Making Climate Information Communication Gender Sensitive

Lessons from Tamil Nadu

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Increasing variability in weather and climate is a major production risk for farming, especially among smallholders and, in particular, women farmers. Advances in forecast development at finer spatial and time scales as well as communication modes offer greater scope to reduce such risks in farming. The practical experiences in understanding farmers' perspectives on local weather and climate, and on communicating climate information and advisories with gender sensitivity are shared. The processes involved in creating trust, understanding gendered needs within existing communication networks, and strengthening the social contract between climate experts and farmers in communicating climate information are discussed.

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The use of appropriate climate forecast information with a suitable lead time and finer spatial scale is considered as one of the best climate change adaptive risk management strategies. The scientific advances and technical capacity in climate modelling have been improving in recent years, resulting in greater accuracy in predicting weather and climate (Stern and Easterling 1999; Tall 2010). Both, medium range weather forecast (MRWF) and seasonal climate forecast (SCF) are helpful to smallholders for taking informed decisions, managing risk in farming, and maximising opportunities when favourable rainfall is predicted. Several experimental research studies indicate that climate information can support farmers in reducing vulnerability to seasonal droughts and extreme events, and harness opportunities when good rainfall is forecasted (Phillips et al [2001] and Patt et al [2005] in Zimbabwe, Meinke et al [2006] in Australia, India, and Brazil, and Roncoli et al [2009] in Burkina Faso).

In India, an economic impact study on agro-meteorological services, coordinated by L S Rathore and Parvinder Maini (2008), in 15 states across the country found that farmers who were using advisories had 10%–15% higher yield and 2%–5% reduction in the cost of cultivation, when compared to farmers not using weather forecast-based agro-advisories. In spite of its potential benefits in improving adaptive capacities to climate risk, there are social and technical challenges in accessing and using climate information by smallholders across developing and underdeveloped countries.

The prevailing inequality in access to and the use of climate information by women producers assumes greater importance in a context where 79% of rural women are engaged in agriculture as against 63% of men in India (NSSO 2011). In rural areas of Maharashtra, Gujarat, Andhra Pradesh and Kerala, Sejal Dand (2010) found a rapid decline in men's contributions to both subsistence and family farming among smallholder households. As they shift to non-farm wage employment in urban and peri-urban areas, women are managing the house and farms, a finding confirmed by Nitya Rao (2012) in her study in Uttar Pradesh.

In the context of changing agrarian systems in India, while women play a dominant role in agriculture management, they continue to have inadequate access to and control over productive assets, including the necessary information and knowledge for farming (FAO 2011; Mehar et al 2016), restricting their capacity to adapt to climate change (Patt et al 2010). Arame Tall et al (2013) have reported five key challenges in supporting the small farmer's access to climate information services: providing the right content, timely information sharing, including farmers' voices in design and delivery, inclusiveness to cover women and other marginal users, and combining climate information delivery with other services for agriculture development. A study by Venkatasubramanian et al (2014) on MRWF pointed to the need for improving its strategy in reaching women and marginalised farmers. This gap persists despite the multiple communication channels used to disseminate forecast and agro-advisories to farmers, including websites, radio, newspapers, Kisan Call Centres, Common Service Centres (CSCs), voice messages, etc. The same study also highlighted the constraints faced by women in accessing and using climate information, such as the inability to read advisories, lack of time to listen to the radio or watch television while advisories were relayed, and low participation in group meetings in the village due to gender-related sociocultural norms.

The most important barriers observed in communicating climate information to smallholders, particularly women, are quality and relevance of the information in terms of the content (lead time and spatial scale) required by smallholders, understanding their traditional knowledge systems on climate forecast and risk management, sharing, and practice, the mode of communication, and the capacity to use the information. In this paper, we focus on these themes to demonstrate how the delivery of climate information can be gendered.

Relevant content: In terms of content, climate information services are primarily provided by the government and research organisations. However, at present, private organisations have also entered with market-based approaches. James Buizer et al (2009) point out that standard knowledge production institutions tend to produce information that is useful only within specific disciplines, whereas decision-making and management activities must integrate various types of information in a complex environment consisting of political, economic and social factors. Thus, further discussion and work is needed to link the information from downscaled models with local scale analysis, with those who possess knowledge of the region on how to close the gap in reaching smallholders, including women farmers. Providing need-based information to men and women farmers is basic for its relevance and use. This requires a paradigm shift from supply-driven activities to user-focused ones by understanding the needs of decision-makers, including women, to develop and adopt appropriate adaptation strategies (Ziervogel and Zermoglio 2009).

