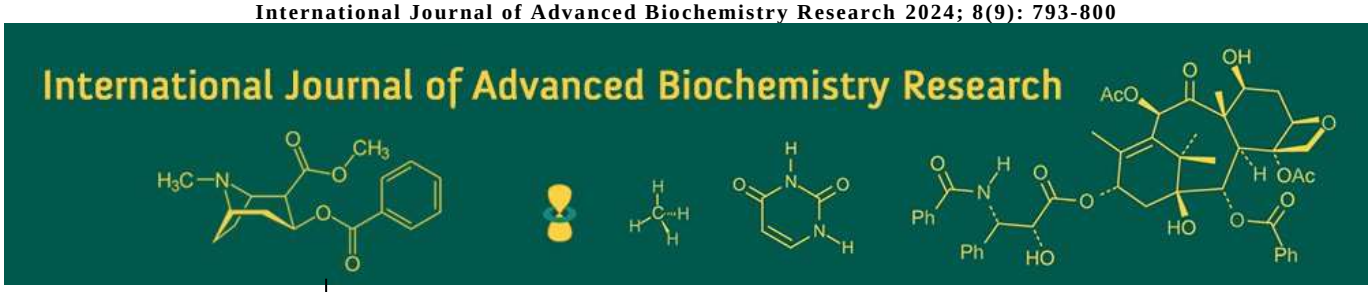

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Constraints and suggestions given by horticulture crop growers in adoption of precision farming technologies

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Abstract
India, with its vast agricultural fragmented landscape and a growing population, faces significant challenges in meeting the food demands of its people. To address these challenges and ensure sustainable growth in agriculture, the adoption and practicing of innovative farming practices like precision farming becomes crucial. The present study was conducted in Chikkaballapur and Kolar districts of eastern dry zone of Karnataka in the year 2021-2022 to elicit the constraints and suggestions of horticulture crop growers towards precision farming technologies. A sample of 40 tomato, 40 capsicum and 40 rose growers were selected randomly. Thus, making a total sample size of 120 growers. Ex-post facto research design was used. The data was collected by personal interview method with pre-tested interview schedule and data was analysed by using appropriate tools. The findings of the study revealed that, the major production constraints expressed by horticulture crop growers practicing precision farming were occurrence of pest and diseases (Rank I) and scarcity of labour during critical stages (Rank II). Lack of technical know-how regarding precision farming technologies (Rank I) and lack of local expertise (Rank II) were the major technical constraints. In case of financial constraints, high cost of inputs (Rank I) and lack of adequate and timely disbursement of loan (Rank II) were the major constraints. Price fluctuations (Rank I) and exploitation by middle men (Rank II) were the major marketing constraints expressed by the growers. The major suggestions given by the horticulture crop growers were availability of inputs at right time at subsidized rates (Rank I) followed by development of user-friendly technologies (Rank II), availability of improved seedlings at right time (Rank III), creation of grading, cold storage and processing facilities at farm gate level (Rank IV), conducting demonstrations on various precision farming technologies (Rank V), intervention of government in price policy mechanism (Rank VI) and standardization of literature in local language (Rank VII).

Keywords: Constraints, suggestions, technical, financial, production, marketing

Introduction
India, with its vast agricultural landscape and a growing population, faces significant challenges in meeting the food demands of its people. To address these challenges and ensure sustainable growth in agriculture, the adoption of innovative farming practices becomes crucial. Precision farming, also known as precision agriculture or smart farming, which has emerged as a transformative solution that harnesses technology to optimize crop production, conserve resources, and promote sustainability. Precision farming in India utilizes cutting-edge technologies and data-driven insights to enable farmers to make informed decisions and maximize productivity. Precision farming optimizes crop production by identifying and addressing factors that limit productivity. The ability to monitor crop health, detect diseases early, and apply interventions precisely leads to improved yields and reduces crop losses. It involves the integration of tools such as remote sensing, satellite imagery, sensors, drones, GPS, and artificial intelligence (AI) to monitor and manage agricultural operations with precision. By collecting real-time data on soil conditions, weather patterns, crop health, and market trends, precision farming empowers Indian farmers to optimize resource allocation and increase efficiency. Precision farming techniques in India promote resource conservation by optimizing the use of water, fertilizers, and pesticides. Through data-driven decisions, farmers can avoid over-application of inputs, minimize wastage, and reduce the environmental impact of agriculture.

