Gap Analysis in Adoption of Scientific Mentha (*Mentha aravensis*) Cultivation in Uttar Pradesh

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ABSTRACT

The study conducted in two mentha growing districts of Uttar Pradesh, the highest mentha producing in India, to assess the extent of adoption of recommended mentha production technology by the farmers and to study the gap in adoption with respect to various socio-personal and technological factors. The findings of the research revealed that among mentha production technology, the extent of adoption was found to be maximum (> 50 %) in case of transplanting and harvesting, on the other hand nursery management and pest management practices showed minimum extent of adoption (<30%). Most of the respondents (65%) had medium level of adoption of recommended practices of mentha cultivation. The study also indicated that the socio-economic factors like education, land holding, annual income, experience in mentha cultivation, contact with extension agent, mass media exposure and labour availability were positively and significantly associated with the extent of adoption of mentha cultivation technology at 1% level of significance whereas age and cropping pattern had a non-significant relationship with the level of adoption. The significant Kruskal-Wallis value (at 1% LS) of socio-economic profiles of the respondents indicated that there was absolute difference among the three categories of adoption level with respect to various socio-economic characteristics, while there was no significant difference among different level of adoption with respect to age, cropping pattern and irrigation sources. Thus the study highlighted the gap in adoption of mentha production technologies with empirical analysis of the observations which may help to enhance mentha production through supply and value-chain analysis.

Keywords: *Mentha production technology; Extent of adoption; Socio-economic profiles; Cropping pattern;*

In the era of globalization and trade liberalization, Indian agriculture has undergone a paradigm shift from production oriented to market driven agriculture thus creating an opportunity of agripreneurship among the stakeholders in our agricultural production system. Amongst the aromatic and medicinal crops in India, mentha (*Mentha aravensis*) popularly known as menthol mint or pudina, considered as country's bread-basket, plays an important role in the export led Indian agriculture that shows both vertical and horizontal expansion over the years fetching soaring market price among the plethora of agricultural produce of the country. In global front, India is the leading producer of mentha oil, producing more than 38000 MT (80 %) followed by China (9%), Brazil (7%) and USA (4%) with the productivity of around 1.1 t/ha^{-1} (2006). India ranks first among the mentha oil exporting countries by exporting about 6000 MT of mentha oil per annum to various countries like China (32%), USA (20%), Brazil (4%), Japan (2%), UK (2%), *etc.* with a revenue earning of more than Rs 800 million per year solely from mentha exports. Out of eight cultivated species of mentha available in India, three major species are preferred for exporting to various countries. Besides being the leading producer, India is also the largest consumer of mentha oil, with an estimated annual consumption of 7500 MT compared to the rest of the world's consumption of about 20,000 MT (2006-07). As a result, the quantum of Indian mentha oil market has shown a phenomenal growth from 2 MT during 1965 to 32,000 MT during 2006, thus registering an implausible increasing trend in mentha production. Mentha is an aromatic herb widely used as raw material in food, pharmaceutical and cosmetic industries. The

mint products like menthol flakes, menthol crystals, mint oils are used as raw materials in preparation of confectioneries, perfumes, mouth fresheners, cough drops, medicated oils, toothpastes, analgesic balms, lotions, shampoos, chewing gums, candies, alcoholic beverages etc.

Spreading across a vast belt of Indo-gangetic plains and foothills of Himalayan range, India's 'mint belt' is stretched over an area of about 1500 km long and 250 km wide covering the states like Punjab, Himachal Pradesh, Haryana, Uttrarkhand, Uttar Pradesh and Bihar. Uttar Pradesh, the highest mentha producing state, accounts for more than 80 per cent of total production of the country followed by Uttarakhand, Bihar and Punjab (*Karvy Commodity Limited., 2011*). The large scale commercial cultivation of Mentha in Uttar Pradesh is confined to mainly three districts namely; Barabanki, Sitapur and Lucknow with a total area coverage of about 1, 07, 513 ha and production of 10,752 MT of mentha oil against the total area of 2, 64, 657 ha under mentha crop and total production of 26,469 MT mentha oil in the rest parts of the state. But despite the high production and acreage; the average productivity of mentha oil in Uttar Pradesh is at a very dismal state (1.4 t/ha^{-1}) as compared to national average of 1.1 t/ ha^{-1} and 3.5- 4.0 t/ha-$^{-1}$ in developed countries like US and China (*Govt. of UP, 2005*). Keeping eye upon the supply-chain analysis from plough to plate, there is neede to empower the small and marginal mentha growers of the country socially, economically and technologically; so that suitable technological interventions can be made for enhancing mentha production.Under these circumstances, the present study was conducted in Barabanki and Lucknow districts of Uttar Pradesh with specific objective to assess the extent of adoption of recommended technology of mentha cultivation by the farmers and to study the relationship of extent of adoption with various socio-personal and technological factors through empirical analysis of observations *w.r.t.* different variables.