Traditional knowledge: It is vital to recognise the existence of a rich repertoire of traditional knowledge and practices among smallholders on climate prediction and local adaptation. The local predictions provide clues about those aspects of climate that are most salient for farmers and about the kind of climate information farmers seek to mitigate climate risk. At the same time, they can help enhance the relevance of scientific forecasts by integrating them with locally specific observations (Eakin 1999; Roncoli 2006). For example, Mexican farmers use environmental indicators such as animal behaviour and phases of the moon for short lead time prediction, and occurrence of snow and wind direction for longer lead time prediction, providing insights to climate modellers on the type of climate information needed by farmers and how it should be communicated to them.

It is important to note that the traditional knowledge systems are socially constructed and gender is a key factor to be considered along with other factors, like caste, class, age, etc. It was observed among smallholder farmers in rural Tamil Nadu that older men and women use more than 12 indicators for weather forecasting, whereas the middle aged (25–35 years) use only three to four indicators. Also, landowning small and marginal farmers use more indicators with high reliability than agricultural labourers (Rengalakshmi 2006). Farmers who trust and value forecast information of MRWF have expressed that integration of farmers' knowledge in the agro-advisory development process needs improvement (Venkatasubramanian et al 2014).

Communication of climate information: Different methods have been adopted to deliver climate information, namely deterministic and probabilistic formats. Surabhi Mittal (2016) studied the use of mobile phones as a potential medium for communicating deterministic forms of MRWF to smallholders, especially women farmers, pointing out the gaps in reaching women. P Roudier et al (2014) used simulation exercises to show crop management strategies under different types of climate, while participatory methods like interactive games and role plays were used to communicate the probabilistic nature of forecasts among subsistence farmers in Zimbabwe (Patt et al 2005) and smallholders in three different agroecosystems in Burkina Faso (Roncoli et al 2009). The use of farmer networks has been another strategy for communicating climate information (Roncoli et al 2011; Venkatasubramanian et al 2014). Tall (2010) and James W Hansen et al (2011) reported that the content of words used in communication, that is, use of technical words, and the one-way mode of the communication channels were some of the factors hindering communications from reaching smallholders in Africa. Lack of trust is another major barrier (Patt 2000), along with salience, credibility, and legitimacy (Cash et al 2003), and limited access to finance and inputs for translating the forecast into practice (Patt and Gwata 2002).

Building capacity of farmers to use the climate information: Forecasting is not a matter of providing information or data, but a continuous process of building confidence and trust on the climate products among farming communities. A Agrawal (1995) points to the cultural divide between the ability of farmers to understand the lexicon and symbols of global and regional climate forecasting, and the ability of scientists to understand and value the knowledge and perceptions farmers have of their environment and climate. One way to bridge the gap between modellers and climatologists, and end users is developing a cadre of intermediaries at the grass-roots level who can interpret and communicate this information effectively, considering the socio-economic and cultural context of the end users. Creating an enabling environment is a vital factor that can facilitate men and women farmers' ability to use climate forecasts.

Methodology

The research study was undertaken during 2011 to 2016 in Reddiarchatram block, a semi-arid region located in Dindigul tehsil and district of Tamil Nadu. The areas covered in the district were Kannivadi, Dharmathupatti, Konur, Kasavanampatti, Kuttathupatti and Anumantharayan Kottai panchayat villages. Agriculture is the primary occupation for 80% of the households, 29% of whom are enumerated as living below the poverty line. Of the landowning farmers, 72% are smallholders, 17% are medium landowners, and 11% are large farmers, according to the 2010–11 agriculture census (GoI nd). The area is culturally heterogeneous. Moopanars and Vettuva Gounders are the demographically dominant backward caste groups involved in agriculture. The other major backward communities include Vellala Gounders, Reddiars, Thevars, Udayars, and Telugu-speaking Naidus. Agriculture is the primary occupation of all these communities. Tamil-speaking Parayans and Telugu-speaking Chakliars are the two Scheduled Caste groups residing in the villages, working on the farms of the landholding groups. Crop cultivation, livestock and wage labour are the main income sources for smallholders, and wage labour is the primary source for landless, Dalit households.

The mean annual rainfall is 846 mm. Rainfall in the region varies widely among seasons (Table 1). October to December is the main cropping season in which crops are grown predominantly under rainfed conditions in most of the land area, followed by June to September and April to May (summer crop), when crops are cultivated using groundwater in smaller areas.

