ROLE OF COOPERATIVES IN CLIMATE SMART AGRICULTURE

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Introduction

Climate change is an important challenge at the global level to secure food to the growing world population through improved agricultural production. Hence, 'climate action' is suggested by formulating Sustainable Development Goal (SDG) of taking urgent action to combat the climate change and reduce its adverse impact on agriculture. The achievement of this goal will have direct bearing on the other two SDGs on poverty and hunger.

There now realisation that global agricultural production needs to be 'climate-smart'; that is, agriculture needs to adapt to feed a growing world population in the face of a changing climate, without degrading the natural resource base. FAO (2012:1) writes that "more productive and resilient agriculture will need better management of natural resources, such as land, water, soil, biodiversity ...". Climate-smart agriculture (CSA), which is rooted in sustainable agriculture and rural development objectives, is expected to reduce hunger and improve environmental management.

Meinzen-Dick *et al* (2010) note that the response strategies addressing the two main manifestations of climate change, namely, global warming and an increased number of extreme environmental events, are mitigation and adaptation. Adaptation "involves actions that communities and individuals can undertake in response to changing conditions. These approaches include strategies within agriculture such as ... implementing water harvesting or

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irrigation schemes. Adaptation strategies within agriculture are connected with effective natural resource management (NRM), such as improved land and water management practices" (Ibid: 2). Mitigation strategies "reduce the probability of climate change through sustainable practices that mitigate the increased occurrence, severity, and unpredictability of weather patterns resulting from climate change" (Ibid: 1).

The discussion around CSA has mostly focused on the introduction of new agricultural technologies and practices at the farm level (Scherr, Shames and Friedman 2012). Meinzen-Dick, Bernier and Haglund (2013) present a list of such technologies and practices which include crop management (intercropping, crop rotation, new crop varieties, greater crop diversity and value chain & marketing), soil and water management (conservation agriculture, contour planting, terraces and bunds, water storage, improved irrigation, rehabilitation of degraded landscapes), livestock management, agro-forestry and so on. They also argue that climate smart agriculture will only succeed in delivering its promised benefits to poor farmers only when institutions promoting equity are in place supporting the new ideas and innovations.

Local institutions have potential to promote collective action to facilitate the adoption of agricultural technologies. They also undertake the functions of information gathering and dissemination, resource mobilisation and allocation, skill development, capacity budiling, leadership to the community, establishing linkages between the decision makers, transforming coping capacity of poor farmers into adaptive capacity and so on. Meinzen-Dick, Bernier and Haglund (2013: 3) note that institutions must “i) provide information about changing climatic conditions as well as possible responses; ii) foster innovation to develop and disseminate new practices and technologies; iii) encourage investment in physical infrastructure and/or in

learning new ways; and iv) provide insurance to cope with risks due to climate shocks and risks of adopting new practices".

In India, cooperatives are local institutions which have potential to promote CSA by undertaking the above functions. Credit cooperatives, which help the farmers in obtaining credit for agriculture, agricultural inputs, agricultural machines or equipments, etc., cater to almost all the villages in India. There has been increase in the number of cooperative institutions that were catering to agriculture from 95,871 in 1980 to 110,000 in 2004 (Mohan 2004). It, however, appears that credit cooperatives play the traditional role of providing credit only to crop production; even the credit disbursed to agriculture declined after the reforms were introduced in India since 1991 (Sahu and Rajasekher 2005) probably because of tendency to restrict their lending activities to risky field of lending to the agricultural sector (Pradhan 2013). This means that cooperatives are undertaking the four functions that are needed for climate smart agriculture.

