



Instability Indices and Compound Growth Rates of Area irrigated by Different Sources in Tirunelveli and Theni Districts

V.David Chella Baskar* S.Usha Nandhini ** K.Mani***

* Karunya Institute of Technology and Sciences, Coimbatore

** Karunya Institute of Technology and Sciences, Coimbatore

*** Dept of Agricultural Economics ,TNAU, TN

ABSTRACT

In the beginning of planning era, massive efforts were made to establish large scale multipurpose river valley projects in the country. Thereafter, the focus was on the maintenance of these irrigation infrastructure and also enhancement of water use efficiency. One such initiative was organization of Water Users' Association (WUA) in the river basins for effective utilization of irrigation water by the member- farmers of WUAs. In the early 1980's, there have been a large scale programs to turn over irrigation management from Government Agencies to organized Water Users' Associations in a number of countries such as Philippines, Indonesia, Senegal, Madagascar, Columbia and Mexico. The acceptance of Participatory Irrigation Management (PIM) has been favored by the dismal state of irrigation systems itself. Poor maintenance of irrigation system has led to non-irrigated fields because of undependable water flows and indiscriminate and inequitable distribution of water used by head-enders depriving the same to the tail enders and the resulting conflicts among farmer-users have created a situation where farmers' participation is beginning to be seen as an answer. The Water Users' Association (WUA) could be seen as a lasting response to such systemic inadequacies. It was thought that wherever the state has failed, the individual farmers will not, and that operation and management of irrigation system by the farmers themselves can change things around. The result is that state after state in India, much like other parts of the world, came up with policies, resolution and then laws supporting PIM. The performance of area irrigated by Water Users' Association in the selected districts were considered accordingly, growth rate analysis and instability analysis were carried out using time series data (secondary data) on net and gross irrigated area by open well, canal and tank irrigation in Tirunelveli and Theni districts as well as area, production and yield of paddy and banana in Tirunelveli and Theni districts, respectively

Key words: Instability Indices. Water Users' Association, South Tamil Nadu

Received 29.07.2019

Revised 23.08.2019

Accepted 03.09. 2019

INTRODUCTION

The water use efficiency could be enhanced by ensuring adequate and timely water availability at the delivery system and by facilitating efficient on-farm use of the irrigation water to optimize agricultural production. Systematic and scientific approach is needed for optimizing water and other resources use to increase the performance efficiency of existing irrigation projects in terms of productivity per hectare. Water Users' Associations (WUA) are voluntary, non-governmental, non-profitable entity established and managed by a group of farmers located along one or several water source canals. Water users include farmers, peasants and other owners who pool together their financial, material and technical resources to improve the productivity of irrigated farming through equitable distribution of water and efficient use of irrigation and drainage systems [3]. Hence, a study on Water Users' Association and problems relating to allocation, distribution and efficient use of water and also to assess the impact and participation of farmers in WUAs of the selected areas in terms of farm productivity becomes very important. The studies on performance of WUAs in Tamil Nadu especially in Tirunelveli and Theni district were very much limited. Therefore an attempt was made to study the economic impacts of WUAs' on productivity of major crops in Thamirabarani and Periyar-Vaigai river basins. to analyze the trends in area irrigated by different irrigation sources in the selected districts as well as area, production and yield of selected crops in the study area;

MATERIAL AND METHODS

Primary data

The primary data were collected from the sample farmers through personal interview and discussion method using a pre-tested questionnaire specially prepared for the present study. The information regarding assets position, cropping pattern, various inputs used *viz.*, seed material, chemical fertilizers, plant protection chemicals, labour, irrigation water and so on for taking up different cultivation practices such as land preparation, transplanting, irrigation, inter-cultural operations and harvesting along with labour requirement were collected from the selected farmers.

Secondary data

The general information related to the districts such as total population, land utilization pattern, cropping pattern, rainfall, area under different irrigation sources etc., were collected from the records available in District Statistical Offices and Joint Directorates of Agriculture of Tirunelveli and Theni Districts.

Compound Growth Rate

The compound growth rate was worked out to examine the growth performance of area irrigated by different irrigation sources as well as area, production and productivity of selected crops in Tirunelveli and Theni districts by using the exponential growth function of the form:

$$Y = a b^t e_t$$

Where,

Y = Dependent variable (area irrigated by different irrigation sources and area, production and yield of paddy/banana crops) in t^{th} year

t = time variable

e_t = Error term

a and b are unknown constants to be estimated

The unknown constants a and b were found by applying methods of least square by transforming the equation into logarithmic form

$$\ln Y = \ln a + t \ln b$$

Where,

$\ln Y$ is natural logarithm of Y, $\ln a$ and $\ln b$ are similarly defined.