Table 1: Annual Distribution of Rainfall in Different Seasons

Season	Rainfall Received (%)
Southwest monsoon: June to September	25.8
Northeast monsoon: October to December	52.5
January and February	5.4
March and May	16.3

Source: Data collected during 2004–17 at the Agro-field Meteorological Unit, Kannivadi, Reddiarchatram block, Dindigul district, Tamil Nadu.

Of the total area sown in the block, 66% is under rainfed systems (Government of Tamil Nadu 2017). The major source of irrigation is rainfall, supplemented with groundwater, and the primary crops grown are cotton, maize, vegetables, flowers, and annual moringa.

There were eight Village Knowledge Centres (VKCs)[1] functioning in the region with a hub centre managed by Reddiarchatram Sustainable Agriculture Producer Company Limited (RESAPCOL),[2] a farmer collective working in this region. Smallholder farmers, who largely belong to backward and most backward castes are the primary members targeted for climate communication. With reference to gender relations, men and women have clear divisions of labour. Women's participation in farm-level decision-making is limited to contribution of labour and execution of agronomic practices like sowing, weeding, and harvesting, based on their traditional roles and experiences. Though women are doing more than 80% of the agricultural work, they seem to lack the confidence to take decisions in the absence of both necessary information and access to inputs from markets. This situation makes women mere contributors of physical labour in crop cultivation. Women's access to formal agriculture extension services and information relevant to agricultural operations were also inadequate due to their limited institutional linkages and informal networks at the village level. Ultimately, they end up depending on men in the household for any new information and knowledge.

The study used qualitative methods to understand the existing climate prediction processes and indicators, associated traditional knowledge, current sources of information, kinds of forecasts with lead time needed by men and women farmers, and existing climate risk management strategies. The gendered traditional knowledge concerning weather and climate forecasting was studied through anthropological tools, such as participant observation, and participatory developmental tools, such as Venn diagrams and focus group discussions (FGDs). During 2013–14, six separate FGDs were conducted in the six study villages with men and women farmers, each with 10 to 12 participants above the age of 40 years: two FGDs with women agriculture labourers, two FGDs with women farmers, and two with men farmers, covering farmers from complete rainfed agroecosystems and a mix of small-scale irrigation and rainfed systems.

During the discussion, the age of the participants and their experience in farming played a crucial role while sharing their perspectives on climate events. Also, women who moved to this village after marriage from different agroecosystems or distant villages were not comfortable as they felt they did not have adequate knowledge and experience of the local systems. To set the context and initiate the discussion with farmers, the climatological analysis (done using 30 years of weather data for the region)—covering quantity, onset, and distribution of rainfall within and across different seasons—was used. Key informant interviews were also conducted during 2013–14 with 12 farmers from different agroecosystems within the region (equal number of men and women), who were both experienced and willing to share their stories on dealing with climate.

The M S Swaminathan Research Foundation (MSSRF) has been a part of the Agro Meteorological Field Unit (AMFU)[3] network of the Indian Meteorological Department (IMD), Government of India, which provides operational MRWF information and advisories at the district scale. Additionally, SCF is provided with the technical support of Tamil Nadu Agricultural University (TNAU) since 2004–05, and extended range forecast at the state scale through the IMD. Here, the MSSRF's role is to add value to the forecast information in partnership with RESAPCOL as agro-advisories suitable to the prevailing local cropping pattern and socio-economic situation, and disseminate this to farmers. While developing forecasts, due attention is given to women-specific issues. The advisories include current and forecasted weather, soil and crop conditions, and recommendations for taking necessary action to minimise losses and optimise the use of inputs. The MSSRF also undertook a research study to investigate the use of SCF,[4] that is, forecasts with one to six months' lead time to enhance food security by reducing climate risks in different lead periods.

MRWF, presented in the deterministic mode, comprises weather variables such as rainfall, minimum and maximum temperature, relative humidity, wind speed and direction, and cloud cover, and SCF, presented in the probabilistic mode, provides the quantity of rainfall in the season. Value is added to the forecast information at biweekly intervals, converting them into suitable agro-advisories, which RESAPCOL communicates to the farmers through regular farmer meetings and through VKCs. In addition, they use bulletin boards, farmer group meetings, voice mails, WhatsApp messages, social media like Facebook and YouTube, and a local newspaper (regularly produced by the farmer's collective). The farmers were organised into smaller groups and the regular monthly group meetings of farmers were used as a forum to collect feedback on the quality of forecasts and appropriateness of the advisories, and assess new climate information needs. The presence of farmer collectives and VKCs in the region for more than a decade has helped the development of a strong social network, especially among women and marginal farmers. The farmer's collective bundles the climate information with different services, such as inputs, finance, technology, and market access.