Can cooperatives bring social innovation to promote climate smart agriculture in India? Mulgan *et al* (2007; 7) regard social innovation as 'new ideas that work to meet pressing unmet needs and improve people's lives'. They define social innovation as "innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly developed and diffused through organisations whose primary purposes are social" (ibid; 8). However, innovation in social field is missing due to lack of institutions and funds (ibid). There are four barriers that come in the way of any social change are: (a) Efficiency – people tend to resist reforms because of the short-term threat of worsening performance, so ensuring efficiency is important; (b) Interests – changing the people's interests in the new models of farming; (c) Minds – people's mind gets solidified in the form of assumptions and norms; (d)

Relationships – social sector rests much on personal relationships rather than formal organigram (Mulgan *et al* 2007).

It is here that cooperatives can bring in social innovations to transform and reorient the current agricultural practices to achieve climate smart agriculture (CSA), which helps in (a) increasing the agricultural **productivity** and thereby improving the farm income; (b) strengthening the resilience through **adaptation** and **mitigation** strategies for agriculture to minimise the short term risks faced by the farmers and to ensure their long term gains.

Credit cooperatives are currently making efforts to improve crop productivity by providing access to short-term credit. They also have potential to address mitigation strategies such as promotion of drought resistant seeds, reducing greenhouse gas effects with the help of good agricultural practices. Agrawala and Carraro (2010) studies the link between MFIs and adaptation to climate change in Bangladesh and Nepal and arrives at three categorises – (a) 'no link' when MFIs do not have any direct connection to adaptation, (b) 'win-win' where those MFI programmes which would automatically contribute to adaptation to climate change and (c) 'climate proofing' which refers to activities which might need to be adjusted to take up the climate change or to facilitate adaptation. However, cooperatives do not have mandate to directly participate in the adaptation activity of development and management of natural resources in rural areas. In the interest of climate smart agriculture, cooperatives need to become innovative in assuming new roles and establishing an interface with the local government and other local organisations. In India, interface between cooperatives and panchayats was envisaged right from the time of independence (Parajothi 2017).

Objectives and Methodology

In this paper, we explore the role that cooperatives can play in the promotion of climate smart agriculture, and social challenges that they face. The following questions will be addressed in the paper: Do farmers, cooperatives and local government perceive that there is climate change? If yes, what changes have they noticed? What measures are being taken up by the local organisations and farmers? How can the interface between cooperatives and local government be strengthened for CSA?

The methodological approach followed is to have an in-depth discussion with representatives of cooperatives, local government and other relevant organisations around issues such as perceptions on climate change, awareness on crops that are suitable for changed climate, drought resistant seeds, quantum of credit to CSA activities, challenges and constraints in promoting climate smart agriculture, the need for interface among local organisations and ways forward in this regard. Information on the following variables has been elicited from the farmers: effect of climate change on crop productivity, adaptation measures (such as growing crops or using seeds that are suitable to changed climate), use of traditional knowledge or practices as mitigation measures, credit and other support availed for climate smart agriculture.

Primary data were collected from four agro-climatically different districts of Karnataka since the potential of cooperatives to adopt social innovation in the climate smart agriculture is likely to be different across differently endowed districts. From each district, one grama panchayat[2] has been randomly selected. From the jurisdiction of each of these grama panchayats, one village was selected for the study. The sample households were randomly drawn. However, it was ensured that all of them are cultivators by asking a screening question on the extent to

[2] Lowest tier of local self-government in India.

which they depend on agriculture. The household which has at least one or more members depending on agriculture were covered for the study. In all, we have collected primary data from 76 farmers from four villages.

Profile of the sample villages

In the village from Backward district of Gulbarga, there are about 850 households. The numerically dominant caste in this village is scheduled caste. But, the caste groups that are socially and economically dominant are Lingayat and Reddys, and Muslims. Since the village is far off from the capital city of Karnataka and located in the backward region of north Karnataka, the village is not developed. The rainfall in the district is scanty and uncertain. The area under irrigation is quite low and the farmers in this village pursue semi-arid agriculture. They grow cotton, red gram and jowar rainfed crops. The government offices in this village include grama Panchayat, credit cooperative society, primary health centre, high school and so on. ***This is called as backward village***.

