International Journal of Innovation Sciences and Research
Vol. 1, No, 7, pp. 23-32, July- 2013

Available online at
http://www.wrpjournals.com

Research Article

KNOWLEDGE SHARING AND INSTITUTIONAL CAPACITY BUILDING FOR CLIMATE CHANGE ADAPTATION

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Accepted 26th June, 2013; Published 26th July, 2013

ABSTRACT

Climate change is a global problem in the centre of sustainable development efforts. It has adverse effects on food production and community livelihoods. African countries are vulnerable to climate change due to their low adaptive capacity. Knowledge sharing is therefore a critical interface for influencing behavioral change and enhancing adaptive capacity among societies and communities because it promotes social learning. This article explores the role of knowledge sharing and institutional capacity building across dynamic local communities for climate change adaptation. It examines the relationships between climate-related vulnerabilities, adaptation practices, institutions, and external interventions to show the role and importance of local institutions and structures in climate change adaptation. The functional structures are influenced by and respond to environmental challenges. The Institutional structures become part of the mechanisms for translating the impact of future external interventions which facilitate adaptation to climate change. The article proposes an analytical framework for classifying adaptation practices based on institutional relationships to different forms of environmental risks. It examines past adaptation responses to climate change, their impacts on the livelihoods of the rural poor, and the role of institutions in facilitating external support for adaptation. The discussion uses evidence from three climate change adaptation application (CCAA) projects that were implemented in Kenya, Tanzania, Malawi and Zambia and Zimbabwe. PAR approach was used to identify communities' vulnerability and build their capacities based on the vulnerability analysis from baseline surveys'. The PAR projects worked with key stakeholders within the agricultural systems at all levels; and custodians of Indigenous Knowledge systems used in rainfall predications. It explains how institutional adaptation can be strengthened through participatory capacity building in action research. This enhances stakeholder buy in and ownership for effective knowledge sharing and the associated challenges and gaps which need to be addressed. The lessons learnt form basis used to make recommendations about the on how best communities could enhance their adaptive capacities using knowledge sharing and social learning.

Key Words: capacity building; climate change and adaptation; rainfall forecasting; institutions; knowledge sharing; participatory action research

INTRODUCTION

Globally, climate change adaptation is a core theme of developmental debate due to its adverse effects on food production and community livelihoods. Climate change is widely recognized as a serious risk especially to developing countries which rely on limited resources and rain-fed agriculture (IPCC, 2007). According to DMCN (2002 and 2004), 70% of natural disasters in the world are weather and climate related. McCarthy *et al*., (2001) state that declining agricultural productivity, deterioration of water quality and quantity and loss of biodiversity are direct negative impacts of climate change. Christoplos (2009) observes that the poor who depend on natural resources and have limited adaptive capacity are more vulnerable and their development budgets are more derailed by climate change impacts. African countries are vulnerable to climate change due to their low adaptive capacity (UN-ISDR, 2005). Knowledge sharing is therefore a critical interface for influencing behavioral change and enhancing adaptive capacity among societies and communities.

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Knowledge sharing is a powerful tool for addressing community vulnerability, resilience and climate change adaptation (KMD, 2007). Reid and Satterthwaite (2007) suggest that adaptation support should be directed to individuals and individuals within households as they struggle to adapt to climate change. Zievogel and Zermoglio (2009) and Sivakumar (2006) identify climate prediction and information sharing as basic to community adaptation. They propose that that climate prediction information should be introduced into the planning process as an input into the design of adaptation/mitigation plans. In Africa, agricultural food production is widely rain-fed; rainfall prediction and information sharing is critical for community adaptation to climate variability and climate change. Emery, (2000) singles rainfall as a key determinant of climate change yet rainfall forecasting is a notoriously difficult area. The increased attention in rainfall prediction in recent years is bringing together the conventional scientific community and the indigenous community scientists to share their knowledge systems. This chapter explores the role of knowledge sharing and institutional capacity building across dynamic communities for climate change adaptation.