Understanding Traditional Knowledge

Recognising and valuing men and women farmers' perceptions and knowledge of climate change and variability is critical for effective communication of scientific forecasts. Knowledge is learnt and shaped within a cultural context; it follows a specific language, beliefs and processes. In this context, three areas were explored in relation to the traditional knowledge of farmers: the proverbs indicating climate- and agriculture-related issues, perceptions of climate variability and risk, and how these measure and explain the intensity of weather events.

Local proverbs associated with weather and climate variables are considered an abstract form of ecological knowledge, observed and consolidated over a lifetime of experience. The proverb is considered and treated as a special genre in ethnographic studies (Fasold 1990) and serves as a powerful tool for personal communication transmitted through speech. Hence, FGDs were conducted with elderly men and women (above 55 years) to understand proverbs that are related to climate and agriculture. Younger generations participated as listeners. The popular proverbs used by the smallholder farmers belonging to the backward and most backward castes, practising rainfed cultivation, reveal patterns of rainfall and their links to cropping seasons, which helps understand the current changes.

The proverbs expressed in Box 1 are region-specific, and differed between men and women farmers, attributed largely to their assigned gender roles in agricultural practices. In the case of proverb A, it reflects crop selection, predominantly decided by men farmers, whereas proverbs B and C are connected to women's concerns in agriculture. Specifically, proverb B, expressed by a smallholder woman farmer, is linked to getting an assured harvest. Proverb C connotes replenishment of trees for livestock feed and decomposition of crop residues, and is commonly used among women who own a few goats (maximum seven to 10 goats), practising open grazing within a limited geographical space around the village. This analysis brings out the need for climate information at a seasonal lead time and indicates how it is used differently by men and women farmers as well as, potentially, by agricultural labourers. Such understanding is necessary for the climate scientists and intermediary organisations to develop gender-sensitive content in the value addition process of forecast information through agro-advisories. The routine needs assessment exercises with men and women farmers may not bring out such deeper issues and perspectives.

Box 1: Proverbs Relating to Climate Variables Used by Men and Women Farmers for Communication

Men

A "thaiyil pottal tharaiyodu pogum" (Do not cultivate any crop during late January to mid-February)

Women

B "panguni malai penjal palaiyasathathuku kooda vazhi illai" (If there is any rain during 15 March to 15 April, there will not be access even to watered rice)

C "masi mazahi peithal maram thazhaikkum" and "thai mazhai peithal thatta madikkum" (Rain during January–February helps the new growth of trees; December–January rain helps decompose the crop)

The FGDs, then, focused on understanding climate change using trend analysis to know the past and present conditions and intensity of climate variability as perceived by the farmers. The region has experienced crop loss due to extreme weather events like flood and drought on many occasions in the past. However, extreme drought—the major climate risk—occurred once in 10 years on an average during the last four decades. The drought situation always led to severe food scarcity in the region and people resorted to a host of coping mechanisms in the past (from the 1960s to the 1980s). For example, to cope with drought conditions, every household used to store grains in big storage bins, meet additional food needs by consuming agave and wild edibles, reduce food intake, get consumption loans from relatives, etc.

Since the 1980s, they have shifted to adaptation strategies, such as changing the cropping pattern, creating access to small-scale irrigation through borewells, men migrating to nearby industrial towns, etc. Such practices are resource intensive and available to farmers who have access and capacity, while others resort to non-farm income/employment/enterprise options to diversify their livelihoods. It also emerged from the discussion that both men and women perceived climate variability differently in farming. Extreme events like prolonged drought and flood were important to men, whereas women additionally mentioned wind as a major weather variable affecting farming (Table 2, p 91).

The above timeline data was collected in separate FGDs with men and women farmers who were more than 60 years old. Though there is a slight variation in the years mentioned for specific events, compared to men, women could recall more climatic catastrophes. The strategies adopted to overcome the extreme events were also different. Women spoke of coping mechanisms based on their labour, while men focused on crops and technologies. Men have considered post-climate events as a chance to improve the production systems and income by reducing and managing risk (by increasing the area under irrigation, diversifying the cropping system, and cultivating commercial crops and tree crops with reduction in the area cultivated under food crops).

Women, on the other hand, appear to be driven by the desire for food security and self-reliance, making them opt for labour opportunities. There is also a difference across caste and class. Changes in cropping systems that focus on coconut, maize, cotton, vegetables, flower crops, etc, have reduced the labour opportunities available to women agricultural labourers, while increasing the scope and work of women as family labour in landowning households. Cultivation of important food crops such as little millet, finger millet, barnyard millet, grain sorghum, pearl millet, and paddy has been drastically reduced, which has reduced both the foodgrain availability in landowning households as well as labour opportunities for landless women. The gender differential in the responses for the strategies used to cope with the different climate risks over a period of more than 50 years in the region reiterates the power relations among men and women and its outcomes.