By reducing input costs, minimizing crop losses, and maximizing yields, precision farming enhances the profitability of farmers in India. This, in turn, improves their economic viability, encourages investment in agricultural practices, and ensures long-term sustainability.

Methodology

The present study was conducted using the "Ex-post facto" research design as it is a systematic enquiry for measuring the phenomenon, which has already occurred and is continuing. The study was conducted in Chikkaballapur and Kolar districts of Eastern dry zone of Karnataka state because of the diversified farming system and wide area under horticulture crops. One potential taluk from each district based on area, production and productivity were selected for the study. Further, from each taluk 20 tomato, capsicum and rose growers were selected respectively, making the sample size of 60 horticulture crop growers from each taluk. Thus, the total number of respondents for the study was 120 farmers. The data was collected by personal interview method with pre-tested interview schedule and data was analysed by using appropriate tools.

Results and Discussion

Constraints faced by various horticultural crop growers practicing precision farming technologies

It is reflected in table 1 that major production constraints expressed by tomato growers practicing precision farming were, scarcity of labour during critical stages (Rank I) and occurrence of pest and diseases (Rank II). Whereas, the major technical constraints expressed by them were lack of technical know-how regarding precision farming technologies (Rank I) and lack of local expertise (Rank II). Lack of adequate and timely disbursement of loan (Rank I) and high cost of inputs (Rank II) were the major financial constraints. With respect to marketing constraints, a price fluctuation (Rank I) and exploitation by middlemen (Rank II).The findings are in line with Jeya R and Sivaperumal R (2019) [2].

Table 1: Constraints faced by tomato growers practicing precision farming technologies

(n=40)

Sl. No	Constraints	F	%	Rank
Production constraints				
1	Non availability of inputs at right time	30	75.00	VI
2	Climate change and environmental factors	35	87.50	III
3	Occurrence of pest and diseases	38	95.00	II
4	Scarcity of labour during critical stages	39	97.50	I
5	High wage rate	33	82.50	IV
6	Lack of skilled labour	32	80.00	V
Technical constraints				
1	Lack of local expertise	34	85.00	II
2	Lack of technical know-how regarding precision farming technologies	37	92.50	I
3	Lack of relevant literature in local language	31	77.50	III
Financial constraints				
1	High cost of inputs	31	77.50	II
2	Cumbersome procedures to avail loans	29	72.50	III
3	High operational cost	27	67.50	V
4	Lack of crop insurance coverage	28	70.00	IV
5	Lack of adequate and timely disbursement of loan	34	85.00	I
Marketing constraints				
1	Price fluctuations	39	97.50	I
2	Lack of marketing information	31	77.50	III
3	Exploitation by middle men	38	95.00	II
4	High transportation cost	22	55.00	V
5	Lack of marketing facilities at local place	26	65.00	IV

F- Frequency, %- Percentage

Table 2 reflects the constraints encountered by capsicum growers, the major constraints were, scarcity of labour during critical stages (Rank I) and climate change and environmental factors (Rank II) with respect to production constraints. Lack of technical know-how regarding precision farming technologies (Rank I) and lack of local expertise (Rank I) were major technical constraints. In case of financial constraints, high operational cost (Rank I) and high cost of inputs (Rank II) were the major constraints. With respect to marketing constraints, exploitation by middlemen (Rank I) and price fluctuation (Rank II) were the major constraints.

Table 2: Constraints faced by capsicum growers practicing precision farming technologies

(n=40)