It examines the relationships between climate-related vulnerabilities, adaptation practices, institutions, and external interventions to show the role and importance of local institutions and structures in climate change adaptation. The functional structures are influenced by and respond to environmental challenges. Thus they become part of the mechanisms for translating the impact of future external interventions which facilitate adaptation to climate change. It proposes an analytical framework to classify adaptation practices based on their relationship to different forms of environmental risks. It examines past adaptation responses to climate change, their impacts on the livelihoods of the rural poor, and the role of institutions in facilitating external support for adaptation. The discussion uses evidence from three CCAA projects that were implemented in Kenya, Tanzania, Malawi and Zambia and Zimbabwe. PAR approach was used to identify communities' vulnerability and build their capacities based on the vulnerability analysis from baseline surveys'. The PAR projects worked with key stakeholders within the agricultural systems at all levels; and custodians of Indigenous Knowledge systems used in rainfall predications. The chapter explains how institutional adaptation can be strengthened through participatory capacity building in action research. This enhances stakeholder buy in and ownership for effective knowledge sharing and the associated challenges and gaps which need to be addressed. The lessons from this review are finally used to make recommendations about the on how best communities could enhance their adaptive capacities using knowledge sharing and social learning.

This underscores the significance of including community structures and institutions as essential units for knowledge sharing and social learning. The adaptive scope can be measured by the extent to which a community is resilient to climate change and variability. The chapter explains that community institutions and networks are created and sustained through continuous process of generation and sharing of information. Social learning in adaptation emerges as a social system that is being continually reshaped through the dynamics on social relationships (Williams, 2003). The chapter proceeds to explores opportunities and challenges of integrating IK and Conventional Methods of rainfall predictions and the extent to which they improve the adaptive capacity of the target communities. The overarching research objective is to establish the extent to which institutional knowledge sharing enhance community climate change adaptation and resilience. This is addresses through raising three specific research questions which guided the chapter structures.

- What roles do institutions play in social learning and climate change adaptation?
- How can IK and convention predictions be integrated to enhance community adaptation to climate change adaptation?
- How effective is the PAR approach in enhancing knowledge sharing and institutional capacity for climate change adaptation?

Conceptualizing Knowledge Sharing Frameworks

This section highlights the key concepts which are relevant to social learning, knowledge sharing and capacity building of local institutions in strengthening adaptation to climate change. The section further provides the conceptual framework for integrating institutional adaptation with capacity building aspects. The section further highlights how Participatory Action Research (PAR) is linked to Innovation Systems Approach (ISA) in facilitating social learning and hence strengthening adaptation to climate change and variability. The section further provides a highlight on the Sustainable livelihood framework in order to place adaptation issues in the context of other stress factors and giving special considerations on institutional aspects.

Local Institutions

Local institutions are the organizational entities and the associated 'rules of the game' within the society they operate. Institutions may be formal (held together by constitutions, rules, regulations, laws, rights, etc.) or informal (cemented by sanctions, customs, mores, or traditions). A distinction is usually made between institutions (rules of the game) and organizations (the players of the game) (North, 1990). What justifies the institutional frameworks are the common interest, common mandate, common responsibilities and common obligations created and expressed in common value systems including management of common property. Core mandate of institutions are to secure and advance the interests of their members within the existing institutional framework, while constantly seeking to influence that framework so as to achieve greater advantages and benefits. The institutions included in this study are family, community, community based organizations (CBOs) and faith based organizations (FBOs) ranging from (micro) to national (meso), regional and international (macro) level. Agrawal *et al*. (2008) recognizes three types of local institutions, which are relevant to adaptation and which are defined as civic, public, and private in their formal and informal forms. Institutions shape the livelihoods adjustments to impacts of climate hazards through a range of indispensable functions they perform in specific contexts: information gathering and dissemination, resource mobilization and allocation, skills development and capacity building, providing leadership, and networking with other decision makers and institutions.

Institutional Adaptation

Institutional arrangements may be considered as the policies, systems, and processes that organizations use to legislate, plan and manage their activities efficiently and to effectively coordinate with others in order to fulfil their mandate. All adaptation practices depend on specific institutional arrangements for their success. Institutional and social factors play a key role in shaping the extent to which communities are vulnerable to different environmental, social and economic risks. Institutions are characterized as follows:

- They are societally determined and govern social, political, cultural and economic exchanges and interactions.
- They define the range of choices, regulate risk and uncertainty and determine transaction and production costs and hence the feasibility and profitability of engaging in economic activity.
- They evolve incrementally, linking the past with the present and future.
- They provide the incentive structure of an economy and set the tone of societal development.

