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RESEARCH ARTICLE

Trend Analysis of Area and Production of Moringa in Dindigul and Theni districts

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ABSTRACT

Moringa is considered to be a "Super Food" which is rich in Vitamins (A & C), Calcium, Potassium and Proteins. The Moringa tree is also considered to be a miraculous tree. It is not only useful in the kitchen, but it can also be used as a non-conventional feed stuff in livestock product and also as raw material in the manufacture of paper. Almost every part of the Moringa tree has some useful role. The PKM1 variety of Moringa is considered to one of the world's best varieties, mainly cultivated in Tamil Nadu and particularly in Dindigul and Theni districts. In this study, we analyzed the trend of the variables area of cultivation and production in the districts of Dindigul and Theni and predicted the area and production for the years 2025 and 2030. The purpose of selecting these two districts is that they contribute to the major part (almost 50%) of the area of cultivation and production of Moringa in Tamil Nadu. The sampling adopted was simple random sampling. The area of cultivation of Moringa in Dindigul district overall shows an upward trend with mean 2005.35 hectares and SD of 666.17 hectares. The Coefficient of variation is 33.22%. The CAGR is 3.85%. The production of Moringa in Dindigul district overall shows an upward trend despite a decrease in the year 2012-13 with mean 96392.68 Tons and SD of 23872.36 Tons. The Coefficient of variation is 24.77%. The CAGR is 4.84%. The area cultivation of Moringa in Theni district overall shows an upward trend with mean 1985.55 hectares and SD of 1185.41 hectares, and the Coefficient of variation is 59.75%. The CAGR is 3.85%. The production of Moringa in Theni district shows an upward trend despite a decrease in the year 2008-09 with mean of 93635 Tons and SD of 48522.54 Tons. The Coefficient of variation is 51.82%. For Dindigul district, the predicted area in 2025 is 3,517.5 hectares and in the year 2030 it is 4039 hectares. For Dindigul district, the predicted production of Moringa in 2025 is 146722 Tons and in 2030 it is 164077 Tons. Similarly, for Theni district, the predicted area of Moringa cultivation in the year 2025 is 4818.5 hectares and in the year 2030 it is 5795.5 hectares. For Theni district, the predicted production of Moringa in the year 2025 is 205832 Tons and in the year 2030 it is 244522 Tons.

Keywords: *Moringa, Area, Production and Trend*

INTRODUCTION

Moringa Oleifera Lam is a valuable crop belonging to the family Moringaceae (Olson, 2002). It is also identified by several synonyms like Spinach tree, Mother's best friend, Miracle tree, Horse Radish tree etc. Its origin is North West India and Africa. Now it is cultivated worldwide, both in the tropics and sub tropics. Moringa is a commercial vegetable of Tamil Nadu and after the introduction of the varieties PKM1 and PKM2, the area under cultivation of Moringa is fast growing in Tamil Nadu and particularly in the selected districts. It started with 1310 ha. in the year 2000 and increased to 3374 ha. in the year 2020 showing Our objectives are to analyze the area of Moringa's cultivation and production for the 20 years from 2000-01 to 2019-20 in the selected districts and predict the area and production of Moringa in the years 2025 and 2030.It started with 1310 ha. in the year 2000 and increased to 3374 ha. in 2020, showing a three-fold increase for Dindigul district. It started with 399 ha. in the year 2000 and increased to 3974 ha. in 2020, showing a ten-fold increase for Theni district