The compound growth rate 'r' was computed by using the relationship

$$r = (\text{Antilog of } (\ln b) - 1) \times 100$$

$$\text{Where, } \ln b = \frac{\sum (t \ln Y) - (\sum t \sum \ln Y) / n}{\sum t^2 - (\sum t)^2 / n}$$

and n is number of time points

The significance of $\ln b$ was tested by t-ratio.

$$t = \frac{\ln b}{SE(\ln b)} \sim (n-2)$$

Where,

$$SE(\ln b) = (SS_{\ln Y} - (\ln b)^2 SS_t) / ((n-2) SS_t)$$

Where,

$$SS_{\ln Y} = \sum (\ln Y)^2 - (\sum \ln Y)^2 / n$$

$$\text{and } SS_t = \sum t^2 - (\sum t)^2 / n$$

Instability Index

To examine the extent of variability in the area irrigated by different irrigation source, area, production and yield of selected crops in Tirunelveli and Theni districts, the Cuddy-Della Valle Index was used formula as given below;

$$II = CV \sqrt{1 - R^2}$$

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

$$r = \frac{n(\sum XY) - \sum X \sum Y}{\sqrt{(n\sum X^2 - (\sum X)^2)(n\sum Y^2 - (\sum Y)^2)}}$$

Where,

II = Instability Index

CV = Coefficient of variation (per cent)

R squared = Coefficient of determination from a time-trend regression adjusted by the number of degrees of freedom.

The simple coefficient of variation over estimates the level of instability in time-series data characterized by long term trends whereas the Cuddy-Della Valle index corrects the coefficient of variation for such errors.

REVIEW OF LITERATURE

[5] analyzed the trend in area, production and productivity of major spices in the north eastern region. The study was based on secondary data from 1982-83 to 2011-12. The linear, non-linear trend models were tried to fit area, production and productivity of major spices in North Eastern region. The study found that, the exponential function was fitted well compare to other trend models. The best model was selected on the basis of highest R² value.

[4] examined trend in growth and instability of major spices in India with study period from 1974- 75 to 2012- 13, which were further divided into three sub- periods. The growth rates were worked out by fitting the exponential growth function and instability analysis was carried out using Cuddy Della Instability Index. The study has observed that almost all the spices have recorded a positive and significant growth rate in all the sub- periods. Sub- period II (1990- 91 to 1999- 00) is comparatively stable in terms of area, production and productivity in all the spices which also recorded a higher growth rates. Sub- period III (2000- 01 to 2012- 13) however witnessed fluctuations in growth rate in most of the spices. Variations in weather and price fluctuations were observed as the main factors affecting growth and instability in spices in India.

[3] studied area, production and productivity of three spices namely pepper, cumin and coriander. For this study statistical tool namely compound growth rate analysis was employed. The empirical results showed that area, production and productivity of pepper shows negative growth rate at national level. Pepper registered a positive but non- significant growth rate in terms of volume of export. At national level area under cumin showed only a meager growth rate while production, productivity and export showed significant positive growth rate. Area, production and export of coriander showed significant positive growth rate while productivity showed non- significant positive growth rate at national level.

[2] studied growth and variability in area production and yield of selected fruit crops in khyber pakhthunkhwa. The study is based on secondary data from 1975-76 to 2011-12 which is further bifurcated into three periods; period-I (from 1975-76 to 1990-91), period-II (from 1991-92 to 2011-12), and period-III (from 1975-76 to 2011-12). Cuddy-Della Valle index has been used for variability analysis. The findings of the study revealed that growth in production of selected fruit remained positive with area under fruit as a major contributor during period-I. Period-II witnessed either low or negative growth in fruit production except peach.

[1] analyzed growth and instability in paddy production in Tamil Nadu and is of great importance for a comprehensive understanding of the food security at the state level and also he exhibited the inter-district analysis of the paddy production in Tamil Nadu. The study concluded that there persist huge increase in the instability of area, production and yield of almost all the districts studied over the review period. Paddy cultivation in the post- reform period remained more unstable as compared to the pre-reform period. The results of the decomposition analysis revealed that the change in mean production of paddy was mainly due to the change in mean yield.

RESULTS AND DISCUSSION

Growth Rates of Area Irrigated by Different Sources in the Selected Districts

The main objective of the study is to analyze the performance of area irrigated by Water Users' Association in the selected districts. Accordingly, growth rate analysis and instability analysis were carried out using time series data (secondary data) on net and gross irrigated area by open well, canal and tank irrigation in Tirunelveli and Theni districts as well as area, production and yield of paddy and banana in Tirunelveli and Theni districts, respectively and the results are presented in Table 4.1 and Table 4.2.

Growth Rate and Instability Indices of Area Irrigated by Different Sources in Tirunelveli and Theni Districts

The growth rate and instability index of net and gross irrigated area by open well, canal and tank irrigation in Tirunelveli and Theni districts are presented in the Table 1.

