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Sustainability indicators of onion cultivation in northern dry zone of Karnataka

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Abstract

Onion (*Allium cepa*) is one of the important commercial vegetable crops grown in India. It is also one of the important condiments widely used in all households. In recent years, the growing demand for onions as per increasing population, export demands poses the challenge for further increasing the production and productivity of onion. The issue of climate change has thrown up greater uncertainties and risks associated with price fluctuation, further imposing constraints on production systems. To increase productivity and to reduce adverse effect of associated factors, sustainable onion cultivation is very necessary. Hence, the present study was taken up to know the sustainability of onion cultivation in northern dryzone of Karnataka. Sustainable index (SI) for onion cultivation was developed and identified 13 indicators under environmental, economic and social dimensions. Selection of suitable varieties indicator had shown highest overall sustainable index with I rank followed by methods of sowing and planting indicator with II rank. Findings make the researcher to study other indicators also to make onion cultivation more sustainable in future.

Keywords: Sustainability, sustainable index, indicators, dimensions

Introduction

Onion (*Allium cepa*) is a significant commercial vegetable crop grown by farmers of all categories and used as a condiment in majority of Indian households. The green leaves, immature and mature bulbs are eaten raw or used in the preparation of vegetables. It can be eaten raw as a salad or seasoned in several ways, including frying, boiling, and roasting. It is also utilized in processed forms, such as pickles, powder, paste, slices, flakes etc. It has excellent therapeutic value. Maharashtra, Madhya Pradesh, Karnataka, Rajasthan, Uttar Pradesh, Gujarat, Tamil Nadu, Andhra Pradesh, Telangana, Haryana, and Bihar are the onion-growing states in India. With a production of 13.66 million Tonnes, Maharashtra is the top producer and would account for 43.13% of all Indian production in 2021-22. With a productivity of 11.99 MT per hectare, Karnataka ranks third in production (2.77 million tonnes) and second in area (0.23 million hectares). (Anon., 2022) ^[1].

Maharashtra, Madhya Pradesh, Karnataka are at the top three positions among the onion growing states in India. Even though Karnataka occupies 2nd place in area, its place is 3rd in productivity. In the year 2021-22, productivity was 14.46 MT/ha for Maharashtra, 24.10 MT/ha for Madhya Pradesh and 11.99 MT/ha for Karnataka which is very low compared to other two states and India (16.33 MT/ha) (Anon., 2022) ^[1]. To fulfil the growing demand with growing population maintaining productivity is very important. To maintain productivity sustainable onion cultivation is very necessary. To attain sustainably it is very important to take proper and timely care with suitable variety, tillage practices, nutrient management, fertilization, water management, plant protection measures, harvesting and post harvest management today. Increasing demand for onion, fluctuation in onion market price and the most important aspect of climate change have made sustainable onion cultivation as challengeable one. Sustainability of onion cultivation is the idea of creating the most positive results, while reducing negative impacts. It encompasses three principles: to maintain and improve lasting environmental social, and economical practices.

Here, in this study an effort has been made to know the contribution of various indicators of sustainability index in onion cultivation under northern dry zone of Karnataka.

Materials and Methods

The present study was conducted during the year 2022-23. In social science when we conduct research after the event has happened, need to choose Ex-post facto research design. Hence, this research design was used for the study purpose. Three districts among northern Karnataka namely Vijayapura, Bagalkote and Gadag which fall under northern dry zone were selected based on the highest area under onion cultivation. Two taluks from each district were selected based on the same criteria. Three villages from each taluk and 15 farmers from each village were selected randomly. Totally the sample size comprised of 270 onion growers.