METHODOLOGY

The locale of the study, Barabanki and Lucknow districts of Central Uttar Pradesh in Indo-Gangetic plains were selected purposively as they represent as major and minor mentha producing districts in UP, respectively, in terms of area and production. In Uttar Pradesh, Lucknow district is having 8 CD blocks and Barabanki district has 15 CD blocks. The selection of these two districts for the study may reveal the difference in the extent of adoption with respect to different independent variables under two extreme situations.

In the two selected districts, one block from each district namely Banki from Barabanki district and Bakshi Ka Talab from Lucknow district were selected purposively. Three villages were selected randomly from each selected block. In all 6 villages, 3 out of 4 from Banki block of Barabanki district such as Patmau, Rampur Joga and Sursanda and 3 out of 6 from B.K.T. block of Lucknow district namely Bibipur, Kumhrava and Roodahi were selected for the study through random sampling method. The respondents were selected from the locale of the study by using proportionate random sampling method thus making the sample size of 120 (60 from three villages per block) mentha growers. In order to measure the extent of adoption of improved mentha cultivation technology by the respondents, thirteen independent variables were hypothesized to find out the correlation between the predicted and predictor variable of the study. Initially the interview schedule was pre-tested with mentha growers in each of the three selected villages in two blocks and on the basis of feedback; it was modified and finally used for data collection**.** The data were collected through personal interview using the well structured interview schedule. The collected data were analyzed by using various statistical techniques and tools like frequency, mean, percentage, standard deviation, chi-square test, t-test, Kruskal –Wallis test, Coefficient of Correlation for interpreting the results and to draw conclusion from the findings.

The adoption quotient was determined as per the following formula:

$$AQ = \frac{Sum\ of\ obtained\ adoption\ score}{Maximum\ possible\ adoption\ score} \times 100$$

Where,
AQ=Adoption Quotient

RESULTS AND DISCUSSION

Adoption level of recommended mentha cultivation practices by the respondents: On perusal of the data in Table 1, it revealed that in respect of adoption of mentha production technology, most of the respondents (65%) belonged to medium level of adoption category followed

by high level (18.33 %) and low (16.67%) with the mean adoption score of 38.49 and Standard Deviation 14.69. The results are in confirmation with the findings of the study conducted by *Chandawat et al. (2009)* and *Gedam & Singh (2012)*.

Table 1. Categorization of respondents on the basis of their adoption level of recommended recommended scientific practices of mentha cultivation (N=120)

Category	AQ	No.	%
Low	< 23.53	20	16.67
Medium	23.53- 53.45	78	65.00
High	>53.45	22	18.33

Mean= 38.49, SD = 14.96, AQ=Adoption Quotient

Adoption of different recommended mentha production technologies: On the basis of component wise adoption of eight nos. of scientifically recommended technologies for mentha cultivation, the respondents were categorized as per Table 2, which revealed that maximum of recommended scientific package of practices like improved varieties, nursery management, nutrient management, water management, harvesting and distillation & storage were adopted by the respondents at medium level; while disease & pest management practice was adopted at low level. However, it was found that transplanting practice was highly adopted by the respondents. The low adoption of disease & pest management practice may be due to fact that the plant protection chemicals like insecticides and pesticides are costly or hardly available to the mentha farmers. High adoption of transplanting practices indicated that due to easy availability of family labour, the respondents followed this labour intensive scientifically recommended practice most effectively.

