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Institutional Role in Climate Resilience Building Process in Rainfed Agro-ecosystem

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ABSTRACT

Krishi Vigyan Kendras (KVKs) are the main implementing agency of National Initiative on Climate Resilient Agriculture (NICRA). They were actively involved in technology demonstration component. KVK activities were at grassroots level in disseminating the technologies and making it familiar to NICRA farmers. Village Climate Risk Management Committees (VCRMCs) were founded in each village constituting representatives from all farmers' categories. VCRMC was involved in all activities for finalizing NICRA interventions, target farmer selection, target area selection, in liaison with gram panchayat and local elected representatives. Custom Hiring Centre (CHC) is innovative institutional mechanism for providing timely access to farm machinery for sowing, harvesting etc, which are imperative elements of adaptation strategy. The research findings substantiated based on farmers' perception that input delivery (mean rank of 7.21) from these institutions was highly useful. Farmers perceived financial assistance was the least useful service (mean rank 1.76) followed by marketing services (mean rank=1.88). Farmers got highest satisfaction from trainings undertaken on climate resilience (mean rank=6.43) and they considered that marketing services were providing least satisfaction (mean rank=1.86).

Keywords: Resilience building, Institutions, NICRA, KVK, VCRMC, CHC etc

INTRODUCTION

The imbalanced growth and short sighted developments threw off the essence of relationships and interdependencies established among various ecological, demographic and climatic entities. These imbalances are exerting ominous pressure on farming system and its dependents. Acting in this foreground, the onus of regaining the balances by establishing sustainable interrelations is on the state and the civil society. The herculean attempt to build resilience of Indian agriculture and the farming community instigated ICAR to set up network project NICRA at the national level. Its commencement was made with preparation of contingency plans for all rural districts of the country, which then led to selection of most vulnerable 100 districts to go ahead with demonstrations and application of improved technological options and adaptive strategies ad hoc. Adaptation requires well managed natural resources, enhanced food security, social and human capital development and strengthened institutional systems (Adger *et al.*, 2003). Mongi *et al.* (2010) suggested that there is a need for multi-level interventions on adaptation to climate change and variability taking into account of involvement of wide range of stakeholder. Institutionalising resilience mechanism is inevitable for NICRA success. Institutions are a set of formal (laws, contracts, political systems, organizations, markets, etc.) and informal (social norms, traditions, customs, etc.) legal ground rules that establish the basis for production, exchange and distribution (North, 1990). Operationally institution can be defined as social and scientific organization functioning for enhancing the resilience of agriculture with improved coping mechanisms to sustain the system against climate change impacts and facilitating local innovation. NICRA is functional through a variety of institutions at the implementation level. According to Swaminathan (2009), climate awareness at the grassroots level plays a catalytic role in mobilising local communities in equipping better management strategies to keep adverse impact of climate change at bay. The institutions carrying out different roles at grass-root level were KVK, Custom Hiring Centre, village climate risk management committee etc. Role is operationalized for the present study as project interventions formulated to address climate change issues in agriculture and related fields. The information about role played by these institutions is vital for further redesigning of the implementation mechanisms to up-scale these technologies. A well functioning institutional arrangement can be replicated to outstretch the benefits of climate resilient technologies to newer regions while giving priority to underserved population.Role of institutions involved in implementing and executing interventions for dissemination of climate resilient technologies must be unveiled inorder to establish their effectiveness and extend of success in achieving the project objectives. Thus, the present study was undertaken to identify various dimensions of roles played by the given institutions, the penetration of their servicesin terms of area of coverage, and number of beneficiaries covered, utility of provided service, level of satisfaction of users. The adhocracy nature of these institutions is instrumental in bringing back resilience of the system.