In the present study sustainability of onion cultivation is operationalised as the process by which farmer manages on-farm resources to enhance productivity and maintains it to meet the present and future needs of farm and family without affecting the production environment. Sustainable index (SI) for onion cultivation was developed following a proper procedure. It included Item pooling, Item scrutiny, Judges rating on indicators. All those indicators with the relevancy co-efficient of 0.75 and above were selected for the development of sustainability index under production, economic and social dimension after the judges rating. They were namely Selection of suitable varieties, Methods of sowing/planting, Integrated nutrient management, Water management, Integrated pest management under production dimension. While Land productivity, Input productivity, Post Harvest management, Marketing were selected under economic dimension. Under social dimension Information self-sufficiency, Input self-sufficiency and Resources possessed were selected. Appropriate statements, based on review of literature and discussion with experts, were prepared and given appropriate scores. Sustainability index was calculated for each of these indicators. After that overall sustainability index was calculated. Sustainability index was also tested for its Reliability and Validity. Structured, pre tested interview schedule was used to collect the data.

Results and Discussion

The results in the Table 1 gave a picture of the contribution of various indicators of sustainability index in onion cultivation under production, economic and social dimensions in northern dry zone of Karnataka. It was observed that, sustainability index for selection of suitable varieties was highest (85.95) for Bagalkote district followed by Gadag district (84.61) and Vijayapura district (81.87). Captivatingly, overall sustainable index for this indicator was highest (84.14) among all the 13 indicators and had scored I rank.

The possible reasons could be that farmers give the most preference for selection of suitable varieties as suitable varieties give back quality produce and fetches better prices in the market. Selection of suitable variety depends upon the source also. So, farmers might have purchased the seeds from reliable sources also.

In case of method of sowing/planting indicator Vijayapura district recorded highest sustainable index (85.00) followed by Gadag district (80.56) and then by Bagalkote district (75.19). Here also overall sustainable index was as high as 80.25 with II rank among all the indicators studied.

This was attributed to the fact importance is given to sowing or planting method next to selection of suitable varieties. There are three types of sowing/planting methods namely transplanting, drill sowing and broadcasting. Best method is transplanting followed by drill sowing and broadcasting. But transplanting method is possible only when irrigation facilities are available. In the study area very, few had protective irrigation facilities. Majority of the onion growers were following drill sowing method as nowadays sowing with tractor and seed drill is very accessible, less time consuming for the farmers. However, few farmers were following broadcasting methods which is an age-old practice.

Similar results were found in the study conducted by Aruna *et al* (2023) [3] and Sarker *et al* (2017) [9].

For input productivity indicator, sustainability index was as high as 66.67 for Vijayapura district, closely followed by Bagalkote district (65.56) and Gadag district (64.81).

This indicator had scored III rank with 65.68 overall sustainable index. This might be due to the efforts of farmers to reduce the cost of cultivation, as the family members involve in various activities of onion cultivation as majority of the onion growers found in medium size family group (5 to 8 members). Onion growers also expressed that relatives, neighbouring farmers work in cooperation to each other as onion cultivation is labour intensive and more expensive also which also might have helped in reducing the production cost. Further, they might be managing onion cultivation with the available resources as majority of the onion cultivation is under rainfed condition, they may not be investing much in onion cultivation except in unavoidable situations such as during diseases and pest occurrences. From this scenario, cost of production might have reduced and net profit could have been increased naturally.

It was also known from the table that input self-sufficiency indicator recorded sustainable index as high as 64.07 for Vijayapura district followed by Gadag and Bagalkote districts with sustainable indices 62.59 and 61.10, respectively. The overall sustainable index had scored 62.59 with IV rank. It may be attributed to the facts that around 70 percent of the onion growers had medium to big family size, nearly 70 percent had less than 10 acres of land holdings with few cattle for farmyard manure. This could also because of the practice of multiple cropping/double cropping or mixed farming when farm wastes are naturally recycled. Hence, dependence on purchase of manures and fertilizers was reduced to considerable extent. The family members, neighbours and relatives might have joined for timely agricultural operations on mutual help basis during sowing, intercultivation, hand weeding and harvesting etc.