Table 2. Practice wise categorization of respondents on the basis of adoption score of recommended scientific practices of mentha cultivation (N=120)

Scientific practices	AQ	AC
Improved Varieties	24.17	Medium
Nursery Management	25	Medium
Transplanting	53.75	High
Nutrient Management	33.33	Medium
Water Management	35.83	Medium
Disease & Pest Management	6.67	Low
Harvesting	50.42	Medium
Distillation & Storage	31.25	Medium

Mean= 38.49, SD = 14.96 AC=Adoption Category

Further, it is evident from Table 3 that majority of the mentha growers (53.34 %) did not prefer to adopt any of the recommended improved varieties viz., Koshi, Kukrali, Sim Madhuras, Sim endus, Tushar, Saryu and Himalaya while a meager percentage (1.66 %) of respondents opted for fully adoption of improved mentha varieties. Similarly in case of recommended disease & pest management practices in mentha, there is hardly any respondents adopted this technology fully while a maximum percentage (10.3%) coming under the purview of non-adoption level with a least adoption quotient of 6.67. The reason may be because of the fact that either the high cost or non-availability of insecticide and pesticide deprived them of better adoption of this practice. Besides that the broader areas of recommended package of practices of mentha cultivation like distillation and storage (AQ- 31.25), nutrient management (AQ-33.33), water management (AQ-35.83) were found to be under medium level of adoption (more than 30 %). In case of nutrient management and nursery management technologies, the distribution percentages of respondents under 'fully adopted' category were observed to be at a very dismal state of 1 per cent and 3 per cent, respectively, with corresponding adoption quotient of 33.33 and 25. It was also found that out of the eight recommended mentha cultivation practices, maximum adoption score was obtained in case of transplanting (129) followed by harvesting (121) and water management technology (86) with adoption quotient of 53.75 (rank I) and 50.42 (rank II) and 35.83 (rank III), respectively. Low level of adoption (less than 30%) of respondents was found out in practices like nursery management, improved varieties, disease & pest management with least ranking of 6th, 7th and 8th, respectively, the reason may be due to lack of knowledge of the majority of farmers regarding the improved production technology and high cash value of the mentha produce which forbade them to take the risk of investing on mentha cultivation.

It is evident from Table 4 that there was a significant difference between two selected districts Barabanki and Lucknow in respect of extent of adoption of the eight recommended mentha cultivation technologies. The statistical analysis through t-test indicated that all the recommended practices except disease & pest management were found to be significantly different

Table 3. Distribution of respondents on the basis of adoption score of recommended scientific packages of mentha cultivation (N=120)

Recommended scientific practices of mentha cultivation	% Distribution			Total Score obtained	Adoption Quotient (AQ)	Adoption rank
	Fully Adopted	Partially Adopted	Non Adopted			
Improved Varieties	1.66	45	53.34	58	24.17	VII
Nursery Management	3	54	63	60	25	VI
Transplanting	25	79	16	129	53.75	I
Nutrient Management	1	79	40	80	33.33	IV
Water Management	37	13	70	86	35.83	III
Disease Pest Management	-	17	10.3	16	6.67	VIII
Harvesting	40	41	39	121	50.42	II
Distillation and Storage	10	54	56	75	31.25	V

from each other in both the districts. From the overall mean adoption score, it was also observed that in case of all the recommended mentha cultivation technologies, the extent of adoption was higher in Barabanki district (40.34) than Lucknow district (22.91) with t-value of 7.10 which is significant at 5 per cent level of probability. The reason may be due to the fact that the mentha growers in Barabanki district had significantly bigger land holding, more knowledge on scientific cultivation practices, better exposure to source of information like mass media, extension literatures etc. and more experienced than the growers of Lucknow district. The results are in confirmation with the study conducted by *Ovhar & Wakle (2013) and Chanu et. al (2014)* where land holding shows positive and significant relationship with adoption level.

Table 4. District wise difference in extent of adoption *of* mentha cultivation practices (N=120)

Scientific practices of mentha cultivation	MS of extent of adoption		t-value
	Barabanki (n=60)	Lucknow (n=60)	
Improved Varieties	.73	.23	5.78**
Nursery Management	.73	.26	5.20**
Transplanting	1.3	.82	9.64**
Nutrient Management	.77	.56	3.41**
Water Management	.98	.56	10.38**
Disease & Pest Mgt.	.14	.12	0.69
Harvesting	1.25	.75	7.56**
Distillation and Storage	.88	.36	5.96**
Overall Adoption Score	40.34	22.91	7.10*****

* = Significant at 5% level of probability,

** = Significant at 1% level of probability

Effect of socio-economic profile of mentha growers on the level of adoption : Table 5 revealed the Kruskal-Wallis analysis result of the predicted and predictor variables, which showed that the socio-economic profiles of the respondents namely education, land holding, annual income, experience in mentha cultivation, contact with extension agent, training exposure on mentha, cropping pattern, labour availability, marketing channel and access to distillation unit were found to have significant Kruskal-Wallis value at 1 per cent level of probability indicating that there was significant difference among the three categories of adoption level of respondents with respect to the aforesaid socio-economic variables. The only variable like mass media exposure was observed to have significant Kruskal-Wallis value of 8.409 at 5 per cent level of probability, while there was no significant difference in Kruskal-Wallis value with respect to different level of adoption in case of variables like age, cropping pattern and irrigation sources.