The second village is from Kolar district which is about 100 kms far from Bangalore city. There are 300 households in this village; most of the households belong to Vokkaliga and Scheduled caste. Vokkaliga is the dominant caste in economic and political terms. Most of the households obtain their livelihood through animal husbandry activities. It has been informed that there has been a shift in the occupational pattern in the village from agriculture to animal husbandry due to climate change. Here too, only the older generation has been depending on agriculture and other allied activities. The younger people have moved out of the village and are engaged in non-farm activities in Bangalore city. ***We call this as transition village***.

The third village is Mandya district which is known for Irrigated agriculture, and the cultivation of sugarcane and paddy. This is small village with about 200 households. Most of the

households belong to Vokkaliga caste. People in this village mostly depend on cultivation. ***This is called as irrigated village.***

The last village is from Dakshina Kannada located in coastal part of the state. The district receives copious rainfall. Although artificial irrigation is not very well developed in the district, farmers cultivate paddy with rain water. The farmers also grow areca nut, coconut and other plantation crops such as rubber, pepper and so on. The primary occupation of most of the households is cultivation, although the non-farm employment is also quite high. The district is one of the most developed in the state in terms of human resource development. This is large village with about 1,000 households. We call this ad developed village.

Table 1: Summary statistics of the sample villages

District	No. of households	Dominant caste groups	Important occupation	Crops grown
Backward	854	Scheduled caste	• Cultivation • Agricultural wage labour	Cotton, Tur dal, Jowar
Irrigated	167	Vokkaliga	• Cultivation • Livestock rearing	Ragi, Vegetables
Developed	1080	Backward caste and Minorities	• Cultivation • Agricultural wage labour • Salaried job	Areca nut, Coconut, paddy, rubber, pepper
Transient	300	Vokkaliga and Scheduled Caste	• Animal husbandry • Cultivation	Ragi, Eucalyptus tree

Source: The source for this table as well as remaining figures and tables is Primary survey.

Perception on Climate Change

All the sample households across the four villages perceived that there has been change in the climate (Table 2). They basically see the climate change in the extreme weather conditions and timings of seasons. A majority of the households reported that the climate change reflected in terms of both decrease in the rainfall and increase in the temperature. Interestingly, the

proportion of the farmers reporting that there been decrease in the rainfall and increase in the temperature was relatively less in the irrigated village.

Since when did the sample farmers observed the climate change? Most of the farmers noted that they have observed climate change in the last 10-15 years. There is however a difference across the study villages. Most of the farmers from the transition and backward villages observed the climate change since the last 10-15 years. On the other hand, a relatively large proportion of the sample households from irrigated and developed villages stated that the climate change is more of recent phenomenon (i.e. in the last 5 years).

