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Working Paper No. 156

CGIAR Research Program on Climate Change,
Agriculture and Food Security (CCAFS)

Kevin Perkins
Sheila Huggins-Rao
James Hansen
John van Mossel
Lisa Weighton
Sarah Lynagh

Working Paper

FARM RADIO INTERNATIONAL

CGIAR

RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security

CCAFS

Interactive Radio's Promising Role in Climate Information Services

Farm Radio International Concept Paper

Working Paper No. 156

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Abstract

This paper focuses on how interactive radio programming can increase the reach of weather and seasonal climate information and related advisory services. In doing so, they can enhance small-scale farmers' capacity to make optimal decisions and manage risks based on a better understanding of probabilistic seasonal forecasts. The objective is to outline strategy that could vastly and affordably expand the number of small-scale farmers that are reached by and benefit from weather and climate information and related advisory services. Building on Farm Radio International's (FRI) pioneering African Farm Radio Research Initiative (AFRRI), we assess the opportunities for interactive radio to provide integrated climate and advisory information while increasing farmers' equitable access to salient and legitimate programming. We describe a number of practical strategies that can be used to make radio-based climate communication interactive, outline elements of a successful interactive radio service targeting rural communities, and discuss costs and other issues required for sustainability.

Keywords

Radio; ICT; Climate services; Advisory services; Communication

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Acronyms

AFRRI	African Farm Radio Research Initiative
CCAFS	Climate Change, Agriculture and Food Security
CBO	Community Based Organization
CIS	Climate Information Service
CSO	Civil Society Organization
CVCA	Climate Vulnerability and Capacity Analysis
FRI	Farm Radio International
ICT	Information and Communication Technology
IVR	Interactive Voice Response
NARES	National Agricultural and Research and Extension Systems
NMS	National Meteorological Service
PRA	Participatory Rural Appraisal
PRC	Participatory Radio Campaign

Introduction

Farmers require relevant, timely and continuous information and advice regarding historic climate variability, probabilistic seasonal forecasts, and monitoring and short-lead information about growing season weather. This information can help them to make informed decisions about their farming practices and enable decision-makers to understand and act on the information (Tall et al., 2014). These services are especially important for farmers in sub-Saharan Africa, where up to 95% of crop production is rainfed, making small-scale farmers vulnerable to the impacts of climate change and seasonal variability.

Climate services are most useful when built upon dialogue between climate scientists, local expert forecasters, intermediaries, and users such as farmers, pastoralists, project and programme staff, government planners, businesses and others who benefit from climate information (Ambani & Percy 2014). However the cost and limited reach of face-to-face interactions presents challenges to scaling up climate services for smallholder farmers.

Radio broadcasts, on the other hand, have tremendous reach and coverage, and are very efficient. However, radio broadcasts are conventionally one-way methods of disseminating data that do not provide the exchange, discussion and explanation that helps with decision-making. Further, radio broadcasts are fleeting; one either hears them when they are broadcast, or they are missed. If the weather forecasts are broadcast at a time that farmers cannot listen, they are not helpful.

Recent developments in interactive radio, which combines radio with widespread and growing mobile phone access, offer the exciting prospect of combining the benefits of participatory interaction with the immense reach of radio and mobile phones. Interactive radio integrates accurate and interpretive radio broadcasts with “on demand” access to interactive voice response (IVR) systems, SMS services, and unique uses of missed call voting to provide users with personalized feedback and allow for two-way communication and learning.

Interactive radio combines some of the benefits of face-to-face interaction (between farmers and climate experts) found in workshops with the reach of mass media to provide equitable access to female and male rural farmers. This paper proposes a framework and strategy for developing interactive radio programing to extend the reach and benefits of weather and seasonal climate information and related advisory services for smallholder farmers. It offers a

promising complement to face-to-face interaction and other methods of delivering climate information to farmers.