Sl. No	Constraints	F	%	Rank
Production constraints				
1	Non availability of inputs at right time	33	82.50	IV
2	Climate change and environmental factors	37	92.50	II
3	Occurrence of pest ad diseases	35	87.50	III
4	Scarcity of labour during critical stages	38	95.00	I
5	High wage rate	37	92.50	II
6	Lack of skilled labour	31	77.50	V
Technical constraints				
1	Lack of local expertise	37	92.50	I
2	Lack of technical know-how regarding precision farming technologies	37	92.50	I
3	Lack of relevant literature in local language	35	87.50	II
Financial constraints				
1	High cost of inputs	34	85.00	II
2	Cumbersome procedures to avail loans	33	82.50	III
3	High operational cost	36	90.00	I
4	Lack of crop insurance coverage	29	72.50	IV
5	Lack of adequate and timely disbursement of loan	34	85.00	II
Marketing constraints				
1	Price fluctuations	36	90.00	II
2	Lack of marketing information	34	85.00	IV
3	Exploitation by middle men	37	92.50	I
4	High transportation cost	32	80.00	V
5	Lack of marketing facilities at local place	35	87.50	III

F- Frequency, %- Percentage

The major production constraint expressed by rose growers practicing precision farming was non-availability of inputs at right time (Rank I) and occurrence of pest and diseases (Rank II) is reflected in table 3. Whereas, the major technical constraints, faced by them were lack of local expertise (Rank I) and lack of technical know-how regarding precision farming technologies. In case of financial constraints, high cost of inputs (Rank I) and cumbersome procedures to avail loans (Rank II). Lack of marketing information (Rank I) and price fluctuation (Rank II) were the major marketing constraints expressed by the growers. The results are in line with Singh *et al*, (2022) [10].

Table 3: Constraints faced by rose growers practicing precision farming technologies

(n=40)

Sl. No	Constraints	F	%	Rank
Production constraints				
1	Non availability of inputs at right time	38	95.00	I
2	Climate change and environmental factors	36	90.00	III
3	Occurrence of pest ad diseases	37	92.50	II
4	Scarcity of labour during critical stages	32	80.00	V
5	High wage rate	33	82.50	IV
6	Lack of skilled labour	31	77.50	VI
Technical constraints				
1	Lack of local expertise	39	97.50	I
2	Lack of technical know-how regarding precision farming technologies	38	95.00	II
3	Lack of relevant literature in local language	38	95.00	II
Financial constraints				
1	High cost of inputs	39	97.50	I
2	Cumbersome procedures to avail loans	34	85.00	II
3	High operational cost	29	72.50	V
4	Lack of crop insurance coverage	30	75.00	IV
5	Lack of adequate and timely disbursement of loan	32	80.00	III
Marketing constraints				
1	Price fluctuations	35	87.50	II
2	Lack of marketing information	36	90.00	I
3	Exploitation by middle men	28	70.00	IV
4	High transportation cost	28	70.00	IV
5	Lack of marketing facilities at local place	29	72.50	III

F- Frequency, %- Percentage

Table 4 represents the constraints faced the horticultural crops growers practicing precision farming. The major production constraints were occurrence of pest and diseases (Rank I) followed by scarcity of labour during critical stages (Rank II), climate change and environmental factors (Rank III), high wage rate (Rank IV), non-availability of inputs at right time (Rank V) and lack of skilled labour (Rank VI). The probable reason might be that incidence of pest and

disease is the serious problem in horticulture crops which affect the quality of the produce. The other reasons may be intercultural operations are must in case of horticulture crops which demand skilled labour at various stages of cultivation and as the study area is the potential area/ belt for the horticulture crop production there is huge demand for labour at critical stages of crop production like staking, pruning, pinching, disbudding, weeding, harvesting and grading etc. The findings are in line with Hanjabam S (2014) [1] and Prabhakar *et al.* (2017) [7].

Table 4: Constraints faced by various horticultural crop growers practicing precision farming technologies

(n=120)

Sl. No	Constraints	F	%	Rank
Production constraints				
1	Non availability of inputs at right time	101	84.17	V
2	Climate change and environmental factors	108	90.00	III
3	Occurrence of pest and diseases	110	91.67	I
4	Scarcity of labour during critical stages	109	90.83	II
5	High wage rate	103	85.83	IV
6	Lack of skilled labour	94	78.33	VI
Technical constraints				
1	Lack of local expertise	110	91.67	II
2	Lack of technical know-how regarding precision farming technologies	112	93.33	I
3	Lack of relevant literature in local language	104	86.67	III
Financial constraints				
1	High cost of inputs	104	86.67	I
2	Cumbersome procedures to avail loans	96	80.00	III
3	High operational cost	92	76.67	IV
4	Lack of crop insurance coverage	87	72.50	V
5	Lack of adequate and timely disbursement of loan	100	83.33	II
Marketing constraints				
1	Price fluctuations	110	91.67	I
2	Lack of marketing information	101	84.17	III
3	Exploitation by middle men	103	85.83	II
4	High transportation cost	82	68.33	IV
5	Lack of marketing facilities at local place	110	91.67	I

