C2 Supporting rural producers with knowledge of CSA

Overview

Farmers, pastoralists, forest dwellers, fisherfolk and other small-scale food providers are central to the efforts to sustainably intensify agriculture production to meet the goals laid out in the Sustainable Development Agenda 2030, especially the ever-increasing demand for more and better food in the face of global climate change. The Sustainable Food and Agriculture Framework, which outlines FAO's common vision for improving the agriculture sector and related human activities, identifies five key principles that need to be simultaneously implemented (see Building a common vision for *sustainable* food and agriculture: principles and approaches. Rural Advisory Services (RAS), especially participatory approaches to extension, capacity development, knowledge generation and resource management are essential to empower the rural populations to adopt and take ownership of these SFA principles and to help communities to thrive in a changing climate. While RAS have always been supporting farmers to adopt new practices, adoption of climate-smart agriculture often demands collective action among farmers and more meaningful collaboration among a range of stakeholders.

This collaboration needs to involve not just the agricultural producers working in the field, but everyone who is responsible for managing natural resources throughout the landscape, and not just those who practice agriculture and resource management but also the decision-makers who set the policies that shape agricultural development. To meet these demands effectively, the capacities of RAS need to be strengthened at many different levels. Access to adequate advisory service is crucial for ensuring that agricultural producers are sufficiently informed about changing conditions, and can adopt sustainable agricultural practices. Current agricultural extension and advisory service system is unable to meet these new demands. RAS will require increased institutional and financial support, and their capacities will need to be upgraded to support agricultural producers in reducing climate-related risks. This module highlights the key role RAS can play in promoting climate-smart agriculture and provides some guidance on how, through strategic capacity development, they can better carry out this role.

This module looks at the evolution of RAS (C2-2.1); why they are important in promoting climate-smart agriculture (C2-2.2) and how they support the three objectives of climate-smart agriculture. Chapter C2-3 presents the key challenges and opportunities for RAS in promoting climate-smart agriculture. Chapter C2-4 provides details on the key capacities that need to be enhanced among RAS providers to promote climate-smart agriculture.

Key messages

- RAS are critical for promoting climate-smart agriculture. Significant investments in strengthening RAS will be needed for climate-smart agriculture interventions to be able to deliver their proposed benefits.
- RAS currently contribute to the three objectives of climate-smart agriculture, but they need to play a much more active role in supporting rural communities to adapt to climate change and contribute to climate change mitigation.
- To fully realize the potential of RAS in promoting climate-smart agriculture, the capacities of RAS need to be enhanced at the individual and organizational level, and throughout the enabling environment.

Role of extension and RAS

C2 - 2.1 What are extension and RAS?

The Global Forum for Rural Advisory Services (GFRAS) defines RAS as consisting of:

"*all the different activities that provide the information and services needed and demanded by farmers and other actors in rural settings to assist them in developing their own technical, organisational, and management skills and practices so as to improve their livelihoods and well-being*" (Christoplos, 2010).

RAS collectively comprise of several types of providers that can be grouped under a number of different terms, including extension agents, community knowledge workers, agronomists, facilitators, advisors, promoters, knowledge intermediaries and programme managers. These providers deliver a range of services and provide technical, organizational, entrepreneurial and managerial support to rural communities.

Over the past two decades, extension services have evolved from an agency of the National Ministry or Department of Agriculture that disseminates technology, to a mix of public, private and civil society groups that provide a broader range of services to rural communities that include the sharing of technology and information; advice related to farm, organizational and business management; and facilitation and brokerage in rural development and value chains. The increasing pluralism in RAS delivery has been mainly due to an increasing participation of private sector providers that deal with agricultural inputs, agribusiness services and financial services; international and local non-governmental organizations (NGOs); producer groups, cooperatives and associations; consultants, either acting independently or in association with agribusinesses and producer associations; and services based on information and communication technologies.

RAS have always supported farmers in modifying their existing farming methods and adopting new and better approaches. This involved many types of activities, such as the adoption of improved crop varieties and better animal breeds; more effective pest management practices; better soil and water management practices; and assistance to farmers organization to collectively deal with natural resource management and marketing challenges.

Until the late 1980s, the main focus of RAS was on increasing productivity by enhancing farming practices among individual farmers. But in the early 1990s, RAS started focusing on promoting collective actions by farmer groups, and fostering collaborative agricultural and institutional innovation, with farmers, researchers and other groups.

Over the last two decades, RAS have facilitated the establishment of groups and associations of farmers to support promotion of new technologies (e.g. farmer interest groups); enhance capacities to deal with pest and disease management (e.g. Farmer Field Schools); manage natural resources (e.g. participatory irrigation management and watershed management groups; community forest management groups); and engage in collective marketing (e.g. producer cooperatives).

In many countries, the public sector extension services' educational role has been neglected over the years. Priority has shifted to other activities that governments consider more important for agricultural development, such as the distribution of inputs and financial assistance, the gathering of farm statistics and organizing relief during natural disasters. Agricultural extension lost momentum in the 1990s after the World Bank withdrew funding from the Training & Visit extension approach (Anderson, Feder & Ganguly, 2006). This situation has eroded the capacities of RAS providers, who now find it difficult to perform their traditional roles, let alone take on new ones (Davis and Oberthür, 2014).

The 2008 food crisis demonstrated the vulnerability of the poor to income shocks due to food price increases. This has led to renewed government and donor interest in agriculture in general and RAS in particular. In the Sustainable Development Goals (SDGs), extension is explicitly mentioned in in SDG2 as one of the areas that need increased investment to meet the goal of ending hunger, improving nutrition and promoting sustainable agriculture. In many countries, RAS advise women farmers on aspects related to agriculture, climate and nutrition. These activities will help meet the goal of SDG5 to provide women and girls with equal access to knowledge.

Farmers are facing several new challenges: sustaining yields under deteriorating and declining soil and water availability; coping with fluctuating demand and prices for their produce; adapting to climate change; responding to new products and quality standards; and attracting and retaining youth in agriculture. RAS must help farmers respond to these challenges. To do this, they need to broaden their mandate and work with many of the other stakeholders and service providers in the agrifood system. This also involve strengthening the capacities of RAS providers and their organizations at varying levels (individual, organizational and enabling environment level) as articulated in the GFRAS Position Paper, **The New Extensionist** (GFRAS, 2012).

C2 - 2.2 Why are RAS important for climate-smart agriculture?

Climate change is already affecting agriculture and food security. If no urgent actions are taken, climate change will put millions of people at risk of hunger and poverty. The expected effects of climate change, which include higher temperatures, more frequent extreme weather events, water shortages, rising sea levels, ocean acidification, land degradation, the disruption of ecosystems and the loss of biodiversity, could seriously compromise agriculture’s ability to feed the most vulnerable populations and impede progress towards the eradication of hunger, malnutrition and poverty (FAO, 2016a). Enhancing the capacities of farmers to manage risks and adopt effective climate change adaptation and mitigation strategies merits special attention.

Promoting climate-smart agriculture involves changing the behaviour, strategies and agricultural practices of millions of agricultural producers. These producers need to be supported in understanding the impacts of climate change and adopting more climate-smart strategies. In this regard, RAS providers can play a critical role, by serving as a link between farmers and new sources of information and tools, and promoting the behavioural changes that can lead agricultural communities to adopt climate-smart agricultural practices (Simpson and Burpee, 2014). No groups other than RAS providers have an explicit focus on supporting changes and innovations among rural communities to enhance their livelihoods.

RAS are able to effectively support the promotion of climate-smart agriculture among farmers for a number of reasons.