The Changing Landscape of Rural Radio

Living in remote communities far from universities, research centres and government departments, farmers rely on radio for agricultural advice, news and market information. Broadcast in multiple languages, radio is understood by farmers regardless of literacy levels. However, in the past, radio stations were predominately state controlled. They offered some agricultural programming, but it was not interactive and, in some cases, content was not relevant to small-scale farmers. Rural radio was seldom based on the local context in Africa. "It was a model of State paternalism in which programs were produced by experts in the cities and beamed to 'ignorant' peasants in the countryside on the State radio frequencies" (Girard 2003, p. 18). There was not much competition, either. In 1988, there were only 10 independent radio stations in sub-Saharan Africa (Girard 2003). When the airwaves were liberalized in the 1990s, community and commercial FM stations not only emerged, but also flourished. This was also due in part to market liberalization, increasing affordability of technologies and a "thirst for alternatives to government controlled media" (Myers 2008, p. 12). This "radio renaissance" led to increased investments by international donors, NGOs, government agencies as well as from the private sector (Myers 2008). Radio became much more accessible. Radios are now so inexpensive that almost everyone can afford one, whether as a radio set or as a feature of a mobile phone, making it the most widely used medium for disseminating information to rural audiences across Africa. In many areas, radio is the only mass medium available (Girard 2003). The reach of radio is vast - there are more than 800 million radio sets in developing countries (FRI 2014a). Radio has long been the technology with greatest reach, but mobile phones are quickly catching up. In fact, some rural areas have higher rates of mobile phone ownership than radio set ownership[1] (Farm Radio International, 2014). Most mobile phones purchased in Africa, including basic 2G phones, have radios installed in them, meaning that nearly everyone with a phone can listen to the radio without using airtime.

[1]

Conventional radio was largely a one-way medium. Broadcasters spoke and audiences listened. Farmers had no way of accessing missed programs. However, with the rapid influx of modern ICTs in Africa, especially mobile phones, radio is becoming increasingly interactive, facilitating a more participatory and horizontal mode of communication (Myers 2008). Instead of replacing radio as some had predicted, research shows that ICTs are enhancing it (Myers 2008). In many countries, more than half the rural population carry mobile phones. Crop prices, weather forecasts and agricultural tips are now in the palms of their hands. While ICTs offer tremendous potential to serve rural farmers' information needs, increase interactive content and integrate effectively within existing social communications networks, ICTs are tools that do not affect social change on their own.

The African Farm Radio Research Initiative (AFRRI) was a multi-stakeholder action research project implemented by Farm Radio International from 2006-2010. It gathered solid evidence of the potential of rural radio (combined with ICTs) to reach millions of farmers with information services (Perkins et al. 2011). Through AFRRI, Farm Radio International learned that participatory farm radio programming – when it meets standards of quality and consistency – is widely listened to and leads to significant gains in knowledge by small-scale farmers. FRI also learned that specialized, carefully designed programs can lead to the application of more effective and productive farming practices by up to 48% (on average 21%) of farming families that live in areas exposed to these programs – five times more than the rate of application among farmers living in similar communities that do *not* have exposure to these radio programs. The study also showed a positive relationship between the frequency of listening to the radio program and both the level of knowledge acquired by listeners and the application by listeners of the featured farming practice. Subsequent outcome evaluations of projects involving participatory and interactive radio programs have delivered similar results in terms of reach, knowledge gain, and the application of new practices (FRI 2013, 2014 a and c). This approach can provide tens of millions of small-scale African farmers with vitally important services at a cost of pennies per person reached for about $1 per adopter (FRI 2014 a and c).

Interactive, participatory radio has several key features that enable it to deliver measurable results that conventional "plug and play" farm radio may not. The process involves extensive consultation with communities, training for the production teams at partner radio stations,

guidance from a range of knowledge partners, including farmers, and synchronization with cropping seasons or partner interventions. Ongoing monitoring, training and feedback ensure quality of content and presentation. Programs focus equally on the expressed needs and desires of women and men farmers. The goal is for radio producers to create exceptionally good programs that attract a large, loyal audience.

The Potential Role of Rural Radio in Climate Services

Weather forecasts out to a few days are simple to understand, and simple to communicate via radio and other media. Weather-based advisories about within-season farm operations, such as when to irrigate and whether to apply pest control measures, are also relatively simple to communicate, and may be relevant to many farmers within a given farming system. However, as lead-time of information increases, the information becomes more uncertain and hence more complex. The many crucial strategic decisions that a farmer must make before the start of the growing season, based on understanding of year-to-year climate variability and potentially seasonal forecasts, are also relatively complex and farmer-specific. Communicating information and appropriate advisories therefore becomes much more challenging as one moves from weather time scales (up to about a week) to seasonal and longer climate time scales.