MATERIALS AND METHODS

The study has followed ex-post facto and survey research to extract out maximum information about role of institutions in routinizing resilience building process. The locales for the study were Tumkur district of Karnataka and Gumla district of Jharkhand. The research locales were selected purposively, as the NICRA has been implemented in these districts since its inception. To record the impact of NICRA, a period of action intervention is essential. Two villages viz. 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. Data were obtained through structured and semi-structured interview schedules, key informant interview, focussed discussions, periodic probing and secondary sources from beneficiaries of the project and KVK officials. The list of NICRA beneficiaries was taken from each KVK and forty respondents were selected by simple random sampling without replacement technique. Thus, a total of eighty beneficiary farmers were chosen. Ten staff each from 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. Penetration of services were determined by identifying the number of units or land area covered in hectare, and total number of beneficiaries involved under each service. Interpretation was based on Simple tabular analysis. The data on penetration was obtained from KVK officials, VCRMC and CHC members, and other secondary sources. For obtaining precise results various descriptive, parametric and non-parametric statistics were used. Utility of services and level of satisfaction obtained from these services were scored based on responses of beneficiaries on a five point continuum. Services were ranked based on mean rank obtained for each service on Friedman test.

RESULTS AND DISCUSSIONS

Krishi Vigyan Kendra (KVK): KVKs are the important implementing agencies of NICRA. They were actively involved in technology demonstration component. KVK activities were at grassroots level in disseminating the technologies and making it familiar to NICRA farmers. KVK supervises Custom Hiring Centre (CHC), Village Climate Risk Management Committee (VCRMC), fodder banks and seed banks operating under NICRA in a particular village. They hold regular meetings, group discussions, exposure visits, field demonstrations, field days and other extension activities for the beneficiaries. Two identified KVKs were studied to know their role in facilitating adoption.

Table 1 presented the activities of KVK, Tumkur (ICAR-IIHR), including its coverage in terms of area, and penetration in terms of number of beneficiaries covered. Under soil management practices trench cum bunding, contour bunding, ploughing across the slope, soil health card are the important ones, whereas construction of new farm ponds and percolation ponds are the major interventions of water management component. In case of crop interventions supply of high yielding and drought tolerant varieties of field crops (finger millet, maize cv. NAH 1137, red gram cv.

Table 1: Penetration of institutional activities-KVK, Tumkur

Technology/services	No. of beneficiaries	Area (ha)/ unit (No.)
Soil Management		
Land levelling and making compartments	15	6
Trench cum bunding	112	80
Contour bunding	25	20
Deep ploughing	2	2
Ploughing across the slope	20	5
Live bunds	14	6
Soil health card as monitoring tool	100	100 nos.
Compost production units	12	12 units
Crop mulching and Stubble mulching	11	4
Water management		
New farm ponds	120	70
Percolation ponds	11	11
Check dams	11	5
Micro irrigation	8	2
Crop interventions		
Field crops: Ragi, Maize, Red gram and Groundnut	346	80.5
Vegetable crops: Tomato and chilli	20	3.5
Fruit crops: Mango, Amla, Tamarind, Lemon, Cashew	20	11
Cropping system interventions		
Ragi + Red gram	30	10
Maize + Red gram	9	3.5
Groundnut + Red gram	60	08
Ragi + Dolichos	20	04

BRG-2, groundnut cv. GBPD-4), vegetables (tomato and chilli), fruit crops (mango, *amla*, lemon and tamarind) are the key interventions. Ragi and red gram based cropping system is another highlight.

KVK Gumla is a operational under Vikas Bharathi, an NGO. Activities and outreach programmes of KVK, Gumla were studied (Table 2). Through a number of interventions this KVK is providing its services to the beneficiaries. Besides the basic areas of work demarcated, the KVK is undertaking a list of activities for the welfare of the people around it. Skill training, processing and value addition, demonstration of scientific farming technologies, conservation of traditional crop varieties, low cost water conservation methodology, zero tillage, animal husbandry and fisheries are the major interventions provided by the KVK.

Table 2: Penetration of institutional activities-KVK, Gumla

Technology/services	No. of beneficiaries	Area (ha)/ unit (No.)
Natural resource management		
In situ moisture conservation	70	19
Water harvesting and recycling for supplemental irrigation	81	30 units
Crop production		
Drought/temp. tolerant varieties	133	53.75
Community nursery for delayed monsoon	35	15(3 units)
Intercropping/mixed cropping	4	2
Cropping strategy for higher income and nutritional security	21	9
Livestock		
Fodder production and improved fodder storage structures	30	12.60
Poultry and duck breed upgradation	5	5 units
Livestock interventions	423	1578 animals
Institutional intervention		
Seed bank	6	2.75
Fodder bank	29	12.6
CHC	68	33.7
Capacity building		
Training	246	11
Extension activities (workshop, field days, gosthi, awareness programme etc.)	1413	34

