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Economics of Low and Unstable Yield in Rainfed Area and Policy Panacea for the Farming in Northern Karnataka

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ABSTRACT

Climate and agriculture are inextricably linked. Climate change is already affecting agriculture, with effects unevenly distributed across the world. Climate change will also have an economic impact on agriculture, including changes in farm profitability, prices, supply, demand and trade. Keeping in view the objective of the study a multistage random sampling procedure was adopted for the selection of the district, taluks, villages and farmers. Dharwad was selected purposively for the present study. The return was more in Greengram is mainly because of lower cost of cultivation especially less use of machine labour. Agriculture is highly depending on climate. Most of the crops respond very quickly to the climate change. During scarce rainfall situation yield of the crops were affected negatively. The variation of rainfall from year to year is mainly due to change in climate parameters like temperature, relative humidity, soil moisture and these changes are mainly because of emission of Greenhouse gases in the atmosphere. The yield gap of major crops is mainly due to the variation in package of practice followed by farmers, climatic factors, especially impact of climate change and loss of soil fertility. Hence farmers' needs to observe the climatological changes for harvesting rich dividends endowed with nature for making an agriculture more profitable.

Key words: *Climate Change, Climate parameters, Returns and Yield gap*

INTRODUCTION

Climate and agriculture are inextricably linked. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, climate extremes, changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations. Climate change is already affecting agriculture, with effects unevenly distributed across the world. Climate change will also have an economic impact on agriculture, including changes in farm profitability, prices, supply, demand and trade. The magnitude and geographical distribution of such climate induced changes may affect our ability to expand the food production, area as required to feed the burgeoning population.

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The increased agricultural activities and organic waste management are presumed to be contributing to the building up of both methane and nitrous oxide in the atmosphere. India's total contribution to global methane emission from all sources is only 18.5Tg per year. Agriculture (largely paddy fields and ruminant animal production) is a major source of CH_4 emission and contributes 68 % to it. Since India and China are the major paddy producing countries, an international opinion was made that Asia and in particular, India and China are contributing significantly to global warming and they should do something to prevent this phenomenon. Sinha *et al*[5]., estimated that global annual methane emission from paddy cultivation is less than 13 Tg. The contribution of Indian paddies to global CH_4 budget was estimated to be only 4.2 Tg/year[6]. The main reasons of low methane emissions from paddy fields in India are that the soils of major paddy growing areas have very low organic carbon and also not continuously flooded. IPCC[2] (Intergovernment Panel on Climate Change) projections for climate change at global level by 2080 are global average surface warming (surface air temperature change) may increase by 1.1 - 6.4 °C, sea level will rise between 18 and 59 cm, oceans will become more acidic, hot extremes, heat waves and heavy precipitation events would continue to become more frequent, there will be more precipitation at higher latitudes and it is likely that there will be less precipitation in most subtropical land areas. It was estimated that a rise of 0.5 ^{0}C winter temperatures could cause a 0.45 tonnes per hectare fall in India's wheat production[3].

Karnataka experienced a severe drought for three consecutive years (2001-02, 2002-03 and 2003-04) and 159 taluks/blocks were listed as drought affected. During these periods, the state received 23 per cent of less rainfall[4]. The agricultural production declined to 64 lakh tonnes against the target of 104.05 lakh tonnes and the availability of crop residues for livestock was substantially low[1]. The intense drought had put most of the farmers in the state to the precarious situation leading to the migration to the nearby towns and cities. Keeping all this in view the present study was undertaken with an objective toassess the impact of climate change on low and unstable yield of major rainfed crops of Northern Karnataka.

MATERIALS AND METHODS

Dharwad district is well known for its varied agro-climatic regions, diversified soil type and cropping pattern. In Dharwad all the crops which are cultivated in different districts of Karnataka are found so it was selected purposively for the present study. Dharwad district falls in the Northern part of Karnataka between 150 15' and 15035'15 N latitude and 750 00' and 750 20' E longitudes, in the Northern Dry Zone (Zone 3) and Northern Transitional Zone (Zone 8). It consists of five taluksviz; Dharwad, Hubli, Kalghatgi, Kundgol and Navalgund. The district has area of 4260 Km^2 constituting about 2.22 per cent of the state area.Keeping in view the objective of the study a multistage random sampling procedure was adopted for the selection of the district, taluks, villages and farmers. In the first stage, Dharwad district was selected as it serves as an agricultural representative of Karnataka state. In the second stage, all the five taluks of Dharwad district were selected. In the third stage, three villages from each taluk were selected for the study. The data collected from these villages served as the primary sources of data. In the fourth stage, a sample of 10 farmers in each of these villages were selected randomly for the purpose of study. Thus, a total of 150 farmers were selected for collection of the required information for the study. The data was collected using pre-tested and well-structured schedule. The farmers were personally interviewed. The data collected were presented in tabular form to facilitate easy comparisons. The results were summarized with the aid of statistical tools namelyBudgeting Technique, Regression and Yield gap analysis to draw valid and meaningful conclusions.

