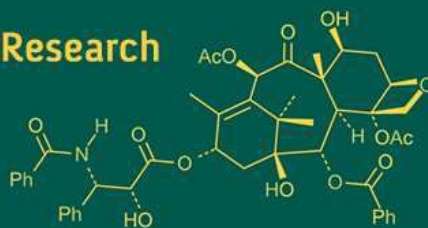
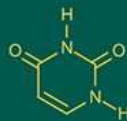


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Unlocking the potential of water soluble and specialty fertilizers: Farmer awareness, attitudes, satisfaction, and challenges

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Abstract

Water Soluble and Specialty Fertilizers (WSF and SF) have gained significant importance in India over the past two decades. This study, conducted in Chikkaballapur and Kolar districts of Karnataka, aims to understand farmers' perspectives on farmer awareness, attitudes, satisfaction in usage of these fertilizers in the eastern dry region of Karnataka. It employs an ex-post-facto design. The research involved interviews with eighty vegetable and flower growers, along with twenty fertilizer dealers, across four taluks in these districts. The study revealed that 100% of farmers are aware of WSF and SF, with primary information sources being fertilizer dealers (mean score: 75.20), cooperatives (62.40), and advertisements (50.55). Farmers generally hold positive attitudes towards these fertilizers, emphasizing increased yield (mean score: 78.60) and nutrient efficiency (75.21). Satisfaction levels are notably high, with 97.5% of farmers expressing contentment and 66.25% being highly satisfied. Despite the high satisfaction levels reported by farmers using WSF and SF, they also highlighted several constraints. Significant constraints were identified, such as the high cost of WSF and SF (Garrett's mean score: 80.00), the need for substantial initial investments (67.31), and technical issues like clogging (61.68). Additionally, the lack of guidance and technical information hampers effective use. Farmers suggested providing subsidies, regular training, credit facilities, and low-interest loans to overcome these barriers. Overall, addressing these financial and technical constraints through comprehensive support strategies can significantly enhance the adoption of WSF and SF, leading to sustainable agricultural practices and increased productivity. This research highlights the potential of WSF and SF in contributing to a greener and more sustainable future in agriculture.

Keywords: Water soluble fertilizers, farmer adoption, nutrient efficiency, agricultural productivity, and sustainable agriculture

Introduction

The adoption of Water Soluble and Specialty Fertilizers (WSF and SF) is being hailed as a transformative step in modern agriculture. These fertilizers are lauded for their precise nutrient management capabilities, which lead to enhanced crop yields, superior produce quality, and overall boosted agricultural productivity (Anonymous, 2020) ^[1]. The nutrient efficiency of WSF and SF ensures that plants receive the necessary nutrients directly at the root zone, minimizing wastage and environmental impact (Singh & Sharma, 2018) ^[3]. This is particularly beneficial in water-scarce regions, as these fertilizers can be efficiently administered through micro-irrigation systems, thereby conserving water and improving irrigation efficiency. Despite these advantages, several barriers hinder the widespread adoption of WSF and SF. The high costs associated with these fertilizers and the substantial initial investment required for micro-irrigation equipment like drip systems, motors, and borewells pose significant challenges, especially for small and marginal farmers (Yadav & Kumar, 2020) ^[5]. These financial constraints often prevent farmers from realizing the long-term benefits of these advanced fertilizers. Additionally, technical issues such as clogging in drip systems and a lack of adequate guidance and technical information further complicate adoption. Farmers need comprehensive support, including training on the proper use of WSF and SF and how to prevent and manage clogging issues in irrigation systems (Tiwari & Gupta, 2019) ^[4].

Nevertheless, the market potential for WSF and SF remains substantial. Progressive farmers, who are quick to adopt new technologies, have already acknowledged the benefits of these fertilizers and are leading the way in their use. The increased emphasis on sustainable agricultural practices and the growing demand for high-quality produce are expected to further drive market growth (Ayyappan, 2015) [6]. Companies in the WSF and SF market are continually innovating and launching new products to establish their prominence. They are expanding production capacities and global reach, which aids the popularity and demand for these fertilizers in agricultural regions worldwide.