1. RAS staff have close working relationships with rural communities, especially at the field level. Farmers

will be more receptive and willing to experiment with advice related to climate-smart agriculture if supported by RAS. In many countries, only RAS have personnel available on the ground to directly work with rural communities.
2. RAS providers often have detailed and nuanced understanding of farmers vulnerabilities and the existing conditions under which they operate. Their understanding extends to the assets of farm households, the social dynamics within and between communities, and farmers' adaptive capacities. This knowledge is a critical prerequisite to devising appropriate strategies to adapt to climate change at the household and community level.
3. RAS providers are often aware of the support and services available locally, and the different types of user groups. When adopting new practices, farmers often need advice on how to access other complementary sources of knowledge, support and services. RAS providers can help farmers make informed decisions based on information from these different sources. For instance, a farmer planning to grow a new crop or a new crop variety may like to know whether there is a market for the produce and the prevailing market prices. RAS providers can also share agrometeorological crop forecasting with farmers in a way they can understand, giving them the ability to determine for themselves whether a new variety will be the best option given future climate projections. In some countries, the capacity of RAS to support farmers with this type of information is improving. Information and communication technologies made more information available to RAS providers and farmers.
4. RAS providers can play needed mediation role for the extensive scaling up of climate-smart agriculture. This requires broader expertise and new levels of innovative thinking to harness appropriate technologies, practices and agricultural products. It will therefore in many cases involve promoting interactions and knowledge flows among a broader range of stakeholders performing a wide range of roles within the policy and practice spectrum.
5. RAS have traditionally acted as intermediaries between research and farmers. This expertise in mediation will be useful for supporting wider interactions among these different stakeholders, including those in the private sector. With suitably developed capacities, RAS can expand its intermediation role to support promotion of climate-smart agriculture.
6. During and post natural disasters and extreme weather events, RAS often assist rural communities in coping with the crises by providing relief and engaging in rebuilding rural livelihoods post-disaster (Shepherd *et al.*, 2013). With their knowledge of the natural resources and rural livelihoods, RAS providers to facilitate promotion of sustainable rural livelihoods post-disaster.

C2 - 2.3 How can RAS contribute in promoting climate-smart agriculture practices?

RAS use a number of approaches and tools to reach farmers with new knowledge, including:

- demonstrations,
- training activities
- individual farm visits,
- the training of lead farmers or farmer trainers to train others,
- training of input and service providers,
- group discussions,
- exposure visits to innovative farmers
- Farmer Field Schools (chapter C2-3.1)
- plant clinics (Box C2.1),
- field days
- messages delivered through various media (e.g. mobile phone messaging, farm radio, participatory videos, television)

However, there are few examples of how RAS are supporting climate-smart agriculture. Most of the examples come from special projects and pilot initiatives promoted by donors, researchers and the development community, for example, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). The GACSA Compendium (FAO, 2016b) discusses some of these initiatives.

Project-based experiences offer several valuable lessons on how RAS could contribute to the following three objectives of climate-smart agriculture:

1. sustainably increasing agricultural productivity and income for food security;
2. adapting and building resilience of agricultural and food security systems to climate changes at multiple levels; and
3. reducing greenhouse gas emissions, where possible, from the agriculture sectors, which include crop and livestock production, fisheries and aquaculture, and forestry (FAO, 2013a).

Each of these objectives are addressed in this chapter.

Box C2.1 Plant clinics

The Centre for Agriculture and Bioscience International (CABI) promotes plant clinics through its Plantwise programme. Plant clinics are a meeting place where local plant health extension officers, known as plant doctors, help farmers struggling with plant pests and diseases. The extension officers provide diagnoses and management advice for any problem and any crop. The plant clinics are owned by national and local bodies and run on a regular basis in public venues that are best suited to serve as meeting places for farmers. Information about plant health problems and the advice given through prescription forms are recorded at the plant clinics.

Data about each farmer's visit are held within a central repository and are an extremely valuable source of real-time information. Based on the information on the crop problems farmers face in a certain region, response strategies can be initiated, or the suitability of the advice given can be assessed and, if needed, corrective action can be taken. Plantwise provides training for plant doctors and connects them with information resources, such as the Plantwise Knowledge Bank, and national research centres that can provide diagnostic support.

Plant clinics contribute to food security by safeguarding physical and economic access to food. The targeted advice given through these clinics have reduced crop losses and increased yields. To date 1 800 plant clinics have been established in 34 countries. A rapid farmer satisfaction survey conducted in Pakistan and Sri Lanka as part of an external evaluation of the programme indicated high levels of customer satisfaction; 92 percent of the respondents were satisfied with the level of knowledge of the plant doctors, and 72 percent reported increased crop yields.

Source: Plantwise, 2015

Sustainably increasing agricultural productivity and incomes for food security

The successful scaling up of climate-smart agriculture to sustainably increase agricultural productivity and incomes involves testing, adapting and evaluating different technologies and management practices with farmers and other stakeholders. This is important for expanding the evidence base, determining which practices and extension methods are suitable in each context, and identifying the synergies and trade-offs between food security, adaption and mitigation (FAO, 2016b). RAS providers are well placed to bring such information to farmers and coordinate information flows back to research activities.

RAS have traditionally promoted new knowledge related to sustainably increasing agricultural productivity and farm incomes. Some of these traditional areas of RAS activities relate to key components of climate-smart agriculture, including:

- improved seeds and planting material, new crops and crop varieties and more efficient cropping systems (Box C2.2);
- sustainable mechanization (e.g. laser levellers, no-till seeders);
- improved land management practices (e.g. terrace farming, soil and water conservation measures, furrow planting);
- efficient and effective pest and nutrient management (e.g. integrated pest management, integrated nutrient management);
- improved feed management practices (e.g. balanced rations); and
- post-harvest management and value addition activities.

RAS have also supported the organization and strengthening of farmer groups to deal with many challenges, especially those related to production and pest management, disaster risk reduction and resilience (e.g. Farmer Field Schools) natural resource management (e.g. water user groups, community forest management groups) and marketing (e.g. producer cooperatives).

As there has been a greater recognition that the quality of the produce and the ability of farmers to negotiate better prices significantly influence farm income, in many countries, RAS have also started advising farmers on how to market farm produce. RAS interventions in this area include:

1. enhancing capacity of farmers to understand and research market demands (e.g. quality standards, price trends);
2. mobilizing farmers for group marketing; and
3. supporting farmers to establish connections with various market players.

However, significantly more efforts are needed in the area of market-oriented agricultural advisory services, and capacities have to be considerably enhanced in this regard within RAS at all levels. (Neuchatel Group, 2008; AFAAS, 2011).

Box C2.2 Promotion of alternative cropping pattern to increase productivity, profitability and employment in Northern Bangladesh

In northern Bangladesh, the *aman* rice-potato-*boro* rice cropping pattern is the most popular cropping pattern due to good potato markets and rice harvests. This cropping pattern, however, can be economically and environmentally damaging. The cultivation of *boro* rice (March-May) after the harvest of potato in sandy loam soils requires withdrawals of huge quantities of ground water. This is already a scarce resource, and climate change may increase pressure on local water resources.

Food insecurity is common among the poor rural population in northern Bangladesh in September and October and April and May. This is primarily due to unemployment during this period, as the long-duration rice varieties, which are the dominant crops in the *aman* season, are not harvested until December and January. These varieties require nearly 150 days to mature, and farmers have to wait until mid-November to harvest this food crop.

Research studies have shown that the food insecurity and unemployment of farm workers in September and October can be mitigated by scaling up the production of short duration *aman* rice (Var. BUdhan 1, BRRI Dhan 56, BINA Dhan 7) that can be harvested in October. This not only helps ensure food security, but also improves productivity, as it facilitates the timely planting of winter potato or wheat after the rice harvest. The timely planting of potato or wheat in the winter season creates the opportunity to cultivate short-duration mung bean (BUmug 4, BARImung 6) and short-duration *aus* rice (variants of Pariza rice) in sequence. These two crops require nearly 60 and 70 days respectively to reach harvest. As short duration *aman* rice and *aus* rice (harvested in July and August) utilize mostly rainwater, they offset the detrimental effect of excessive ground water withdrawal needed in *boro* rice cultivation in traditional cropping systems.

The RDRS Bangaldesh (an NGO based in Northern Bangladesh) in collaboration with the Bangabandhu Sheikh Mujibur Rahman Agricultural University and with financial assistance from the Krishi Gobeshona Foundation, tested an intensive four-crop sequence (*aman* rice-mustard or potato - mung bean - *aus* rice) with 400 selected farmers in eight north-west districts, and compared it with traditional cropping pattern (*aman* rice - potato - *boro* rice). The project provided critical inputs, such as seeds, micronutrient fertilizers and pesticides, to establish demonstration sites for selected crops. The selected farmers had experience in cultivating rice, mustard, and potato, but they lacked knowledge on new cropping systems and modern agricultural technologies, and the effective and efficient use of inputs. RDRS and the Department of Agricultural Extension provided one day of field-based training activities for the farmers on the selection of good quality seeds and crop varieties, fertilizer application and management, irrigation water application and water saving techniques.