Table. Compound Growth Rates and Instability Indices of Area irrigated by Different Sources in Tirunelveli and Theni Districts

Sl. No	Sources of Irrigation	Tirunelveli District (1954-1955 to 2013-2014)		Theni District (1978-1979 to 2013-2014)	
		CGR	Instability index	CGR	Instability index
I	Net irrigated area (ha)				
1	Open well	-0.26 ** (-1.71)	20.78	-3.43 * (-9.35)	25.89
2	Canal	-0.63 * (-8.49)	9.65	-6.80 * (-8.14)	42.38
3	Tank	-1.68 * (-10.46)	19.39	-12.16 * (-19.91)	28.16
	Net irrigated area	-0.88 * (-7.08)	15.53	-4.82 * (-10.92)	27.38

II	Gross irrigated area (ha)				
1	Open well	0.01 ^{NS} (0.06)	19.56	-3.35 * (-9.54)	23.38
2	Canal	0.96 ** (2.31)	16.57	-5.86 * (-7.34)	43.29
3	Tank	-1.24 * (-8.14)	18.29	-12.04 * (-19.12)	27.83
	Gross irrigated area	-0.96 * (-3.44)	23.74	-5.04 * (-11.19)	28.17

Note: Figures in parentheses indicate t values

* Significant at 1% level; ** Significant at 5% level; *** Significant at 10% level;

NS – Non Significant

It is obvious from Table 1 that growth rate of net and gross irrigated area by open well in Tirunelveli district was negative and significant at one per cent level with -0.88 per cent and -0.96 per cent. The growth rates estimated for net and gross irrigated area by tank was -1.68 per cent and -1.24 per cent were negative and significant at one per cent level. The growth rate for gross irrigated area by open well was found to be non-significant during this period. In general, compound growth rate for net and gross irrigated for tank irrigated areas were found to be negative during this period from 1954 to 2014. It could be observed that there was an increase in gross irrigated area by canal water and this has contributed for the formation of more number of water users' associations in Tirunelveli district.

The highest instability in net irrigated area of Tirunelveli district was in open well (20.78 per cent) and the lowest was observed in canal (9.65 per cent). In case of gross irrigated area the highest instability was observed in open well (19.56 per cent) and lowest in case of canal (16.57 per cent). Thus it could be concluded that net irrigated area in Tirunelveli district has been more stabilized relatively when compared to that of gross cropped area.

It is observed from Table 1 that growth rate of net and gross irrigated area in Theni district was negative and significant at one per cent level with -4.82 per cent and -5.04 per cent respectively. The growth rates estimated for net and gross irrigated area by tank was -12.16 per cent and -12.04 per cent were negative and significant at one per cent level. The growth rate for gross and net irrigated areas by open well were found to be negative and significant during these periods. Also, the net and gross irrigated areas for canal were also found to be negative and significant at one per cent level. In general, total net and gross irrigated were found to be negative during this period from 1978-2014 in Theni district.

The highest instability in gross irrigated area in Theni district was observed in canal (43.29 per cent) and the lowest was observed in open well (23.38 per cent). In case of net irrigated area, instability was highest in canal irrigated area (42.38 per cent) and lowest in open well irrigated area 25.89 per cent. In canal irrigated area (both in gross and net cropped areas) the instability index was more than that of the other sources in Theni district.

Growth Rate and Instability Indices of Area, Production and Yield of Paddy in Tirunelveli District and Banana in Theni Districts

The compound growth rate and instability indices for area, production and productivity of Paddy and Banana in Tirunelveli and Theni district respectively were estimated and the results are presented in Table 2.

Table 2 Compound Growth Rates and Instability Indices of Area, Production and Yield of Paddy in Tirunelveli District and Banana in Theni Districts (Per cent)

Sl. No	Variables	Paddy (1954-1955 to 2013-2014)		Banana (1978-1979 to 2013-2014)	
		CGR	Instability index	CGR	Instability index
1	Area	-1.17 * (-7.62)	18.50	-1.99 * (-3.16)	39.74
2	Production	-0.10 ^{NS} (-0.59)	20.81	1.99 ** (1.98)	53.20
3	Yield	1.08 * (8.15)	18.06	4.06 * (5.83)	39.83

Note: Figures in parentheses indicate t values

* Significant at 1% level; ** Significant at 5% level; *** Significant at 10% level;

NS – Non Significant

The growth rates of area of paddy in Tirunelveli district showed negative growth rate whereas production of paddy was found to be non-significant. In case of yield of paddy, the compound growth rate was found to be positively significant with 1.08 per cent and area was negative and significant with -1.17 per cent. The instability in area, production and yield of paddy was 18.50 per cent, 20.81 per cent and 18.06 per cent, respectively. Instability was more in production of paddy followed by area (18.50). The advancement of production technology caused the reduction in instability in yield.