While evidence shows that climate information services can play an integral role in helping farmers manage risk, there are a number of challenges to consider when developing climate services for smallholder farmers. CCAFS has identified five key challenges – salience, access, legitimacy, equity and integration – that must be addressed if smallholder farming communities are to benefit fully from climate information (Tall et al. 2014). Building on successful experience with participatory climate communication approaches, we argue that complementing face-to-face communication with well-designed interactive radio programming has potential to extend the reach of climate services while helping to address each of these challenges.

Experience with participatory communication approaches

Effective use of seasonal forecasts places substantial demands on knowledge management skill, as it involves using new information presented in new formats to possibly adjust many interrelated decisions. The probabilistic nature of seasonal forecasts presents a significant

challenge – not because farmers have difficulty making decisions in the face of uncertainty, but because formal probability formats must be mapped onto their mental models for dealing with uncertainty. There is growing evidence that group interaction contributes substantially to farmers' understanding of seasonal climate forecast information, and to willingness and ability to act on that information (Patt et al. 2005; Marx et al. 2007; Roncoli et al. 2009).

CCAFS has successfully piloted participatory, workshop-based approaches for communicating complex climate information with rural communities and for supporting their use for farm decision-making. The IRI developed a participatory process to help farmers interpret and respond to downscaled, probabilistic seasonal climate forecasts, in a manner that is consistent with the way they deal with variability in the absence of forecasts (Hansen et al. 2004, 2007). The process starts with farmers' collective memory of past variability, and goes through a progression of examining historic variability through time series graphs, sorting local data into probability-of-exceedance graphs, interpreting how to interpret the graphs, then showing how El Niño or La Niña conditions shift the probability distribution – in a format that is used to present locally downscaled seasonal forecasts. This process was the starting point for pilot activities at CCAFS Climate Smart Village sites in Kaffrine, Senegal and Makuene, Kenya; and adapted for training for agricultural extension and NGO staff in northern Tanzania (Hansen 2015; Njiru et al. 2015).

In parallel, CCAFS worked with University of Reading to develop a participatory workshop process, known as PICSA (Participatory Integrated Climate Services for Agriculture), that starts with local historic station data presented in graphical form; examines locally relevant crop, livestock and livelihood options in context of past variability and climate-related risks; and explores implications of forecasts for adjusting options (Dorward et al. 2015a, b). The approach was piloted successfully in Zimbabwe, and is being used to train agricultural extension staff and other relevant organizations in climate services capacity-development projects in Tanzania and Malawi (GFCS Adaptation Program in Africa), and in Ghana (CCAFS CASCAID project).

Three factors, shared by both approaches, appear to enhance the ability of participating farmers to understand complex climate information and apply it to their farming and livelihood decisions. First, both ground discussions about climate in local historical observations. Second, both employ visual representation and hands-on exercises with graphs

based local data, as a means to communicate variability, probability and associated risk. Third, group interaction appears to foster understanding and willingness to act on information, by facilitating open dialog with climate information providers and trusted technical experts, and by promoting farmer-farmer learning. Plans are underway to bring the complementary strengths of the two CCAFS approaches together, branded as a new version of PICSA.

CARE's Participatory Scenario Planning (PSP) approach (Ambani & Percy 2014; Ambani et al. 2013) follows a similar methodology to CCAFS' workshops, and offers some important insights. CARE holds that for "climate information to be actionable, communication channels between producers and users need to be accessible, effective, timely and bi-directional." Factors that contribute to effective use of climate information by communities include: "the language, style and channel through which communication is done;" "packaging of climate information tailored to specific users' capacities and needs;" and "the style and visual packaging of translated climate information." In its review of the PSP, CARE includes these recommendations (Ambani & Percy 2014, p. 21): (a) Multi-stakeholder dialogue (among scientists, local forecasters, intermediaries and users) is essential in generating (co-producing) useful climate information. (b) Climate information services must be embedded in local, national and regional processes to enable scaled-up support for widespread adaptation activities. (c) Harnessing communication opportunities in the 21st century such as smart phones and other ICTs as well as linkages to private sector platforms such as market information systems will enable a wider, targeted and timelier reach of climate information. (d) Capacity building of all stakeholders (including non-scientific audiences such as users and intermediaries) on technical aspects (of information provided by climate science) is critical for the value of climate information to be realized.

Can radio help address the challenges?