The proverbs, references, and words used by the farmers and the historical trend analysis point out the necessity for seasonal climate information with higher lead time, used differently by men and women farmers. Such an understanding of gendered knowledge of climate risks, but equally differential coping and adaption strategies, reveals the type of climate information and events that are important to men and women farmers, and forms an important input in the forecast advisory development process for ensuring gender sensitivity of the contents.

Relevant Content

The second important element in climate communication is providing relevant and user-friendly content. Climate information is communicated at two levels: first, the basic climate forecast information, which farmers interpret and use according to their field situations, and, second, experts add value to the forecast and communicate this to farmers as agro-advisories. Both types of information are necessary for farmers considering the diversity and heterogeneity of farming systems among smallholders.

Table 2: Gendered Perception on Climate Variability and Response Strategies

Year	Major Climate Events	Strategies Adopted to Cope with the Climate Risks
Men farmers		
1960s	Red gram famine (*Thuvarai Pancham*)	Cultivating white sorghum, irungu (fodder sorghum) sugar cane, banana, tomato, ladies finger, paddy, bajra, groundnut
1977	Very high (intense) rainfall within a short period of time led to the Azhagapuri dam breaking, and crop loss	
1983	Continuous rain for eight days during January–February	Tapioca, betel leaves, sunflower, cotton and mulberry were introduced
	Drought	Maize, coconut plantation, melons introduced and area under paddy cultivation reduced
	Due to seasonal drought the coconut palms with nuts shedding started first and gradually within a span of six to nine months trees were dried up	Borewells were introduced to provide assured irrigation to smaller portion of the fields, where vegetables, flower crops, etc, were cultivated
	Food scarcity, famine experienced	People ate agave leaves, wild foods
2004	Continuous, heavy rainfall experienced in one day	SRI in rice, Bt cotton varieties, micronutrients and biofertilisers introduced, MGNREGA introduced, cropping intensity increased to more than 200% using groundwater
2005	Loss of cotton due to heavy rain at harvest	
	Maize also affected due to heavy rain	
2012	Banana and sugar cane loss	Drip irrigation and mulching technologies introduced
	Cultivation affected due to disruption in electricity supply for long periods (the overall storage at the dams of water collected from rainfall is linked to electricity production; inadequate rainfall at the regional scale during the main monsoon season in the state would lead to disruption in electric supply)	
Women farmers		
1955–60	Red gram famine (*Thuvarai Pancham*)	Red gram grains (*thuvari*) and tubers of agave (*kattrazha kizhangu*) were widely consumed
1964	Heavy rain and flood	Severe crop loss, wilting of crops
1972–75	Drought	Small millets, bajra and sorghum were main diets
1977–78	Heavy rain and storm along with wind, tank bunds and Azhagapuri dam broke, resulted in heavy crop losses and famine	Depended on household grain reserves for food and resorted to consuming wild foods especially Agave
1980s	Drought	Maize was introduced, vegetables grown in small areas, migration to Coimbatore and Tirupur regions to work in garment factories
1990	Food scarcity, famine	Small millets replaced by cotton and maize
2001–03	Drought	Area under maize cultivation increased, borewells introduced, side bore was was increasingly used
2009–10	Heavy rain, groundnut and tobacco affected	During complete crop failure due to extreme climate events, farmers changed their livelihood from cultivators to agricultural labourers and, in search of wage employment, they moved to faraway places spending more time in travel (up to 120 km in a day) apart from doing fixed hours of agricultural work
2011	Heavy rain, bunds were broken, paddy fields were covered under soil	
2012	Heavy wind and seasonal drought, maize crop failure due to heavy wind	

Source: Developed by authors from the FGDs with men and women's groups.

At the first level of communication, the forecast is decoded and communicated to farmers, including women farmers. The most important point in communicating the climate information is ensuring that farmers understand the meaning of the weather variables that are being communicated by the scientific institutions. For example, if one communicates 25 mm of rainfall as forecast, most farmers would not understand this scientific expression of rainfall. Instead, if researchers/extension persons understand the local terms and expressions, and use them, the information is likely to be better understood and used for making decisions. In this case, most of the men farmers relate 25 mm as "one plough" rainfall (that is, sufficient to carry out one ploughing) and women measure the quantity of rainfall based on the amount of water gathered in the grinding stone pit near the house. Similarly, if a forecast of wind direction of 100° is communicated to a particular village as "lessana kathu sanimolaiyilurunthu addikkum," which means mild wind blowing from the north-western direction, farmers are likely to understand the correlation better. This understanding is further enhanced when they visit such weather parameter monitoring systems in the observatory.