Institutions mediate the access of the poor to assets, technologies and markets. They regulate customary practices and administrative processes that determine whether the poor benefit from such access or would be affected by it. Broadly speaking, local institutions help in shaping the effects of climate hazards in three important ways: they influence how communities are affected by climate impacts; they shape the ability of communities to respond to climate impacts and pursue different adaptation practices; and they mediate the flow of external interventions in the context of adaptation.

Institutional Adaptation and Capacity Building Related Issues

The success of adaptation practices depend on specific institutional arrangements. The conceptual framework for institutional adaptation to climate change and adaptation (Table 2.1) is guided by an outline of key institutional types and capacity related questions (Kituyi, 2008). The key adaptation issues are later used to analyse the relevance of institutions in strengthening adaptive capacities. The conceptual framework further uses Participatory Action Research (PAR) in strengthening social learning and institutional capacity building for adapting to climate change and variability. Embedded within this Conceptual Framework is the Innovative System approach (ISA), which may be defined as a 'network of organizations, enterprises and individuals focused on bringing new products, new processes and new forms of organization into social and economic use, together with the institutions and policies that affect their behaviour and performance' (World Bank, 2006). The Innovation systems approach recognises the roles of different players in the system and the opportunities for working differently together in strengthening adaptation through social learning. This approach fits well with the PAR principles since it implies working with networks of organizations and individuals focused on bringing new processes or products into use, together with the formal and informal institutions that affect their behaviour and performance. This approach is important in enhancing social learning through knowledge sharing to strengthen adaptation through capacity building.

Table 2.1 A Framework for analyzing adaptation capacities of local institutions

Institution type	Critical capacity-related overarching questions for adaptation
Prediction of extreme events	Can local institutions predict extreme events and give early warning to vulnerable groups? Can IK and Conventional Methods be integrated?
Knowledge & technology development	Are research programmes and agenda focus on needs of vulnerable groups and goals of policymakers? Are the scientists equipped to generate knowledge that addresses needs of vulnerable groups and goals of policymakers?
Knowledge conveyance	Are local institutions equipped to package and disseminate new knowledge and technologies to communities and monitor impacts? Is process documentation beneficial in monitoring and evaluation and capturing lessons learnt?
Training/Capacity building	Are programmes adequately packaged to build capacity of groups working on adaptation projects/programmes? Can Multi-stakeholders engagement strengthen adaptation?

The understanding that reality is socially-constructed and viewed in different ways by different actors in a system points to the need for external researchers to be engaged in processes of joint learning with those directly affected by climate change. A Social Learning process uses participatory approaches such as PAR, which engage both the learners and the facilitator from identification of the problem to crafting the most cost efficient and cost effective strategy to addressing the vulnerability/ knowledge gap. Bringing together diverse stakeholders as co-learners or co-researchers is a way of promoting the use of Indigenous Knowledge (IK) and its integration with scientific/conventional methods to enhance local adaptation. Therefore promoting social learning is essential in strengthening community adaptation to climate change and variability. The analysis of institutional adaptation issues is also done in the context of the overall DFID's (1999) Sustainable Livelihood (SL) framework. The Sustainable livelihoods (SL) framework, presents the main groups of factors that affect people's livelihoods, and typical relationships between these. This approach puts people at the centre of conceptualization, planning and the assessment of the impact of implementation (Carney, 1998). Vulnerability was considered in terms of trends, shocks and seasonality affecting livelihood options. This approach provides an understanding of peoples' adaptive capacity, in terms of assets and strategies and how these are currently or potentially converted into livelihood outcomes. The framework further highlights the structures and processes of mediating people's actual strategies included public and private sector organizations and formal and informal institutions.