Further, sustainable index was higher for Gadag district (66.11) closely followed by Bagalkote (65.56) and then by Vijayapura district (49.96) for the indicator information self-sufficiency. The overall sustainable index recorded as 60.54 with V rank. The possible reasons could be that majority of onion growers of the study area belonged to medium age group, more than 50 percent of the onion growers were educated above high school level which included PUC and graduate and above category. They had medium (45.18%) to high (32.96%) level of extension contact and the medium (43.33%) to high level (36.30%) of extension participation. All these factors might have made them to become more self-sufficient and depend on others only for some information on marketing, transportation etc. Majority belonged to medium innovative proneness category, who might be enthusiastic to learn and update their knowledge level about sustainable onion cultivation.

Table 1: Contribution of various indicators of sustainability index in onion cultivation

Sl. No.	Indicators	Sustainability index of onion cultivation				
		Vijayapura	Bagalkote	Gadag	Overall Index	
		(n ₁ = 90)	(n ₂ = 90)	(n ₃ = 90)	(n = 270)	Rank
		Index				
I	Production Dimension					
1	Selection of suitable varieties	81.87 (II)	85.95 (I)	84.61 (I)	84.14	I
2	Methods of sowing/planting	85.00 (I)	75.19 (II)	80.56 (II)	80.25	II
3	Integrated nutrient management	25.13 (V)	38.2 (IV)	24.72 (V)	29.35	XI
4	Water management	37.36 (IV)	36.46 (V)	25.00 (IV)	32.94	X
5	Integrated pest management	61.02 (III)	45.62 (III)	43.02 (III)	49.89	VII
II	Economic Dimension					
6	Land productivity	47.31 (III)	45.15 (IV)	36.3 (IV)	42.92	IX
7	Input productivity	66.67 (I)	65.56 (I)	64.81 (I)	65.68	III
8	Post-harvest management	55.20 (II)	54.8 (II)	54.76 (II)	54.92	VI
9	Marketing	47.06 (IV)	48.83 (III)	38.63 (III)	44.84	VIII
III	Social Dimension					
10	Information self-sufficiency	49.96 (II)	65.56 (I)	66.11 (I)	60.54	V
11	Input self-sufficiency	64.07 (I)	61.10 (II)	62.59 (II)	62.59	IV
12	System/Institutional support	37.1 (III)	26.67 (III)	21.33 (III)	28.37	XII
13	Resources possessed	12.1 (IV)	12.43 (IV)	10.82 (IV)	11.79	XIII

Roman numbers in parentheses indicate ranks

In case of post-harvest management indicator, Vijayapura district scored a little bit more than fifty sustainable index (55.20) closely followed by Bagalkote district (54.80) and Gadag district (54.76). The overall sustainable index was 54.92. It was observed from the study area that majority of onion growers aware of post harvest management activities such as curing, cleaning, grading and sorting as onion cultivation is an age-old practice. At the same time it was found that none of the onion growers had turn their mind towards value addition activity. High cost incurred in value addition, non-availability of processing units at village level, less exposure to marketing of their value-added products, might have contributed to disinterest towards processing activities. Moreover, organized efforts are needed for value addition so that the cost involved can be shared and sustained.

It was also disclosed that integrated pest management indicator scored better (61.02) sustainable index in Vijayapura district when compared with Bagalkote district (45.62) and Gadag district (43.02). Here, overall sustainable index was 49.89 with VII rank almost 50.00 percent. This might be due to that even though farmers wanted to save their onion crops by insects, diseases, weeds such as thrips, aphids, twister, bulb rotting, purple blotch etc. which were prevailing in study area, the high cost of chemicals, non-availability of labours for these agricultural operations, erratic rain fall might have hindered them in controlling pests. Other onion growers, who knew that if they save the crops from these insects, pests, weeds and diseases get quality produce and better prices for their produce and who could afford the expenditure on IPM might have followed IPM methods.

With respect to marketing indicator is concerned, sustainable index of 48.83 for Bagalkote district was closely followed by Vijayapura district (47.06) and then by Gadag district (38.63). The overall sustainability index was as fair as 44.84 with VIII rank. The possible reasons for low sustainable index might be that farmers sold their produce to local traders and commission agents because of high cost of transportation and loading and unloading charges. Markets, APMCs operate under certain rules and regulations. And they also wanted money immediately after harvesting to bear family and farm expenditure.

