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Constraints in Adoption of Climate Resilient Technologies in Rainfed Agro-Ecosystem

Jasna V. K.[1], R. Roy Burman[2], R. N. Padaria[3], J. P. Sharma[4], Eldho Varghese[5], Bidisha Chakrabarty[6], N. Loganandhan[7] and Sanjay Kumar[8]

ABSTRACT

Climate change and food security are the two daunting present day agrarian challenges. Adaptation through climate resilience is an undebatably accepted solution to better respond to these challenges. National Innovations in Climate Resilient Agriculture (NICRA) is an Indian Council of Agricultural Research (ICAR) initiative launched with a focus on making most vulnerable districts of the nation climate resilient. Since the inception of the project, a number of climate resilient technologies have been demonstrated across the country. The present investigation was undertaken with an objective to isolate the constraints in adoption of these technologies in rainfed agro-ecosystem. The results showed thatOfficials evaluated technical constraints, and labour and economic constraints as the most severe than that by the farmers.Among different technical factors, 'inadequacy of inputs' stood first with mean rank 3.87 in hindering adoption as regarded by the farmers. But officials considered 'poor availability and accessibility of short duration drought tolerant crop varieties' as the most severe one (mean rank is 3.3). Among labour and economic constraints, 'longer gestation period (mean ran k=3.74) to get the returns from adopted intervention' and 'shortage of owned resources'(mean rank =3.95) were major constraints as per the opinion of farmers and officials, respectively. 'Resistance to change the conventional practices' was considered as the most severe by both farmers(mean rank =3.99) and officials (mean rank = 4.05) in social and personal constraints. The findings will help in redesigning the already implemented interventions to ensure a higher adoption by managing the constraints.

Key words: Climate resilience, climate resilient technologies, nicra, adoption, constraints

INTRODUCTION

Agriculture and climate are strongly linked. Any change in climatic parameters, may it be positive or negative, has a greater implication on agricultural production and hence food security of the nation. Agriculture has become disrupted, uneconomical and risky venture as it lost all the balances it maintained with climate, environment, soil, plants, animals and the manipulator human being. Rainfed agriculture is the most vulnerable to climatic fluctuation among other agro-ecosystems because; monsoon rain acts as pulse of this system. Similarly, date of onset of monsoon has equal say on rainfed system. Rainfed agriculture dominates Indian agriculture, occupying a large chunk of cultivable land. In the midst of climate change and climate generated issues, each nation is seeking to formulate and institutionalize appropriate mechanisms inorder to sort out the impact problems and to generate a set of viable solutions. The scenario of global climate change requires an immediate redesigning the agriculture system to better respond with increasing climate variability. Climate resilience is a potent tool to cope with climate induced imbalances and its relevance is manifold for farming sector than any others sectors. Mitigation and adaptation seem to be the two principal strategies to deal with climate resilience. With the limited scope for emphasizing mitigation, need of the hour is to concentrate on activities instituting adaptation. Planned adaptation is essential to elate resilience of agriculture to climate change. More resilient

[1.] PhD Scholar, [2.] Principal Scientist, [3.] Professor Division of Agricultural Extension, [4.] Jt. Dir. (Extn.) [5.] Scientist, IASRI,
[6.] Scientist CESCRA, New Delhi

infrastructure, more climate resilient technologies and new agriculture practices are required for adaptation to counter increased climate risks.

National Innovations in Climate Resilient Agriculture (NICRA) is an Indian Council of Agricultural Research (ICAR), launched to focus on process of developing contingency plans for all the rural districts of the country and it has been implemented at 100 districts of the country in collaboration with ICAR research institutes, SAUs and KVKs.

The focus of the programme is not only to demonstrate the climate resilient agriculture technologies but also to institutionalize mechanisms at the village level for continued adoption of such practice in sustainable manner. During the past years, the project has successfully demonstrated several climate resilient technologies across the country. Multitudes of the evaluation studies have reported positive side of impact of the technologies. Despite the profound benefits of these technologies they are securing only a creeping rate of adoption. So the present study was conducted to analyse the factors constraining adoption and to test the hypothesis that all constraints are of equal severity in retarding adoption.

METHODOLOGY

The study was conducted in two purposively selected districts, Tumkur of Karnataka and Gumla of Jharkhand. The research locales were selected purposively, as the NICRA has been implemented in these districts since its inception and rainfed agro-ecosystem is predominant in both the districts. Tumkur and Gumla districts represent rainfed agro ecosystem and are mostly affected by drought and poor soil health.

The selected study locales were vulnerable to climatic variability. Two villages say,Gunia of Ghagra block of Gumla and D. Nagenhalli village of Tumkur were selected purposively as the project has been implemented only in these villages of the respective states. The ex-postfacto research design was used in the study, as the manifestation of the variables presumably had already occurred and there was no scope for further manipulation.

The respondents for the study were the beneficiaries and officials of NICRA. The list of NICRA beneficiaries was taken from each KVK and forty respondents were selected by simple random sampling technique. Thus, a total of eighty beneficiary farmers were selected from two districts. Ten staff of each of the KVKs of Gumla and Tumkur districts were selected purposively summing to total of twenty officials. Thus, the sample comprised of total 100 respondents including officials.