METHODOLOGY

Overview of Project Areas

The projects worked with selected communities from Kenya (Case Study 1), Zambia and Zimbabwe (Case Study 2), and Tanzania and Malawi (Case Study 3). This Chapter reports on research experience based on Participatory Action Research that was implemented in these countries from 2007 to 2011 under the CCAA programme. In Kenya, the project worked with the Nganyi community whose mainstay is rain-fed subsistence agriculture, supported by IK on rainfall prediction. The area is densely populated with small land-holdings of approximately 0.5ha; dominated by hard rock. The project facilitated integration of IK and Conventional rainfall prediction methods to enhance early warning dissemination for climate change adaptation. In Zimbabwe and Zambia, the project worked with dry land crop producers in semi-arid areas that receive low and erratic rainfall. The communities rare animals and depend on gardening during the dry season.

The project engaged farmers in integrating indigenous knowledge on rainfall prediction and scientific seasonal weather forecast; to come up with crop management adaptive strategies for climate change. In Tanzania and Malawi, the project worked with farmers residing in peri-urban areas in the semi-arid and sub-humid agro-ecological zones. The communities in the semi-arid zones; for instance in Tanzania, traditionally used to be agro-pastoral but are rapidly changing to agricultural communities focusing on horticultural production. In the sub-humid areas farmers are slowly changing from production of staple crops such as maize to horticultural production due to various factors including climatic related ones. The project supported these communities through field testing of various innovations for horticultural

intensification in addressing climatic risks in the respective zones and also taking advantages of the rural-urban interdependencies.

Research Approach

The three projects used Participatory Action Research (PAR) approach with the aim of engaging key stakeholders from the onset of the projects in strengthening their adaptive capacity. PAR approach places communities at the centre; and start with learning from the known to unknown. It emphasizes the need for collective experimentation and learning (i.e. learning by doing and experiencing) to design and test new innovations in adapting to climate variability and change. The understanding that reality is socially-constructed and viewed in different ways by different actors in a system points to the need for external researchers to be engaged in processes of joint learning with those directly affected by climate change. PAR was hence used as a means of bringing together diverse stakeholders as co-learners or co-researchers, and bringing the knowledge and skills of each player to bear on the problem. The approach promotes the use of local knowledge, leads to more relevant research questions, and ensures that results and skills are shared with those who will use them (Checkland, 1991; Checkland and Holwell, 1998).

Participatory action research is a reflective process of progressive problem solving led by individuals working with others to improve the way they address issues and solve problems. PAR is generally applied within social learning contexts, where multiple actors collectively construct meanings (problem definition, objectives) and work collectively toward solutions (Maarleveld and Dangbégnon, 1999). Thus, it is a process of social learning and change carried out by development actors themselves (such as villagers/local communities, organizations and policy makers), and operationalized through iterative process of planning, action, monitoring, reflection and adjustment of action plans (Figure 3.1). Iterative cycles of community-level action and reflection makes change processes more robust and effective by ensuring that systematic learning and sharing take place, by fostering continuous adjustment of actions to align them with agreed upon objectives, and by empowering the actors themselves to learn and adapt (German, 2010).

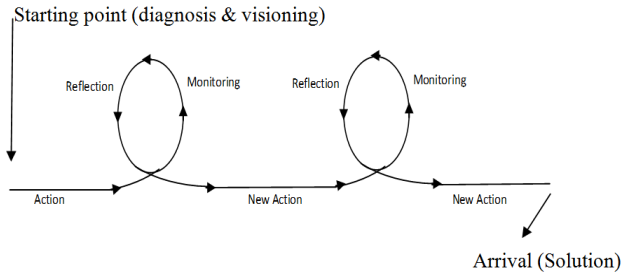

Figure 3.1: Iterative cycles of learning and doing in the PAR process

(Source: Adapted from German et al., 2010)

The projects teams applied PAR to facilitate social learning among diverse groups of stakeholders (e.g. government ministries, extensions workers, civil societies, and local communities who are also custodians of IK) in planning for adaptation interventions and in the implementation of the action research. The diverse groups of stakeholders bring unique perspectives of the problems identification and definitions, and devising "best bet" options to enhance adaptive capacity (Colfer, 2005; Lebel *et al*, 2006). This includes testing these practices/options in the fields, monitoring outcomes and adjusting actions where appropriate. This helped the projects in capturing experiences and priorities with regard to interventions required to adapt to climate change and variability based on various perspectives of relevant stakeholders. Climate change will change development options for different communities in different ways based on existing conditions in respective agro-ecological zones (Prowse and Scott, 2008; Quan, 2008). Climate compatible strategies need to be at the heart of the response of the target communities (Ogallo, 2009). The projects inception facilitated multi-stakeholders engagement in the research processes. Their involvement in subsequent project activities contributed to the social bonding which enhanced knowledge sharing. Knowledge sharing facilitated crafting innovative strategies in adapting to climate change and variability.