F- Frequency, %- Percentage

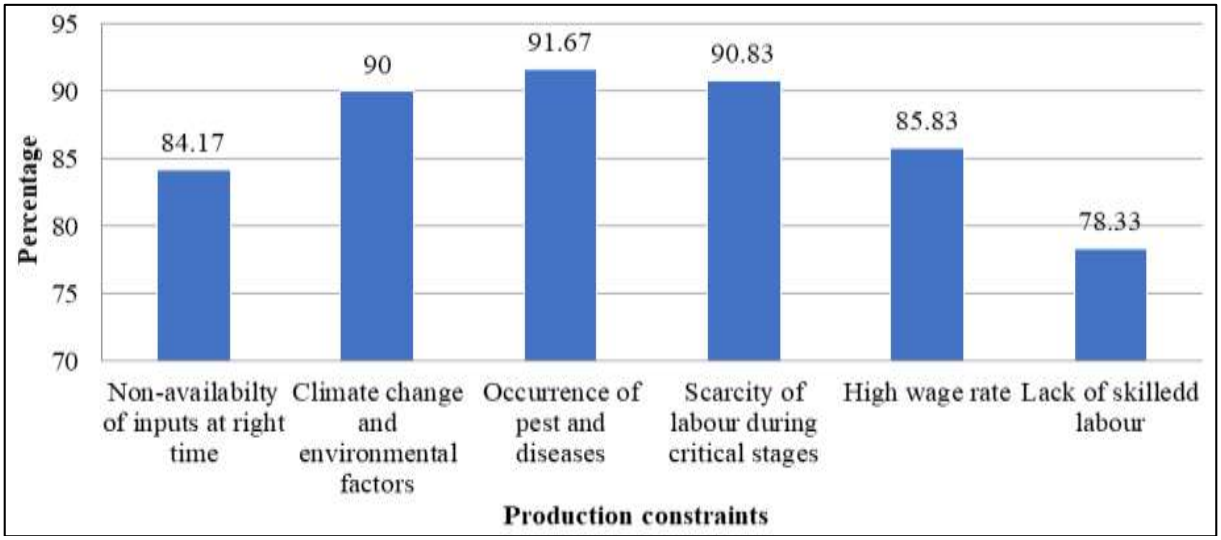

Fig 1: Production constraints faced by various horticultural crop growers practicing precision farming technologies

Major technical constraints in table 4 indicates that growers were lack of technical know-how regarding precision farming technologies (Rank I), lack of local expertise (Rank II) and lack of relevant literature in local language (Rank III). Precision farming is a technology intensive approach. It is very important to have adequate technical competency to adopt these technologies by the growers. Hence, adequate and appropriate knowledge, training and demonstration regarding various components/ technologies of precision farming are very important for adoption of these technologies at farmer's level. It is also crucial that there must be technical sound experts at local level to assist the farmers at various levels and literature regarding precision farming technologies in local language must be easily available to farmers to refer and understand the various aspects and to adopt these technologies in their field.The findings are in line with Kudari *et al.* (2016) [3].