Based on the whole cropping pattern, the cost-benefit ratio was 2.93 in the alternate cropping pattern and 1.72 in the traditional cropping pattern. In the project design, it was expected that about 2 000 farmers would adopt the new cropping pattern. However, by the end of the project in 2014, nearly 4 000 farmers had adopted the alternate cropping pattern. The project used print and electronic media to share the details of its activities and its success, which helped convince other extension service providers and country administrators of the value of promoting the new practice.

Source: Rashid and Haque, 2016

Adapting to climate change

Actions to adapt to climate change can range from behavioural shifts (e.g. farmers planting more drought-resistant crops or more farmers buying crop insurance) to large-scale infrastructure projects (e.g. building coastal defences to protect against sea-level rise or setting aside land corridors to help species migrate). In many areas, successful adaptation to the impacts of climate change will require adjustments to existing systems (e.g. changes in crop management practices) and transformational changes (e.g. shifting to entirely different production systems). See Module A2 on climate change adaptation approaches.

While RAS play a crucial role in helping farmers to adjust to a changing conditions and adapt new practices, an important aspect of the support provided by RAS to farmers to help them adapt to climate risks is the delivery of climate information (see also chapters B1-2, B6- 4.2 and B10-5 for more information on weather forecasts). RAS use traditional media, such as radio, and new communication tools, such as mobile phones, to communicate climate information, including early warning weather advisories to farmers (Box C2.3).

In several of its projects, CCAFS has been researching ways of providing climate services to farmers. Using up-to-date information and communications technologies can clearly support the dissemination of information that can reduce the risks farmers face, and the use of mechanisms, such as weather insurance, can compensate for losses incurred when risks cannot be avoided (Davis and Sulaiman, 2013).

Weather and climate information is communicated to farmers through a variety of information and communications technologies, with Short Message Service (SMS) being one of the most common mechanisms. For an example from the public sector, visit the web site of the **India Meteorological Department**; for examples from the private sector, visit these web sites: **Ignitia**, **Esoko**, **Farmerline**. These mechanisms deliver information to support farmers' short-term decision-making by sending notices directly to their phones though text messages or mobile applications. In Paraguay, the Ministry of Agriculture and Livestock has initiated such a system, called **Agro Ayuda** (web site in Spanish). To overcome communication barriers and illiteracy, information is sometimes delivered through voice-based systems. Interactive voice response systems automate the answering of incoming calls and interact with callers based on their answers to the listed options. Such systems have been used by the **India Meteorological Department**, and by Farm Radio International in various sub-Saharan African countries (e.g. Farm Radio International's **Uliza initiative**). Information technology is also used as the backbone for hotlines that have been set up to deliver information to farmers. One such hotline, is the **8028 Hotline**, which was established in Ethiopia through a partnership established among the Ministry of Agriculture, the Ethiopian Institute of Agricultural Research, Ethio Telecom, and the Ethiopian Agricultural Transformation Agency.

Box C2.3 Climate Advisory Support to farmers in Ghana

In 140 communities across 10 districts in the northern region of Ghana, the CCAFS has implemented the Climate Advisories and Insurance Development (CASCAID) project, is operating Participatory Integrated Climate Services for Agriculture (PICSA). PISCA has trained established farmer groups to use accurate, user-friendly and location-specific historical climate and weather information in the form of graphs and climate probabilities. Forty percent of the participants who have been trained are women. This information, produced by the National Meteorological Service and the African Institute for Mathematical Sciences is analysed together with locally relevant crop, livestock and livelihood options. Using participatory decision-making tools, farmers are able to make choices in response to climate variability. Seasonal and short-term forecasts are also provided.

The Adventist Development and Relief Agency (ADRA-Ghana) and OXFAM trained government employees, staff NGOs and agricultural extension officers who then put their new skills and ideas to use in working with groups of farmers. Along with training, ZAA FM, a prominent radio station in northern Ghana, broadcasted a series of farmer mobile phone-in programmes based on the PICSA approach, which included representatives from the Ghana Meteorological Agency and the trained agricultural extension officers.

A survey found that 97 percent of farmers trained in the PICSA approach had made changes in their farming practices, for example, using the historical climate information to select crops and varieties, such as shorter duration maize varieties, that were best suited to the local climate. A large number of farmers also reported diversifying their livelihood activities. Many were using the participatory tools, especially participatory budgeting, in their planning and decision-making.

Following the training, extension workers reported that farmers had been approaching them to discuss new ideas and seek their help in acquiring new crop varieties and their advice in taking up new livelihoods.

The fact that farmers were enthusiastic about sharing the information with others is a testament to the strength of the PICSA approach. Eighty-four percent of the participating farmers had shared PICSA information with their peers, with each farmer reaching an average of five other farmers.

Source: CCAFS, 2016a

RAS generally perceive adaptation to climate change as something that is done at the farm level using technological approaches. There are several examples of RAS promoting technologies and practices (e.g crop varieties that can better tolerate or resist to specific climate change related stresses, and hardier livestock breeds) that help farmers cope with the impacts of climate change. There is little appreciation that climate change adaptation also involves changes in the policies and institutional regimes that govern agricultural production (Leuwis and Hall, 2013). New capacities have to be built among RAS providers and all the stakeholders in agricultural systems to effectively promote climate-smart agriculture. However, capacity development in the context of climate change is often perceived as training farmers on new practices and technologies and the distribution of inputs that will support their adoption (Sulaiman, 2012). Some initiatives, such as Climate-Smart Villages (see Box C2.4), multistakeholder innovation platforms, and a number of Farmer Field School programmes have been designed to enhance capacities of different stakeholders to deal with changing climate and ensure long-term resilience.

Box C2.4 Climate-Smart Villages: Lessons so far

In West and East Africa, South and Southeast Asia, and Latin America, CCAFS is working with a number of partners, including national governments, research institutions, local farmers, community-based organizations, national meteorological institutions and private sector stakeholders to test a range of interventions in Climate-Smart Villages (CSVs).

After potential sites have been selected, a steering group of community representatives and researchers work together to identify appropriate climate-smart agriculture options for that village. These include climate-smart technologies, climate information services, local development and adaptation plans, business models and associated supportive institutions and policies, all tailored to that community's needs.

One of the strengths of the CSV approach is its inclusiveness. Farmers from different communities, researchers from different disciplines, NGOs and other partners, all come together to test a range of options in an integrated fashion. This has led to the identification of climate-smart agriculture responses that are based on women and men's differing farming needs and constraints. Results to date have shown how food security and resilience can be improved in the face of climate change, and have pointed to ways in which smallholders farmers in many types of communities can adapt their agricultural practices.

Some of the important lessons learned from the implementation of CSVs are:

- Engaging different stakeholders to identify and understand their different knowledge, skills, interests and constraints provides new insights into farmers' perceptions of climate-smart agriculture practices that are suitable for adoption.
- Targeting women and youth, and ensuring they are included in making decisions on climate-smart agriculture options, makes the benefits of climate-smart agriculture practices more sustainable.
- CSVs can be a model for communication and partnerships for a variety of stakeholders and institutions at all levels.
- The early attempts at implementing CSVs have potential for improvement, including the sustainability of results beyond the project implementation.
- Beyond productivity, there is a lack of other indicators capable of providing evidence as to the degree to which initiatives are climate-smart.
- There is a need to balance technological and socio-economic aspects of the activities; acknowledge more fully indigenous knowledge; and overcome a lack of involvement of poor farmers.
- More research, engagement and documentation are needed to facilitate the scaling up of activities.

Source: CCAFS, 2015

If farmers are to be supported to adapt to climate change, RAS need to combine the testing, the refinement and the promotion of locally applicable technological innovations with institutional innovations related to the development of farmer organizations, the creation of new business models and pro-active policy engagement. The capacities of RAS to promote these types of interventions are currently limited, and should be an important area for capacity development.