Capacity Building Approach

For each of the three projects capacity building activities were consistent with addressing the vulnerability that had been identified during the baseline surveys. The three communities faced different vulnerability and hence the capacity building interventions were responded to communities' needs.

Kenyan Case

In Nganyi community the vulnerabilities identified through baseline survey included food insecurity due to population density and small agricultural land-holding and prediction skill disparity between different gender groups. Capacity building addressed these disparities at different levels of the project. Knowledge sharing was effected at harmonization and application scientific and IK rainfall prediction advisory that served as early warning. The harmonized product was disseminated as early warning to enhance agricultural production. Other line ministries used the messages of harmonized predictions to plan adaptive measures which were consistent with risks predicted. The next stage of capacity building addressed vulnerabilities to which different gender groups were prone to due to culture. To enhance the adaptive capacity of women and youths they were trained in enterprise operation crafts and tree nurseries technologies focusing on raising seedlings from indigenous trees which are used to rehabilitate infringed observatory shrines; enterprise training for the youths to equip them with income-generating skills. The thirdly the research sponsored formal training of 5 youths identified by the community to pursue disaster related programmes (1 at certificate level, 3 at diploma level and 1 master's level) as a form of planning for exit strategy and sustainability of the project activities. To ensure continuity of adaptive process, the research team in collaboration with relevant stakeholders developed a course on IK to be taught at Diploma level.

Zimbabwe and Zambia Case

Prior to the project most of the farmers including some extension workers solely depended on on the indigenous seasonal climate forecast. They had never heard of the

scientific seasonal climate forecast that is issued by the meteorological department. Initially informal capacity building for adaptation to climate change was done at the farmers' level, extension worker levels while formal training was done at the researcher level. Both farmers and extension workers were trained on how to interpret the scientific seasonal forecast and how to respond to it in terms of adopting crop management adaptive strategies depending on whether the forecast was for a dry or wet year. Formal training was given to farmers and extension workers on which crop management decisions to take depending on the characteristic of the weather forecast. To further knowledge exchange most of the undergraduate students who are employed by the Department of Agricultural Extension were included in the training for climate change and adaptation to enable them upscale farmer knowledge sharing for adaptation. Farming decisions are influenced by the seasonal climate forecast which include decisions on choice of crop and variety, tillage systems to use, planting dates, fertilizer amounts to use and when and how to weed. As part of the capacity building sustainable plan, a course on climate change and adaptation was developed and offered to undergraduate students who are future change agents. Post graduate training at PhD and MSc level was also done to ensure a pool of lecturers who would teach climate change and adaptation courses to undergraduate students.

Tanzania and Malawi Case

In Tanzania and Malawi, farmers were trained on climate change and adaptation issues focusing on intensifying horticultural production, which was the priority area of focus. Farmers across the two countries were further trained on Process Documentation in order to capture various project activities including interventions in the learning plots. This included capturing what activities have been done, when, why, how, by whom, achievements, challenges, results, solution, lesson leant and recommendations for future actions. Through these learning plots, informal capacity building took place through interactions of participating farmers and other villagers.

Stakeholders' training workshops on Climate Change and Adaptation were also conducted in respective zones, and other key stakeholders such as Government representatives – particularly from Ministry of Agricultural, Meteorological staff, relevant NGOs, researchers, and local government – particularly agricultural extension staff, community development officers and Savings and Credit Cooperative Organizations. Furthermore, farmers were trained on entrepreneurial skills. Audio Visual documentation on progress made by the project and lessons learnt were also done to enable sharing with other target farmers and key stakeholders elsewhere. Apart from training sessions, Field visits were also done in areas where farmers could learn more on how to improve their horticultural production. Accordingly, visits were made to Farmers Exhibition Grounds in Dodoma, located in the Central Zone of Tanzania. In Malawi Farmers were taken to Bvumbwe Agricultural Research Station and Zakudimba Cooperative. Through these learning visits, the target group farmers could learn on how to improve horticultural production and marketing opportunities and strategies aimed at improving the marketing of their products. The lessons learnt on these trips motivated the participating farmers to devote themselves to the experiments and apply lessons learnt.