In the case of SCF, which is in a probabilistic mode and given only for rainfall, a different approach in communication is used. It is expressed as normal, above normal and below normal. As a first step, decoding these terms here, characterising what is normal rainfall for the region was most crucial to understand the categories of normal, above normal and below normal, since these terms are relative. The farmers were involved in defining what they considered or perceived as normal season in terms of the quantity of rainfall they expect in the growing season, which is 375 mm within a four-month interval. This decoding helped them understand the different probability of rainfall for the given season starting from a climatology scenario of equal chances of normal, dry and wet season, and vary the probabilities.

At the second level of communication, the value addition and communication of agro-advisories, there were two important steps in which gender sensitivity was brought in. Usually at the advisory development phase, as per the suggested protocol, the nodal person selects four major crops based on the area under cultivation, without taking into account men's and women's priorities. Here, the interface institutions such as RESAPCOL and VKCs were oriented and sensitised to the issues of gender, caste and class with a focus on women and smallholders. While developing the agro-advisories, due care was taken to include one or two advisories directly relevant to women farmers. For example, one advisory is related to livestock and another one is on crops, in which the women's role is dominant. In the second value addition phase, the integrator needs to be aware of the local farming systems and differential roles of men and women to ensure responsiveness to women's climate information needs. While adding value to climate information and communicating it, the roles of technical and boundary partners are crucial in designing and disseminating the contents that are appropriate and suitable to women and small farmers, and hence their sensitivity towards equity issues need to be considered.

A common challenge is that, while in the pilot phase, equity and inclusive approaches are given due priority with multiple strategies when upscaling and institutionalising the results in the systems, the intensity of the processes gets diluted. How these inclusive processes can be sustained while upscaling remains a question, an issue also highlighted by Tall et al (2014), who suggest a proactive targeting approach to reach small farmers, including women, in the design and dissemination phase of climate information services.

At the national level, for interpreting and adding value to MRWF and extended range forecast, the IMD has established institutional mechanisms, such as the Integrated Agro Advisory Systems with AMFUs. These institutions have fine-tuned the systems and processes over a period of 10 to 15 years at the national scale. To communicate climate information, they have also made partnerships with boundary institutions like farmers' associations/collectives, the department of agriculture or the animal husbandry extension, representatives of CSCs, etc. However, the approach of gender and social inclusiveness of such organisations needs sustained attention.

Mode of Communication

Communication channels play a crucial part in disseminating the intended information to women and smallholder farmers. The use of communication channels with two-way communication modes, such as bulletin boards, farmer group meetings, voice mails, WhatsApp messages, web-based sharing through an exclusive portal, telephones, and local newspapers with feedback options were important for farmers to access and use the information (see Jost [2013] for East and West Africa). Being in contact with the farmers' association representatives supported farmers in clarifying and taking further inputs. The farmers' association also recorded short case stories on the usefulness of climate information and shared these through social media like Facebook and YouTube. Tall et al (2014) have pointed out that combining information and communication technology (ICT) and digital platforms with a cadre of trained local knowledge workers in dissemination helps benefit smallholders. Apart from this, women farmers suggested the use of traditional communication strategies, such as the traditional messengers (*thandora*, a person assigned by the village head to orally spread the given information by beating drums at street corners) to communicate information.

In the case of SCF communication, considering its complexity, the team adopted a participatory workshop mode with equal participation of men and women farmers and used different decision-support tools like decision trees, decision graphs, and wonderbean[5] to communicate SCF information. The economic value of SCF was assessed against multiple and potential decisions that could be made using the forecast. According to Carberry et al (2000), the decision analysis tools help analyse the trade-offs between competing decisions and are useful for comparing the relative profitability of the likely decisions that the farmer may make based on the forecasts. Participatory processes adopted in engaging farmers have supported in strengthening the social contract between climate scientists, intermediary organisations, and farmers, especially smallholder and women farmers. Meinke et al (2006) stated that the credibility has to be built through the process of engagement, and not just from the scientific value of the communication. Box 2 provides an illustrative example from the current study.