Different categories of constraints were collected by literature review, expert opinion and from the field based on officials' and farmers' perception. Data was obtained by administering a semi-structured interview schedule. Responses were obtained on a three point continuum of severity. Constraints were ranked based on mean rank obtained for each constraints using Friedman test. Comparison of constraints between farmers and officials were made with Mann-Whitney-U test.

RESULTS AND DISCUSSION

A constraint is anything, any factor that prevents or limits an individual or group from adopting an intervention or restrains them from tapping the intended virtues of an intervention. Constraints can be personal or external to an individual or a social system. Hindrances encountered while implementing climate resilient technologies by officials were studied along with the constraints perceived by farmers in adopting the technologies.

An attempt was made to analyze the technical, labour and economic, social and personal constraints that hinder both the rate and success of adoption among the NICRA beneficiaries. The information is purely based on perceptions of beneficiary farmers and officials engaged with NICRA implementation.

Technical constraints perceived by NICRA beneficiaries

Technical constraints were those factors which impeded adoption due to its technical complexity and requirement for knowledge and skills on the adoption of climate resilient technologies. Five different constraints on technical aspects were enlisted and NICRA farmers' and officials' responses on their severity were collected. The constraints were compared using Friedman test.

The computed 'p' value was less than significant at 1 per cent level. Among the different technical factors, inadequacy of inputs with mean rank 3.87 stood first in hindering adoption followed by poor availability and accessibility of short duration drought tolerant crop varieties(mean rank=3.56). Lack of awareness about climate change was ranked the least(mean rank=2.03) by the farmers as they could see enough evidences from their surroundings (Table 1).

Table 1: Ranking of Technical constraints as perceived by the farmers

Constraints	Mean rank
Lack of awareness about climate change	2.03
Lack of timely information related to climate resilient technologies	2.62
Lack of awareness about climate resilience	2.93
Poor availability and accessibility of short duration drought tolerant crop varieties	3.56
Non availability of required inputs	3.87
Test statistics	**118.545***

*Significant at p < 0.01

Labour and economic constraints perceived by NICRA beneficiaries

Various constraints under the category were compared and tested using Friedman statistics and obtained 'p' value explained high level of significance. Longer gestation period to get the returns from adopted interventions was taken as major constraint(mean rank=3.74) among labour and economic constraints because of lower observabilityof climate resilient technologies in immediate future. This was in consonance with findings of Simpson and Burpee (2014) that the positive benefits of most NRM changes took time to manifest and was easily masked by seasonal stresses.Giller et al.(2009) stated the fact that, though sustainable land management activities increase productivity in the medium to long run through improved soil characteristics and water retentionbut in the short run, cultivation intensities and yields can decline. The farmers were more aware about climate change and its consequences.Inorder to avoid further damage they were willing to take up the resilience activities. So shortage of owned assets was not considered as a severe constraint impeding adoption and has given the least rank(Table 2).

Table 2: Ranking of labour and economic constraints as perceived by the farmers

Constraints	Mean rank
Shortage of owned assets	2.30
Higher investment cost on farm machinery and land development	2.55
Inadequate financial support	2.80
Labour scarcity	3.61
Longer gestation period	3.74
Test statistics	**71.059***

*Significant at p < 0.01

Social and personal constraints perceived by NICRA farmers

For identifying mean ranks of constraints a Friedman test was run and it was obtained that resistance to change the conventional practices was considered as the most severe constraint (mean rank=3.99) among social and personal constraints because the farming community was value preserving and emotionally attached to traditional practices (Table 3). Besides this, they were more skeptic about the success of entirely new technologies in their local situation. Criticism from various social groups (mean rank=2.6) was regarded as the least severe factor as they have not experienced any such hindrances while adopting climate resilient technologies.

Table 3: Ranking of social and personal constraints as perceived by the farmers

Constraints	Mean rank
Lack of proper community action for the promotion of climate resilient technologies	2.61
Resistance to change the conventional practices	3.99
Criticism from various social groups	2.60
The belief that 'It is better to follow conventional farming today and let tomorrow take care of it'	2.93
Requirement of longer period to get positive responses from the ecosystem	3.97
Test statistics	**66.8598***

*Significant at p < 0.01

Constraints in adoption of climate resilient technologies perceived by NICRA officials

Various constraints in different categories were compared based on the response of officials using Friedman test. The test results revealed that officials perceive different constraints as different. The test statistic (Table 4) was significant at five per cent level of significance.

a) Technical constraints as perceived by the officials

Among the enlisted constraints relating to technical aspects, poor availability and accessibility of short duration drought tolerant crop varieties was perceived as the most severe one by the officials so it was ranked first with a mean rank 3.3. Similar results were shown by Ahmed(2013), where he found that most of the farmers were well informed about the new development in agriculture and they were ready to adopt the new farming technology but were not in a position to adopt the improved technology at full scale due to certain constraints including Input constraints comprising, impurity of seeds, high cost of HYV seeds, high cost of fertilizers, inadequate irrigation facilities, high rate irrigation charge of private pumping sets, erratic supply of electricity, insufficient availability of effective and pure chemicals, pesticides, insecticides etc. Proper linkage and communication with research institution may resolve the issue. It indicated need for strengthening community oriented seed banks. Alike farmers, officials also considered lack of awareness about climate change has the least contribution (mean rank=2.85) towards inhibiting adoption.