The Key Findings and Discussions

The Roles of Institutions in Social Learning and Capacity Building

The role of local institutions was examined on predicting extreme events, knowledge conveyance, knowledge and technology development, and training/ capacity building. Issues addressed included climatic risks that each project areas faced among other stress factors; and how this affected food security and community livelihoods. It was found that local institutions provided entry points of communication and information sharing. With regard to influencing behaviors based on early warning as predicted by both climate scientists and indigenous predictors; institutional and social factors played a key role in shaping the target communities' adaptive capacity as explained in case studies of Kenya, Zambia and Zimbabwe. This was achieved through capacity building and training community members on how to integrated scientific prediction methods with the Indigenous knowledge used in prediction of seasons; towards improving their livelihoods. Adaptive capacity was also built through knowledge conveyance through multi-stakeholders training sessions and farmers learning plots in the case of Tanzania and Malawi. The learning plots were used as means for generating knowledge and technology development through field testing various agricultural interventions. The knowledge and experience generated from these learning plots was informally shared within the communities; and formally shared during the stakeholders training sessions.

Experience from the three Case studies indicates that local institutions facilitated connections between different stakeholders in the projects. Informal relationships between households, helped in the identification, definition of the localized vulnerability and also in designing appropriate interventions which were consistent with the prevailing environments. It was found that climate phenomenon had very different effects on the livelihoods of residents in the targeted areas, depending on the nature of local governance and local institutional arrangements as elaborated in section 4.2. Institutions link individuals with collectives and provide the framework within which households and collectives choose adaptation practices. For example, strong institutional norms around labor sharing will reduce the ability of households to adapt by migrating or diversifying. Social groups that do not have secure rights to land will find it more difficult to diversify asset portfolios or engage in exchange. Closely knit social networks make it easier to undertake communal pooling of resources. Communities that lack access to capital and infrastructure may be unable to use storage or exchange to cope with environmental risks. Without access to markets, communities may be forced to adopt storage of harvests as an adaptation response and invest resources into storage infrastructure.

The local institutions in the projects areas provided intermediaries for channeling external support to climate change adaptation. Through these institutions project teams found common platforms for debating ideas and making informed decisions on the kind of external interventions that reinforced or undermined existing adaptation practices as

shown in case narratives in section 4.3. This underscored the fact that for all external interventions, to be effective, they needed local institutional collaborations to leverage the impact of interventions. PAR application in mobilization indicated willing involvement of local institutional partners which greatly strengthened the effectiveness of external interventions. PAR techniques conducted during the inception and outcome mapping workshops served to identify communities' vulnerability and prioritize adaptive interventions. Knowledge exchange occurred as modern scientific community interacted with IK integrated.

Integration of IK and convention predictions Methods

PAR approach created framework for IK and Conventional Methods of prediction to be integrated. With in the framework of WMO, all scientific research centers and weather services are working on a common area, share their data and information before getting a forecast for that area. In the Greater Horn of Africa, ICPAC coordinates this sharing through the Greater Horn of Africa Climate Outlook Forums (GHACOFs) while this is coordinated by SACOF in southern Africa. These are pre-season forums which bring together everyone in the world involved in seasonal forecast development relevant to the GHA and southern Africa to develop the best forecast for the regions through a consensus. The product that comes out of the GHACOFs and SADC are regional in nature covering the whole of the GHA and SADC. After the GHACOFs and SACOF each of the GHA and SADC countries' meteorological departments, downscale the regional product to their country-specific forecasts. The scientific forecast provides the quantitative rainfall in probabilistic mode for seasonal climate and determined amount for medium range weather; it does not support farmer's need in terms of onset of rainfall and the distribution (Rengalakshmi, 2010).

