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# Influence of Climate Change on Costs, Yield Levels And Returns of Ragi and Redgram - A Case Study in Eastern Dry Zone of Karnataka

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**ABSTRACT**
*The impact of climate change is studied in many aspects in different locations in the country and it is concluded that there is high impact on agriculture compared to any other sector in the country. For this purpose, two groups of farmers were selected namely, a group adopting the agro met advisories regularly in their operation (AAS farmers) and other group of farmers not aware of agromet advisories (Non-AAS farmers). 12 farmers (both AAS and Non AAS) from 4 villages have been identified and AAS information issued for only 30 farmers in each village during Kharif season and care was taken to implement the advisories by this group. Crop situation of these farmers was compared with nearby fields having the same crops where forecast is not adopted in non AAS farmers. Further Expenditure incurred by the farmers from land preparation till the harvest at every stage has been worked out and crop growth and yields were monitored regularly in the farmer's field belonging to both the groups. Costs, yield levels and returns showed increasing trend over a period of time. The crop growth and yield were observed to be good and high in case of farmers who have adopted the AAS information regularly compared to the farmers who have not adopted the AAS information. The net income of AAS farmer's was about Rs. 6644 in case of finger millet (ragi) and Rs. 7763 in case of redgram crops over non AAS farmers of Rs.3788 and Rs.5162, respectively. The farmers who have adopted the Agromet Advisories in their day to day operation have realized an additional benefit in finger millet and red gram crops, respectively.*
***Key words***: *climate change, AAS farmers, Non-AAS farmers, yields and returns*

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## INTRODUCTION

Climate is one of the main determinants of agricultural production. Throughout the world there is significant concern about the effects of climate change and its variability on agricultural production. Researchers and administrators are concerned with the potential damages and benefits that may arise in future from climate change impacts on agriculture, since these will affect domestic and international policies, trading pattern, resource use and food security. The Climate change is any change in climate over time that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere in addition to natural climate variability observed over comparable time periods (IPCC, 2007). Since climatic factors serve as direct inputs to agriculture, any change in climatic factors is bound to have a significant impact on crop yields and production. Studies have shown a significant effect of change in climatic factors on the average crop yield [ Seo and Mendelsohn(2008), and Cline(2007)]. In developing countries climate change cause yield declines for the most important crops and South Asia will be particularly hard hit (IFPRI, 2009). Many studies in the past have shown that India is likely to witness one of the highest agricultural productivity losses in the world in accordance with the climate change pattern observed and scenarios projected. Climate change projections made up to 2100 for India indicate an overall increase in temperature by 2-40 c with no substantial change in precipitation quantity (Kavikumar, 2010).
The study conducted by the International Food Policy Research Institute (Glwadys Aymone Gbetibouo, 2009) has indicated approximately half of the farmers have adjusted their farming practices to account

for the impacts of climate change. Lack of access to credit was cited by respondents as the main factor inhibiting adaptation. The results of the multinomial logit and Heckman probit models highlighted that household size, farming experience, wealth, access to credit, access to water, tenure rights, off-farm activities, and access to extension are the main factors that enhance adaptive capacity. Thus, the government should design policies aimed at improving these factors.

## MATERIALS AND METHODS

The villages were selected purposively for the study. The sample villages were selected from Bangalore north taluk of Bangalore Urban district which comes under the eastern dry zone of Karnataka viz., Seetakempanahalli, Shanubhoganahalli, Dibburahalli and Itgalpura. Primary data of 120 famers were collected through personal interview by pre-tested schedule thirty farmers from each village were selected.The descriptive statistics like mean or averages and percentages were worked out for analysing majority of issues in the present study for a comparison the between the groups and to interpret the results. Primary data was collected for the year 2014-15 through interview schedule. Secondary data was collected from ACRIP, UAS, Banglore on Agromet Advisory Service and Control farmers. The costs and returns were worked out on per acre basis for ragi and redgram. The costs and returns were worked out separately for sole cropping system. The expenditure incurred on human labour, bullock labour and machine labour constituted the labour costs. The different types of labour employed for each activity was recorded which includes both hired and family labour. The labour was converted into rupees by multiplying the wages paid by the grower in the locality. Material costs include expenditure on seeds, fertilizer, FYM, plant protection chemicals etc. The costs of these inputs were arrived based on the value as indicated by the farmers. For estimating the cost of FYM, the price prevailing in the locality was imputed even though many a times part of it was produced on the farm itself. While computing the costs of fertilizers and plant protection chemicals, the actual price paid by the growers along with the transportation cost incurred was considered. The interest on working capital was calculated at the rate of ten per cent. Marketing and transportation costs costs include the cost of cleaning, sorting, bagging, loading, unloading and transportation of produce, etc.