Village Climate Risk Management Committee (VCRMC): With approval of *gram sabha*, VCRMCs were founded in each village constituting representatives from all farmers' categories. VCRMC was involved in all activities for finalizing NICRA interventions, target farmer selection, target area selection, in liaison with gram panchayat and local elected representatives. VCRMC maintained bank account for all its financial transactions under NICRA embracing farmers contribution for different activities, handling of payments recovered from CHC. Bank account was opened in the name of VCRMC and was operated by any two signatories. For ensuring post-project sustainability extensive capacity building was organized by VCRMC. A sub-committee within the VCRMC was entrusted with the operation and management of the CHC. The revenue generated by way of hiring out the machines was deposited in a bank account managed by VCRMC and the revenue so generated was mostly used for the maintenance, upkeep and repair of the machines.

The organizational structure of both Tumkur and Gumla VCRMCs were consisting of 15 villagers with nominated members as President, Vice president, Secretary and Members.

The mandates of the VCRMC are to conduct meeting every month and discuss about the programme and climate resilient intervention, send notice in advance to members and farmers to attend the meeting, direct the committee in all stages of development and to take responsibility for the improvement of the committee, maintain bank account of the VCRMC under the supervision of Principle Investigator and Nodal Officer and maintain village seed bank.

Custom Hiring Centre (CHC): CHC is innovative institutional mechanism for providing timely access to farm machinery for sowing, harvesting etc., which are imperative elements of adaptation strategy. CHC emerged as a solution for prevalent problems in rainfed areas like very short sowing window and poor accessibility of small farmers to farm machinery. Activities of CHC resulted in avoidance of miseries due to inability to sow the crop timely.

Some of the important farm implements and machines provided through custom hiring center of Gumla, (Table 4) were - diesel pump, wheat thresher (maximum no. of beneficiaries-17 and maximum coverage-10.60 ha), power sprayer, gutur pump, knapsack sprayer, groundnut striper, portable rice thresher, cono-weeder, burdizocastrator, budding & grafting knife, sicke-tier, paddy drum seeder, computer with accessories, maize sheller, hand rotating duster, winnowing machine, GPS, small weather station, weighing machine, hand ridger, power tiller, seed treatment drum, CIAE seed drill, hedge cutter(labour saving highest -92.5%) are some of the important farm implements and machines which are part of the custom hiring center. Some of the perceived advantages of this CHC were; ensured timely operation especially in nursery and vegetable field preparation, helped in proper utilization of wheat by product as fodder, and development of consciousness for proper utilization of crop by product and storing of fodder.

CHC, Tumkur provided a number of implements and machineries to farmers (Table 5), like weed cutter with accessories, trencher, land leveler, furrow opener,

Table 3: Penetration of VCRMC activities

Interventions	No. of beneficiaries	Area (ha)/ unit (No.)
Natural resource management		
1.*In situ* moisture conservation practices		
Trench cum bunding	20	16
Levelling and bunding	9	4
Tree based farming system	2	-
Bio-digester	50	15
2.Water harvesting and recycling for supplemental irrigation		
New farm pond	7	4 nos.
Plastic lining of farm pond	1	1 nos.
Rejuvenation of farm pond	8	4 nos.
Heightening of check dam	5	1 nos.
Crop production		
Contingency crop planning–Navane	09	0.4
Drought tolerant varieties Ground nut ICGV91114	02	1.0
Dolichos Arka Amogh	15	2.0
Short duration varieties		
Red gram BRG2	32	3.0
Red gram BRG4	15	5.0
Varietal evaluation		
Water saving paddy cultivation methods		
Aerobic Paddy MAS26	05	2.0
Livestock interventions		
Improved shelters for reducing heat stress in livestock		
Heat resistant livestock shed	02	12
Institutional interventions		
Mechanization through custom hiring for timely planting	98	33
Capacity Building (No. of training)		
Forest tree/ agro forestry plantation	49	1
Livestock management science and technology in livestock Management	61	1
Management of horticultural crops	49	1
Natural resource management	43	2
Soil health management	30	1
Capacity building		
Exposure visit	50	1
Amla Field Day	51	1
Women awareness	40	5

heavy duty disc plough, disc harrow (ten plates), chaff cutter 3 hp, portable stroke power sprayer, water tanker (maximum area-30 ha and maximum farmers covered-75), power operated weeder1 hp, water pumping diesel engine (maximum area-30 ha and maximum farmers covered-75), tamarind deseeder, chisel plough, amla

