Association of cropping system over the period in Dharwad district of Karnataka

■ **H.S. SOWMYA AND A.R.S. BHAT**

SUMMARY : Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interaction of these elements. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt suitable farming practices to maximize agricultural production. Hence, present study were conducted with the objective to know association of cropping system over the period in Dharwad district of Karnataka. Data used for the study were collected from Directorate of Economics and Statistics, Government of Karnataka, Bangalore for the crops like chilli, maize, groundnut, sorghum, cotton and soybean. Only two parameters considered namely area and price and the method used is co-efficient of concordance / Kendall w-co-efficient. Both area and price study revealed the association in cropping system over the years.

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BACKGROUND AND OBJECTIVES

Agriculture is the basic activity by which humans live and survive on the earth. Assessing the impact of climate change on agriculture is a vital task. Both developed and developing countries, the influence of climate on crops and livestock persists despite irrigation, improved crop varieties and growing use of chemical fertilizers. The continued dependence of agricultural production on solar radiation, rainfall and other climatic factors and the significant magnitude and rapid rates of possible climate changes creates the need for a comprehensive consideration of the impacts of climate on regional global agriculture.

There are many questions which arises on the climate change and agriculture practices, these are interrelated processes, both of which take place on global scale. Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interaction of these elements. These conditions determine the carrying capacity of biosphere to produce enough food for the human population and domesticated and wild animals. The overall effect of climate change on agriculture will depend on the balance of these effects. Assessment of the effects of

global climate changes on agriculture might help to properly anticipate and adapt suitable farming practices to maximize agricultural production. In order to study the impact of climate change on agricultural productivity in Karnataka, Dharwad district which belongs to Northern transition zone was selected. Further the dominant crops are chilli, maize, groundnut, sorghum, cotton and soybean. Hence, these crops were selected for the present study with the objective to know association of cropping system over the period in Dharwad district of Karnataka.

RESOURCES AND METHODS

Crop yield data were collected from Directorate of Economics and Statistics, Government of Karnataka, Bangalore for the crops like chilli, maize, groundnut, sorghum, cotton and soybean .Two parameters namely area and price were considered separately to know the association of crops over the years.

Kendall's W-co-efficient / co-efficient of concordance (r_w):

This method is used when the ranks are given. Concordance will be applied when n-ranks will be given to m-objects. Here ranks will be given year wise for selected crops.

$$r_w = \frac{12 \ddot{y} D^2}{Nm^2 (N^2 - 1)}$$

where,
N= Number of years.
m = Number of crops.
D = Sum of the ranks of each crops over the years – average sum of the ranks
Average sum of the ranks is given by =

$$\frac{\text{Sum of the ranks of all the crops over the years}}{\text{Number of crops}}$$

Here, for the selected crops the ranks will be given for the crops over the years for area and price separately. Lesser the changes in the ranks of crops indicates no shifting in the cropping systems.

Significance of the test :

The significance of the co-efficient of concordance (r_w) can also be tested using χ^2 test with n-1 degrees of freedom is given as,

$$m(n-1)r_w \sim \chi^2_{n<1}, \%$$

OBSERVATIONS AND ANALYSISH

The results obtained from the present study as well as discussions have been summarized under following heads:

Average rainfall of major cities of India :

Hundred years average rainfall of major cities of India is presented in Table 1.

The rainfall was highest in Mumbai (1971 mm) with 73 rainy days in a year followed by Kolkata (1670 mm) with 84 days of rain / year and Chennai (1333 mm) and Bangalore (929 mm) with 58 and 57 days, respectively.