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MATERIAL AND METHODS

The secondary data of the area and production of Moringa for 20 years from the year 2000-01 to 2019-20 were collected from the Season & Crop Report of Tamil Nadu, Department of Economics and Statistics, Chennai-600 006 (various issues) and from the Office of the Director of Horticulture, Dindigul and Theni and also from reliable Internet sources. After collection of the secondary data, Statistical analysis was done using MS Excel. The Mean, Standard Deviation and Coefficient of Variation were calculated for area, production in both the districts Dindigul and Theni. The mean is computed using the formula $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$ and SD, $S=\sqrt{\frac{1}{n-1}\left(\frac{\sum(x_i-\bar{x})^2}{n}\right)}$. The CAGR is computed as $\left(\frac{x_n}{x_1}\right)^{\frac{1}{n}}-1$ where x_1 is the initial value, x_n is the final value and n is no. of years of the period of study. The Compound Annual Growth Rate (CAGR) was computed for both area and production of Moringa. The correlation coefficient between the area of cultivation (x) and production (y) was analysed and computed as $r = \frac{n\sum_{i=1}^{n} xy-\sum_{i=1}^{n} x\sum_{i=1}^{n} y}{\sqrt{n\sum_{i=1}^{n} x^2-\left(\sum_{i=1}^{n} x\right)^2}\sqrt{n\sum_{i=1}^{n} y^2-\left(\sum_{i=1}^{n} y\right)^2}}$ and the regression equation of y on x is $y = a + b_{yx}x$ with production of Moringa, y as dependent variable and area of cultivation of Moringa, x as independent variable was also analysed. The regression coefficient is computed as $b_{yx} = \frac{n\sum_{i=1}^{n} xy-\sum_{i=1}^{n} x\sum_{i=1}^{n} y}{n\sum_{i=1}^{n} x^2-\left(\sum_{i=1}^{n} x\right)^2}$ where y is the dependent variable and x is the independent variable. The intercept a in the regression equation is computed as $a=\bar{y}-b_{yx}\bar{x}$. Then the regression equation is fitted as $\hat{y}=a+b_{yx}x$, where $\hat{y}$ is the predicted area / production accordingly.

RESULTS AND DISCUSSION

Dindigul district

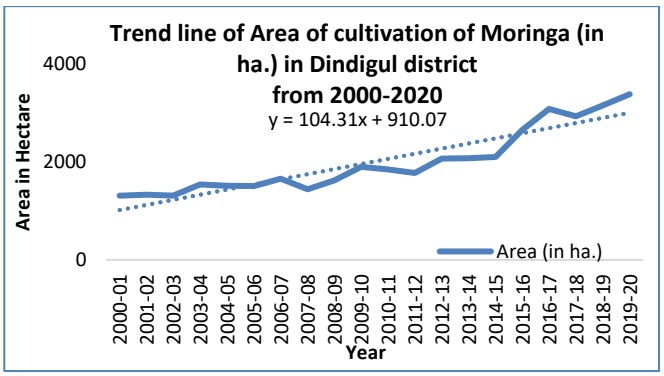
The mean area of cultivation of Moringa for Dindigul district is 2,005.35 ha. with Standard Deviation 666.17 ha. The Coefficient of variation is 33.22% The Compound Annual Growth Rate (CAGR) for area of cultivation of Moringa is 4.84%. The mean production of Moringa for Dindigul district is 96,392.68 Tonnes with Standard Deviation 23,872.36 Tonnes. The Coefficient of variation is 24.77% The Compound Annual Growth Rae (CAGR) for production of Moringa is 3.85% The correlation coefficient between area of cultivation and production of Moringa was found to be 0.83 with probability of significance at 18 d.f. being 0.000. The observed t statistic value was 6.25; The critical value for 18 d.f. at 1% level is 2.88. Hence there is a highly significant correlation exists between the area of cultivation of Moringa and production in Dindigul district. The regression equation of production (y) on area of cultivation (x) for Dindigul district is found to be y=36923.12+29.66x. The regression coefficient and the intercept both being significant with p value 0.00.

Theni district

The mean area of cultivation of Moringa for Theni district is 1,985.55 ha. with Standard Deviation 1,186.41 ha. The Coefficient of variation is 59.75%. The Compound Annual Growth Rate (CAGR) for area of cultivation of Moringa is 12.14%. The mean production of Moringa for Theni district is 93,635 Tonnes with Standard Deviation 48,522.54 Tonnes. The Coefficient of variation is 51.82% The Compound Annual Growth Rate (CAGR) for production of Moringa is 11.07% The correlation coefficient between area of cultivation and production of Moringa was found to be 0.937 with the probability of significance for 18 d.f. being 0.000. The observed t statistic value was 11.38; The critical value for 18 d.f. at 1% level is 2.88. Hence there is a highly significant correlation exists between the area of cultivation of Moringa and production in Theni district. The regression equation of production (y) on area of cultivation (x) for Theni district is found to be y=17544.03+38.32x. The regression coefficient was highly significant with p value 0.00 and the intercept was significant at 5% level with p value 0.04.