## RESULTS AND DISCUSSION

### Influence of the climate change on input use

It is interesting to observe from Table 1 and Table 2 that the share of non-cash inputs to the respective total input cost has decreased over the years. In case of AAS farmers, the share of owned human labour cost to the total labour cost in ragi crop was 53.67 per cent in the year 2009-10, it has decreased to 44.56 per cent in 2014-15. In case of control farmers, it has decreased from 51.07 per cent to 45.79 per cent during the same period similar trend was observed regarding human and bullock labour. The contribution of the farm grown seeds to the total cost of the seeds has decreased over the years in redgram crop in both farmer groups than ragi crop. The contribution of farm produced FYM cost to the total cost of FYM in both crops has decreased over the years in both types of the farmers. The contribution of farm grown seeds to the total cost of the seeds has decreased over the years. The decreased share of human labour may be attributed to less dependence of farmers on agriculture and diversifying into subsidiary enterprises for income. This is also evident from migration of farmers. Hence, it could be concluded that there is reduction in non-cash inputs use in crop production over a period of time.

### Influence of climate change on costs, yield levels and returns of ragi.

The cost of cultivation of ragi per acre for the year 2014-15 by the AAS farmers (Rs. 7,582.61) was marginally lower than that of control farmers (Rs. 8,906.36) and could be observed from Table 3. The labour costs, bullock and machine labour costs, cost of seeds, fertilizers were more for the control farmers contributing for 8.08 per cent increased cost over the AAS farmers.The main product yield levels of AAS farmers and control farmers were 10.1 and 9.10 quintals respectively and the gross returns of the AAS and control farmers were Rs. 12,393 and Rs. 11,042 respectively . The returns from AAS farmers were 12.24 per cent more than that of the control farmers. The gross returns per rupee of total cost of cultivation of AAS and control farmers were 1.63 and 1.36 respectively. It was also evident that the per acre variable cost of cultivation of ragi has increased over the years for both AAS and control farmers with the increased human labour and bullock labour cost, seeds and fertilizer costs. In case of AAS farmers the yield has increased over the years but in case of control farmers from 2012-13 to 2014-15 the yield has decreased. In spite of decreased yield, the returns have increased over the years for both respondent group farmers.

**Table 1: Comparison of cost of non-cash inputs use by AAS farmers over the years (Rs./acre)**

| SI.No | Crops | Inputs | 2009-10 | | 2012-13 | | 2014-15 | |
|---|---|---|---|---|---|---|---|---|
| | | | Total cost | Non cash input cost | Total cost | Non cash input cost | Total cost | Non cash input cost |
| 1 | **Ragi** | Human labour | 1215.28 | 652.30 (53.67) | 1294.50 | 610.23 (47.14) | 2250 | 1002.56 (44.56) |
| | | Bullock labour | 300.00 | 180.54 (60.18) | 300.00 | 155.58 (51.86) | 450.00 | 184.58 (43.95) |
| | | Seeds | 81.30 | 72.34 (88.98) | 87.46 | 60.52 (69.20) | 121.50 | 62.84 (51.72) |
| | | FYM | 978.06 | 860.54 (87.98) | 984.40 | 778.45 (79.08) | 686.50 | 487.26 (70.98) |
| 2 | **Redgram** | Human labour | 2119.53 | 1365.21 (64.41) | 2249.50 | 1245.58 (55.37) | 3896.00 | 1747.29 (44.85) |
| | | Bullock labour | 401.25 | 370.42 (92.31) | 400.00 | 201.51 (51.13) | 712.50 | 325.46 (45.68) |
| | | Seeds | 110.23 | 91.64 (83.14) | 122.40 | 72.62 (59.33) | 351.60 | 160.34 (45.60) |
| | | FYM | 879.63 | 801.46 (91.11) | 888.90 | 712.84 (80.19) | 1335.00 | 854.26 (64.31) |