RESULTS AND DISCUSSION

In consistence with the objectives of the study, the necessary data collected from different sources were analyzed and interpreted. The

results of such analysis are presented and discussed in this chapter under the following objectives.

Objectives

1. Input Utilization Pattern and Cost and returns Structure of Major RainfedCrops in Dharwa district
2. Influence of Seasonal Weather Parameters on Major Rainfed Crop Yields in Dharwad district
3. Yield Gap Analysis of Major Rainfed Crops of Dharwad District

Input Utilization Pattern and Cost and returns Structure of Major Rainfed Crops in Dharwad district:

Table-1 represents Input utilization pattern of sample farmers in Dharwad district. In Maize, the major items of cost of cultivation was Human labour (Rs.3.297/acre), Machine labour (Rs.1.689/acre), Animal labour (Rs.737/acre), seed (Rs.735.68/acre), Manure (Rs.275/ acre) and insecticide (Rs.193/ acre). Sorghum: In sorghum cultivation the major item of cost was human labour (Rs.3918/acre). The insecticide cost was nil it means no insecticides are used in Sorghum cultivation.

Greengram: Human labour cost (Rs.3562/acre) shares major item of cost in greengram cultivation and least money was spent on manure application.

Blackgram: The major item of cost in Blackgram cultivation was human labour (Rs. 2,532/acre) and seed cost (Rs.1625/acre). These two items are dominated in cost of cultivstion.

Cotton: The resource cost was more in cotton cultivation. Among the used resources, human labour cost (Rs.5848.65/acre) was major item of cost followed by seed (Rs.2121.24/acre), fertilizer (Rs.1434.19/acre), machine labour (Rs.1378.46), animal labour (Rs.1031.45/ acre), pesticide (Rs.404.95/acre) and manure (Rs.225.53).

Soybean: In Soybean cultivation also, human labour (Rs.2707.78/acre) was major item of cost of cultivation and least cost spent was Rs.286.77/acre for manure application. Among all the crops, total cost of cultivation was more in cotton due to more use of human labour because cotton requires more number of picking but other crops are harvested at single time.The returns obtained in major crops of rainfed in Dharwad district was presented in the Table-2. The total quantity of yield obtained in Maize, Sorghum, Greengram, Blackgram, Cotton and Soybean were 17.70 quintals, 6.86 quintals, 2080 quintals, 4.02 quintals, 7.24 quintals and 5.3 quintals per acre respectively. The net return in cotton was more (Rs.15692.22/acre) followed by Soybean (Rs.9611.36/acre), Greengram (Rs.9492.78/ acre), Blackgram (Rs.8683.38/acre), Maize (Rs.8321.85/acre) and Sorghum (Rs.7089.50 /acre). Further, the Benefit-Cost ratio was higher in Greengram(2.42) followed by Cotton (2.26), Soybean (2.24), Blackgram (2.17), Sorghum (1.98) and Maize (1.96). The return was more in Greengram is mainly because of lower cost of cultivation especially less use of machine labour.

Influence of Seasonal Weather Parameters on Major Rainfed Crop Yields in Dharwad district:

In Dharwad district the coefficient of determination of climatic parameters for the crops like Sorghum, Maize, Greengram, Blackgram, Cotton and Soybean were observed to be more than 50 per cent and confirm on their contribution towards better performance of these crops.The estimated coefficients of multiple regression function for major rainfed crops is presented in Table-3. The weather parameters such as minimum temperature and actual rainfall were significantly influencing the sorghum yield in Dharwad district. Sorghum is best adapted to areas having an average annual rainfall of 45 to 65 cm so it threw well if actual rainfall of that region lies in this range. Similarly, in case of maize, actual rainfall and minimum temperature were significantly influencing maize yield. Maize is one of the most widely cultivated crop and grown in both tropical and warm temperate latitude. Water is more important for maize crop. In areas of lesser rainfall, the crop is irrigated. Long dry spells are harmful to maize and affect the yield levels. Greengram were influenced by actual rainfall significantly at positive rate. Warm and moist conditions are very favorable for

Greengram crop. Therefore, actual rainfall was significantly contributing to yield levels. Blackgram and cotton were significantly influenced by maximum relative humidity. Minimum relative humidity (-7.95) in case of soybean, maximum relative humidity (13.79) in case of Blackgram (14.54) and cotton (9.40) were significantly contributing to their respective yield levels.