In India, the market for WSF has grown significantly, from a mere 10,000 tonnes in the early 2000s to 300,000 tonnes in 2021. Key drivers for this growth include the exponential increase in the area under drip irrigation, the need for improved nutrient delivery efficiency, and constraints related to power and labour availability in rural areas (Jat, 2011) [8]. Recognizing the importance and benefits of WSF and SF in achieving goals like doubling farmers' incomes through reduced cultivation costs and increased returns, it becomes evident that these fertilizers offer a sustainable solution to the issue of indiscriminate fertilizer use (Anonymous, 2021) [2] & Tandon, 2012) [9].

However, challenges such as low awareness among farmers, unavailability of these fertilizers, and lack of technical guidance have limited their reach. The recent advancements in the water-soluble and specialty fertilizer industry necessitate a study on farmers' perceptions to understand the market changes, adoption levels, and constraints faced at the ground level. This research aims to address these issues and support the growing population's needs by understanding farmers' perspectives in the Eastern dry zone of Karnataka. The objectives include analysing farmers' awareness and attitudes towards WSF and SF, assessing their satisfaction levels, and identifying the constraints faced and suggestions for improvement.

Methodology

This study dives into understanding farmers' perspectives on water-soluble and specialty fertilizers, particularly their awareness, attitudes, satisfaction levels, and the constraints they encounter. Conducted in Karnataka's Chikkaballapur and Kolar districts, the research involved personal interviews with 80 vegetable and flower growers spread across four taluks.

Random selection was used to choose farmers, ensuring a broad representation. Data collection happened in March and April 2022, focusing on fertilizer management practices. The ex-post-facto research design was apt for examining existing phenomena, as it allows for a systematic look at ongoing or past occurrences without manipulating variables. This method was chosen because the researcher had no control over the independent variables, which were inherent and unmodifiable.

From each district, two taluks were selected using random sampling, and 20 farmers per taluk were interviewed to gather detailed insights into their fertilizer management practices. Additionally, 10 retailers from each district were also interviewed to understand the market dynamics of these fertilizers.

The respondent selection followed a random sampling method, targeting vegetable and flower growers without any specific criteria. Personal interviews provided relevant data

during March and April 2022. This ex-post-facto research design enabled a systematic empirical inquiry into phenomena that had already occurred or were ongoing, giving a real-world perspective on the use and perception of these fertilizers.

To achieve the study's objectives, descriptive statistics and Garrett's ranking method were employed for data analysis. These techniques provided in-depth insights into farmers' awareness, attitudes, satisfaction levels, and the constraints they face in adopting water-soluble and specialty fertilizers. By using this comprehensive methodology, the study aimed to offer a thorough understanding of the factors influencing the adoption and use of these fertilizers in the eastern dry region of Karnataka. Through this approach, the study not only highlights the challenges and benefits associated with WSF and SF but also sheds light on practical solutions and strategies to enhance their adoption, ultimately leading to more sustainable agricultural practices and increased productivity.

Results and Discussions

Awareness of farmers towards water soluble fertilizers and specialty fertilizers

The Table 1 highlights the awareness levels of farmers regarding water-soluble fertilizers (WSF) and specialty fertilizers (SF). The findings revealed that all 80 surveyed farmers were aware of both types of fertilizers, indicating a 100% awareness rate. This high level of awareness suggests that farmers are well-informed about the usage, advantages, and functioning of these fertilizers. The data further categorized awareness into three levels: low, medium, and high. It was found that 45% of the farmers had high awareness, 32.5% had medium awareness, and 22.5% had low awareness. The mean awareness score was 1.275, with a half standard deviation of 0.635. Several factors contribute to the high awareness levels among farmers. Primarily, the effectiveness of WSF and SF in improving crop yield and quality, along with their efficiency in reducing labor costs, makes them highly attractive to farmers. Additionally, the long-term use of these fertilizers has provided farmers with practical experience, further enhancing their understanding and awareness. Private dealers and advertisements have also played a crucial role in spreading awareness, educating farmers about the benefits and proper usage of WSF and SF, leading to higher adoption rates.