Average rainfall, temperature and relative humidity of Karnataka and study district :

The average rainfall, temperature and rainfall of the study area *i.e.* Dharwad district which is very low compared to the state average rainfall (1218 mm), temperature (33 ^{0}C) and relative humidity (75%) (Table 2)

Classification of total geographical area in Karnataka and study district :

The total geographical area of Karnataka is 190.49 Million ha out of that Dharwad is having 4.27 Million ha. (Table 3)

Area, production and productivity of study crops:

The area, production and productivity of study crops *i.e.* chilli is growing in an area of 1.387 Million ha and production of 1.382 Million tonnes with productivity of 1048 kg/ha whereas other crops such as maize with an area of 1.24 Million ha, production 2.92 Million tonnes with productivity of 2482 kg/ha, groundnut with area of 0.82 Million ha, production 0.46 Million tonnes and productivity of 589 kg/ha, sorghum with an area of 1.37 Million ha, production of 1.30 Million tonnes and productivity of 996 kg/ha, whereas soybean with an area of 0.18 Million ha, production 0.08 Million tonnes with productivity 472 kg/ha and cotton with area of 0.46 Million ha, production 0.71 Million tonnes with productivity of 672 kg/ha (Table 4).

Optimum temperature and water requirement of study crops :

Optimum temperature and water requirement of chilli is 21-26^{0}C and 800-900 mm, respectively whereas

other major crops of the district such as for maize 18-20^0C and 500-800 mm, for groundnut 22-28^{0}C and 500-700 mm, respectively whereas for sorghum 15-32^{0}C and 450-650 mm, respectively and for soybean 18-35^{0}C and 450-700 mm, respectively and cotton 18-30^{0}C and 700-1300 mm (Table 5).

Results of Mann-Kendall test :

The results of Kendall's w-co-efficient for area and

price are presented in the Table 6 and 7, respectively.

The results of Table 6 revealed that the ranks given for area of selected crops. Here no changes were observed in cotton crop throughout the years, whereas for remaining crops there was small variation. And also it revealed that on average cotton, chilli, groundnut, soybean and maize retained the area of cultivation in the order of size of cultivation. Here cotton retained first position over the years. It indicates that there is

Table 1 : Average rainfall of major cities of India		
Major cities	Number of rainy days/year	Average rainfall (mm)
Bangalore	57	929
Hyderabad	50	787
Chennai	58	1333
Mumbai	73	1971
Delhi	38	718
Kolkata	84	1670

Table 2 : Average rainfall, temperature and relative humidity of Karnataka and study district			
Name of the state/ District	Average rainfall (mm)	Temperature (^{0}C)	Relative humidity (%)
Karnataka	1218	33.00	75.00
Dharwad	720 (302.3-891)	26.03 (25-27)	64.36 (60-69.7)

Source: Extracted from annual season and crop report DE and S Bangalore: 2011-12.
Figures in the parenthesis indicate range

Table 3 : Classification of total geographical area in Karnataka and study district			
District/State	Total geographical area (M ha)	Net area sown (M ha)	Total cropped area (M ha)
Karnataka	190.49	104.04	128.73
Dharwad	4.27 (2.24)	3.33 (3.20)	5.53 (4.30)

Source: Extracted from annual season and crop report DE and S Bangalore: 2011-12.
Figures in the parenthesis indicate range

Table 4 : Area, production and productivity of study crops			
Crop	Area (M ha)	Production (M tonnes)	Productivity (kg/ ha)
Chilli	1.387	1.382	1048
Maize	1.24	2.92	2482
Groundnut	0.82	0.46	589
Sorghum	1.37	1.3	996
Soybean	0.18	0.08	472
Cotton	0.46	0.71	672

Source: Extracted from annual season and crop report DE and S Bangalore: 2011-12

Table 5 : Optimum temperature and water requirement of study crops		
Crops	Optimum temperature (^{0}C)	Water requirement (mm)
Chilli	21-26	800-900
Maize	18-20	500-800
Groundnut	22-28	500-700
Sorghum	15-32	450-650
Soybean	18-35	450-700
Cotton	18-30	700-1300