Table 4: Penetration of CHC services, Gumla

Implements	No. of farmers	Area covered (ha)	Mechanization capacity (output/hr)	Conventional method capacity (output/hr)	Labour saved (%)
Diesel pump	03	7.40	25000 lit/hr.	2000 lit/hr.	92
Power tiller	07	1.40	0.15 ha/hr	0.04 ha/hr	73.33
Wheat thresher	17	10.60	6 q/hr	2 q/hr	66.66
Portable rice thresher	02	2.50	31 kg/hr	20 kg/hr	35.49
Winnowing machine	03	3.40	3 q/hr	1.5 q/hr	50
Power sprayer	-	-	0.12 ha/hr	0.01 ha/hr	91.67
Knapsack sprayer	05	2.10	0.05 ha/hr	0.03 ha/hr	40
Hand rotating duster	-	-	0.02 ha/hr	0.015 ha/hr	25
Seed treatment drum	05	2.00	100 kg/ha	60 kg/ha	40
CIAE seed drill	06	2.20	0.01 ha/hr	0.007 ha/hr	30
Gutur pump	-	-	0.15 ha/hr	0.05 ha/hr	66.67
Groundnut striper	-	-	62 kg/hr	8 kg/hr	87.1
Conoweeder	-	-	0.01 ha/hr	0.001 ha/hr	90
Paddy drum seeder	-	-	0.3 ha/hr	0.15 ha/hr	50
Hand ridger	-	-	0.001 ha/hr	0.001 ha/hr	0
Weighing machine	-	-	40 q/hr	36 q/ hr	10
Maize sheller	-	-	15 kg/hr	10 kg/hr	33.33
Burdizocastrator	10	13 no.	10 animal/hr	6 animal/hr	40
Budding & grafting knife	-	-	10 plant/hr	8 plant/hr	20
Hedge cutter	01	0.20	0.04 ha/hr	0.003 ha/hr	92.5
Sicketier	-	-	95 plant/hr	60 plant/hr	36.85

Table 5: Penetration of CHC services, Tumkur

Implements	No. of farmers	Area covered (ha)	Mechanization capacity (output/hr)	Conventional method capacity (output/hr)	Labour saved (%)
Disc plough	8	2	2 ha	0.3 ha	85
Brush cutter	25	10	0.75 ha	0.1 ha	86
Water tanker	75	30	4 ha	0.8 ha	80
Disc harrow	8	3	2.5 ha	0.4 ha	84
Farrow opener	16	6	2.5 ha	0.4 ha	84
Amla deeseeder	3	-	180 kg	10 Kg	94
Land leveler	16	10	0.75 ha	0.1 ha	86
Trencher	11	7	50 mt	5mt	90
Power sprayer	40	16	2.5 ha	0.2 ha	92
Power weeder	17	24	0.75 ha	0.1 ha	86
Water pumping diesel engine	75	30	6000 L	580 L	90
Weighing balance	50				

deseeder (highest labour saving-94%), chain saw, small weather station and weighing machine etc. for helping them to complete farm operation without any delay. It was observed that these implements and accessories contributed towards saving more than 80 per cent of labour cost. Water tank was best used among the provided services for irrigation.