The study further classified the awareness levels into three categories using mean and standard deviation as observed in Table 2. It was observed that 22.50% of farmers had low awareness, likely due to lower educational backgrounds and the complexity of the technical information. On the other hand, 45% of farmers exhibited high awareness, benefiting from previous years of experience and the technical knowledge provided by dealers and advertisements. This classification highlights the need for targeted educational programs to bridge the awareness gap. Simplifying technical information and making it more accessible to farmers with lower educational backgrounds is essential. The high awareness levels among farmers indicate a positive trend towards the adoption of WSF and SF. However, the presence of a significant proportion of farmers with low awareness underscores the need for targeted educational programs. These programs should focus on simplifying the technical information and making it more accessible to farmers with lower educational backgrounds. Moreover, the

role of private dealers and advertisements in spreading awareness underscores the importance of collaboration between agricultural extension services and the private sector. By working together, they can ensure that accurate and comprehensive information reaches all farmers, thereby promoting the widespread adoption of these advanced fertilizers. The study demonstrates that farmers are generally well-aware of the benefits and usage of water-soluble and specialty fertilizers. The high levels of awareness are driven by the effectiveness of these fertilizers, practical experience, and the efforts of private dealers and advertisements. However, to achieve even greater adoption rates, it is essential to address the awareness gaps among farmers with lower educational backgrounds. Targeted educational initiatives and continued collaboration between public and private sectors will be crucial in promoting the sustainable use of WSF and SF, ultimately contributing to improved agricultural productivity and sustainability. This approach not only supports farmers in achieving better yields but also contributes to the broader goal of sustainable agriculture, ensuring food security for the growing global population.

Table 1: Awareness regarding Water soluble and specialty fertilizers

(n = 80)

Sl. No.	Particulars	Aware		Not Aware	
		Number	Percentage	Number	Percentage
1	Water soluble fertilizers	80	100	0	0
2	Specialty fertilizers	80	100	0	0

Table 2: Total Awareness regarding Water soluble and Specialty fertilizers

(n = 80)

Category	Frequency	Percentage
Low (Mean-½ SD)	18	22.50
Medium (>Mean-½ SD to <Mean-½ SD)	26	32.50
High (Mean-½ SD)	36	45.00
Total	80	100.00
Mean = 1.275 ½ SD = 0.635		

Source of information regarding Water soluble fertilizers and Specialty fertilizers

Table 3 reveals the prominent sources of information regarding water-soluble and specialty fertilizers among the 80 farmers surveyed. The primary source was private fertilizer dealers, with a mean score of 75.20. Local cooperatives followed with 62.40, hoardings/advertisements at 50.55, farmer meetings at 49.40, friends/relatives at 41.05, and Krishi melas at 39.35.

Private fertilizer dealers ranked highest (mean score: 75.20). Their direct interaction and established trust with farmers are likely the reasons behind this preference. Local cooperatives, with a mean score of 62.40, also play a crucial role due to their accessibility and the trust they've built within the community. Hoardings and advertisements, with a mean score of 50.55, came in third. The visually appealing and targeted nature of these advertisements helps in reaching a broader audience, making them effective in conveying information about fertilizers. Farmer meetings, friends, and relatives also play a part in information dissemination, with scores of 49.40 and 41.05, respectively. These informal channels are vital for the exchange of information within the community, emphasizing the role of

personal networks.

Krishi melas, though ranked last with a mean score of 39.35, provide valuable exposure to new technologies and practices. These agricultural fairs allow farmers to interact with experts and learn about the latest advancements. The study underscores the multifaceted approach farmers use to gather information, combining both formal and informal sources. Personal interactions, community support, and mass communication are all crucial in ensuring farmers have access to reliable and comprehensive information, allowing them to make informed decisions and adopt innovative solutions for improved productivity and sustainability.

Table 3: Source of information on Water Soluble and Specialty Fertilizers

(n = 80)

Sl. No.	Particulars	Mean score	Rank
1	Fertilizer dealers	75.20	I
2	Cooperatives	62.40	II
3	Hoardings/Advertisements	50.55	III
4	Farmer meetings	49.40	IV
5	Friends/Relatives	41.05	V
6	Krishi melas	39.35	VI

Attitude of farmers towards water soluble fertilizers and specialty fertilizers

Table 4 provides insights into farmers' attitudes toward using Water Soluble and Specialty Fertilizers (WSF and SF), analysed through Garrett's ranking method. The results reveal a clear hierarchy of beliefs and opinions among the 80 farmers surveyed. Farmers believe that WSF and SF significantly increase yields, giving this opinion the highest mean score of 78.60. They also recognize the high nutrient efficiency these fertilizers offer, with a mean score of 75.21. Another positive belief is the improvement in the quality of produce, scoring 73.72.