Salience

Salience involves ensuring climate information and advisory services are relevant to the decisions of rural small-scale farmers. It requires bridging a substantial gap between farmers' information needs, and the information that is routinely available.

Interactive radio programs are built from a thorough understanding of the circumstances facing local farmers, through formative research processes that capture local knowledge,

attitudes, and decision-making processes. Village-based intermediaries, regional research institutions, local NGOs and government extension services are all engaged in the planning of interactive radio services and as participants in the programs (Rao, 2015). Through interactive features such as community discussions, interviews, live panel discussions, and call-in shows, salient issues can be addressed for each zone reached by a rural radio program.

The complexity of climate information that is salient to farmers' decisions presents a significant challenge. In order for climate change information to enable action, it has to be available in a form that people can understand, but without discarding crucial information about its uncertainty. Communication of uncertainty and probability are not easy, especially in oral-based cultures and in a variety of local languages. Interactive radio programs can help address the issue of complexity and complement face-to-face communication through on-air interpretations and discussion of forecasts, the concept of probability, and other climate issues related to agriculture. Participatory workshops, together with interactive radio programs can help to reinforce key messages and translate complex climate information into locally relevant possibilities for action.

Access

Access involves providing timely climate services access to remote rural communities with marginal infrastructure. Tall et al. (2014) argue that scaling up access to climate services will require a combination of communication channels, including ICTs (e.g., SMS, call-in services), rural radio, agricultural extension services, farmer organizations, and social networks.

Interactive radio can respond to the need for timely information better than conventional radio for two reasons. First, the participatory research and planning process should identify the best times to broadcast programs, maximizing the likelihood of listening. Second, interactive voice response systems can provide listeners with "on demand" access to the most important information through the use of voice prompts and pre-recorded information, thereby allowing users to access information at their convenience. For example, FRI's Beep4Weather system is designed to provide anytime access to weather advisory services with a simple missed call, utilizing weather interpretations recorded by extension workers or other experts.

Legitimacy

Making sure farmers own and have an effective voice in the design, production and delivery of climate information services is key to ensuring legitimacy, as are continuous assessments of service quality and delivery (Tall et al. 2014, p. 34). Tall et al. further note that trust, local relevance and use are fostered when meteorological information is integrated with local indigenous knowledge.

Successful interactive radio, should always be informed by a research design process that values farmers' local knowledge, cultural beliefs and attitudes, and preferred communication channels. In order to overcome the challenge of producing legitimate information, interactive radio programs should include the voices and perspectives of local farmers and indigenous weather forecasters, together with those of experts, so that each group can learn from the other. Dialogue between the two is facilitated through phone-in shows, recorded community discussions and vox pops, panel discussions and other interactive program formats. Taken together, this approach creates a service with a high level of farmer representation, and hence a high level of legitimacy and trustworthiness for listening farmers. Results from the African Farm Radio Research Initiative (AFRRI) demonstrated that listenership increases when communities are engaged in the development and monitoring of farmer-centred radio programs (Perkins 2011).

Equity

Research shows that women who have greater access to extension services and other resources are better able to contribute to the food security of their families and communities (FAO 1997; Feed the Future 2011). Yet women generally have less access to information and resources than men do, especially in rural Africa. There is evidence that conventional radio programming is less beneficial to women than to men, due to competing domestic duties, limited access to communal radios, level of formal education and cultural biases about women's' access to technology (Myers 2009; Perkins et al. 2011). Despite these obstacles, FRI evaluations of Participatory Radio Campaigns found that interactive radio services reach many women, and that women farmers who are exposed to them obtain a level of knowledge that is equal to the knowledge level of male counterparts (FRI 2014a; 2014c). Simple features of interactive radio program formats can further enhance the benefits of such programs for women. For example, FRI encourages its radio partners to use two phone lines for their call-in

shows: one line for male callers, the other for female callers. This allows radio program hosts to answer alternating calls from the two lines, resulting in 50% of the answered calls coming from females. Interactive radio can also provide on-demand access to information, so that relevant updates can be accessed at any time of day.

Interactive radio also has the potential to serve minority language groups, either through community radio stations that broadcast in the specific group's language, or through rebroadcasting the same programs in multiple languages at different times.