Source: *www.fao.org*

Table 6 : Ranks for area of selected crops over the years

Year	Chilli	Maize	Groundnut	Sorghum	Cotton	Soybean
1995	4	5	3	2	1	6
1996	2	5	4	3	1	6
1997	3	5	2	4	1	6
1998	3	5	4	2	1	6
1999	4	5	3	2	1	6
2000	3	5	4	2	1	6
2001	2	6	4	3	1	5
2002	2	6	4	3	1	5
2003	2	6	4	3	1	5
2004	2	5	4	3	1	6
2005	2	5	4	3	1	6
2006	4	6	3	1	2	5
2007	2	6	4	3	1	5
2008	2	6	2	4	1	5
2009	2	6	3	4	1	5
2010	2	6	4	3	1	5
2011	2	6	3	4	1	5
2012	2	6	3	5	1	4
Average rank	2.5	5.56	3.44	3	1.06	5.39

Table 7 : Ranks for price of selected crops over the years

Year	Chilli	Maize	Groundnut	Sorghum	Cotton	Soybean
1995	1	6	4	5	2	3
1996	1	6	3	5	2	4
1997	1	5	3	6	2	4
1998	1	6	3	5	2	4
1999	1	6	3	5	2	4
2000	1	6	3	5	2	4
2001	1	6	4	5	2	3
2002	1	6	4	5	2	3
2003	1	6	4	5	2	3
2004	1	6	3	5	2	4
2005	1	6	3	5	2	4
2006	1	6	4	5	2	3
2007	1	6	4	5	2	3
2008	1	6	4	5	2	3
2009	1	6	3	5	2	4
2010	1	6	3	5	2	4
2011	1	6	4	5	2	3
2012	2	6	4	5	1	3
Average rank	1.06	5.94	3.5	5.06	1.94	3.5

Table 8 : Summary of Kendall's w-co-efficients

Variables	r_w value	Chi- square value	Critical Chi –square at 5%	Critical Chi –square at 1%
Area	0.8826	79.4370	11.0005	15.08
Price	0.8372	75.348	11.0005	15.08

association in cropping pattern *i.e.* whatever the period changes same crop is grown throughout the years.

Table 7 revealed that ranks for price of selected crops. There was no change were observed in chilli, maize and cotton crops. Whereas, for remaining crops there was small variation. And also it revealed that on an average cotton, chilli, groundnut, soybean and maize retained the price of cultivation in the order of size of cultivation. Here chilli retained first position over the years. It indicates that there is association in cropping system *i.e.* the magnitude of preference of the crops may same over the years.

Table 8 showed that the final results of Kendall's w-co-efficients. For area the r_w value was 0.8826 and for price the r_w value was 0.8372 both area and price showed significant results. *i.e.* there is association in cropping system. It indicates that if, period of the crop changes farmers decision does not changes *i.e.* they will prefer the existing system. The prices of the crops also support their decision over the years *i.e.* the magnitude of preference of the crops may same over the years. Similar work related to the present investigation was also conducted by Indrani Pal and Abir Al-Tabbaa (2009); Prasad Rao *et al.* (2008); Miroslav and Franc (2009) and Srivastav *et al.* (2010).

Conclusion :

The significant results for both price of the crops over the years and area of the crops over the years showing some kind of association in cropping system. It indicates that both area and price of the crops over the years retains the same position and if, period of the crop changes, farmers' decision unchanged.

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REFERENCES

Indrani Pal and Abir Al-Tabbaa (2009). Trends in seasonal precipitation extremes – An indicator of climate change in Kerala, India. *J. Hydrolo.,* **367** : 62-69.

Prasad Rao, G. S. L. H. V., Ram Mohan, H.S., Gopakumar, C.S. and Rishankumar, K.N. (2008). Climate change and cropping system over Kerala in the humid tropics. *J. Agrometeorol.* (Special issue - Part-II), pp. 286-291.

Miroslav, V. and Franc, K. (2009). Co-efficient of structural concordance and an example of its application: Labour productivity and wages in Solvenia. *Panoeconomicus*, **2** : 227-240.

Srivastav, N.N., Rao, V. U. M., Korwar, G. R. and Venkateswaralu, B. (2010). Micro-level spatial variability and temporal trends in reference evapotranspiration (ETo) at a semi-arid tropical station. *J. Agrometeorol.,* **12** (2) : 208-212.

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