In case of land productivity indicator, the sustainable index score was 47.31 for Vijayapura district followed by Bagalkote district (45.15) and then by Gadag (36.30) district. The overall sustainable index was 42.92 with IX rank. This could be attributed to soil fertility and soil productivity. Soil fertility is what soil is and soil productivity is what soil does. The possible reasons for poor land productivity could be as land productivity was calculated for the last three kharif seasons yield. Further, study area received erratic rainfalls during 2020 and 2021 and crops were suffered by incidence of diseases like twister and bulb rotting, heavy manifestation of weeds as expressed by the respondents.

Water management indicator had sustainability index of 37.36 for Vijayapura district followed by Bagalkote district (36.46) and poorly followed by Gadag district (25.00). Here, overall sustainable index was fair (32.94) with X rank. Majority of the farmers depend on rainfall as the study area is northern dry zone. Very few farmers were using protective irrigation. Lack of knowledge about rain water harvest, initial investment for making irrigation facilities might be the other possible reasons.

It was also depicted that integrated nutrient management scored very low in all three districts. However, relatively better value with 38.20 in Bagalkote district followed by Vijayapura district (25.13) and then by Gadag district (24.72). Here the overall sustainable index was less (29.35) with XI rank.

Integrated nutrient management indicator performed poorly with the overall sustainability index of 29.35. This might be due to lack of awareness about the importance of soil testing and use of major, minor and micro nutrients, bio fertilizers and other soil amendments based on soil testing to improve soil fertility and productivity. Further they may not be following recommended amendments after soil testing.

With respect to system/institutional support, again all the three districts scored very low sustainable indices. Vijayapura district scored relatively better (37.10) sustainable index followed by Bagalkote district (26.67) and Gadag district (21.33) as the lowest. The overall sustainable index was very low (28.37) with XII rank. This poor performance with this indicator might be attributed to non-supply or untimely supply and insufficient supply of agril. inputs like, seeds, manures, chemicals, fertilizer, weedicides, farm equipment, subsidies etc. Even though banks provide subsidies, it is little time-consuming and more formalities as expressed by the onion growers. Hence, the institutional support indicator was poor.

Resources possessed indicator had scored lowest sustainability index of all indicators with overall sustainability index as least as 11.79. This could be attributed to the fragmentation of lands as per Government Succession Act. Due to division of lands and families into successors the possession of farm resources (land, cattles, tractors/carts/borewell machine/pump sets etc.) might had reduced. Rearing of dairy animals is very poor in all the villages of study area as non availability of fodder as majority grow cash crops, non availability of labours to maintain these animals, young people do not involve in such activities etc.

Studies on sustainability on crops especially on onion were very few. However, effort has been made to found studies to support the results such as Naik (2012)^[7], Jagadish *et al* (2025)^[5], Bhise (2014)^[4], Kale *et al* (2025)^[6], Subhashree (2022)^[10], Sambo and Godfrey (2022)^[8].

Conclusion

The onion is the sole bulb crop that is widely grown in India. Productivity was 14.46 MT/ha for Maharashtra, 24.10 MT/ha for Madhya Pradesh and 11.99 MT/ha for Karnataka which is very low compared to other two states Maharashtra, Madhya Pradesh and India (16.33 MT/ha). To fulfill the growing demand with growing population maintaining productivity is very important. To maintain productivity sustainable onion cultivation is very necessary. Sustainable index (SI) for onion cultivation was developed and identified 13 indicators under environmental, economic and social dimensions. Selection of suitable varieties indicator had shown highest overall sustainable index with I rank followed by methods of sowing and planting indicator with II rank. These results can be used by government to make policy and suggest concern authorities to provide suitable varieties on time at reasonable prices and proper training on sowing or planting methods. This study also emphasizes on the need to study sustainability of onion cultivation in transition zone of Karnataka where major area is located.

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