Table 4: Ranking of technical constraints as perceived by the officials

Constraints	Mean rank
Lack of awareness about climate change	2.85
Lack of timely information related to climate resilient technologies	2.95
Lack of awareness about climate resilience	2.95
Poor availability and accessibility of short duration drought tolerant crop varieties	3.3
Non availability of required inputs	2.95
Friedman Test statistics	**1.959***

*Significant at $p < 0.05$

b) Labour and economic constraints as perceived by the officials

Most rigorous constraint retarding the adoption process according to officials was shortage of owned assets of farmers. It was given first rank (mean rank=3.95) among the set of labour and economic constraints (Table 5). Labour shortage and long gestation period share an equal rank after resource constraint because farmers were endowed with lesser resource and they have very limited alternative income sources to sustain during gestation period. A well-functioning custom hiring centre (CHC) in the NICRA villages was evident from the least ranked constraint (mean rank=2.25) 'higher investment cost on farm machinery and land development'.

Table 5: Ranking of labour and economic constraints as perceived by the officials

Constraints	Mean rank
Shortage of owned assets	3.95
Higher investment cost on farm machinery and land development	2.25
Inadequate financial support	2.35
Labour scarcity	3.25
Longer gestation period	3.25
Friedman Test statistics	**20.211***

*Significant at $p < 0.01$

Social and personal constraints as perceived by the officials

Data presented inTable6 revealed that resistance to change the conventional practices was an epitome of most severe constraint among social and personal constraints with a mean rank of 4.05. Criticism from various social group was considered the least important (mean rank=2.5) by officials, which portrayeda nurturing social environment and attitude towards climate resilient technologies.

Table 6: Ranking of social and personal constraints as perceived by the officials

Constraints	Mean rank
Lack of proper community action for the promotion of climate resilient technologies	2.6
Resistance to change the conventional practices	4.05
Criticism from various social groups	2.4
The belief that 'It is better to follow conventional farming today and let tomorrow take care of it'	2.8
Requirement of longer period to get positive responses from the ecosystem	3.15
Test statistics	**21.742***

*Significant at $p < 0.01$

Comparative severity of constraintsas perceived by NICRA farmers and officials

Three independent sets of five constraints, say technical, labour and economic, social and personal constraints were enlisted and administered to farmers and officials involved with NICRA project. The perception of severity of constraint was different for farmers and officials. Table 7displayed that mean ranks for technical constraints (90.5),labour and economic constraints (71.5) were higher for officials which surpassed the mean rank given for farmers on both the categories of constraints.So, technical constraints,labour and economic constraints were perceived as most severe by officials than the farmers. According to farmers, labour and economic constraints, and technical constraints are of less severity. Using Friedman test, a further analysis of each category of constraints was undertaken and it was obtained that each individual constraint in each category varied in farmers' perception. Value of test statistics and its significance level were given in Table7.

Table 7: Comparison of different constraints in adoption of climate resilient technologies perceived by NICRA officials and NICRA farmers

Constraints	Mean rank	
	Officials	Farmers
Technical constraints	90.5^{a}	40.50^{a}
Labour and economic constraints	71.5^{b}	45.25^{b}
Social and personal constraints	58.25^{c}	48.56^{d}

Numerals superscripted with same character indicate they are statistically different with each other.

Their responses were based on intensity of severity of the identified constraints. These sets of constraints were compared using Mann-Whitney U Test. The value of test statistic and its significance level has been given in Table 8. The p-value computed highly significant for technical, labour and economic constraints. Hence, it could be inferred that the farmers and officials had a different perception on level of influence of different constraints. Level of significance of social and personal constraints was significant at five percent level($p>0.05$), so this constraint was statistically insignificant.

Table 8: Mann-Whitney U test for categories of constraints and its level of significance

Categories	Technical	Labour and Economic	Socio-personal
Mann-Whitney U	.000	380.000	645.000
Wilcoxon W	3240.000	3620.000	3885.000
Z	-7.136*	-3.693*	-1.387

*Significant at $p < 0.01$

CONCLUSION

Constraints perceived in adoption of climate resilient technologies had an influencing role in determining the rate of diffusion of these technologies. Both the farmers and officials shared a common perception about social and personal constraints that worked as resistance to change the conventional practices.This calls for redesigning the implementation mechanism of such intervention in order to enhance adoption of climate resilient technologies and its diffusion. The suggestions put forwarded by both farmers and officials from their field experiences and insights can be used for further restructuring the mechanism for effective delivery and devising new strategies to eliminate the flaws.

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