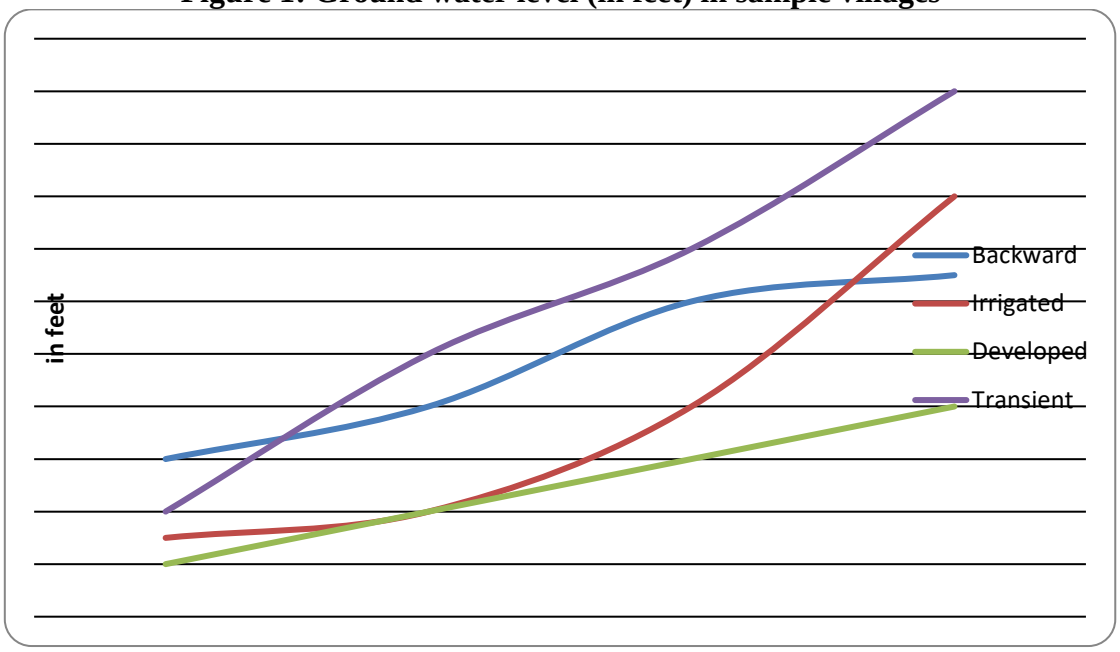
Table 2: Distribution of farmer households (%) by their statement on climate change

	Backward district [N=20]	**Irrigated district [N=20]**	**Developed district [N=20]**	**Transient district [N=16]**	**Total [N=76]**
Proportion of farmers perceiving climate change	100.0	100.0	100.0	100.0	100.0
Climate change reflected in terms of decrease in the rainfall and increase in the temperature	75.0	60.0	70.0	81.3	71.1
Farmers reported that climate change noticed					
- in the last 5 years	25.0	65.0	50.0	12.5	39.5
- in the last 10 years	55.0	30.0	45.0	62.5	47.4
- in the last 15 years	20.0	0.0	0.0	25.0	10.5

In the sample villages the climate change has also contributed to the decline in the ground water table. Discussion with key informants in the study villages shows that there has been decline in the ground water table in all the villages although the rate at which such a decline took place varied across the villages (Figure 1). As can be seen from the graph, the situation of ground water table has worsened in the last two decades. Two decades ago, the depth at which the ground water was available in the sample villages was ranging between 100 (in developed village) to 300 feet (in transition village). The depth at which ground water was available increased in all the villages thus signifying a decline in the ground water table. The decline in the ground water table was alarming in the transition and irrigated villages; now farmers have to dig 800-1000 feet to get water into their bore wells. Key informants attributed such a drastic

decline to less rainfall leading to drying up of water bodies. In addition, there has been over exploitation of ground water by digging more number of borewells in the village. The ground water level is comparatively better in developed district. This is only expected as this district is situated in coastal area and receives relatively highest rainfall.

Figure 1: Ground water level (in feet) in sample villages



Adaptation Measures undertaken by farmers

Faced with the climate change, did farmers undertake measures to adaptation? The response has been affirmative from 69 out 76 sample farmers (almost 91 per cent). These farmers have undertaken some or the measure to overcome the problems posed by the climate change. These measures could be positive or negative. Some measures such as soil and water conservation will address the problems posed by the climate change. Measures such as migration to city may help the farmer household to overcome the crisis posed by the climate change; but such a measure does not contribute to climate change. Let us now examine the type of adaptation measures adopted by the sample farmers.

However, it may be noted that farmers were not completely aware of the different adaptation strategies that can be adopted to address the impact of climate change. Many of them simply

reacted to the market changes! Various adaptation measures that were undertaken by the farmer households are provided in Table 3. These are both positive and negative strategies for climate smart agriculture.

Nearly 30 per cent of the farmer households reported that they have undertaken water and soil conservation activities such as building bunds, farm ponds, etc. Interestingly, these activities are more prominent in the backward and transition villages. A farmer from the backward village has been facing the problem of dwindling ground water table and inability to irrigate the crops with the help of open well that was dug years ago. He therefore devised a method to recharge open well. In the transition village, several farmers have undertaken the adaptation measures of bund construction and farm ponds with the help of funds earmarked for National Rural Employment Guarantee Scheme implemented by the grama panchayat.

