow at 50% by drying and followed by 74.16 per cent of the turmeric growers had knowledge about the harvesting by digging method which is traditional method, and 53.34 per cent of the turmeric growers had knowledge about the harvesting by using turmeric harvester machine which is scientific method.

In case of post-harvest management practices, 95.84 per cent of the turmeric growers had knowledge about the boiling of turmeric after harvesting, and 95.84 per cent of the turmeric growers had knowledge about testing of those boiled turmeric. 100 per cent of the turmeric growers had knowledge about the sun drying of turmeric to leave the moisture left up to 10%. The 83.34 per cent had knowledge about traditional method of polishing the turmeric by manual rubbing and 46.66 per cent of turmeric growers had knowledge about scientific method of polishing by using polishing drums. After that 81.66 per cent of the turmeric growers had knowledge about the grading method which is grading of rhizomes according to their size and separating the mother rhizomes. 55.00 per cent of them had knowledge about colouring the polished turmeric with 2 lit of edible oil and 3 to 4 kg of turmeric powder for attaining fresh yellow colour.

During storage, 100 per cent of the turmeric growers had knowledge about storing the turmeric in gunny bags and 36.66 per cent of the turmeric growers had knowledge about storing the turmeric in Iron peb which is cold storage steel warehouse which is used to store huge amount of turmeric for future use up to three years.

Table 2: Distribution of turmeric growers according to their knowledge levels was ascertained and presented in table

Sr. No	Knowledge level	Respondents (n = 120)	
		Number	Percentage
1	Low (up to 33.33)	03	02.50
2	Medium (33.34 to 66.66)	107	89.16
3	High (above 66.66)	10	08.34
	Total	120	100.00

It is revealed from Table 2, majority 89.16 per cent of turmeric growers had possessed medium level of knowledge, followed by 08.34 per cent had high level of knowledge and only 02.50 per cent had low level of knowledge about recommended practices of turmeric cultivation. Thus, it was found that majority of turmeric growers 89.16 per cent had medium level of knowledge.

The similar findings are in line with findings of Gopiram (2005) [1] revealed that majority of the turmeric growers were having medium level of knowledge.

Adoption

Adoption indicates the present state use of adoption in recommended practices by the turmeric growers. The results obtained after analysis of data about adoption in recommended practices by turmeric growers are presented.

Table 3: Distribution of the respondents according to their adoption of recommended practices of turmeric cultivation

Sr. No.	Recommended cultivation practices of turmeric crop	Respondents (n = 120)	
		Complete Adoption	No Adoption
1.	Medium land, well aeration and drainage required (pH 6-6.5)	100 (83.34)	20 (16.66)
2.	Method of sowing (Ridge and furrow) or Broad bed furrow (BBF)	110 (91.66)	10 (08.34)
3.	**Field preparation:** One deep Ploughing and Harrowing (2 to 3 times)	95 (79.16)	25 (20.84)
	FYM: 15 - 20 bullock carts	98 (81.66)	22 (18.34)
4.	**Planting:** Spacing (distance between ridges and furrows) 30 X 15 cm	85 (70.84)	35 (29.16)
	Rhizome selection: Free from Pest & Diseases.	100 (83.34)	20 (16.66)
	Time of planting: May/June - February/ March	81 (67.50)	39 (32.50)
	Rhizome Treatment: Inorganic-(Bavistin 3g / litre water, Mancozeb 75% WP 3gm per lit of water)	64 (53.34)	56 (46.66)
	Organic - *Pseudomonas fluorescens* (10g/kg), *Trichoderma viride* (4 g/kg).	73 (60.84)	47 (39.16)
	Weight of rhizome: (25 - 35g approx.)	68 (56.66)	52 (43.34)
5.	**Mulching:** (Dried grasses, leaves or green leaves) (or)Silver black plastic mulch	69 (57.50)	51 (42.50)
6.	**Irrigation Management:** Critical stages of irrigation 1st irrigation in first week of planting	120 (100.00)	00 (00.00)
	2nd critical stage of irrigation at Rhizome development	90 (75.00)	30(25.00)
	3rd critical stage of irrigation at vegetative stage	82 (68.34)	38 (31.66)
	4th critical stage of irrigation at maturity stage	75 (62.50)	45 (37.50)
7.	**Weed management:** 1st weeding - 3 weeks after planting	88 (73.34)	32 (26.66)
	Total - 5 to 6 Weeding- for organic farming	86 (71.66)	34 (28.34)
8.	**Weed management:** Pendimethalin (pre-emergence) 4 DAP - for inorganic farming	40 (33.34)	80 (66.66)
	Earthing up 1st - 45 to 60 DAP	82 (68.34)	38(31.66)
	2nd - 90 to 105 DAP	68 (56.66)	52 (43.34)
	3rd - 120 to 135 DAP	50 (41.66)	70 (58.34)
9.	**Fertilizer management:** 200:100:100 NPK Kg/ha	96 (80.00)	24 (20.00)
	Application of N by splitting it into 3 doses 1/3 N, full P and K, @40-50 DAP	62 (51.66)	58 (48.34)
	1/3 N application @ 80-90 DAP	58 (48.34)	62 (51.66)
	1/3 N application @ 115 - 120 DAP	50 (41.66)	70 (58.34)
	Application of micro-nutrient (ZnSo4 & Borax in 5g/lit of water (2 splash in 20-30 days difference).	48 (40.00)	72(60.00)
	Application of organic matter.	80 (66.66)	40(33.34)
10.	**Plant protection** For control of Rhizome borer (Humni pest) Spray malathion 0.1% at 30 days interval during July to October	83 (69.16)	37 (30.84)
	Rhizome scale insect / Maggot - Apply poultry manure in 2 splits followed by drenching Dimethoate 30 EC @ 2ml.	72 (60.00)	48 (40.00)
	Thrips: Spray insecticide quinalphos 0.025% or Phosalone 0.07%	33 (27.50)	87 (72.50)
11.	**Plant protection for Disease management** **Leaf blight / blotch:** Spray mancozeb 0.25% or COC 0.25% immediately appearance of symptom at 15 days interval	45 (37.50)	75 (62.50)
	Leaf spot (Karpa): Spray carbendazim 500g/ha or Mancozeb 1kg/ha or COC 1.25 kg/ha.	80 (66.66)	40 (33.34)
12.	**Harvesting period:** PDKV-Waigaon variety- 6 to 7 months	60 (50.00)	60 (50.00)
	Salem variety - 8 to 9 months	60 (50.00)	60 (50.00)
13.	**Harvesting:** Yellowing of leaves followed by drying @ 50% is the major indication of	120 (100.00)	00 (00.00)