Integration

Integration entails providing climate services as a part of a larger package of agricultural support or interventions to enable the effective management of climate related agricultural risk. In order to meet farmers' needs, climate information should be integrated with other forms of agricultural information. "While national meteorological services (NMS) have the expertise to produce raw weather and climate information, national agricultural research and extension systems (NARES) are generally in a better position to translate this information into advice and support for farmers" (Tall et al. 2014, p. 34). Interactive radio can be used as a tool to help facilitate the integration of climate information and advisory services through the use of segments on the meaning of forecasts, extension advice, farmer news, and interviews with key intermediaries.

Interactive Radio for Rural Climate Services

The face-to-face methods of climate information service delivery that have been practiced by CCAFS, CARE and others are effective because they build on the knowledge base of farmers, facilitate dialogue and knowledge exchange, are integrated into wider agricultural development efforts, and can target the most vulnerable farmers. However, they have limited reach, and are expensive to scale up to many communities at the same time. On the other hand, distributing climate information and advisories through conventional radio broadcasts or SMS can reach many farmers at relatively low cost; but lack some of the benefits of intensive face-to-face interaction. We propose interactive climate service radio programming that combines the penetration and scale of radio and mobile phones with a level of dialogical social learning complementary to that of face-to-face methods to enable wide-scale participation (Harvey 2013). A variety of approaches to using technologies provide

broadcasters with opportunities to access information and communication channels between information producers (broadcasters, stations) and consumers (Sullivan, 2011). ICTs provide a means to link scientific experts and extension agents with rural farmers, and thereby connect farmers to needed and pertinent information so that they can make more informed decisions. Through the use of ICTs, farmers can also share their knowledge, concerns and questions.

Designing successful interactive radio climate service programming

There are number of key design factors to take into account in the development and operation of an interactive radio service that complements face-to face workshops and learning events with farmers. The primary purpose of farmer engagement, using a variety of radio strategies, is to reinforce learning and adaptive action by farmers, as well as contribute to the saliency and the legitimacy of the service. Other factors to consider include the accessibility of services, integration with other farmer services and ensuring that equitable strategies are established for all targeted farmers. The following are a number of design factors to consider when planning for an interactive climate radio service.

Situation Analysis

An interactive radio program has the potential for contributing to a comprehensive process for communicating and disseminating climate information to farmers, if farmers and other stakeholders identified it as a useful channel and strategy for communicating to farmers in the relevant communities. This process begins with an extensive formative or participatory research process in the targeted communities and serves as a situation analysis. It also includes tools for communications and dialogue on agricultural and climate-related topics. This process usually involves a mix of qualitative methods, such as focus group discussions and key informant interviews, and quantitative methods such as household surveys. The basis for this research process is to form a thorough understanding of farmers' livelihoods and perceptions of risk in a particular community, and to uncover information about cultural beliefs and attitudes, local knowledge about weather and climate, and what communication channels are most effective for reaching farmers, among other insights.

This initial analysis can also examine the information needs and preferences of women and youth through specific strategies to increase listenership and interest in programs (FRI 2014a). These initial activities involve close collaboration and joint learning amongst

knowledge partners at all levels in the communication, dissemination, and use of climate information products, including climate experts, local forecasters, agricultural extension staff, and farmers. This process ultimately leads to a more responsive, useful climate information delivery package that serves the needs of farmers. The development of an interactive radio service should be informed by this initial research process.

Multi-stakeholder engagement and integration

Stakeholder engagement is needed to generate knowledge and advice on upcoming seasons, specifically on seasonal forecasts, based on knowledge of local systems and constraints – for sharing broadly with male and female farmers. The full range of stakeholders, including men and women who are farmers, community leaders, government ministries and their extension agencies, local CSOs, universities/research institutes, donor agencies, and the national meteorological agency should all be engaged in the development, implementation, monitoring and evaluation of the interactive radio service. In addition to these stakeholders, the participation of experts in social learning, radio/audio communication and participatory social animation should be sought. It is recommended that these stakeholders be assembled in a consultative or advisory group that will meet at key intervals and can be at the national district or ward-levels depending on the targeted reach and scope of the service. The groups should meet early in the process to discuss the main features of the program – informed by an initial formative research process – to identify information requirements, and to decide which regions, districts and zones should be covered by the service. Later, the consultative group would agree on a process for consulting on the content to be featured in the program in advance of each season. The development of these multi-stakeholder consultative or advisory groups would engage farmers, connecting them with experts and key decision makers, and draw these players into the process of designing, developing and delivering the service.