**Table 2: Comparison of cost of non-cash inputs use by control farmers over the years (Rs./acre)**

| Sl. No. | Crops | Inputs | 2009-10 | | 2012-13 | | 2014-15 | |
|---|---|---|---|---|---|---|---|---|
| | | | Total cost | Non-cash input cost | Total cost | Non-cash input cost | Total cost | Non-cash input cost |
| 1. | Ragi | Human labour | 1,512.22 | 772.30 (51.07) | 1,496.80 | 752.44 (50.27) | 2,539.20 | 1,162.62 (45.79) |
| | | Bullock labour | 267.50 | 192.45 (71.94) | 300.00 | 165.84 (55.28) | 472.50 | 201.84 (42.72) |
| | | Seeds | 102.89 | 82.48 (80.16) | 90.80 | 60.24 (66.34) | 151.80 | 65.28 (43.00) |
| | | FYM | 1,079.30 | 850.64 (78.81) | 1,045.20 | 748.86 (71.65) | 625.30 | 362.87 (58.03) |
| 2. | Redgram | Human labour | 2,316.53 | 1,465.32 (63.25) | 2,423.40 | 1,386.67 (57.22) | 4,090.40 | 1,864.48 (45.58) |
| | | Bullock labour | 366.67 | 308.25 (84.07) | 402.10 | 261.48 (65.03) | 732.50 | 325.46 (44.43) |
| | | Seeds | 124.46 | 98.64 (79.25) | 130.90 | 78.29 (59.81) | 394.00 | 154.42 (39.19) |
| | | FYM | 1,152.10 | 801.46 (69.57) | 976.60 | 698.56 (71.53) | 1,425.00 | 916.24 (64.30) |

**Influence of climate change on costs, yield levels and returns of redgram**

The costs incurred on human labour, bullock labour, machine labour, seeds, FYM, fertilizers and plant protection chemicals were more for control farmers than that of AAS farmers. As a result the variable cost of control farmers has increased by 5.31 per cent over the AAS farmers (Table 4). The total return per rupee of total cost of cultivation was 1.49 in case of AAS farmers and was 1.36 in case of control farmers. The yield levels were 5.36 and 5. 14 quintals per acre respectively for the AAS and control farmers showing marginal increase in the yield of AAS farmers compared to control farmers. It was evident that the cost of human and bullock labours have increased over the years. Similarly, the cost of seeds, FYM, fertilizers and plant protection chemicals have increased over the years for both AAS and control farmers. The yield levels have decreased for both respondent groups from the year 2012-13 to 2014-15. The returns showed an increasing trend over the years and the net returns increased over variable costs over the years.

**Table 3: Comparison of costs and returns of the Ragi crop for different years in Rs./acre**

| Sl. No. | Particulars | AAS farmers | | | Control farmers | | |
|---|---|---|---|---|---|---|---|
| | | 2009-10 | 2012-13 | 2014-15 | 2009-10 | 2012-13 | 2014-15 |
| 1. | Cost of human labor | 1,215.28 | 1,294.50 | 2,250.00 | 1,512.22 | 1,496.80 | 2,539.20 |
| 2. | Cost of bullock labor | 300.00 | 300.00 | 420.00 | 267.50 | 300.00 | 472.50 |
| 3. | Cost of machine labor | 991.67 | 1200.00 | 535.80 | 994.93 | 1200.00 | 600.40 |
| 4. | Cost of seeds | 81.30 | 87.46 | 121.50 | 102.89 | 90.80 | 151.80 |
| 5. | Cost of FYM | 978.06 | 984.40 | 686.50 | 1,079.30 | 1,045.20 | 625.30 |
| 6. | Fertilizer cost | 572.20 | 580.40 | 1,267.24 | 599.95 | 613.70 | 1,362.09 |
| 7. | Cost of PPC | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8. | Irrigation charges | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9. | Total variable cost | 4,180.71 | 4,440.60 | 5,748.47 | 4,556.79 | 4,746.50 | 6,253.43 |
| 10. | Main product yield(Qtls.) | 9.89 | 10.02 | 10.10 | 8.80 | 9.21 | 9.10 |
| 11. | Gross returns | 7,672.17 | 8,891.40 | 12,393.00 | 6,949.39 | 8,246.50 | 09,042.00 |
| 12. | Net returns over variable cost | 3,491.46 | 4,450.80 | 6,644.53 | 2,392.58 | 3,500.00 | 3,788.57 |

**The discussion of 'influence of climate change on costs, yield levels and returns' is as follows**

The per acre cost of cultivation of ragi crop in AAS farmers was lower than that of control for the year 2009-10. Similarly, the costs were more in control farmers for other crops also. This increased cost may be due to increased labour costs, increased quantity of seeds used, increased FYM and fertilizer costs because of unavailability of Agromet Advisory Services.