The adaptation measure of agro-forestry was undertaken by 30 per cent of the farmers. Under this, some of the farmers from the backward district planted trees in their farm land or on bunds. Some of them planted neem trees in their field, which is very beneficial to cattle especially during summer season. A few farmers reported that they planted trees that would provide fodder to their cattle. From the transition village, farmers have started to grow horticultural crops as these would require less water.

More than half of the households reported that they have gone for new agricultural technology. The new technologies adapted differed across the villages. In the transition village, some of the farmers have gone for plastic mulching as this technology helped them in conserving moisture, reducing the need for irrigation water, lowering expenditure on weeding and so on. A few of

them have also gone for drip irrigation. Farmers adapting these measures were happy with the results as the water use efficiency has gone up.

In the other villages, especially in the backward and irrigated villages, farmers have gradually shifted from ploughing of land with animal power to tractor ploughing. The shift or dependence on tractors or tillers was essential because of the following reason. With the climate change, scanty and uncertain rainfall and unseasonal rains, the farmers could not grow those crops which will provide fodder to animals. Even if farmers wanted to cultivate these crops they could not simply do so as they did not have control anymore on the timing of rains. Such a change, which often recurred, meant that the farmers gradually did not have fodder for livestock. Under these circumstances, they sold away their draught animals and switched to tractor ploughing. So much so that the tractor is also used for land preparation, sowing, weeding, harvesting and so on.

About 42 per cent of households reported that they have changed seed variety. In the olden days, they were storing seeds of crops grown in the previous year and use the same for sowing in the next year. However, farmers not having control on timing of the rainfall, seeds stored could not be used and farmers were compelled to sow crops other than what they had planned. In such cases, they had to approach the shops for buying of seeds. With the timing of rainfall becoming uncertain every year, the farmers have almost stopped to store seeds. Now they only depend on shops for the seeds. In some of the cases, the new seeds proved to be better in the context of climate change. The farmers could now sow drought resistant seeds, which were also short maturing. The farmers opined that the new seeds grow better and faster as compared to the traditional ones. In the transition village, officials from the horticulture department visited the village to provide information on drought-resistant seeds and also supply them.

Most of the sample farmers reported that they started to use chemical fertilizers and pesticides because of two reasons. First, with the decline in the livestock population, the quantum of organic manure decline in the study villages. This has compelled them to use chemical fertilisers for better yield. Second, climate change has resulted in the emergence of new pests and farmers were of the opinion that the application of pesticides is must. Similarly, different type of fertilizers was applied to the crops in order to ensure better yields.

Table 3: Distribution of farmer households (%) by their statement whether they have undertaken any adaptation strategies

Adaptation measures	% of sample households saying "Yes"				
	Backward	Irrigated	Developed	Transient	Total
Positive					
Planted more trees/ Afforestation	45.5	0.0	31.8	22.7	28.9 (22)
Undertook water and soil conservation activities	36.4	13.6	18.2	31.8	28.9 (22)
Changed the cropping pattern	27.3	0.0	27.3	45.5	28.9 (22)
Changed the seed variety	56.3	3.1	25.0	15.6	42.1 (32)
Started using different type of fertilizers/ pesticides	37.7	13.2	35.8	13.2	69.7 (53)
Started using new technologies	38.1	19.0	26.2	16.7	55.3 (42)
Negative					
Reduced the cultivable land	14.3	0.0	28.6	57.1	18.4 (14)
Started to seek non-farm employment	17.1	39.0	24.4	19.5	53.9 (41)
Distress migration to urban areas	25.0	56.3	6.3	12.5	21.1 (16)

Nearly one-third of the farmers have resorted to a change in the cropping pattern. For instance, a farmer from the backward village reported that earlier he used to grow red gram. The precipitation for this crop should be optimal; in other words, precipitation should be more or less. Given the scanty and uncertain rainfall, farmers have shifted from red gram to cotton cultivation.