Radio station selection and capacity development

For an interactive radio service to be effective, it must be produced and broadcast by a radio station that farmers like to listen to and that has a production team with the skills and commitment to develop and air a good program. The situation analysis process described above helps to identify the radio stations that farming families (particularly female farmers) like to listen to and trust. In fact, it is often possible to identify the presenters that listeners prefer and put their faith in.

With this knowledge in hand, the implementing body should approach and enter negotiations with the radio stations that can have the biggest impact on the target audience. Normally, radio stations are asked to sell "airtime" to broadcast a program or "messages" produced by the airtime buyer. Therefore, the negotiation process takes time, because radio stations are generally not accustomed to being asked to be partners in the development of a new program that the station itself would own and offer as a service to its listeners.

Once an agreement is entered, the capacity building process may begin. We recommend a set of five capacity-building activities: (a) a workshop on the *content* of the radio program (in this case, climate information and advisories); (b) an *In-Station Training Program* delivered on the job at the station by an expert trainer to the full production team that will be responsible for the interactive radio program; (c) direct support and training for the integration of modern ICTs; (d) weekly monitoring of and feedback on each episode of the interactive radio program, and individualized coaching aimed at quality improvement; and (e) business training and consulting for radio station managers in support of developing a sustainable business model.

Technical Design for Interactivity

There are a number of possible innovative approaches to integrating ICTs with radio with the goals of achieving scale, enhancing interactivity, improving accessibility and lowering the cost of agricultural advisory services. These methods can be readily adapted to support and enhance other face-to-face methods and broaden overall reach of climate services for farmers.

Different technologies provide specific interactivity services, depending on the overall needs of the climate service and targeted community. For example, Bulk SMS services will help to increase listenership of a targeted community by sending reminders of programs schedule, upcoming topics. "Beep-to-…" services provide opportunities for question and answer exchanges between listeners and the hosts and climate service guests of the program. Similarly, FRI installs Interactive Voice Response systems (IVR), in each partner radio station as part of the capacity building exercise. IVR is a technology that allows farmers to access audio messages stored on a radio station's computer through their mobile phone to either access short succinct information at their convenience or to leave a message. These messages open a dialogue between broadcasters and farmers and can be addressed during a subsequent program (Sullivan 2011). MP3 recording players accompany radio broadcasters

and sometimes extension officers on visits to farms and allow for recorded interviews, as well as additional production and sound recordings that are not available when programs use only in-studio recordings or live broadcasts.

The ICTs used in these approaches, including cell phones, recordable MP3 players, interactive voice response (IVR) systems, bulk SMS messaging systems, and various uses of "beeps" or missed calls, can be used to send information from farmers to those who serve them including extension officers, district, ward or village-level climate service contacts and policy-related institutions.

Many of these mobile phone-based systems, allow farmers to register their interest, their opinion, or their experiences. These tools are particularly effective at engaging audiences and crowdsourcing local information (such as weather experiences and adaptation responses) and amassing feedback from listeners in near real time. These ICTs all boost the interactivity, reach and accessibility of radio.

Setting up community listening groups could support live radio broadcasts and recorded programs in order to create an archive, and overall enhance and encourage participation. Group listening has the potential to encourage further dialogue and complement existing face-to-face activities. FRI's recent work showed that women and youth benefit from facilitated learning opportunities (FRI 2014c). Listening groups also provide a point of contact between radio stations and other climate service providers.

Radio Program Design

Developing the content of the radio program and the program plan itself, in addition to the interactivity system and architecture will have a significant bearing on the saliency, accessibility, and legitimacy of the service. It should ensure that a variety of voices are heard, local experiences are discussed and respected, and accurate information is conveyed in a timely and useful way.

Content can be both informational and responsive in that it combines programs that respond directly to listeners information needs while also providing additional information from program guests. Listeners may want to comment on discussions, while hosts and guests may also want to share additional information that might not have been previously disseminated. Seasonal and historical climate variability context of specific information provision through

interactive radio offers listeners and program guests an opportunity to interact and exchange information, questions and experiences. Therefore, the content can be both technical and experiential as a means to maximize the potential for interactivity.