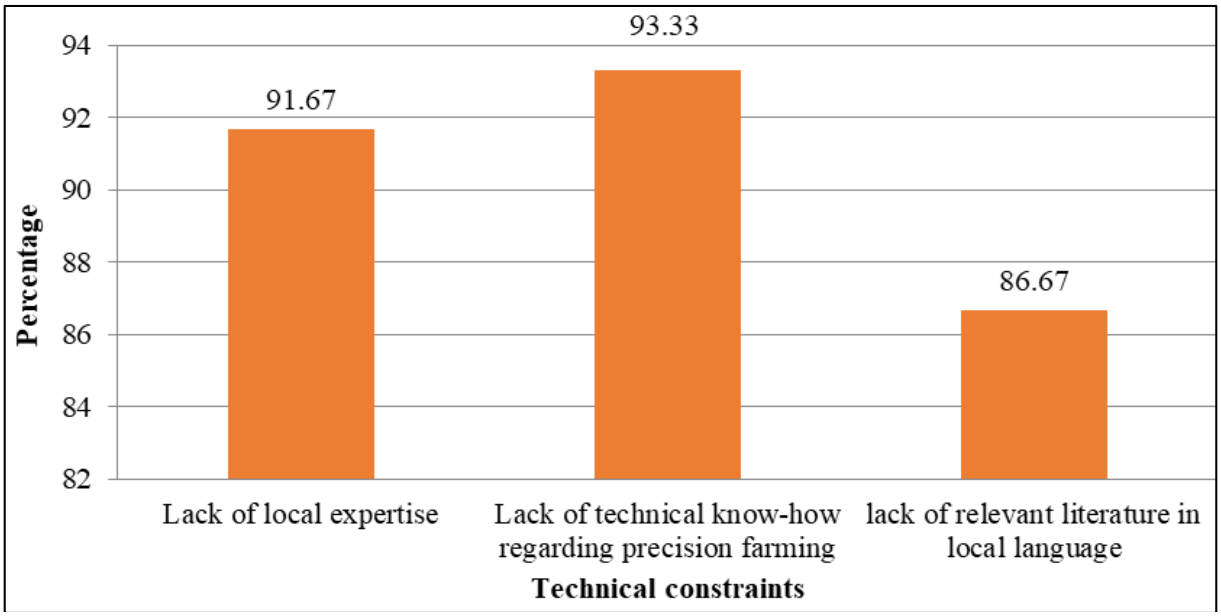

Fig 2: Technical constraints faced by various horticultural crop growers practicing precision farming technologies

Among the financial constraints, high cost of inputs (Rank I) was the major constraint expressed by the growers in practicing precision farming followed by lack of adequate and timely disbursement of loan (Rank II), cumbersome procedures to avail loans (Rank III), lack of operational cost (Rank IV) and lack of crop insurance coverage (Rank V). Precision farming technologies are capital intensive at all the stages of production. It demands huge initial investment which causes economic burden to the growers. The inputs like plant protection chemicals, drip materials, mulching materials are costly. The growers also stated that it is very tedious to obtain loans from banks and it is more time-consuming resulting in non-availability of loan amount at critical stages. The findings are in line with Singh *et al.* (2022) [9].