Regarding the influence of climate change on costs of variable inputs it can be seen that over the years, the variable cost of cultivation has increased in both types of farmers. This may be attributed to increased wages due to scarce availability of labourers, increased cost of inputs like fertilizers, plant protection chemicals etc. As it was observed that the household members of the farm families migrated to nearby cities for their livelihood, it would lead to scarcity of labours. As a result there would be higher wage rates and this may cause increased labour costs. The decrease in the number of bullocks now-a-days might have caused the increased bullock labour cost. The analysis revealed that the yield levels of ragi were more for the AAS farmers than that of control farmers. Similarly, the yield levels of redgram was observed to be more for the AAS farmers over the control farmers. This may be attributed to the timely information available to the AAS farmers on day to day weather parameters like temperature and rainfall and the information on the operations to be taken up with the prevailing weather conditions.

As a result of increased yield among AAS farmers, obviously the returns of these farmers were found to be more. The gross and net returns over the total cost were observed to be more for AAS farmers when compared to the control farmers. This may be attributed to the higher variable costs incurred by the control farmers due to non-availability of information on the aberrant weather parameters. This above outcome sufficiently support that the hypothesis there is a reduction in yield due to climate change was accepted.

**Table 4: Comparison of costs and returns of the Redgram crop for different years in Rs./acre**

| Sl. No. | Particulars | AAS farmers | | | Control farmers | | |
|---|---|---|---|---|---|---|---|
| | | 2009-10 | 2012-13 | 2014-15 | 2009-10 | 2012-13 | 2014-15 |
| 1. | Cost of human labor | 2,119.53 | 2,249.50 | 3,896.00 | 2,316.53 | 2,423.40 | 4,090.40 |
| 2. | Cost of bullock labor | 401.25 | 400.00 | 712.50 | 366.67 | 402.10 | 732.50 |
| 3. | Cost of machine labor | 858.33 | 1000.00 | 817.00 | 858.33 | 1000.00 | 881.60 |
| 4. | Cost of seeds | 110.23 | 122.40 | 351.60 | 124.46 | 130.90 | 394.00 |
| 5. | Cost of FYM | 879.63 | 888.90 | 1,335.00 | 1,152.10 | 976.60 | 1,425.00 |
| 6. | Fertilizer cost | 516.97 | 548.00 | 1,002.40 | 609.20 | 661.00 | 1,032.61 |
| 7. | Cost of PPC | 393.00 | 439.50 | 546.00 | 523.23 | 605.60 | 585.00 |
| 8. | Irrigation charges | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 110.00 |
| 9. | Total variable cost | 5,377.67 | 5,648.28 | 9,466.22 | 4,750.53 | 4,998.50 | 9,997.40 |
| 10. | Main product yield (Qtls.) | 4.98 | 5.40 | 5.36 | 4.87 | 5.18 | 5.14 |
| 11. | Gross returns | 12,632.17 | 13,027.30 | 17,230.00 | 9,714.74 | 10,712.75 | 13,460.00 |
| 12. | Net returns over variable cost | 7,254.50 | 7,379.02 | 7,763.78 | 4,964.21 | 5,714.25 | 5,162.60 |

The above findings were in conformity with the studies by Ravindrababu *et al.* (2007) and Jagadeesha *et al.* (2010). They have opined that the cost of cultivation of few crops grown by AAS farmers was low who have been adopting the advisory time to time as compared to the non-AAS farmers. Further, the crop yield was also higher with low investment in AAS farmers resulting in the higher benefit-cost ratio. The percent net income gain of AAS farmers over non-AAS farmers was high. It was observed that AAS farmers were better than the control farmers due to the information available for them regarding the weather parameters and the activities to be taken up. This helped in reducing the costs with critical use of timely inputs. This is also supported by the findings of Baethgen *et al.* (2003) that the availability of better climate and agricultural information helps farmers make comparative decisions among alternative crop management practices and this allows them to choose better strategies that make them cope well with changes in climatic conditions.

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