Reducing and/or removing greenhouse gas emissions for climate change mitigation

Climate change mitigation involves implementing measures that reduce greenhouse gas emissions and enhance carbon sinks. In some case, this can be done by using new technologies and renewable energies, making older equipment more energy efficient, modifying management practices or changing consumer behaviour.

RAS are contributing to climate change mitigation by promoting practices that increase the amount of soil organic carbon and/or reduce the relative rate of carbon dioxide released through the mineralization of soil organic carbon (e.g returning organic matter to the soil as plant residues and manure). Other practices promoted by RAS that support climate change mitigation are those that optimize the use of external agrochemicals, such as pesticides and fertilizers, that have a high carbon footprint (e.g. promoting integrated and ecological pest management. RAS also promote agroforestry systems (see module B5), mangrove conservation, the proper management of agricultural wastes, and good agronomic practices and technologies, such as improved grazing land management, crop rotations and associations, sustainable mechanization (e.g solar powered tractors or plant jabbers for conservation agriculture), and improved fallows.

In most developing countries, RAS have very limited presence among organizations involved in forest management and agroforestry promotion. However, in some countries, RAS are engaging with private landowners and other professionals in the forestry sector to consider how local temperature and precipitation patterns have changed and encourage the implementation of widely accepted management practices to build resilience in the forests. For instance, in the United States of America, the Pine Integrated Network: Education, Mitigation, and Adaptation (PINEMAP) focuses on the 20 million acres of planted pine forests managed by private landowners (see Box C2.5).

Box C2.5 PINEMAP

In the United States of America, PINEMAP integrates research, extension, and education to enable landowners with planted forests of southern pine to manage their forests in ways that, by 2030, will lead to a 15 percent increase in carbon sequestration and 10 percent increase in the efficiency of nitrogen inputs and other fertilizers. PINEMAP also helps forest managers adapt their forest management approaches to build forest resilience and safeguard sustainability under variable climatic conditions. PINEMAP focuses on loblolly pine (Pinus taeda), which accounts for about 80 percent of planted forests in the coastal states of America, from Virginia to Texas, as well as Arkansas and Oklahoma.

PINEMAP is designed to develop and evaluate mitigation and adaptation activities that will reduce potential risks associated with changes in climate variability and educate landowners to ensure the continued sustainability of southern pine management in a changing world. To achieve this goal, the PINEMAP extension activities include:

- Developing partnerships among extension foresters and state climatologists to build a regional network of climate extension and outreach specialists that will collectively develop and review materials; provide oversight and advice to research and education activities; and prepare and implement workshops on climate variability and climate change impacts for local and regional forest industry and non-industrial private forest landowners.

- Implementing state and regional extension advisory committees with forest management, climatology, social science, and extension expertise to provide oversight to regional specialists that will develop, deliver, and evaluate PINEMAP extension programming and outcomes.
- Assessing stakeholder perceptions, their information and decision-making needs, and their current practices to determine the preferred and most cost-effective methods of communication, education, and evaluation.
- Developing a web-based decision support system that will include the results of the genetic, silvicultural, and economic information obtained from project research, and provide an open-source set of current and future decision-support tools to support innovative management practices in southern pine forests.
- Developing extension products, including online learning modules for extension, a national Internet-based educational network, fact sheets and webinars.
- Conducting training workshops for educators from a variety of agencies, county extension agents, and state forestry and natural resource professionals with outreach responsibilities in climate change mitigation and adaptation.
- Developing impact assessments regarding the adoption of alternative planted pine forest management systems designed to enhance climate change mitigation and adaptation; the engagement of non-corporate landowners in active planted pine management and carbon markets; the quantitative changes in regional planted pine forest carbon sequestration and nitrogen use efficiency resulting from adoption of alternative management systems; and clientele understanding of interaction between climate and forests.

Source: PINEMAP

Climate change mitigation, including the monitoring and assessment of greenhouse gas emissions, is an area where RAS have not been active. RAS can contribute to mitigation efforts, for example, by strengthening farmer groups and rural organizations in their efforts to implement farming approaches and technologies that reduce emissions or sequester carbon as a co-benefit of increased productivity or climate change adaptation; supporting them in their efforts to access voluntary and regulated carbon markets; and promoting payment for ecosystem services programmes (David, 2016).

Climate change mitigation also demands engagement with those involved in policy making at different levels. RAS providers should be able to play an important role in communicating the realities on the ground with respect to climate change mitigation to policy makers and advocate for policy changes to enhance mitigation. However, their technical knowledge on climate change mitigation is not strong, and they often lack the skills needed for effective policy engagement (e.g. generating policy-relevant evidence, lobbying and preparing advocacy communications).

The potential for RAS to contribute to mitigation efforts remain largely untapped. RAS could contribute equally to the three objectives of climate-smart agriculture, if its capacities were enhanced in a number of areas.

Key challenges and opportunities of RAS to support climate-smart agriculture

Farmers have always responded to new challenges, such as changing weather patterns and natural disasters, and new opportunities, such as improved technologies and better market opportunities. Climate change adds urgency to the need for a quicker response by a range of different agricultural stakeholders at various levels. Responding to climate change does not just require technical change of agricultural practices at the farm level. To bring tangible benefits to smallholder farmers and provide stewardship to the landscapes that support them, changes also need to be made in policies, institutions and financing, and there must be a clear recognition of the driving role farmers play in adapting to changing circumstances and constructing innovative solutions to the challenges they face (FAO, 2016c).

C2 - 3.1 Farmer Field Schools: A successful approach for education and social mobilization on climate-smart agriculture

Farmer Field Schools (FFS), which have been established in over 90 countries, have been embraced by many farmers, governments and development practitioners as an effective mechanism for capacity development and education to promote sustainable agriculture, livelihoods and climate resilience. FFS uses a dynamic, participatory and interactive learning approach that emphasizes problem solving and discovery-based learning. They are designed to build farmers' capacity to understand and observe their production systems, identify problems and test possible solutions. Ultimately, participants in FFS are encouraged to make informed decisions for themselves, adopting or adapting the practices that are most suitable to their particular farming system. The learning process in the FFS reinforces the participant's understanding of complex ecological relations in the field.

In FFS, a group of 20-25 farmers, pastoralists or fishers meet to engage in hands-on learning over an entire cropping season or natural production cycle. For crop-based FFS, activities may cover from farming practices from 'seed to seed'; in livestock-producing communities, they may deal with activities from 'egg to egg' or 'calf to calf'.

FFS have expanded from dealing with a single topic (integrated pest management) on a single crop (rice) in one country (Indonesia) in 1989, to cover multiple crops and many diverse topics (e.g. sustainable agriculture, climate change adaptation, livelihoods and rural empowerment, integrated production, soil health, land and water management, agro-pastoralism, agroforestry, crop-fish systems, aquaculture, disaster risk reduction, credit and savings and resilience funds, and nutrition). FFS group learning is a solid basis on which to build successful community-driven platforms for sustainable territorial development.

FFS provide a risk-free and conducive learning environment for participants to experiment by combining local knowledge on potential adaptive solutions with options proposed by researchers. By building each individual participant's functional capacity to observe, analyse, communicate and take informed decisions, the FFS methodology strengthens their overall capacity to respond to changes in their environment. At the group level, participants learn to organize themselves and their communities, and collaborate with each other. The resulting social capital is a strong asset in the implementation of collective actions to respond to the impacts of climate change and other drivers of change.

FFS to support climate change adaptation have been undertaken in a number of countries. The socio-economic diversity of different households and the ecological diversity of different agricultural ecosystems require locally adapted field-level approached to ensure the appropriate responses to changing climatic conditions. FFS provide a platform to strengthen individual and community climate resilience (i.e. the ability to survive, recover from, and even thrive in changing climatic conditions in a locally adapted manner).

Since 2010, a number of countries have started working on strengthening community climate resilience using a field school approach. Climate-related field school projects have been implemented with support from FAO in many countries, including Angola, Burkina Faso, Chad, Ethiopia, Kenya, Malawi, Mali, Mauritania, Mozambique, Niger, Senegal, South Sudan, and Uganda. Projects in Eastern and Southern Africa, particularly Uganda, have integrated disaster risk reduction and climate change adaptation to address multiple threats to livelihoods with short- and medium-term interventions. Other groups have also experimented with 'climate field schools' in a number of countries (e.g. Bangladesh, the Democratic Republic of Congo, Indonesia and Nepal). CARE has used Farmer Field and Business Schools to address climate change in Honduras, South Sudan and many other countries.