Table 4: Attitude of farmers towards usage of Water Soluble and Specialty Fertilizers

(n = 80)

Sl. No.	Particulars	Garretts ranking	
		Mean score	Rank
1	WSF and SF leads to increased yield	78.60	I
2	Nutrient efficiency is high with WSF and SF	75.21	II
3	WSF and SF increases the quality of produce	73.72	III
4	Fertigation facilitates reduction in quantity of fertilizer requirement	63.96	IV
5	Fertigation facilitates reductions in weed problems	61.50	V
6	Fertigation reduces leaching and evaporation losses	53.85	VI
7	Drip irrigation needed for WSF and SF	52.06	VII
8	Labour requirement and cost incurred can be reduced with WSF and SF	50.38	VIII
9	Composition of WSF and SF are available to our requirements	44.75	IX
10	Technical information readily available on usage of WSF and SF	43.38	X
11	WSF and SF suitable for saline and alkaline soils	37.93	XI
12	WSF and SF are locally available	37.61	XII
13	WSF and SF available in required packages	34.46	XIII
14	Available electricity can be effectively used	24.52	XIV
15	WSF and SF are cost effective	17.02	XV

Fertigation, the process of supplying fertilizers through irrigation, is appreciated for its efficiency, reducing the quantity of fertilizer needed (mean score: 63.96) and minimizing weed problems (mean score: 61.50). Additionally, farmers value fertigation for its role in reducing leaching and evaporation losses, which scored 53.85. Despite these benefits, some practical concerns remain. The need for drip irrigation systems to utilize WSF and SF scored 52.06, while the perceived reduction in labor requirements and associated costs scored 50.38. Farmers also value the availability of WSF and SF compositions that meet their specific needs (mean score: 44.75) and appreciate the accessible technical information on their usage (mean score: 43.38). However, the suitability of these fertilizers for saline and alkaline soils (mean score: 37.93) and their local availability (mean score: 37.61) are seen as less significant. Packaging options (mean score: 34.46) and the effective use of available electricity (mean score: 24.52) also rank lower. Lastly, the cost-effectiveness of WSF and SF is the least convincing factor, with a mean score of 17.02, highlighting farmers' concerns about their higher costs compared to traditional bulk fertilizers. However, farmers appreciate the yield and quality benefits of WSF and SF, along with their efficiency in nutrient delivery and weed control. However, the perceived higher cost remains a barrier. This suggests a need for continued education and support to highlight the long-term benefits and cost savings associated with these advanced fertilizers.

Farmers' trust and experiences with WSF and SF played significant role in their positive attitudes. They see these fertilizers as tools for achieving higher yields and better-quality produce through optimized nutrient intake. Additionally, WSF and SF are viewed as effective in reducing cultivation costs by lowering labour expenses and minimizing weed issues. However, the perception of higher costs remains a barrier. Despite the reduced requirement of fertilizers, many farmers believe that WSF and SF are more expensive than traditional bulk fertilizers. This suggests a need for more education on the long-term cost benefits and efficiencies associated with these advanced fertilizers. WSF and SF are highly valued for their efficiency and effectiveness, greater emphasis on their cost benefits could further enhance their adoption among farmers.

Farmers' perspective regarding the factors that influenced the adoption of these fertilizers

The perspectives of farmers with regard to purchase of water soluble and specialty fertilizers is being analysed with descriptive statistics and represented in Table 5.

Farmers' adoption of Water Soluble and Specialty Fertilizers (WSF and SF) is influenced by multiple factors, as shown in Table 5. Positive attitudes towards these fertilizers are prevalent, with 93.75% of farmers expressing trust in their benefits. Progressive farmers are especially inclined to adopt them, with 92.50% doing so. A significant driver of adoption is the ease of application, appreciated by 97.50% of farmers, while higher prices present a barrier for an equal percentage. Technical consultation from dealers and the government is vital, influencing 100% of the farmers. Similarly, the credibility of the brand and the quality of the product are crucial, with both factors affecting all surveyed farmers.