A variety of programming formats can and should be used in interactive climate radio service to keep them engaging and to explore different topics in different ways. These formats are normally combined into a weekly "anchor program" or "magazine" with a distinct name, sound, and style. Formats presented within the magazine may include:

- Vox Pops (a collage of short, on-the-spot individual or group comments related to a single topic or issue);
- call-in shows;
- village dialogues and mini-dramas;
- Beep2Vote (a free polling service through mobile phones) opinion or feedback questions to bring farmers experiences and opinions into the program;
- panel discussions featuring key influencers (in studio or on the phone) farmers and climate experts;
- probabilistic weather forecasts explained by meteorological service representatives and agricultural advisors.

The program can also include elements or "bites" of the service that farmers can access on demand by calling or "beeping" an interactive voice response service (IVR). For example, the forecast itself, together with advice, can be uploaded onto an IVR, and the radio station can announce a number that, when called, provides the recorded information. A farmer can trigger the IVR system to phone them back – at no cost to the farmer – by making a "missed call" – or "beep" – to the number.

While the design of the radio program should be set in advance and modified over time based on feedback, the content priorities of the program should be developed with input from the multi-stakeholder advisory or consultative group during a PICSA process, taking into account seasonal probabilistic forecasts.

Programming should be used to guide and enhance the forecast experience that is being disseminated on the ground as well as through rural radio. This should include a focus on

building farmers' awareness of their climate risk and the impact of their farm management decisions, as well as discussions of what the forecast means for farmers.

Some additional suggestions for program material include a discussion of risk perceptions, and available farm management options prior to the season, a radio campaign at the start of the season to spread forecast awareness, monitoring segments during the season to evaluate the current success of different chosen adaptation methods and provide updates on the seasonal outlook, and discussion segments following the end of the season to review choices and share ideas and knowledge for future seasons. During periods of low on-farm investments, programming could be combined with PICSA workshops, and include additional material, that will help communicate seasonable trends and variability and test tools for documenting and utilizing such information.

Each episode of the program would likely be produced by the radio station's production team, based on the design, potentially with input and oversight from a radio craft development specialist.

It is important to fit the interactive radio program to the annual cycle of the farmers, with appropriate programming based on the season. Timing is very important with regards to climate information for farmers. An important consideration for any interactive radio program is the fact that farmers have less time to listen to the radio during the planting/growing/harvesting periods. Decision timeframes are another important consideration, as farmers require lead-time in order to incorporate information into their decision-making process and prepare for resultant adaptations.

It is envisaged that the full process of researching, planning, designing, producing and evaluating the first full year of interactive radio program broadcasts would take about 2 years. Ideally, the program would carry on for at least 1 more year beyond the end of the first to allow for a complete assessment of the effectiveness and appropriateness of the service and allow the program to support action by those farmers who are not early adopters, but who may be eager, or at least willing – once they see others doing so – to make changes based on seasonal forecast information and the advisories.

Mechanisms for monitoring radio programs and other climate services are often integrated as specific aspects of the service design. For radio, monitoring tools can be directly integrated

with interactivity tools, using 'cloud-based' data collection. Implementing organizations, together with the radio stations and radio design specialists could collaborate to develop key questions, indicators and data collection forms that will efficiently monitor progress, while also identifying information needs requiring immediate attention. Together with feedback from listeners (through SMS, phone systems and community visits), this process should be used to adjust and enrich programs throughout the broadcast period. Randomly selected programs could also be translated and transcribed into English to make them available to wider audiences and partners. Regular meetings with key climate service partners, including local meteorological services will ensure that regular, updated information is provided in a timely manner. This will help to ensure that farmers have accurate and up-to-date messages.

Evaluation for improvement and scale-up

In addition to the ongoing monitoring and course correction described above, the concept should include a comprehensive evaluation toward the conclusion of the first full year of broadcasts. This evaluation would use a combination of qualitative and quantitative research methods, including an end-line survey of a statistically significant sample of farmers in areas both within and outside areas reached by the broadcasts. The results of the latter would be compared to similar data collected at baseline during the formative research process described above. The evaluation design, therefore, would allow a before-and-after comparison, and a comparison of communities exposed to the program with communities not exposed to it. Through this, the evaluation would assess: rates and frequency of listening and interacting among male and female farmers; how farmers used the service to make decisions and manage risk based on probabilistic seasonal weather forecasts; the level of adoption of new climate smart farming practices featured in the programs; how the program connected with and impacted other agricultural development services for farmers. The evaluation should consider the key issues of saliency, access, legitimacy, equity, and integration. It should also estimate the cost per farmer served, so that the investment needed to scale the service to more regions and more countries can be forecast.