	harvesting stage in turmeric		
	Harvesting is done by digging	105 (87.50)	15 (12.50)
	With turmeric harvester.	54 (45.00)	66 (55.00)
14.	**Post - Harvest management** **i. Boiling**	114 (95.00)	06 (05.00)
	ii. Testing of boiled turmeric (Includes vapour of boiling and smell and by hand pressing)	95 (79.16)	25 (20.84)
	i. Drying Sun drying for 15 days in march to May and drying till 8-10% moisture content left	115 (95.84)	05 (04.16)
	ii. Polishing Traditional- - Manual polishing (includes Abrasion or mutual rubbing)	96 (80.00)	24 (20.00)
	Scientific- - Mechanical polishing (by polishing drums)	23 (19.16)	97 (80.84)
	iii. Grading According to rhizome size and separating mother rhizomes	74 (61.66)	46 (38.34)
	iv. Colouring 100 kg Polished rhizomes + 1.5-2.0 lit edible oil + 3-4 kg turmeric powder.	56 (46.66)	64 (53.34)
	v. Storing Storing in gunny bags	120 (100.00)	00 (00.00)
	Storing in iron peb	27 (22.50)	93 (77.50)

From Table 3, it was revealed that, in case of complete adoption 83.34 per cent of turmeric growers had adopted soil selection, followed by method of sowing using ridge and furrow or Broad Bed Furrow (BBF) 91.66 per cent. The 79.16 per cent of turmeric growers had completely adopted the field preparation of one deep ploughing and harrowing and the 81.66 per cent of turmeric growers had completely adopted the FYM compost application.

While, 70.84 per cent of turmeric growers had completely adopted the plant spacing, 83.34 per cent of turmeric growers had completely adopted the rhizome selection, followed by time of planting (67.50) per cent, rhizome treatment (53.34) per cent chemical application in case of inorganic farming, (60.84) per cent of organic farming. The 56.66 per cent of turmeric growers had completely adopted the weight of rhizome, (57.50) per cent of turmeric growers had completely adopted the mulching technique.

In case of irrigation management, 100 per cent of turmeric growers had completely adopted the 1st critical stage of irrigation during the first week after planting of rhizome, 75.00 per cent of turmeric growers had completely adopted the 2nd critical stage of irrigation at rhizome development, 68.34 per cent of turmeric growers had completely adopted the 3rd critical stage of irrigation at vegetative stage and 62.50 per cent of turmeric growers had completely adopted the 4th critical stage of irrigation at maturity stage.

Followed by 73.34 per cent of turmeric growers had completely adopted the weed management practice as 1st weeding which is three weeks after planting, 71.66 per cent of turmeric growers had completely adopted the hand weeding practices and 33.34 per cent of turmeric growers had adopted the weedicide application for inorganic cultivation.