Trend analysis for the area of cultivation Moringa in Dindigul district

The equation of the linear trend analysis of the area of cultivation (in hectares) of Moringa in the Dindigul district is found to be y=104.3x+910 where y denotes area in hectares, x denotes the year of operation (taken 2000-2001 as 1 and 2019-20 as 20) and the predicted area for the year 2025 is 3517.5 hectares and for the year 2030 is 4039 hectares.



Summary Output Regression Statistics – Dindigul district

Multiple R	0.8276
R Square	0.6848
Adjusted R Square	0.6673
Standard Error	13768.81
Observations	20

ANOVA Table

Source of Variation	df	SS	MS	F	Significance F
Regression	1	7415460906	7415460906	39.11516	6.72427E-06
Residual	18	3412443779	189580210		
Total	19	10827904686			

Parameters	Coefficients	Standard Error	t Stat	p-value	Lower 95%	Upper 95%
Intercept	36923.12	9994.74	3.69	0.00	15924.96	57921.29
Area (in ha.)	29.66	4.74	6.25	0.00	19.69	39.62

Summary Output Regression Statistics – Theni District

Multiple R	0.9370
R Square	0.8780
Adjusted R Square	0.8712
Standard Error	17413.16
Observations	20

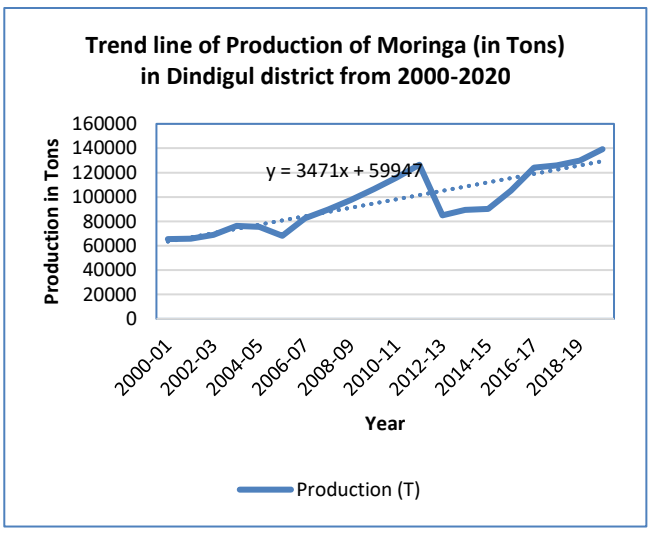
ANOVA Table

Source of Variation	df	SS	MSS	F	Significance F
Regression	1	39276375960	39276375960	129.5317	1.17772E-09
Residual	18	5457927223	303218179.1		
Total	19	44734303184			

Parameters	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	17544.03	7736.88	2.27	0.04	1289.44	33798.63
Area (in ha.)	38.32	3.37	11.38	0.00	31.25	45.40

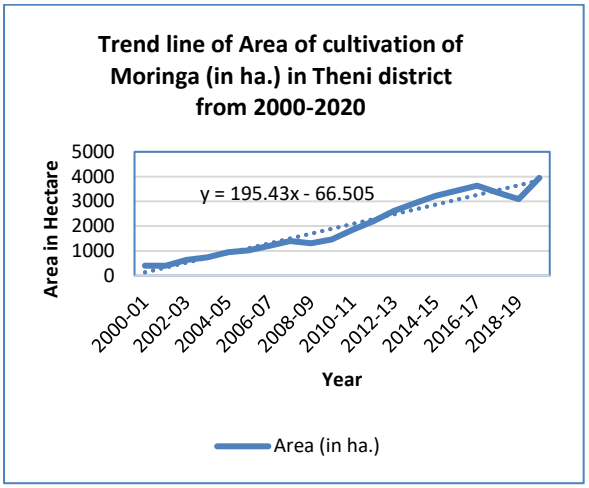
Trend analysis for the production of Moringa in Dindigul district

The equation of the linear trend analysis of the production (in Tons) of Moringa in the Dindigul district is found to be y=3471x+59947 where y denotes production in Tons, x denotes the year of operation (taken 2000-2001 as 1 and 2019-20 as 20) and the predicted production for the year 2025 is 146722 Tons and for the year 2030 is 164077 Tons.