Box 2: Discussion with Men and Women Farmers on Communicating SCF

The researchers used the decision tree method among men and women farmers to weigh the potential decisions and outcomes by mapping under a given forecast. It was helpful to evaluate the decisions based on economic outputs. The common crops grown during the main growing season were taken as an example while discussing the strategic decisions in terms of managing climate risks. The farmers selected crops such as maize, cotton and vegetables. Among vegetables, ladies finger, a commonly cultivated vegetable in the region, was chosen for analysis. The hypothetical SCF given was chances of 60% normal, 20% above normal and 20% below normal rainfall. In the analysis, ladies finger crops worked out to be a good option in terms of gross margin to the farmer. However, in the discussion, farmers were not willing to take up this crop as it demands more family labour, especially of women, early in the morning during harvesting season. Instead, cotton and maize were considered as ideal crops for the region. Further discussion revealed and reiterated the holistic nature of the farmers' decision-making criteria in considering non-climatic factors as well when using the forecast to take decisions. Though cotton fetches a higher gross margin than maize under the different rainfall scenarios considered for analysis, farmers with access to irrigation opted for maize because it is a short-duration crop and they can use a small plot of the same land for another high-value crop with irrigation (Manjula and Rengalakshmi 2015).

Most studies confirm that trainings and discussions with farmers in villages are the best modes for dissemination (Venkatasubramanian et al 2014; Tall et al 2014). These facilitate two-way communication, and are thus helpful in effectively communicating scientific forecasts through building on the farmers' own knowledge and experiences, when compared to the outreach efforts through government extension and mass media, which are characterised by one-way communication (Phillips and Orlove 2004; Patt et al 2005; Roncoli et al 2005).

Following this, efforts were made to understand how farming-related information and climate forecast information and advisories were shared at the farmers' level in the villages (Gaillard et al 2014), the existing communication channels and patterns among men and women farmers, using participatory tools such as Venn diagrams and social network analysis (SNA). The SNA among smallholders revealed well-established and effective formal and informal networks for farming and climate information dissemination and sharing in Pudupatti village, where 66% of the respondents were women farmers. A similar approach was adopted by Cornnie Valdivia et al (2003) to explore the flow of climate information among different categories of Andean farmers, from local experts to intermediaries, to users.

The primary sources of information listed by respondents include experienced farmers, leaders of various farmer groups, staff of the VKC, the technical officer of the RESAPCOL, the assistant agricultural extension agent, the Kulumai Federation marketing executive,[6] a retiree from the cooperative bank, and a bicycle shop owner who is also a farmer, for centrality scores. The SNA reveals the interweaving of both formal and informal networks. Most "formal" nodes identified are well connected both through their formal roles, and also informally because they frequently interact with people who work or live in the village (and thus are part of the village community) and/or are also farmers (having farms or fields in Pudupatti).

Such interweaving of roles allows these individuals to access and exchange information both inside and outside the village. Most informal nodes (for example, experienced farmers) are connected to formal structures such as farmer groups, VKCs, and governmental and non-governmental extension services. The institutional analysis also reiterated the point that the interaction with informal institutions located within the village was higher than with those outside in accessing climate information. VKCs have evolved as a potential source for receiving the information and they play a key role in dissemination at the village level (Table 3).

Table 3: Institutions That Help Small Farmers Access Climate Information, Pudupatti

Boundaries	Institutions	Intensity of Interaction
Within village	VKC and farmer groups	High
	Cooperative society	Low
Block	Farmers' association	Medium
	Agriculture office, input dealers	Low
District	Agriculture department, Krishi Vigyan Kendra	Low

Source: Developed by authors based on the focus group discussions.

The VKC in Pudupatti was managed by young women, who are also responsible for supporting about 20 women farmer producer groups of RESAPCOL (about 300 farmers). The VKC complemented the formal extension systems and served as an intermediary between the women farmers and formal institutions. The VKC's presence in the village helped address the issue of "exclusion" of women from the formal institutions disseminating climate- and agriculture-related information in the region. It played a significant role in making climate information locally relevant through appropriate agro-advisories and making dissemination "gender inclusive" in the study areas. The physical proximity of the centre and the familiarity with the knowledge provider helped the women in the village overcome any inhibition in approaching the VKCs to access information and other services. Men do sometimes share information, but this may not be complete for women to understand and relate to for making decisions in farm operations.

Building Capacity

Women intermediaries, integration of climate information with other services for agriculture development, working through women's groups, and group discussions on climate information, were some of the more successful strategies in reaching women and building their capacities to demand climate information. The collective learning and horizontal transfer of knowledge among women farmers in these groups created the confidence to seek seamless forecasts, climate information, and advisories. Recognising the centrality of farmer-to-farmer communication, the climate risk management project in Burkina Faso also trained key farmers (representative of different social groups) to operate as information nodes between forecast producers and their own communities (Roncoli et al 2005).