The growth rates of area of banana in Theni district showed negative growth rate whereas production of banana was found to be positive and significant at five per cent level. In case of yield of banana, compound growth rate was found to be positive and significant with 4.06 per cent and area was negative and significant with -1.99 per cent.

The instability in area, production and yield of banana under was 39.74 per cent, 53.20 per cent and 39.83 per cent, respectively. Instability was more in production of banana followed by yield (39.83). Thus it could be concluded that the instability in production of banana in Theni district was more when compared with that of area and yield.

CONCLUSION

Growth Rate and Instability Indices of Area Irrigated by Different Sources in Tirunelveli and Theni Districts

Growth rate of net and gross irrigated area by open well in Tirunelveli district was negative and significant at one per cent level with -0.88 per cent and -0.96 per cent respectively. The growth rates estimated for net and gross irrigated area by tank was -1.68 per cent and -1.24 respectively and per cent were negative and significant at one per cent level. The growth rate for net and gross irrigated for tank irrigated areas were found to be negative during this period from 1954 to 2014 in Tirunelveli district. The highest instability in net irrigated area of Tirunelveli district was in open well (20.78 per cent) and the lowest was observed in canal (9.65 per cent). In case of gross irrigated area the highest instability was observed in open well (19.56 per cent) and lowest in case of canal (16.57 per cent) in Tirunelveli district. Growth rate of net and gross irrigated area in Theni district was negative and significant at one per cent level with -4.82 per cent and -5.04 per cent respectively. The growth rates estimated for net and gross irrigated area by tank was -12.16 per cent respectively and -12.04 per cent were negative and significant at one per cent level. The growth rate for gross and net irrigated areas by open well was found to be negative and significant during these periods. Net and gross irrigated were found to be negative during this period from 1978-2014 in Theni district. The highest instability in gross irrigated area in Theni district was observed in canal (43.29 per cent) and the lowest was observed in open well (23.38 per cent). In case of net irrigated area, instability was highest in canal irrigated area (42.38 per cent) and lowest in open well irrigated area (25.89 per cent). In canal irrigated area (both in gross and net cropped areas), the instability index was more than that of the other irrigation sources in Theni district.

Hence, it could be concluded that for Tirunelveli district the net and gross irrigated area was found to be negatively significant at one per cent level. Similar trend was observed in Theni district. Both district the instability index for canal was found to be stable.

Growth Rate and Instability Indices of Area, Production and Yield of Paddy in Tirunelveli District and Banana in Theni Districts

The growth rates of area under paddy in Tirunelveli district showed negative growth rate whereas production of paddy was found to be non-significant. In case of yield of paddy, the compound growth rate was found to be positively significant with 1.08 per cent and area was negative and significant with -1.17 per cent. The instability in area, production and yield of paddy was 18.50 per cent, 20.81 per cent and 18.06 per cent, respectively. Instability was more in production of paddy followed by area with 18.50 per cent in Tirunelveli district.

The growth rates of area under banana in Theni district showed negative growth rate whereas production of banana was found to be positive and significant at five per cent level. In case of yield of banana, compound growth rate was found to be positive and significant with 4.06 per cent and area was negative and significant with -1.99 per cent. The instability in area, production and yield of banana under was 39.74 per cent, 53.20 per cent and 39.83 per cent, respectively. Instability was more in production of banana followed by yield in Theni district.

It could be observed that the production of both paddy and banana was not stable during the study period and this could be attributed to instability in area and yield of them.

REFERENCES

1. Pradeep Kumar., (2015), "Growth and Instability in Paddy Production in Tamil Nadu: An Inter- District Analysis", *International Journal of Management and Social Science Research Review*,1 (17): 288-297.
2. Sajid Ali and Abdul Jabbar, (2015),"Growth and Variability in Area Production and Yield of Selected Fruit Crops in Khyber Pakhtunkhwa", *Pakistan Journal Agricultural Research*, **28**(1).
3. Soumya, C., Burark, S.S., Sharma, L. and Jain, H.K., 2014, "Growth and Instability in Production and Export of Selected Spices of India", *International Journal Seed Spices*, **4**(2): 1-10.
4. Joshi, D. and Singh, H.P., (2015), "An Empirical Analysis of Growth and Instability in Major Spices in India", *International Journal of Agriculture Sciences*, **7**(2): 440-444.
5. Sharma, A., (2015), "Trends of Area, Production and Productivity of Spices in the Northeastern Region", *Journal of Spices and Aromatic Crops*, **24**(2): 112- 118.

CITATION OF THIS ARTICLE

V. David Chella Baskar, S.Usha Nandhini, K.Mani. Instability Indices and Compound Growth Rates of Area irrigated by Different Sources in Tirunelveli and Theni Districts. *Bull. Env. Pharmacol. Life Sci.*, Vol 8 [10] September 2019: 87-92