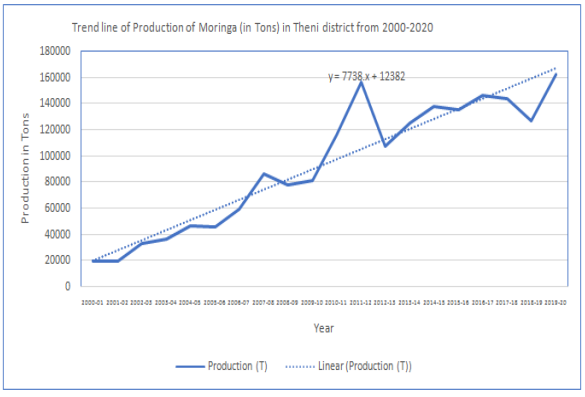
Trend analysis for the area of Moringa in Theni district

The equation of the linear trend analysis of the area of cultivation (in hectares) of Moringa in the Theni district is found to be y=195.4x-66.50 where y denotes the area in hectares, x denotes the year of operation (taken 2000-2001 as 1 and 2019-20 as 20) and the predicted area for the year 2025 is 4818.5 hectares and for the year 2030 is 5795.5 hectares.



Trend analysis for the production of Moringa in Theni district

The equation of the linear trend analysis of the production (in Tons) of Moringa in the Theni district is found to be y=7738x+12382 where y denotes production in Tons, x denotes the year of operation (taken 2000-2001 as 1 and 2019-20 as 20) and the predicted production for the year 2025 is 205832 Tons and for the year 2030 is 244522 Tons.



The area of cultivation of Moringa in the Dindigul district overall show an upward trend with mean 2005.35 hectares and SD of 666.17 hectares, the Coefficient of variation is 33.22%. The CAGR is 3.85%. The production of Moringa in Dindigul district overall shows an upward trend despite a decrease in the year 2012-13 with mean 96392.68 Tons and SD of 23872.36 Tons, the Coefficient of variation is 24.77%. The CAGR is 4.84%. The correlation coefficient between the area of cultivation and production is 0.83 with high probability of significance. The regression equation of production on the area was 29.66x+36923.12, with both the regression coefficient and intercept being highly significant. This ensures the significant dependence of production on the area.

The area of cultivation of Moringa in Theni district overall shows an upward trend with mean 1985.55 hectares and SD of 1185.41 hectares, the Coefficient of variation is 59.75%. The CAGR is 3.85%. The production of Moringa in Theni district shows an upward trend despite a decrease in the year 2008-09 with mean 93635 Tons and SD of 48522.54 Tons, the Coefficient of variation is 51.82%. The correlation coefficient between the area of cultivation and production is 0.937 with high probability of significance. The regression equation of production on area was 38.32x+17544.03, with the regression coefficient being highly significant and intercept significant at 5% level only not significant at 1% level. This ensures the significant moderate dependence of production on the area.

CONCLUSION

After analyzing the trend of area and production, the future prediction of area of cultivation in both the selected districts (Dindigul and Theni) of Tamil Nadu was analysed. For the Dindigul district, the predicted area of Moringa cultivation in the year 2025 is 3,517.5 hectares. and in the year 2030 it is 4,039 hectares. For the Dindigul district, the predicted production of Moringa in the year 2025 is 146722 Tons and in the year 2030 it is 164077 Tons. Similarly, for Theni district, the predicted area of Moringa cultivation in the year 2025 is 4818.5 hectares and in the year 2030 it is 5795.5 hectares. For Theni district, the predicted production of Moringa in the year 2025 is 205832 Tons and in the year 2030 it is 244522 Tons. Since the richness of Moringa for its proteins, carotenoids, and vitamins is very important to human growth from childhood onwards, the research can be extended to analyze the trend in value added products based on Moringa viz. Moringa powder, Moringa oil, Moringa paste, Moringa, Moringa gel and other products.

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