The data in Table 6 depicted the association of socio-economic profile of the respondents with the dependent variable i.e. level of adoption of mentha cultivation technologies. In both Pearson Correlation (r) and Chi-Square test, age was found to be non significant associated with extent of adoption indicating that adoption has nothing to do with the age of the farmer and the finding was well supported by *Gedam and Singh (2012)*. The Pearson correlation value (r) indicated that the socio-economic factors like education, land holding, annual income, experience in mentha cultivation, contact with extension agent, mass media exposure and labour availability were positively and

Table 5. Kruskal -Wallis test of effect of socio-economic profile of mentha farmers (N=120)

SE variables of mentha growers	Mean Rank			Kruskal-Wallis value
	Low (n=20)	Medium (n= 78)	High (n= 22)	
Age	54.58	61.09	63.80	0.551
Education	44.50	60.01	76.80	13.515**
Land holding	38.55	54.62	101.30	55.475**
Annual income	54.00	56.31	81.27	24.955**
Cropping pattern	64.65	60.37	57.77	2.314
Irrigation sources	46.50	64.49	59.07	43.020
Experience in mentha cultivation	41.88	62.71	71.52	11.296**
Contact with extension agent	39.90	59.18	83.91	28.351**
Mass media exposure	49.50	61.83	65.77	8.409*
Training exposure on mentha cultivation	48.50	57.73	81.23	21.105**
Labour availability	60.85	53.52	84.95	6.419**
Marketing channel	50.00	55.39	88.18	32.196**
Access to distillation	93.42	53.52	84.95	50.094**

** = Significant at 1% level of probability,
* = Significant at 5% level of probability

Table 6. Association of dependent variable with the selected independent variables (N=120)

SE variables of mentha growers	(r)	χ^2
Age	-0.055	3. 213
Education	0.270**	15.060**
Land holding	0.714**	62.982**
Annual income	0.588**	25.165**
Cropping pattern	0.084	3.718
Irrigation sources	0.124*	65.661**
Experience in mentha cultivation	0.462**	13.293**
Contact with extension agent	0.466**	33.887**
Mass media exposure	0.402**	8.659
Training exposure on mentha cultivation	0.244*	21.282**
Labour availability	0.239**	2.646*
Marketing channel	0.311*	32.466**
Access to distillation unit	0.754*	57.505**

** Significant at 1% level of probability,

* Significant at 5% level of probability

significantly associated with the extent of adoption of mentha cultivation technology, whereas age and cropping pattern had a non-significant relationship with the level of adoption. The result of chi-square test also showed that the socio-economic factors like education, land holding, annual income, experience in mentha cultivation, contact with extension agent, training exposure on mentha, cropping pattern, irrigation source, marketing channel and access to distillation unit were positive and highly significant with respect to the extent of adoption of the farmers; where labour availability was found to be significantly associated. The result corroborates the findings of *Mbanso et al. (2012)* and *Chouhan et al.(2013)* which entails that farming experience positively influences the adoption behavior of respondents for scientific production technologies.

CONCLUSION

Based on the findings of the study, it may be concluded that more than sixty five per cent of the mentha farmers were under medium level of adoption category mostly confined to medium age group; whereas the extent of adoption of most of the recommended practices was found to be significantly higher in Barabanki district as compared to Lucknow district. The probable reason for high adoption was because of the fact that all the above practices were felt to be more important for getting higher yield and adoption of some practices were found to be low due to the probable reasons like lack of training and lack of market linkage for mentha oil. However, the extent of adoption of mentha cultivation practices was found to be significantly affected by most of the socio-economic characters of the farmers. Hence, in order to enhance the adoption of scientific mentha cultivation practices by mentha growers, they should be facilitated with latest technology know-how and motivated to conduct large scale technology demonstration by imparting skill based capacity building programmes. Beside, concentrated efforts should be made by line departments to offer technical support, guaranteed market linkage, value addition facilities and other input supply service to different stakeholders that may create entrepreneurial opportunity in mentha cultivation leading to its large scale adoption. Thus the study highlighted the gap in adoption of mentha production technologies with empirical analysis of the observations which may give an impetus in terms of policy planning to harness the potentials of commercial productions of mentha through supply and value-chain analysis (*Singh et al. 2007*).

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