As an outcome of these initiatives, a number of manuals and technical modules on building resilience through field schools have now been made available (FAO, 2013b; FAO, 2015).

C2-3.2. Developing the content of FFS on climate change

FFS that address climate change will primarily focus on learning to improve practices in the field to increase production sustainably and adapt to climate change. Learning processes in FFS reflect the principles of non-formal adult education. Whether they focus on climate change or other topics, the learning processes reinforce participants' understanding of the local ecology to improve their management and decision-making skills.

In the FFS approach to addressing climate change, a first step involves learning about climate change at the field level. However, a broader production system approach that covers the entire landscape must also be considered. Some management actions (e.g. the restoration of degraded land through vegetated stone rows) for rehabilitating local ecosystems and improving resilience to climate change need to be addressed at a scale beyond an individual producer's farm. Activities in this area, start during preparation work with the communities, when an analysis is undertaken on the climate-related challenges facing the community and possible solutions are identified for addressing them. A broad strategy based on community action can be used to implement these solutions and ensure they are linked to other complementary community initiatives (see Box C2.6).

Box C2.6 Key lessons learned and challenges in Mali

Launched in 2012, the FAO project, Integrating Climate Resilience into the Agricultural Sector for Food Security in Rural Areas, benefited from the 15 years of experience that has been gained by the FAO Integrated Production and Pest Management regional programme in its work with FFS and sustainable crop production intensification. The project had three main objectives: identifying, testing and adapting climate-smart practices in collaboration with farmers; strengthening the technical and functional capacities of RAS and farmers in the experimentation of sustainable and resilient practices through FFS; and advocating at the institutional level for greater support in responding to climate change. After three years of implementation, national stakeholders judged the results very positively.

Some of the challenges that needed to be overcome included limited policy coordination and the marginal status of the agriculture sectors in drafting planning and policy documents on climate change adaptation. This situations was addressed by setting up an inclusive national climate change group that included the Ministry of Agriculture, the Agency for Environment and Sustainable Development (AEDD), the Ministry of Territorial Administration and Decentralization, the Office of Food Security, farmer organizations, NGOs and civil society organizations, development organizations and research centres, including Mali's Institute of Rural Economy (IER) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Stakeholders met twice a year to exchange information and ideas on climate change; identify climate-smart practices, including those based on indigenous knowledge; and visit field activities. Sensitization was done with political, administrative and local authorities. For instance, FAO and AEDD organized training activities for members of Parliament on the role of agriculture in climate adaptation and mitigation, and training sessions on access to climate finance. In addition, various national institutions (e.g. the National Directorate of Agriculture , AEDD, research organizations) were directly contracted to implement components of the project, which improved national capacities and significantly increased national ownership of the project. This inclusive process led to better integration of the agriculture sectors into Mali’s Intended Nationally Determined Contribution for the Paris Agreement; helped improve stakeholder coordination; and generated co-financing of activities by multiple partners.

Malian smallholders have poor access to advisory services and little awareness of innovative practices for climate-smart, sustainable agriculture. Working with the government, researchers and farmer groups, the project trained several hundred government extension agents and farmer facilitators on technical and functional skills to implement participatory diagnostics, implement field schools and facilitate community action planning with a focus on climate change. In turn, these extension agents and farmer facilitators, using FFS, built the capacities of 23 000 producers, including 5 000 women, to implement climate-smart agriculture.

The project promoted farmer testing and the adoption of improved seeds in 242 villages; the dissemination of 13 improved and adapted varieties; and the creation of four agroforestry zones and barriers made from trees and shrubs, which were managed by producer organizations whose membership was 75 percent female. These results all contribute to building the resilience of farmers to climatic changes, such as increased weather variability.

The FFS approach to climate change adaptation was scaled up in 134 municipalities thanks to the full commitment from local and national authorities.

Dynamic and innovative rural institutions help support farmers in making the transition to climate-smart agriculture. The project strengthened several farmer organizations, which are now actively promoting climate-smart approaches and have replicated the approach on their own. Networks of FFS farmers, FFS facilitators and government focal points have enabled the approach to expand into several communes where farmers are progressively shifting to climate-smart agriculture.

Source: FAO Mali, M. Soumaré

The activities undertaken in a climate change field school typically are more integrated than actions carried out in field schools that focus on the sustainable intensification of a single crop (see Box C2.7). For instance, in the FFS demonstrations cassava production can be associated with agroforestry rather than being the focus of a single crop production system. Some climate field schools start with an analysis of different elements of farming systems (e.g. crops, animals, rangelands) and work at a landscape level, which creates in integrated curriculum that runs over a number of seasons. In such cases, multidisciplinary facilitation teams are extremely helpful.

The topics dealt with in field schools learning plans will depend on the needs and aspirations of the participants. Some examples of topics that are often addressed are:

- indicators to measure climate change;
- introduction to the subject of rainfall to understand the difference between variability and change, and how to measure it, which is supported by gradual learning that responds to problems that become visible in the field as the sessions progress;
- difference between weather and climate (e.g. in Colombia, farmers are measuring precipitation and temperature with a low-cost climate station, and they use a soil humidity tool to relate weather behaviour with crop water needs in the soil);
- an analysis of rainfall, which is done through discussions with farmers that focus on the consequences of changes in precipitation patterns on fields and farming practices, and is based on rainfall measurements used in making seasonal climate scenarios (Indonesia); and
- sustainable agricultural management practices.

Box C2.7 Climate field schools in Malawi

FAO, CARE and the Evangelical Association of Malawi are implementing a programme with support from the European Union to increase the capacities of rural communities, individual households and supporting institutions to adapt to adverse effects of climate change and contribute to poverty reduction in rural areas.

The programme adopted a community outreach model where resource users in given micro-catchment are organised into clusters of FFS. Communities map the drivers of the climate risks in respective micro-catchments. This forms the basis for the tailored learning activities and relevant short to medium term adaptation Investments.

Activities blend three dimensions - ***technical***, ***social*** and ***financial***, in a mutually reinforcing way to enhance diversification and accumulation of assets at household and community levels. The technical dimension involves building knowledge and skills on sustainable and climate resilient agricultural production practices, post-harvest handling, bio-intensive backyard gardening, food safety, HIV and gender-sensitive nutrition education among others through 240 FFS. The social dimension focus on group cohesion reinforced through governance structures and conflict management, leadership and dignified safety nets like common savings mechanisms; while the financial incorporates aspects of farming as a business, entrepreneurial skills, income generating activities, savings and investment mechanisms, and group marketing among others.

Lessons from the activities include:

- The entire community is affected by the impacts of climate change, not just the selected households. Activities should start with community outreach.
- Group activities contribute to solving wider community problems and enhance the acceptability of proposed adaptation actions.
- It is good strategy to have holistic, interventions that consider the entire water catchment area.
- Integrate disaster risk reduction and climate change adaptation to address multiple threats to livelihoods with short- and medium-term interventions.
- There is a need for an effective diagnosis of the main problems facing the community, adequate learning tools and sufficient resources in terms of time, personnel and materials.

Source: FAO Malawi, J. Okoth

Lessons learned from the FFS approach

Over its 30-year history, FFS have become a well-tested capacity development approach. Some of the lessons learned from its application that RAS providers can use when promoting climate-smart agriculture are presented here. More capacity development approaches are covered in module C1.

- One season of learning in an FSS is not enough to address impacts of climate change and strengthen resilience. Funding and programming need to provide a sufficient time frame (minimum 2 to 3 seasons) for interactions with community. Programmes should have an even longer duration to ensure proper planning and allow for exchanges of experiences and lessons learned among different communities and groups.
- FFSs are an effective platform to discuss the perceived impacts of climate change with rural people. Brainstorming about historical trends in the community, combined with meteorological information can be used to learn about experienced changes, and the differences between variability in weather and changes in climate. Different types of changes are also likely to be occurring at the same time, and sometimes mutually reinforcing each other. Factors driving these changes including population trends, modifications in land tenure regimes, the degradation of local natural resources and market dynamics. While climate-smart

agriculture development interventions will have climate change as an entry point, they must address broader changes faced by communities if they wish to have a lasting impact on community resilience and the sustainability of livelihoods.