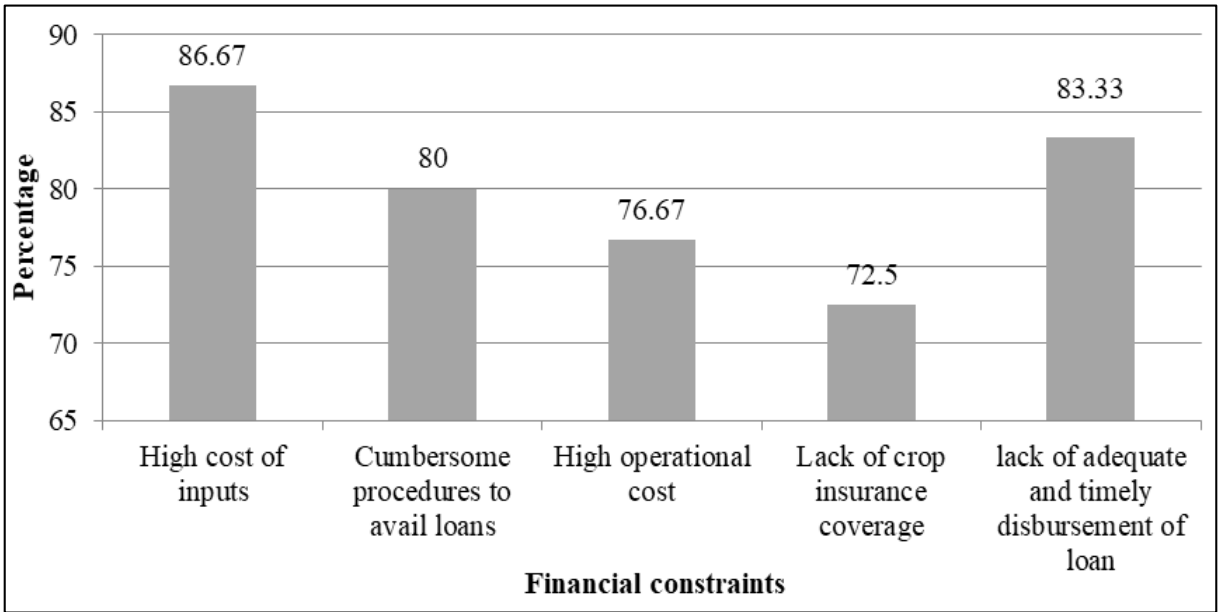

Fig 3: Financial constraints faced by various horticultural crop growers practicing precision farming technologies

With respect to marketing constraints, price fluctuations (Rank I) was the major constraint expressed by the growers followed by exploitation by middle men (Rank II), lack of marketing information (Rank III), high transportation cost (Rank IV) and lack of marketing facilities at local place (Rank V). The price fluctuation is the major problem in marketing of the produce as growers reported that their produce fetches lower price during the bumper harvest resulting in great economic loss. Further, middle men are ruling the market where the farmers are price takers rather than price fixers. In addition to this, lack of marketing facilities at local place results in higher cost of production and reduced income. The findings are in line with Pandit and Basak (2013) [5].

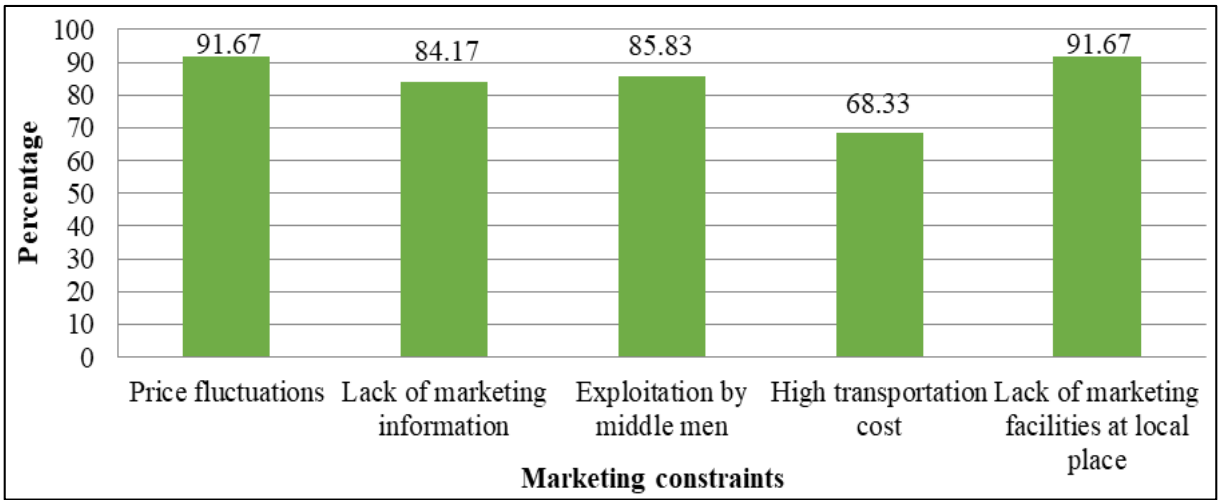

Fig 4: Marketing constraints faced by various horticultural crop growers practicing precision farming technologies

Suggestions given by horticulture growers practicing precision farming technologies

Table 5 reveals that major suggestion given by the tomato growers was development of user friendly technologies (Rank I) followed by availability of inputs at right time at subsidized rates (Rank II), creation of grading, cold storage and processing facilities at farm gate level (Rank III), availability of improved seedlings at right time (Rank IV), intervention of government in price policy mechanism (Rank V), conducting demonstrations on various precision farming technologies (Rank VI) and standardization of literature in local language (Rank VII). The results are in line with Pachpute and Shelke (2022) [4].