Yield Gap Analysis of Major Rainfed Crops of Dharwad District:

The yield gap analysis of major crops is indicated in Table-4. It reveals that among major crops the highest yield gap was observed in Maize with a gap of 8.3qtls followed by sorghum (2.14qtls), cotton (1.76qtls), Soyabean (1.61qtls), Greengram (1.6qtls) and Blackgram (0.98qtl). This yield gap is mainly due to the variation in package of practice followed by farmers, climatic factors, especially impact of climate change and loss of soil fertility.

Table 1: Input utilization pattern of sample farmers in the study area (Rs/acre)

(n=150)

Sl. No.	Particulars	Maize	Sorghum	Greengram	Blackgram	Cotton	Soybean
1	Seed	735.68	269.37	593.32	1,625.00	2,121.24	1,559.42
2	Fertilizer	1,739.82	800.00	355.19	750.00	1,434.19	624.45
3	Manure	275.00	250.00	209.00	220.00	225.53	286.77
4	Pesticide	193.00	0.00	250.00	655.00	404.92	1,022.00
5	Human Labour	3,297.00	3,918.00	3,562.00	2,532.00	5,848.65	2,707.78
6	Animal Labour	737.00	821.00	880.23	665.41	1,031.45	356.34
7	Machine Labour	1,689.00	1,148.00	819.41	979.02	1,378.46	1,200.00
8	Total Cost	8666.50	7206.37	6669.15	7426.43	12444.44	7756.76

Table 2: Returns Structure of Major Rainfed Crops in the study area (Rs/acre)

(n=150)

Sl. No.	Crop	Maize	Sorghum	Greengram	Blackgram	Cotton	Soybean
1	Yield (qtl/acre)	13.70	6.86	2.80	4.02	7.24	5.39
2	Return (Rs/qtl)	1,240.74	2,080.00	5,761.11	4,004.12	3,883.33	3,234.09
3	Gross return(Rs/acre)	16,988.52	14,295.00	16,162.22	16,109.85	28,136.67	17,368.18
4	Net return	8,321.85	7,089.50	9,492.78	8,683.38	15,692.22	9,611.36
5	B:C Ratio	1.96	1.98	2.42	2.17	2.26	2.24

Table 3: Influence of Seasonal Weather Parameters on Major RainfedCrops Yield in Dharwad District (1999-2000 to 2013-14)

Variables	Sorghum	Maize	Green gram	Black gram	Cotton	Soybean
Intercept	20.30	27.51	100.81	-198.91	-61.92	48.95
Actual rainfall	1.92** (0.48)	1.66** (0.41)	1.94** (0.75)	0.414 (0.48)	0.52 (0.53)	-0.42 (0.34)
Maximum temperature	-14.13 (9.58)	-15.52 (8.35)	-21.43 (15.00)	30.01 (19.56)	0.38 (10.68)	-11.66 (6.80)
Minimum temperature	23.95** (9.65)	-28.98** (8.41)	19.77 (15.10)	23.07 (12.99)	7.04 (10.76)	9.85 (6.85)
Maximum relative humidity	-4.19 (4.44)	-6.36 (3.87)	-10.55 (6.95)	14.54** (4.63)	9.40* (4.95)	0.75 (3.15)
Minimum relative humidity	-7.21 (5.78)	-8.72 (5.04)	-11.21 (9.06)	-6.67 (5.19)	-0.23 (6.45)	-7.95* (4.10)
R^2	**0.82**	**0.79**	**0.61**	**0.60**	**0.72**	**0.49**
F	**7.31**	**6.23**	**2.54**	**2.47**	**4.25**	**1.58**

Note: Figure in the parentheses indicate standard error

*, **, *** indicates significance at 10 %, 5 % and 1 % respectively

Table-4: Yield Gap Analysis of Major crops in the Study Area (qtl/acre)

Sl. No.	Crop	Potential Yield	Actual Yield	Yield Gap
1	Maize	22	13.70	8.3
2	Sorghum	9	6.86	2.14
3	Green Gram	4.4	2.80	1.6
4	Black Gram	5	4.02	0.98
5	Cotton	9	7.24	1.76
6	Soybean	7	5.39	1.61

CONCLUSION

Among all the crops, total cost of cultivation was more in cotton due to more use of human labour because cotton requires more number of picking but other crops are harvested at single time. The returns per rupee of investment was higher in Greengram (2.42) followed by Cotton (2.26), Soybean (2.24), Blackgram (2.17), Sorghum (1.98) and Maize (1.96). The return was more in Greengram is mainly because of lower cost of cultivation especially less use of machine labour. Agriculture is highly depending on climate. Most of the crops respond very quickly to the climate change. During scarce rainfall situation yield of the crops were affected negatively. The variation of rainfall from year to year is mainly due to change in climate parameters like temperature, relative humidity, soil moisture and these changes are mainly because of emission of Greenhouse gases in the atmosphere. The yield gap of major crops is mainly due to the variation in package of practice followed by farmers, climatic factors, especially impact of climate change and loss of soil fertility.

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