- FFS groups can be used to discuss how some of the impacts of climate change can be dealt with by decisions made by single individuals or jointly within household (e.g choosing drought-tolerant variety selection, crop rotations and associations or mulching). Other impacts may require action by a larger group or involve a broader community effort (e.g. building vegetated stones rows, slope erosion control measures, restoration of forest cover). Other issues will require improving local or national governance (e.g. securing access to shared water or forest resources). Development interventions should support the articulation of the differences between participatory diagnostics, community adaptation action plans, the FFS group plan and participatory territorial development approaches. Selection of specific management responses might create new risks that will need to be considered.
- A combination of participatory diagnostic tools should be used to define the action and learning plans within the FFS group. This combination of tools could include for example, a historical analysis, community mapping, manifestations of changes in weather and climate, the task men and women carry out during each season and during the day, livelihood rankings, problem prioritization, and the identification and ranking of potential solutions at community level. These can be combined in turn with monitoring and evaluation tools to build a comprehensive participatory monitoring, evaluation and learning framework.
- Social mobilization beyond the FFS and its complementary activities are needed to strengthen community resilience and implement adaptation actions. At the project level and local level, this involves efforts to create a convergence among all the technical teams or service providers that are involved. Facilitators with networking skills are needed to connect different stakeholders and build bridges linking multiple thematic and geographical areas.
- Policy-level actions are necessary to support investments in capacity development of farming communities. FFS programmes are good entry points for discussing people-centered climate change adaptation measures with governments and other stakeholders. A well-defined communication strategy can also facilitate policy engagement.

Challenges

- Climate-smart agriculture is a complex subject. Interventions need to rely on technically and functionally skilled facilitators. There is a need for continuous in-service capacity development for individuals, organizations and the people working within the broader enabling environment to support farmers.
- The results of some restoration measures or crop rotations might not be immediately visible to farmers. Maintaining the motivation of farmers and ensuring that benefits can be seen over different time spans is crucial.
- Addressing intertwined challenges of sustainable livelihoods, climate change adaptation and mitigation requires working across different geographic scales, from individual plots and farms to entire farming systems, landscapes or territories. This adds to the complexity of climate-smart interventions.
- Implementing interventions in the field that address climate change at the community level often require multidisciplinary teams with stakeholders that have diverse working methodologies, education and rationale. This can be a significant challenge in terms of human resources, institutions and policies that must be to overcome to ensure lasting contributions are made to community resiliency to climate change and sustainable livelihoods.

Potential for scaling up FFS that focus on climate-smart agriculture

After decades of FFS operations, there now exists a strong foundation of documented information and trained individuals that can be harnessed to scale up FFS to focus on climate-smart agriculture. The many FFS master trainers, resource people and facilitators that have been trained in many countries could be instrumental in this regard. However, a key component is to integrate climate-smart agriculture knowledge and tools into the process. Currently, most FFS trainers do not have sufficient knowledge about climate-smart agriculture.

Several platforms exist that can help RAS providers and others harness the FFS approach for adopting climate-smart agriculture. In 2017, FAO in partnership with IFAD, Bioversity, the Japan International Cooperation Agency (JICA), CARE, Agronomes et Vétérinaires Sans Frontières (AVSF) and many others, established the **Global FFS Platform**. The Platform brings together the documentation, expertise and partners involved in the FFS approach and its application to support climate change adaptation by smallholders. National country consultation platforms in Burundi and Mali have also been set up by government request to support intersectoral coordination and ensure that lessons learnt from FFS interventions are integrated in National Adaptation Plans and climate finance.

Regional and national networks of FFS practitioners have matured and are expanding worldwide. These communities of practices, which are currently active in Africa, Asia and the Near East, support the sharing of lessons and tools, and exchanges of experts among countries. One of the topics most requested by practitioners is how to adapt and use FFS to support climate change adaptation among smallholder producers.

Enhancing RAS capacities to promote climate-smart agriculture

RAS are well placed to support farmers with new knowledge that can achieve the three objectives of climate-smart agriculture. However, their capacities to do so vary widely. Limited knowledge on how to capture the synergies and manage the trade-offs among these three objectives; and the absence of a landscape approach to achieve the multiple objectives of climate-smart agriculture have constrained RAS in their ability to fully support farmers in this area.

In many developing countries, RAS have little involvement in climate change adaptation and mitigation efforts. Few national RAS providers have initiated specific programmes in this area. While the promotion of technology and the dissemination of information are traditional RAS activities, RAS providers face challenges in determining what types of adaptive changes farmers need to make and when to make them; and ensuring that relevant technologies and modes of dissemination keep up with the constant need to adjust to changing climate conditions (Simpson and Burpee, 2014).

RAS can play a strong role in promoting climate-smart agriculture, if there is an enabling environment and their capacities are strengthened in the following areas:

The capacity to conduct local climate change impact and vulnerability assessments

RAS should have the capacity and the appropriate tools to identify, evaluate and propose the adaptation options that are best suited to local conditions, based on an assessment of vulnerability to climate change and its impact on different groups. Climate change affects people differently. Its impacts will depend on gender, education, health and age, and on the adaptive capacity of communities. Some of the most vulnerable groups are the poor and smallholder farmers living in coastal areas and those who practice rainfed agriculture. RAS should be aware of how climate change affects these different client groups and what options are available for lowering their exposure to hazards, reducing their sensitivity to impacts and increasing their adaptive capacity. RAS also need more reliable and locally relevant climate projections.

Greater respect for indigenous and local knowledge

Indigenous knowledge is a valuable for finding local solutions to the challenges posed by climate change (see module C1). Farmers, forest-dependent people and fisherfolk often possess traditional and locally specific knowledge on a range of key subjects, such as locally adapted crops livestock and fish, integrated production systems, soil and water management methods, and the collection and management of neglected and underutilized species. RAS providers should be able to tap into this valuable knowledge as an entry point for developing well researched and locally adapted approaches for climate change adaptation (see also chapter B1-4). The importance of indigenous knowledge has been incorporated into the design and implementation of some RAS projects. However, little attention has been paid to integrating this knowledge into formal climate change adaptation and mitigation strategies (Nyong *et al.*, 2007)

Stronger engagement with research

The linkages between research and extension services continue to remain problematic in most developing countries, despite the fact that this has been an important area of reform in the agriculture sectors. Researchers need to build closer connections with RAS to incorporate into local knowledge, gain a clear understanding of farmers' needs and problems, and obtain feedback on how technological interventions related to climate-smart agriculture are working. RAS need to establish stronger connections with researchers, as most of the technological options promoted under climate-smart agriculture are more knowledge-intensive and locally specific than traditional approaches for agricultural development. RAS also require more technical backstopping to promote climate-smart agriculture (see chapter B1-4). There is a need to "reorient the institutional capacity of RAS to better align with the change in research focus towards climate-smart agriculture and sustainable practices" (CAPSA-ESCAP, 2014, p.3).

Ability to organize a wider search for solutions

In addition to collaborating with researchers to identify locally appropriate climate-smart agriculture practices, RAS personnel can benefit from learning about effective climate-smart agriculture practices from other regions facing similar challenges. RAS need mechanisms for learning from a range of practitioners. This will include includes systems for sharing knowledge and more effective virtual and face-to-face networking with practitioners in many locations. RAS providers need to have the ability to experiment and integrate newly gained knowledge in their activities to support rural communities in adopting climate-smart agriculture.

Capacities to expand the focus of RAS from households and farmer fields to the entire landscape

The promotion of climate-smart agriculture often requires collective action among farmers and collaboration among different stakeholders in the agricultural landscape. Climate-smart agriculture options related to adaptation and mitigation at the landscape level need to build consensus among the varied stakeholders (e.g. different ministries and departments; different communities and livelihood groups) and sometimes manage conflicts among them. Multistakeholder consultations and negotiations are needed to improve local governance, jointly prioritize options and make decisions on land use and access to and management of natural resources. These are important areas where RAS personnel need capacity development at different levels. Integrated landscape management is addressed in module A3.