Table 5: Suggestions given by tomato growers practicing precision farming technologies

(n=40)

Sl. No.	Statement	F	%	Rank
1	Availability of improved seedlings at right time	36	90.00	IV
2	Availability of inputs at right time at subsidized rates	38	95.00	II
3	Development of user-friendly technologies	39	97.50	I
4	Intervention of government in price policy mechanism	35	87.50	V
5	Creation of grading, cold storage and processing facilities at farm gate level	37	92.50	III
6	Conducting demonstrations on various precision farming technologies	34	85.00	VI
7	Standardization of literature in local language	32	80.00	VII

F- Frequency, %- Percentage

Suggestions given by the capsicum growers are seen in table 6, development of user friendly technologies ranked first followed by availability of inputs at right time at subsidized rates (Rank II), intervention of government in price policy mechanism and conducting demonstrations on various precision farming technologies (Rank III), availability of improved seedlings at right time (Rank IV), creation of grading, cold storage and processing facilities at farm gate level (Rank V) and standardization of literature in local language (Rank VI). The major suggestions given by rose growers were availability of inputs at right time at subsidized rates (95.00%) followed by availability of improved seedlings at right time (92.50%), creation of grading, cold storage and processing facilities at farm gate level (90.00%), conducting demonstrations on various precision farming technologies (87.50%), standardization of literature in local language (85.00%), intervention of government in price policy mechanism (82.50%) and development of user friendly technologies (80.00%).The findings are in line with Rajesh (2020) [8].

Table 6: Suggestions given by capsicum growers practicing precision farming technologies

(n=40)

Sl. No.	Statement	F	%	Rank
1	Availability of improved seedlings at right time	35	87.50	IV
2	Availability of inputs at right time at subsidized rates	37	92.50	II
3	Development of user-friendly technologies	39	97.50	I
4	Intervention of government in price policy mechanism	36	90.00	III
5	Creation of grading, cold storage, and processing facilities at farm gate level	34	85.00	V
6	Conducting demonstrations on various precision farming technologies	36	90.00	III
7	Standardization of literature in local language	33	82.50	VI

F- Frequency, %- Percentage

The major suggestions given by rose growers are presented in table 7. Availability of inputs at right time at subsidized rates (95.00%) followed by availability of improved seedlings at right time (92.50%), creation of grading, cold storage and processing facilities at farm gate level (90.00%), conducting demonstrations on various precision farming

technologies (87.50%), standardization of literature in local language (85.00%), intervention of government in price policy mechanism (82.50%) and development of user friendly technologies (80.00%).

Table 7: Suggestions given by rose growers practicing precision farming technologies

(n=40)

Sl. No.	Statement	F	%	Rank
1	Availability of improved seedlings at right time	37	92.50	II
2	Availability of inputs at right time at subsidized rates	38	95.00	I
3	Development of user-friendly technologies	32	80.00	VII
4	Intervention of government in price policy mechanism	33	82.50	VI
5	Creation of grading, cold storage, and processing facilities at farm gate level	36	90.00	III
6	Conducting demonstrations on various precision farming technologies	35	87.50	IV
7	Standardization of literature in local language	34	85.00	V

F- Frequency, %- Percentage

The major suggestions given by the horticulture crop growers were replicated in table 8, availability of inputs at right time at subsidized rates ranked first followed by development of user friendly technologies (Rank II), availability of improved seedlings at right time (Rank III), creation of grading, cold storage and processing facilities at farm gate level (Rank IV), conducting demonstrations on various precision farming technologies (Rank V), intervention of government in price policy mechanism (Rank VI) and standardization of literature in local language (Rank VII). Similar trend was reported by Parmar *et al.* (2017) [6]. As the horticulture crops are resource intensive availability of inputs at right time is very crucial. The growers expressed that majority of them needed inputs which should be made available at their locality so that they would get the inputs at right time. They also opined that these inputs should be subsidized at fair rate as the precision farming is costlier affair. In addition to it, precision farming technologies are complex to understand and use so that they expressed that these technologies should be simplified and made user friendly. The horticulture crops are highly perishable in nature therefore; sophisticated / well equipped storage structures should be created at farm gate level to store the products particularly at market glut stages. The growers are unaware of the major components of precision farming so it is necessary to educate the farmers through training and demonstrations on handling and potentiality of the various precision farming technologies so that growers would be aware of the various precision farming technologies available and their potential usage.