Costs and sustainability

Developing and sustaining an interactive radio service includes general fixed start-up costs, variable developmental costs, and long-term operational costs. The first two types of costs are an investment in developing a relevant and effective service, while it is a goal that the last –

long term operational costs – would ultimately be covered by revenues attracted by each station through advertisements, sponsorships, announcements and other internally generated income.

Fixed start-up costs

Regardless of the number of radio stations that are involved in producing and broadcasting, there are fixed costs associated with stakeholder consultations and engagement, media landscape study, formative research and baseline survey, overall program design, and assembling a team of staff and consultants. The fixed start-up costs will depend on conditions in the country – geographic size, labour market, local price structure, previous experience with interactive radio, and the presence of an existing implementation agency office in that country.

Variable developmental costs

A variety of costs are involved in working with each station to: build its capacity for interactive radio; conduct location-specific community consultations and formative research; gather content-specific input and guidance from subject matter specialists; design each individual program; produce main content; and improve quality through weekly monitoring and feedback. A thorough evaluation of the quality, reach and impact of each program is another essential element of the developmental process that must be anticipated. Specialized staff and some local consultancies are needed to develop the program at each station, including radio craft development specialists, trainers, ICT specialists and researchers.

Radio stations require financial support to participate in developing the program. Specifically, it is necessary to facilitate transportation for the production team so that it can visit farmers and communities, provide for communication costs (mobile credit for cell phone use, mass SMS messages, and internet access), and, for the first year at least, enable the station to assign a dedicated production team and airtime to the program.

The average cost per station that participates in developing the program will vary by country, by the level of capacity development needs at each station, by the distance of the station from the project coordinating office, and by the ability of the station to reach the target audience (more popular stations can command a higher price for participation – but allow the program to serve more farmers).

Long-term operational costs

Sustaining the service will require a continuous flow of funds to allow the station to cover all costs associated with producing and airing the service. These costs would include: electricity, transportation, wages for the production team, other regular production costs, mobile credit, maintenance of equipment, a share of station overhead, and ongoing, though gradually diminishing, technical support and backstopping from the implementing agency. The ultimate aim would be to have these costs covered by advertising, sponsorship, announcements and other station-generated revenue. In the medium term, the station will need continued infusions of project funds together with business development coaching and marketing support as it builds a sustainable business model.

Additionally, the ongoing input of the multi-stakeholder consultative group will be needed to develop seasonal agendas and areas of content focus for the climate services radio programming. The aim would be to have this group conduct its meetings virtually rather than face-to-face so that the costs could approach zero. A final and thorough evaluation at the end of the third year of broadcasting should also be anticipated so that lessons can be applied to an ambitious scale-up strategy.

Conclusions

Communication strategies that convey good information, provide timely advice, and facilitate dialogue and exchange about weather, historic climate information, and probabilistic seasonal forecasts can increase the capacity of small-scale farmers to adapt to a variable and changing climate. To be successful, such strategies must meet requirements of saliency, legitimacy, accessibility, integration and equity, and they need to be effective in communicating complex information to low-literacy populations. Strategies that involve face-to-face meetings and interactions between farmers and extension workers are effective, but are expensive on a per-farmer basis and challenging to scale up. Because radio broadcasts have tremendous reach and coverage at relatively low cost, they have potential to complement and expand the reach of facilitated face-to-face communication with rural communities. However, radio programming in its conventional form is largely a one-way method of disseminating information that can be devoid of the exchange, discussion and explanation that aid in decision-making. Further, radio broadcasts are only available at the time when they are

broadcast: if the weather forecasts are broadcast at a time that farmers cannot listen, they are not helpful.

Recent developments in interactive radio, which combines radio with widespread and growing mobile phone access, offer the exciting prospect of an approach that combines a level of interactivity with the immense reach of radio and mobile phones that can help to fill this gap in knowledge. Interactive radio integrates accurate and interpretive radio broadcasts with "on demand" access to interactive voice response (IVR) systems, SMS services and unique uses of missed call voting. It can serve as an extremely beneficial complement and correlate to face-to-face efforts on the ground and can help to broaden the reach of climate information for farmers, at a very low cost per farmer.

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