Stronger set of functional capacities

Promoting climate-smart agriculture at the ground level involves enhancing farmers' decision-making and problem-solving capacities. RAS personnel working in the field should have sufficient 'soft' capacities related to communication, facilitation, conflict management and negotiation. They should also be able to combine technical and institutional innovations to promote climate-smart agriculture options. The Farmer Field Schools approach provides an example of this. Skills related to policy engagement is also an important area of capacity development that has been identified for RAS (GFRAS, 2012; GFRAS, 2013; Sulaiman and Mittal, 2016).

GFRAS has been supporting new learning materials to enhance these core competencies for individual RAS providers. These approaches need to be widely promoted to influence reforms in the curricula of educational and training organizations that deal with RAS. There are currently limited capacities among RAS that would enable them to shift from their role of trainer to that of a facilitator capable of brokering connections between farmers and different sources of knowledge and service providers. This should be an important area for capacity development of RAS.

Recognizing the importance of strengthening capacities in the area of climate change among RAS providers, many organizations have published training manuals in the area of climate change adaptation and mitigation (FAO, 2015; Simpson, 2016; Campbell *et al*, 2013; Solar 2014; GIZ, 2015; CCAFS, 2016b).

In a changing environment, developing new capacities and strengthening existing ones is critical for RAS to reinvent its role and embrace effective strategies that support of climate-smart agriculture. The GFRAS has articulated the capacities that for RAS need to develop at the individual, organizational and enabling environment levels (FAO, 2012; GFRAS, 2012.).

Capacities for promoting climate-smart agriculture at different levels, based on the GFRAS framework, are described below.

Individual level

Technical capacities, including knowledge related to:

- climate change and its direct and indirect effect on the agriculture sectors and specific farming systems;
- climate-smart agriculture principles and the synergies and potential trade-offs between adaptation, mitigation and food security;
- the identification of climate change risks and assessing vulnerability;
- access to and use of agrometeorological data to improve resilience and sustainability of farming systems;
- technologies and practices appropriate for promotion of climate-smart agriculture;
- climate change adaptation options in agriculture, including technological, institutional and policy options;
- climate change mitigation options in agriculture, including the monitoring and assessment of greenhouse gas emissions;
- different mechanisms for risk management, including crop, animal and weather insurance; and
- different extension tools and approaches to promote climate-smart agriculture

Functional capacities, including knowledge and expertise related to:

- participatory climate change adaptation planning;
- community mobilization and the development of farmer organizations for promoting climate-smart agriculture; supporting producers and rural women to organize into different types of interest and activity groups; and sustaining and federating farmer organisations;
- facilitation to encourage discussions, mediate conflicts, build consensus and foster joint action in multistakeholder processes;
- negotiation to help reach a satisfactory compromises or agreements between individuals or groups, and increase the negotiating capacities among other stakeholders;
- ways of brokering and creating 'many-to-many' relationships among the wide range of stakeholders:
- networking and partnership development, including in areas where work is done in multi-organizational and multisectoral teams.

Organizational level

Enhancing the capacities of RAS to promote climate-smart agriculture also involves developing capacities at the organizational level. Adaptation to climate change in agriculture often requires more and better coordination among a wide range of stakeholders at a range of levels, and RAS need to establish a culture of networking and partnership development to ensure coordinated action. Adaptation does not occur in an institutional vacuum (Agarwal, 2008). Circumstances at many different levels, within households, throughout the wider communities and within governments, affect the choices made by individual farmers (Ojha *et al*, 2014). Experiences from CVS reveal the need for continuous experimentation and learning to promote climate-smart agriculture options. It is not merely farmers who need capacities to adapt to climate change. Other groups who are actively supporting farmers to adapt to climate change should have the capacities to anticipate changes, promote planned adaptation interventions and continuously learn from these interventions. In this regard, some of the organizational capacities that are needed for RAS relate to:

- the capacity to anticipate and respond to emergencies and organize support and services;
- enhanced financial resources and adequate human resources to effectively promote climate-smart agriculture;
- systems for human resource development, which includes training infrastructure, appropriate curricula and well-trained faculty:
- information and communications technology and knowledge management infrastructure to enhance the flow of information among different stakeholders;
- strategic policy advocacy to forcefully articulate the impact of climate change on agriculture and the need for RAS to promote climate-smart agriculture; and
- rules, norms and values that encourage collaboration among people working in different areas (e.g. research, agrometeorological services, seed systems and the agricultural value chain), and promote sharing, interacting and collective learning in the joint pursuit of climate-smart solutions.

Enabling Environment

The enabling environment refers to the framework conditions that facilitate and support organizations to play their roles effectively. An enabling environment may provide the laws, regulations and incentives that shape an organization's mandate; the roles it plays; and the ways it operates. In the context of RAS, the enabling environment includes policies, institutional arrangements, stakeholder involvement, infrastructure and access to knowledge and support from a wide range of other organizations that are critical for the effective functioning of RAS, especially in promoting climate-smart agriculture.

At the national level, the need to address climate change must be recognized by and addressed through policy instruments, such as National Adaptation Plans, and financial mechanisms that provide access to climate funds to implement adaptation and mitigation policies. The importance of adapting the agricultural sectors to climate change; how they could contribute to mitigation; and how RAS could support these activities, all need to be articulated in policy instruments, such as National Adaptation Plans and Nationally Appropriate Mitigation Actions. The success of these kinds of frameworks relies heavily on stakeholders' commitment to commonly defined objectives, and their willingness to collaborate, both financially and in terms of their political institutions (Box C2.8).

Box C2.8 Climate-smart agriculture Prioritization Framework in Guatemala

In 2014, the Ministry of Agriculture, Livestock and Food (MAGA) of Guatemala worked closely with the International Center for Tropical Agriculture (CIAT) and CCAFS to look for opportunities for making climate-smart agriculture investments in Guatemala's dry corridor region. The Climate-Smart Agriculture Prioritization Framework (CSA-PF) initiative sought to identify and prioritize climate-smart agriculture practices that contribute to enhancing the food security and livelihoods of vulnerable farmers in the region.

The CSA-PF facilitated the creation of a decision-making forum for stakeholders to narrow down a long list of climate-smart agriculture options into portfolios for promotion and scaling up. The prioritization process was organized into four main phases between 2014 and 2015:

1. A team of experts from MAGA's Climate Change Unit, the main facilitators of the process, defined the objectives and the scope of the prioritization activities and developed an extensive list that covered potentially vulnerable regions, production systems and related climate-smart agriculture practices. External experts evaluated the impacts of these practices using indicators for adaptation, mitigation and productivity, and identified the practices expected to deliver the highest aggregate amount of benefits for reaching the objectives of climate-smart agriculture.
2. The stakeholders, which included government decision-makers, academics, donors and producer organizations, were brought together in a participatory workshop where they discussed and validated the expert assessment to ensure usability and consistency with stakeholders' agendas. This process succeeded in finalizing a short list of climate-smart agriculture practices that were relevant for small-scale maize and beans farmers in the dry corridor region.
3. The costs and benefits of these short-listed practices were calculated using a combination of economic analysis, expert interviews, literature reviews and household surveys.
4. The results of the cost-benefit analysis were brought back to the stakeholders for discussion and validation and to decide on the next steps to be taken. Using multiple sets of results from the different phases, which considered the different dimensions of climate-smart agriculture (adaptation, productivity, mitigation) from different perspectives (social, economic, environmental, policy and institutional), stakeholders grouped the practices into portfolios that would be consistent with their investment priorities in the area. Through this process, a climate-smart agriculture investment portfolio was developed.

Political will was particularly important for legitimizing the process. It also created a favourable environment in which the potential of the climate-smart agriculture portfolios to influence national policies and strategies could be effectively tapped. However, without further commitment of the stakeholders, who were the direct and indirect users of the results, to remain engaged in the process, either through planning policies and strategies or through financing climate-smart agriculture investments, the implementation of these prioritized interventions may be at risk.

Source: Nowak *et al.*, 2016.