Table 8: Suggestions given by horticultural crop growers practicing precision farming technologies

(n=120)

Sl. No.	Statement	F	%	Rank
1	Availability of improved seedlings at right time	108	90.00	III
2	Availability of inputs at right time at subsidized rates	113	94.17	I
3	Development of user-friendly technologies	110	91.67	II
4	Intervention of government in price policy mechanism	104	86.67	VI
5	Creation of grading, cold storage, and processing facilities at farm gate level	107	89.17	IV
6	Conducting demonstrations on various precision farming technologies	105	87.50	V
7	Availability of improved seedlings at right time	99	82.50	VII

F- Frequency, %- Percentage

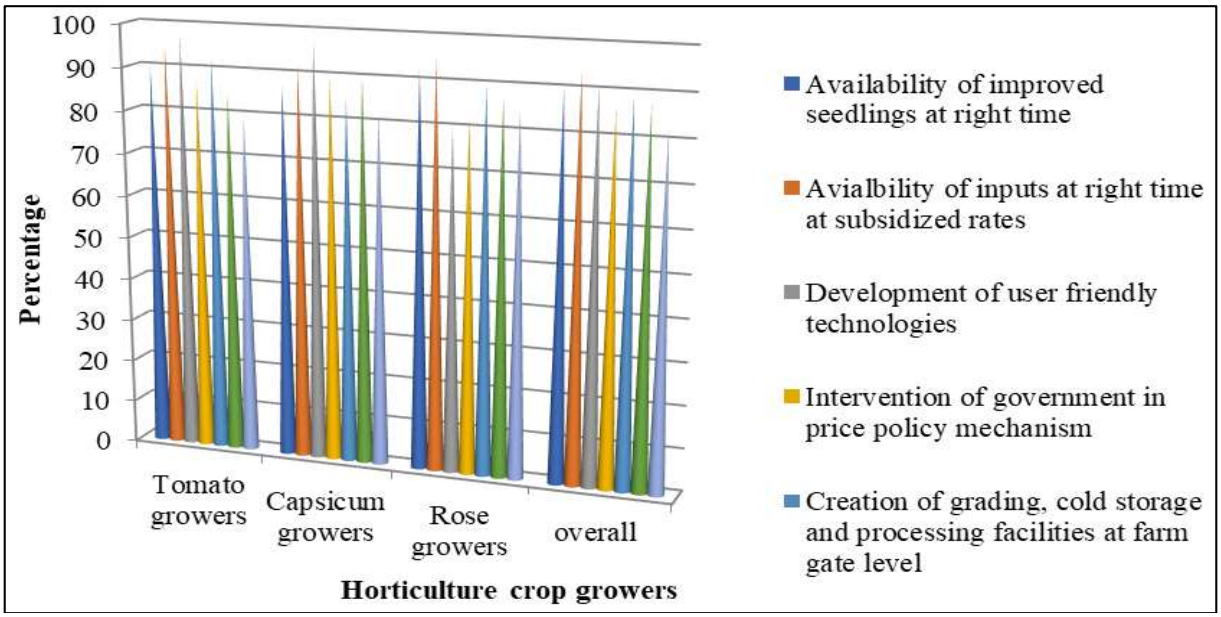

Fig 4: Suggestions given by horticultural crop growers practicing precision farming technologies

Conclusion

Precision farming holds immense potential for transforming Indian agriculture, there are challenges that need to be addressed. These include the high initial investment costs, limited access to technology and data in rural areas, and the need for comprehensive training and support for farmers to adopt these practices effectively. Looking ahead, the future of precision farming in India is promising. Continued advancements in technology, increased government support, and collaborations between research institutions, private sector companies, and farmers' organizations can drive the widespread adoption of precision farming practices. India has the potential to revolutionize the agricultural sector by optimizing productivity, conserving resources, and promoting sustainability. By leveraging advanced technologies and data driven insights, Indian farmers can make informed decisions, increased yields, and economic viability. However, addressing challenges related to access, affordability and training is crucial for the widespread adoption of precision farming practices. With continued efforts, precision farming can play a pivotal role in ensuring food security, environmental sustainability, and the overall growth of Indian agricultural sector.

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