In response to the climate change, some of the farmers have also adopted negative strategies. Nearly 54 per cent of the sample farmers stated that they have undertaken non-farm activities, while 21 per cent of them migrated to urban areas under distress. This proportion was high in

irrigated district, which is closer to Bangalore city. Nearly one-fifth of the farmer households reported that they have reduced their cultivable land. This is especially the case in transition village. It was reported that because of shortage of rainfall or water, most of the farmers in transition village started to plant eucalyptus trees or mango trees in their farm land and started to depend on non-farm work especially on animal husbandry. The households eke their livelihood through milk selling.

Case: Ineffective adaptation strategies led to migration
A marginal farmer belonging to SC caste, from the backward village, has been cultivating red gram, cotton and jowar with the help of borewell irrigation. However, with declining water table, it has become progressively difficult to irrigate crops with borewell. This problem continued despite ground water recharge measures undertaken. Hence, one of the household members had to resort to migration to city to work as wage labourer in the unorganised sector.

When did the farmers adapt to climate change? Most of the sample farmers stated that they have adapted to climate change since 2005 (Table 4).

Table 4: Distribution of farmer households (%) by their statement on when was the adaptation strategies undertaken

When was it undertaken					
	Before 2000	2001-2005	2006-2010	2011-2015	Above 2015
Planted more trees/ Afforestation	40.9	4.5	22.7	31.8	0.0
Undertook water and soil conservation activities	9.1	0.0	27.3	54.5	9.1
Changed the cropping pattern	9.1	18.2	27.3	31.8	13.6
Changed the seed variety	9.4	31.3	25.0	34.4	0.0
Started using different type of fertilizers/ pesticides	3.8	39.6	34.0	20.8	1.9
Reduced the cultivable land	28.6	0.0	50.0	21.4	0.0
Started using new technologies	7.1	19.0	47.6	26.2	0.0
Started to seek non-farm employment	17.1	22.0	34.1	24.4	2.4
Distress migration to urban areas	0.0	6.3	31.3	62.5	0.0

How did they farmers mobilise funds for adaptation strategies? The farmers basically constructed farm ponds in the field with their own sources or through government programme, namely, MGNREGS (Table 5). Only activities such as water and soil conservation were supported by the watershed department or taken up under MGNREGS. Subsidy for drip

irrigation was provided by the horticulture department. Activities undertaken with the help of loan from cooperative society has been very miniscule.

Table 5: Distribution of farmer households (%) by source of funding for adaptation strategies

	No funding required	GP Provided	Loan from Cooperative societies	Loan from others	Own sources	Others
Planted more trees/ Afforestation	31.8	4.5	0.0	0.0	50.0	13.6
Undertook water and soil conservation activities	18.2	50.0	4.5	0.0	22.7	4.5
Changed the cropping pattern	36.4	0.0	0.0	4.5	50.0	9.1
Changed the seed variety	34.4	0.0	0.0	3.1	62.5	0.0
Started using different type of fertilizers/ pesticides	30.2	0.0	3.8	1.9	60.4	3.8
Reduced the cultivable land	100.0	0.0	0.0	0.0	0.0	0.0
Started using new technologies	47.6	0.0	0.0	0.0	31.0	21.4
Started to seek non-farm employment	41.5	0.0	0.0	2.4	51.2	4.9
Distress migration to urban areas	100.0	0.0	0.0	0.0	0.0	0.0

Role of Cooperatives

About 46 per cent of households reported to have obtained the loan from cooperative societies in the last 5 years. The proportion of households obtaining loan from cooperative societies has been relatively high in the irrigated village and the least in developed district. Nearly 63 per cent of them obtained crop loan for purchase of seeds, fertilizers, etc., while remaining had obtained loans for the purchase of cattle/ poultry or sheep rearing.