Expanding the practices from climate-smart agriculture pilot projects to a wider scale requires both higher levels of political commitment and enhanced capacity for policy learning. Some of the specific characteristics of the enabling environment that facilitate promotion of climate-smart agriculture are:

- political commitment to agricultural development and the promotion of macro-economic policies that provide incentives to climate-smart agriculture;
- the capacity of policy-making bodies to adapt policies based on lessons learned from climate-smart agriculture interventions;
- the capacity and willingness of other stakeholders to share data, resources and good practices, and engage in collaborative action with RAS;
- mechanisms that facilitate collaboration and joint action among the range of stakeholders; and

- mechanisms that ensure farmers have equitable access to a variety of inputs, including access to subsidies and financial support.

Conclusions

RAS, which have a long history of supporting farmers to respond to different types of challenges and opportunities, have a very important role in promoting climate-smart agriculture. The current contribution of RAS to the three objectives of climate-smart agriculture vary widely mainly due to lack of sufficient capacities at different levels. The capacities of RAS at the individual, organizational and enabling environment level need to be enhanced, if they are to effectively contribute to the promotion of climate-smart agriculture.

Acknowledgements

Coordinating lead authors: Rasheed Sulaiman (GFRAS), Delgermaa Chuluunbaatar (FAO), and Anne-Sophie Poisot (FAO).

Contributing authors: Soniia David (FAO), Deborah Duveskog (FAO), Nimisha Mittal (CRISP), James Okoth (FAO), Suzanne Phillips (FAO), Mohamed Soumare (FAO).

Reviewers: Deissy Martinez Baron (CIAT-CCAFS), Magdalena Blum (FAO), Bianca Dendena (FAO), Marjon Fredrix (FAO), Patrick Kalas (FAO), Federica Matteoli (FAO), Karin Nichterlein (FAO), Lisen Runsten (FAO), Simone Sala (FAO), Brent Simpson (FAO).

Notes: New module (2017)

References

African Forum for Agricultural Advisory Services (AFAAS). 2011. *Market-oriented agricultural advisory services (MOASS)*. Guidelines for setting up MOAAS pilots Study on Market-Oriented Agriculture Advisory Services (MOAAS) Approaches.

Agrawal. 2008. *The role of local institutions in adaptation to climate change*. International Forestry Research and Institutions Program (IFRI) Working Paper, Cambridge, UK: Cambridge University Press.

Anderson, J. R., Feder, G. & Ganguly, S. 2006. *The Rise and Fall of Training and Visit Extension: An Asian Mini-drama with an African Epilogue*. Policy Research Working Paper; No. 3928. World Bank, Washington, DC.

Beccera, T.A., Middendorf G., Campbell A. & Tomlinson, P. 2016. *Climate Change Challenges for Extension Educators: Technical Capacity and Cultural Attitudes*. Journal of Extension, 54(6).

Campbell H., Hills T., Stone S., León M.C., Harlig R. & Dave R. 2013. *Conservation International, Social Policy and Practice Department, 2013*. Adapting to a Changing Climate: A Community Manual.

CAPSA-ESCAP. 2014. *Expert Consultation on Strengthening Linkages between Research and Extension to Promote Food and Nutrition Security*. 11-12 December 2013, Bangkok, Thailand.

CCAFS. 2015. *Workshop report: Climate-Smart Villages (CSVs)*. Ludhiana, India. September 3-6th 2015.

CCAFS. 2016a. *Better decision support for improved livelihoods among farmers in northern Ghana*.

CCAFS. 2016b. *CSA Guide*.

Christoplos, I. 2010. *Mobilizing the Potential of Rural and Agricultural Extension*. Food and Agricultural Organization of the United Nations and the Global Forum for Rural Advisory Services.

David, S. 2016. Extension & CSA: introduction. In Sala. S, Rossi. F & David. S. (eds). *Supporting agricultural extension towards Climate-Smart Agriculture. An Overview of existing tools*.

Davis, K. & Oberthür, F. 2014. *Rural advisory services - back on the development agenda!* Rural 21.

Davis, K. & Sulaiman, R. 2013. *Extension Services for Effective Agricultural Risk Management*.

FAO. 2012. *Corporate Strategy on Capacity Development*. Rome.

FAO. 2013a. *Climate-smart agriculture sourcebook*. Rome.

FAO. 2013b. *Supporting Communities in Building Resilience through Agro Pastoral Field Schools*. Rome.

FAO. 2015. *Climate change: junior farmer field and life school - facilitators' guide*. Rome.

FAO. 2016a. *Climate change and food security: risks and responses*. Rome.

FAO. 2016b. *Supporting Agriculture extension towards Climate Smart Agriculture*. An overview of existing tools. Compendium Climate-smart agriculture & extension.

FAO. 2016c. *Planning, implementing and evaluating Climate Smart Agriculture in Smallholder Farming Systems*. The experience of the MICCA pilot projects in Kenya and the United Republic of Tanzania. Rome.

Global Forum for Rural Advisory Services (GFRAS). 2012. *The "New Extensionist": Roles, Strategies, and Capacities to Strengthen Extension and Advisory Services*.

GFRAS. 2013. *Extension Policy Compendium*.

German Agency for International Cooperation (GIZ). 2015. *Capacity Development for Climate Change Adaptation and Mitigation*. A Training Manual- 2014. Deutsche Gesellschaft für Internationale Zusammenarbeit and National Bank for Agriculture and Rural Development.

Leeuwis, C. & Hall, A. 2013. *Facing the challenges of climate change and food security*. The role of research, extension and communication for development.

Neuchâtel Group. 2008. *Common Framework on Market-Oriented Agricultural Advisory Services*.

Nowak, A., Corner-Dolloff, C., Lizarazo, M. & Barón, D. M. 2016. *The CSA Prioritization Framework: an innovative planning tool to prioritize CSA practices*. In Sala. S, Rossi. F and David. S. (eds). Supporting agricultural extension towards Climate-Smart Agriculture. An Overview of existing tools.

Nyong, A., Adesina, F. & Elasha, B.O. 2007. *The Value of Indigenous Knowledge in Climate Change Mitigation and Adaptation Strategies in the African Sahel*. Mitigation and Adaptation Strategies in Global Change, 12: 787-797.

Ojha, H. R, Sulaiman, V. R., Sultana, P., Dahal, K., Thapa, D., Mittal, N., Thompson, P., Bhatta, G., Dutt, G. L. & Aggarwal, P. 2014. *Is South Asian Agriculture Adapting to Climate Change?* Evidence from the Indo-Gangetic Plains.

Pine Integrated Network: Education, Mitigation, and Adaptation project (PINEMAP). 2017. *PINEMAP* [online].

Plantwise. 2015. *Final Evaluation Report: External evaluation of the on-going donor-funded programme "Plantwise: integrated plant health systems"*

Rashid, M., Haque, M. 2016. *New Cropping Pattern Gives Four Crops Annually, Good Practices 14*.

Shepherd, A., Mitchell, T., Lewis, K., Lenhardt, A., Jones, L., Scott, L., & Muir-Wood, R. 2013. *The geography of poverty, disasters and climate extremes in 2030*. London: Overseas Development Institute, Met Office Hadley Centre, and Risk Management Solutions.

Simpson, B.M. & Burpee, C.G. 2014. *Adaptation under the "New Normal" of Climate Change: The Future of Agricultural Extension and Advisory Services*. Michigan State University and Catholic Relief Services.

Simpson, B.M. 2016. *Preparing smallholder farm families to adapt to climate change*. Pocket Guide 1: Extension practice for agricultural adaptation. Catholic Relief Services: Baltimore, MD, USA.

Solar, R. 2014. *Building Climate Resilience: A Training Manual for Community Based Climate Change Adaptation.* Regional Climate Change Adaptation Knowledge Platform for Asia, Partner Report Series No. 14. Regional Resource Centre for Asia and the Pacific (RRC.AP), Asian Institute of Technology, Thailand.

Sulaiman, V.R. 2012. *Reframing Climate Adaptive Agricultural Innovation*. CCAFS Blog.

Sulaiman, V.R. & Mittal, N. 2016. *Capacity Needs of Extension and Advisory Services (EAS) in South Asia*. Policy Brief No.1. July 2016.