Utility of services: It was obtained from Table 6 that most of the respondents found input delivery from these institutionshighly useful, gaining a mean rank of 7.21, followed by utility from agro-advisory services (mean rank=6.91). Studies have demonstrated that both the timing and frequency of resource delivery can influence the responsiveness of recipient ecosystems, with even short lived events of low frequency demonstrating disproportionately large effects on population demographics and community structure and function (Nowlin *et al.,* 2008, Yang *et al.*, 2008, Yang and Naeem, 2008, Flecker *et al.*, 2010, Yang *et al.,* 2010). The analysis of the data further showed that beneficiaries scored financial assistance as the least useful service (mean rank 1.76) followed by marketing services (mean rank=1.88). This indicated a need to provide crop loans, medium term and long term loans, subsidized supply of critical inputs at higher quantity and insurance coverage of crops, therein increasing rate of adoption.Various researches on credit showedahighly significantrelationship between use of variable inputs and production credit disbursement (Sidhu *et al.*, 2008). It is imperative to have a mechanism for differential credit supply after assessing the credit demand, cropping pattern and input requirement state/region wise rather going for uniform credit supply across the states (Vadivelu and Kiran, 2013). Marketing is one of the few missing link NICRA bears. Individual farmers' lack of market power, in combination with the lack of competition among input suppliers and among output intermediaries, leads to capture of much of the profit from improved technologies by market actors other than the farmer (Jack, 2013). Kashyap and Raut, (2006) identified, a need to design promising solutions like e-marketing to meettypical challenges of the rural environment such as physical distribution, channel management promotion and communication. NICRA should go for better marketing facilities through inclusion of a module on marketing.

Table 6: Utility of services as per Friedman test

Services	Mean rank
Agro-advisory	6.91
Input delivery	7.21
Training	5.99
Demonstration	5.30
Marketing of products	1.88
Financial assistance	1.76
Weather advisory	5.94
Soil testing and card	5.39
Farm literature	4.63

Various services provided by institutional arrangementswere compared using Friedman test to find utility and thus to get a picture on the most useful and least useful services according to the perception of beneficiaries. The results were found to be significant at less than five per cent level of significance. Test statistics and level of significance is given in Table 7.

Table 7: Friedman test for utility of services and its significance level

Category	Value
Test statistics	436.110
df	8
Asymp. Sig.	.000

Level of satisfaction of services: To find the relative level of satisfaction from different services provided on aspect of climate resilience a Friedman Test was conducted. The analysed data has been presented in Table 8.

Table 8: Level of satisfaction of services as per Friedman test

Services	Mean rank
Agro-advisory	5.48
Input delivery	6.07
Training	6.43
Demonstration	5.12
Marketing of products	1.86
Financial assistance	2.20
Weather advisory	6.38
Soil testing and card	5.86
Farm literature	5.61

The respondents perceived that they got highest satisfaction from trainings undertaken on climate resilience (mean rank=6.43) and the next highest satisfaction from weather advisory services (mean rank=6.38). Trainings were able to empower the farmers through improved skills and intelligent decision making ability. Improvement in knowledge, attitude and practice of farmers was achieved by trainings offered through farmer training centre (eg. Narayan *et al.*, 2015). While timely weather advisory helped them to escape from the evil trap of nature's calamity and crop failures. Sarkar (2014) found that the adaptive capacities of the farmers were enhanced through different technological intervention and through capacity building program of NICRA. Farmers considered that marketing services were the providing least satisfaction (mean rank=1.86), because; many times they unharvested the mature crops due to lower price and unavailability of suitable market for the products. The test statistics value was significant and it is given in Table 9.

Table 9: Friedman test for level of satisfaction from services and its significance level

Category	Value
Test statistics	371.468
df	8
Asymp. Sig.	.000

CONCLUSION

The resilience building mechanism of the vulnerable rural villages stems from the dynamic role played by a set of institutions. The activities of these institutions are in broad horizon ranging from advisory services to training and capacity building. In the study area, KVK, VCRMC, and CHC were identified to be the major agencies carrying out various interventions in promoting climate resilient technologies. The adhocracy nature of these institutions is instrumental in bringing back resilience of the system. These institutions theatre diverse set of roles in this game. Study of utility of services provided from KVK, CHC, and VCRMC proved that people were highly satisfied with input delivery from these institutions, followed by satisfaction from agro-advisory services. Further analysis arrived at conclusion that financial assistance as the least useful service followed by marketing services. This indicated to need to provide short term, medium term and long term loans, subsidized supply of critical inputs at higher quantity and insurance coverage of crops. The study revealed that trainings on climate resilience possess highest satisfaction according to perception ofrespondents and the next highest satisfaction is occupied by weather advisory services through issuing customized agro-advisory services and improving weather literacy. These institutions can createimmense impact towards climate resilience by undergoing some trivial changes to address the concerns felt and raised by farmers and field level functionaries. There is enough scope for improvement in performance of the institutions by concentrating on the strengths and bridging the lacunae highlighted in this study.

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