While, for the earthing up practices, 68.34 per cent of turmeric growers had completely adopted the 1st earthing up practices at 60 days after planting, 56.66 per cent of turmeric growers had adopted the 2nd earthing up practices at 105 days after planting and 41.66 per cent of turmeric growers had completely adopted the 3rd earthing up practices at 135 days after planting.

In case of fertilizer management, 80.00 per cent of turmeric growers had completely adopted the NPK basal dose application and followed by the N has to be applied by splitting it into 3 doses which most of the growers are not adopted, in that only 51.66 per cent of turmeric growers had completely adopted the 1st dose of N application at 50 days after planting, 48.34 per cent had 2nd dose of N application at 90 days after planting and 41.66 per cent had 3rd dose of N application at 120 days after planting. Only 40.00 per cent of turmeric growers had completely adopted the application of micro nutrient. The 66.66 per cent of turmeric growers had completely adopted the organic matter application such as jeevamrut etc.

It was also revealed that 69.16 per cent of turmeric growers had completely adopted the plant protection control measures of pest attack for Rhizome borer, 60.00 per cent for Rhizome scale insect / maggots, and 27.50 per cent for thrips. In case of disease management, only 37.50 per cent of turmeric growers had completely adopted the plant protection measures for leaf blight disease and 66.66 per cent for leaf spot (karpa) disease.

Most of the turmeric growers had adopted the harvesting method in that 100.00 per cent of turmeric growers had completely adopted the harvesting stage during when the leaves turn yellow followed by 50% drying of leaves is perfect for harvesting, followed by 87.50 per cent of turmeric growers had completely adopted the harvesting method by digging, sometimes it may cause damage of rhizomes and requires labours for harvesting, and only 45.00 per cent of turmeric growers had completely adopted the harvesting using the turmeric harvester machine which reduce the damage while harvesting and decrease the manual work.

While, the post-harvest management practices for turmeric crop are more comparatively other crops, which need proper technical knowledge and practice for adopting the post harvest management practices, such as 95.00 per cent of turmeric growers had completely adopted the boiling of turmeric after harvesting, followed by 79.16 per cent for testing of boiled turmeric, 95.84 per cent for drying of boiled turmeric after boiling under sun drying up to 10% moisture left on the turmeric, 80.00 per cent for polishing the dried turmeric by using traditional polishing method by manual rubbing, and only 19.16 per cent of turmeric growers had completely adopted the scientific method for polishing the dried turmeric by using polishing drums,

followed by 61.66 per cent for grading of those polished turmeric by separating them according to their sizes and separating mother rhizomes, 46.66 per cent for colouring those graded rhizomes, by mixing the 100kg of polished rhizomes with 2.0 lit of edible oil and 4 kg of turmeric powder to become bright yellow colour turmeric. And at last, the storage in which all 100 per cent of the turmeric growers were completely adopted the storage using gunny bags and only 22.50 per cent of turmeric growers had completely adopted the storage using Iron peb, which is cold storage steel warehouse which is used to store huge amount of turmeric for future use up to three years.

Table 4: Distribution of the respondents according to their overall adoption in turmeric cultivation

Sr. No	Adoption level	Respondents (n = 120)	
		Number	Percentage
1	Low (up to 33.33)	25	20.84
2	Medium (33.34 to 66.66)	75	62.50
3	High (above 66.66)	20	16.66
	Total	120	100.00

From Table 4 it was revealed that, majority 62.50 per cent of turmeric growers had medium level of adoption, followed by 20.84 per cent of turmeric grower had low level of adoption and 16.66 per cent turmeric grower had high level of adoption in turmeric cultivation. Thus, it was found that majority 62.50 per cent of turmeric growers had medium level of adoption.

Similar types of finding were observed by Kulkarni (1999) [2] observed that majority 63.33 per cent of turmeric growers had medium level of adoption.

Conclusion

The findings indicate that while turmeric growers demonstrated high levels of knowledge in practices like ploughing and harrowing (100%), soil selection (91.66%), and harvesting during drying and yellowing of leaves at 50% (100.00%), rhizome selection (83.34%), time of planting (91.66%), rhizome treatment for inorganic (57.50%) and for organic cultivation (65.00%). In terms of actual adoption, practices like soil selection, ploughing and harvesting showed higher adoption levels. However, the adoption practices such as timely recommended fertilizer application, control of pest and diseases and chemical weed management are relatively low, despite growers being aware of them. This indicates that while awareness is present, the dissemination of knowledge into reliable practice remains limited in certain areas. In such cases, extension strategies must focus not only on creating awareness but also on enabling farmers to adopt the right practices more effectively and efficiently.

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