Table 6: Distribution of farmer households (%) by the status of borrowing loan from cooperative societies

	Backward	Irrigated	Developed	Transient	Total
Proportion of HHs borrowing loan from cooperative societies	45.0	60.0	35.0	43.8	46.1
Reasons for borrowing					
• Crop loan	100.0	33.3	100.0	28.6	62.9
• Dairy farming/ cattle rearing	0.0	66.7	0.0	42.9	31.4
• Poultry	0.0	0.0	0.0	14.3	2.9
• Sheep rearing	0.0	0.0	0.0	14.3	2.9

Remaining households have not obtained due to several reasons such as not aware of the cooperative society, not needed as unable to repay the loan, etc. Lack of access to credit seems to be a major constraint for not taking up adaptation measures in Ethiopia and South Africa Bryan *et al* (2009).

The above shows that the cooperatives have continued to play a traditional role of disbursing the loans. It was reported that the loan is provided to only land holders who possess proper titles and land documents. Another major issue is that cooperative loans were renewed year after year especially given that the rate of interest is zero.

The discussion with cooperative staff revealed that they have not interfaced with the other local organisations such as grama panchayats, horticulture department, micro-finance groups and so on. On the whole, the role of cooperatives was inadequate especially in the context of climate change and the need to promoted climate smart agriculture.

Conclusions and Policy implications

Farmers in the selected village have been experiencing climate change, which is getting reflected in terms of less rainfall, increased temperature and declining ground water table. Farmers have been making efforts to adapt to climate change in order to pursue climate smart

agriculture. However, it needs to be noted that these strategies are not very well thought out ones undertaken with full information on pros and cons of these strategies. The discussion makes it amply clear that the farmers are simply responding to climate change and market impulses. Here, the cooperatives should have played an important role in providing information on climate smart agriculture with the help of grama panchayats and self-help groups in the village, and preparing them.

In the absence of adequate information on adaptation strategies for climate smart agriculture, farmers have been adopting negative strategies with considerable future consequences. Here, cooperatives can play an important role in converting coping strategies as those enabling the farmers to adapt to climate change.

Cooperatives need to interface with horticulture and agriculture department in transferring the new information and knowledge relating to new seeds, new agricultural technologies. This is however not being done. Cooperative should also provide credit to farmers to adapt to climate smart agriculture. They are however playing traditional role of disbursing the loans for only crop production. The mere renewal of loans is also not becoming effective given the clime change. Cooperatives have therefore not yet become social innovation and consequently, there are several unmet needs of farmers.

Social innovation take place when there are unmet needs (Mulgan *et al* 2007). Given the climate change, there are several unmet needs of farmers. Thus, calls for social innovation to address the issues relating to agriculture. Climate smart agriculture through cooperatives is new idea that will meet the unmet needs of the farmers. In other words, one would like to see the cooperatives adopt the new idea of promoting climate smart agriculture so that the needs of

farmers are fulfilled. The unmet needs of farmers are: not able to obtain credit for new and innovative agricultural technology and for undertaking new cultivation practices. Another unmet need is undertaking soil and conservation activities in their farms.

Cooperatives cannot do so many activities on their own. They need to collaborate and work with self-help groups, panchayats and line departments such as horticulture and agriculture departments.

Mulgan *et al* (2007: 5) note that "many of the most successful innovators have learned to operate across the boundaries between these sectors and innovation thrives best when there are effective alliances between small organisations and entrepreneurs (the 'bees' who are mobile, fast, and cross-pollinate)". The same analogy can be extended to cooperatives as well. Cooperatives should operate beyond the boundary of disbursal of credit for crop production and collaborate with other organisations such as self-help groups, panchayats, line departments etc. There is a need for Cooperatives to be "mobile" to go around the villages, reach the farmers "fast" and "cross-pollinate" just like bees.

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