Financial considerations also play a role, with 97.50% of farmers indicating that credit facilities could boost adoption

rates. Past experiences with these fertilizers impact 96.25% of farmers' purchasing decisions, while 93.75% believe that easy availability would further encourage their use. Overall, farmers are motivated by the positive outcomes associated with WSF and SF, such as increased yields and reduced labour costs. However, the perceived higher costs remain a concern, underscoring the need for better awareness of the long-term benefits and potential savings these fertilizers offer. Addressing these factors can support broader acceptance and usage among farmers, enhancing productivity and sustainability in agriculture.

Table 5: Farmers' perspective on factors that influenced the adoption of these fertilizers (n = 80)

Sl. No.	Particulars	Number		Per cent	
		Yes	No	Yes	No
1	Farmer has positive attitude towards WSF and SF	75	5	93.75	6.25
2	Progressive farmers are adopters of WSF and SF	74	6	92.50	7.50
3	Ease of application of WSF and SF leads to more adoption	78	2	97.50	2.50
4	Higher prices also effects the adoption of WSF and SF	78	2	97.50	2.50
5	Adoption of WSF and SF also depends on technical consultation provided to the farmers by dealers and Govt.	80	0	100.00	0
6	Availability of credit facility could increase the adoption of WSF and SF	78	2	97.50	2.50
7	Credibility of brand is also considered while choosing WSF and SF	80	0	100.00	0
8	Quality of the product is major factor in choosing WSF and SF	80	0	100.00	0
9	Easy availability of WSF and SF could lead to more adoption among farmers	75	5	93.75	6.25
10	Past experience with WSF and SF also influence the buying behaviour of farmer with regard to WSF and SF	77	3	96.25	3.75

Satisfaction level of farmers with regard to water soluble and speciality fertilizers

The satisfaction levels among farmers regarding Water Soluble and Specialty Fertilizers (WSF and SF) are remarkably high, as depicted in Tables 6 and 7. According to Table 6, an impressive 97.5% of farmers expressed satisfaction with these fertilizers, while only 2.5% reported dissatisfaction. This indicates that most farmers find WSF and SF effective and beneficial for their agricultural practices. Probing into overall satisfaction, Table 7 shows that 31.25% of farmers are satisfied, and a significant 66.25% are highly satisfied with WSF and SF. This strong endorsement reflects the substantial benefits these fertilizers provide. Only a minor fraction (2.5%) remains unsatisfied, underscoring the general approval and acceptance of WSF and SF among the farming community.

The consistently positive experience with these fertilizers is evident from the overall mean satisfaction score of 0.325 and a standard deviation of 0.545. Farmers attribute their high satisfaction levels to improved crop yields, enhanced quality of produce, ease of application, and efficient nutrient management provided by WSF and SF. These factors contribute significantly to their contentment.

Moreover, the small percentage of dissatisfaction may be due to specific challenges or unmet expectations, which can be addressed through targeted support and education. Providing tailored solutions and guidance could help

mitigate these concerns and further enhance satisfaction levels. In summary, the overwhelmingly positive feedback highlights the importance of continued support and accessibility to WSF and SF. Ensuring farmers have the necessary resources and knowledge to use these advanced fertilizers effectively will maintain and boost their satisfaction, fostering sustainable agricultural practices and improved productivity. The satisfaction among farmers can largely be attributed to the increased productivity, better quality of produce, higher returns, and reduced labor requirements that Water Soluble and Specialty Fertilizers

(WSF and SF) provide. These factors combine to make the farming process more efficient and profitable, leading to high satisfaction levels.

Table 6: Satisfaction level of farmers regarding Water Soluble and Specialty Fertilizers

(n = 80)

Particulars	Satisfied		Not Satisfied	
	Number	Percentage	Number	Percentage
Water soluble and specialty fertilizers	78	97.5	2	2.5

Table 7: Total Satisfaction level of farmers regarding Water Soluble and Specialty Fertilizers

(n = 80)

Category	Frequency	Percentage
Unsatisfied	02	2.50
Satisfied	25	31.25
Highly satisfied	53	66.25
Total	80	100.00
Mean = 0.325 ½ SD = 0.545		

However, some farmers express dissatisfaction due to the high costs associated with these fertilizers. They feel that the price does not always justify the results, leading to a perception that the products are overrated. Additionally, issues such as clogging in drip irrigation systems and non-suitability for certain farming conditions contribute to their dissatisfaction. These challenges highlight the need for better support and tailored solutions to address specific farmer concerns and enhance their overall experience with WSF and SF.