The representatives of the intermediary organisation, in this case RESAPCOL and VKCs, are continuously trained in understanding weather and climate and its relation to crop production, types of forecast and its interpretation, climatological analysis of the region, potential climate risks and contingency plans, communicating deterministic and probabilistic forecast information, and thumb rules in interpreting the forecast. Such training helps build the intermediaries' capacity in interpreting MRWF and SCF, and developing agro-advisories for the given forecast. Though the climate information and advisories are given to all farmers, (both men and women) to enable them to adopt appropriate risk management strategies on their farms, adjusting cropping patterns, stocking rates, and irrigation scheduling as required, women intermediaries also provide need-based support to women producers to translate such agro-advisories into action. Due to this enabling environment, women gained confidence in using climate information, to make strategic and day-to-day farm decisions to reduce climate risks and vulnerability. This is especially important given men's outmigration and reducing role in agriculture in smallholder households. In this process, however, women are able to renegotiate their position in the household from being mere contributors of labour to decision-makers in different agricultural operations (adaptation strategies). They now actively participate in taking decisions related to selection of crops, crop varieties, purchase of other inputs, and planting patterns. As noted earlier, while farmers manage risks holistically, scientific information is generally derived using reductionist approaches, leading to a "disconnect" between scientists and farmers. Although scientifically sound, climate information then often lacks relevance. To make it relevant to farmers, especially women, bundling locally understandable relevant climate information and advisories with appropriate services is crucial.

In Conclusion

In the context of the expanding participation of women farmers in smallholder farms, their ability to access available climate information, and trust and respond to it is very important in managing the increasing range of climate risks. Little attention is, however, given to the gender dimensions of climate information services at the field level. This paper has attempted to demonstrate the possibilities for addressing such challenges by facilitating the co-production of knowledge, between climate modellers and climatologists with end users on the one hand, and between men and women farmers on the other. Local organisations, such as farmers' collectives, play a central role in bridging these gaps and, in the process, adding value based on both the local socio-economic and biophysical conditions of the smallholders. Without ensuring equitable access to climate information, it will not be possible to build farmers' adaptive capacities and reduce vulnerability.

The empirical experiences presented in this paper indicate that inclusive and special strategies are needed to reach women farmers. Several key learnings emerge, relevant for policy and practice. First, the design and delivery of climate information services need to be both relevant to the specific context and gender sensitive in content. Second, there is a wealth of traditional knowledge of climate variability and change within communities, both with farmers and individual specialists, such as water diviners. The efficacy of these knowledge systems needs to be tested based on scientific climate information to facilitate the co-production of knowledge, which is both effective and relevant. Third, continuous interaction helps build relations of trust alongside capacities to demand climate information. This could include supporting local social networks and farmer-to-farmer exchanges, and a degree of household cooperation and sharing of information, as agriculture still entails divisions of labour between men and women. Finally, when dealing with smallholders, and those with limited resources, it is critical to bundle climate information along with other agriculture services like access to quality seeds of required crop varieties, credit and remunerative markets.

While we have shown the potential for renegotiating gender roles and relations in more equitable ways, how far this can be attributed to the access to climate information needs further exploration.

NOTES

1 The VKCs are computer-based knowledge centres with an internet connection that provides need-based static and dynamic locale-specific information. The local community manages the VKCs with one or two women as managers; access is ensured to all, irrespective of caste, class, gender and age.

2 RESAPCOL is a farmers' collective, working to strengthen the linkages of farmers with research institutions, extension agencies and the market.

3 The AMFUs record agro-meteorological observations through manual weather stations and develop district-wide agro-advisories.

4 The project is a multi-country, multi-institutional research project funded by AusAID to develop a blueprint for the use of improved SCF across the Indian Ocean Rim Countries from 2012–14, implemented in India and Sri Lanka.

5 The wonderbean game was developed by Peter Hayman, Principal Scientist, Climate Applications, South Australian Research and Development Institute, Australia and used in the training course on Climate Variability and Food Security at International Research Institute for Climate and Society, Columbia University in 2001 and has been further developed for the Australian Centre for International Agricultural Research project "Bridging the Gap between SCF and Decision Makers." The purpose of the game is to decide how much (% area) of a new crop "wonderbean" to plant. There are three rounds. The first is where participants just hear from an agronomist how valuable the new crop is. The second round introduces the idea of a probability distribution of the profit of the two crops, and the third round involves seasonal climate forecasts. The exercise gave useful insights on the crop choice decisions of farmers and helped understand the factors driving these decisions.

6 The Kulumai Federation is a federation of SHGs with a membership of rural men and women producers.

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