Constraints faced by farmers in using water soluble and specialty fertilizers and to seek farmer's suggestions

Table 8 lists the constraints farmers face when using Water Soluble and Specialty Fertilizers (WSF and SF). The findings indicate that the high cost of these fertilizers is the most significant constraint, with a Garrett mean score of 80.00. This is followed by the high initial investment needed for the equipment to apply WSF, scoring 67.31. Clogging of drip systems (61.68) and lack of guidance (53.00) also rank high among the concerns.

Table 8: Constraints faced by the farmers

(n = 80)

Sl. No	Particulars	Garrett's Mean score	Rank
1	High Cost of WSF & SF	80.00	I
2	High initial investment for equipment's to apply WSF	67.31	II
3.	Clogging of drip system	61.68	III
3	Lack of guidance	53.00	IV
4	Lack of technical information	47.00	V
5	Non-Suitability to all crops	39.20	VI
7	Non availability of required fertilizer	33.80	VII

Farmers point out that the high costs associated with WSF and SF can be a barrier, particularly for small and marginal farmers who may not have the financial flexibility to invest in more expensive inputs. The need for micro irrigation systems, which require substantial initial investment in equipment like drip systems, motors, and borewells, further exacerbates this issue. The clogging of drip systems when using water soluble fertilizers, particularly in powder form,

is another significant concern. This technical challenge can deter farmers from adopting these fertilizers. There's also a notable lack of guidance and technical information available, leaving many farmers without the necessary support to effectively use these products. Additionally, the non-suitability of WSF and SF for all crops and the unavailability of required fertilizers during peak seasons add to the challenges.

Farmers have suggested several ways to mitigate these constraints. They recommend selling WSF and SF at subsidized rates to make them more affordable. Regular training sessions on the use of these fertilizers could also help farmers overcome technical challenges. Providing credit facilities and low-interest loans for purchasing equipment and fertilizers would make these products more accessible. Lastly, training on how to prevent clogging in drip systems would address one of the major technical barriers to adoption. Overall, addressing these constraints through financial support, technical guidance, and improved accessibility could significantly enhance the adoption of WSF and SF among farmers, leading to better productivity and sustainability in agriculture.

The reasons for the above findings could be due to the reason that the water soluble and specialty fertilizers are little costlier than other straight fertilizers and do not come under subsidy. They also require the well-set drip irrigation system, motor, borewell and electricity to run this set-up. This leaves the farmer an impression that the usage water soluble and specialty fertilizer involved high cost and is viewed as a constraint by small and marginal farmers. Clogging of the drip system is another constraint faced by the farmers while using water soluble fertilizers in powder form. For this reason, farmers are showing interest towards the liquid form of these fertilizers which could enable an ease of application to farmers. The suggestions given by the farmers were sale of Water Soluble and Specialty Fertilizers at subsidized rate, training for use of Water Soluble and Specialty Fertilizers should be conducted on regular basis, credit facilities should be provided to buy Water Soluble and Specialty Fertilizers, loans with low interest rate should be given to buy equipment's and training regarding methods to avoid clogging of equipment's should be conducted.

Conclusion

The study highlights the various dimensions of farmers' awareness, attitudes, and satisfaction regarding Water Soluble and Specialty Fertilizers (WSF and SF). The high levels of awareness and positive attitudes towards these fertilizers are evident, with most farmers appreciating their benefits, including increased yields and improved produce quality. Sources of information like fertilizer dealers and cooperatives play a crucial role in disseminating knowledge. Farmers' adoption of Water Soluble and Specialty Fertilizers (WSF and SF) is influenced by several factors. High costs and the need for significant initial investments in equipment, along with technical issues like clogging, are major constraints. Despite these challenges, the majority of farmers express satisfaction due to increased productivity, better quality produce, and efficient nutrient management. Addressing these constraints through subsidies, training, and credit facilities can enhance adoption rates. Providing technical support and ensuring easy availability will further help farmers overcome barriers, leading to improved agricultural practices and sustainability.

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