It is one of the significant variables necessary for the farmers to make decisions on the initial agricultural activities. Traditional forecast knowledge enables farmers to make use of indicators to determine onset of rainfall and when rainfall is expected at any time during the growing season. In this way by integrating the two it is possible to establish a continuum between scientific and traditional forecast, which combines the scale, and time of the onset of rainfall (Rengalakshmi, 2010). Apart from this, there has been reduced confidence in indigenous forecasts because of increased rainfall variability in recent years that is associated with climate change (Kalanda-Joshua *et al*., 2011). The lack of confidence can be reduced by the integration of IK and scientific climate forecast at the local level (ICPAC, 2010) so as to enhance the resilience of communities to climate change. Different communities in the study areas (Kenya, Zambia, Zimbabwe, Malawi, Tanzania and Malawi) have their own methods of predicting the season that include various flora, fauna and changes in the solar system. Examples includes flowering of fruits, extended drought, thunders without rains, absents of haze in the sky, very early rains, insects e.g. butterflies hovering in the air certain constellation, indicating that the season is going to be good or bad. These indicators are localized and therefore readily acceptable by local communities and cost-effective (no a need for constructing observatories).

In this regard, most farmers reported that they rely on indigenous weather forecast to predict the weather. In Zambia, for example, a significant total percentage of 88.8% indicated that they are not aware of SCF and rely on traditional indicators for climate variability and change (Mubaya, 2010). In contrast, negligible (11.2%) farmers indicated that they do not know of any indicators for climate change, with the greater proportion of 7.1 % coming from Zimbabwe and 4.1% from Zambia. This gives an indication that reliance on traditional indicators in the study areas is widespread. In most of these countries there is scantiness of meteorological data due to spatial distribution of the Meteorological stations. The lack of access to weather forecasts gives an indication of the significant complementary role that indigenous knowledge on weather forecasts can play in mitigating the vulnerability to climate variability that farmers may use. Technical language used by the Meteorological authorities in packaging their forecast is also another limiting factor. It is along these constraints that integration of IK and conventional methods becomes important. IK custodians can be used as strategic entry point into local communities for wider dissemination of consensus early warning predictions. In Kenya, Zambia and Zimbabwe PAR facilitated integration by harmonizing IK seasonal predictions with the conventional meteorological predictions in a participatory way translated in local languages to enhance social learning and knowledge sharing.

Effectiveness of PAR approach in enhancing knowledge sharing

In the three research projects used PAR approaches in Sensitization, Mobilization, identification of target groups, planning for interventions, implementation and monitoring and evaluation to ensure inclusivity. Initially, baseline surveys were conducted in all the three cases using PAR principles to understand the existing situation of the communities. The analysis of baselines facilitated identification of respective communities' vulnerabilities on which capacity building interventions were planned and implemented.

Case Study No.1 Kenya

In Kenya, PAR facilitated the platform for understanding how the Nganyi community uses IK applications for rainfall prediction and early warning systems. Collection of both meteorological and IK data facilitated a comparison between IK and modern science to support demystifying the former. To induct the local community into modern science approach of rainfall data collection KMD installed two rain gauges at Esibila secondary school and at a local chief camp. This was to better capture the local weather conditions in the study area. IK and climate datasets were analyzed to correlate past major climate extremes, especially droughts in the Nganyi community. The analysis of socio-economic survey data captured the traditional, social, economic and demographic profile of the Nganyi community. For the IK data, all the eleven Nganyi community were fully represented in rainfall-prediction institution and prior to releasing their forecast, they built their own consensus. Their community structures provided an institutional framework for initiating forecasters into art and practice of IK forecasting. Cultural rules and regulations that are closely linked to the community's spirituality safeguard the integrity of the art. It was established that up to 60% of the local community members believed more on Nganyi rainfall prediction over the modern scientific predictions (Government of Kenya, 2002) prior to the project.

Consistent with (UNEP (2007), the research established that Nganyi Indigenous Knowledge of Rainfall Prediction is a knowledge system that incorporates skills and complex ideologies including spiritualism. The findings were also consistent with Mbiti (1969) and Mugambi and Kirima (1976) who observed that Africans are too religious and use divine interventions and spirituality permeates the very spirit through which the traditional interveners make things happen. It was found that Nganyi community uses bio-physical, social and astronomical indicators to track climatic changes on flora and fauna within special observatory shrines. The flora and fauna were under stress due to environmental infringement due to poverty. Through PAR, the research established that droughts and famines that have ravaged this area in the past were predicted correctly by IK custodians in

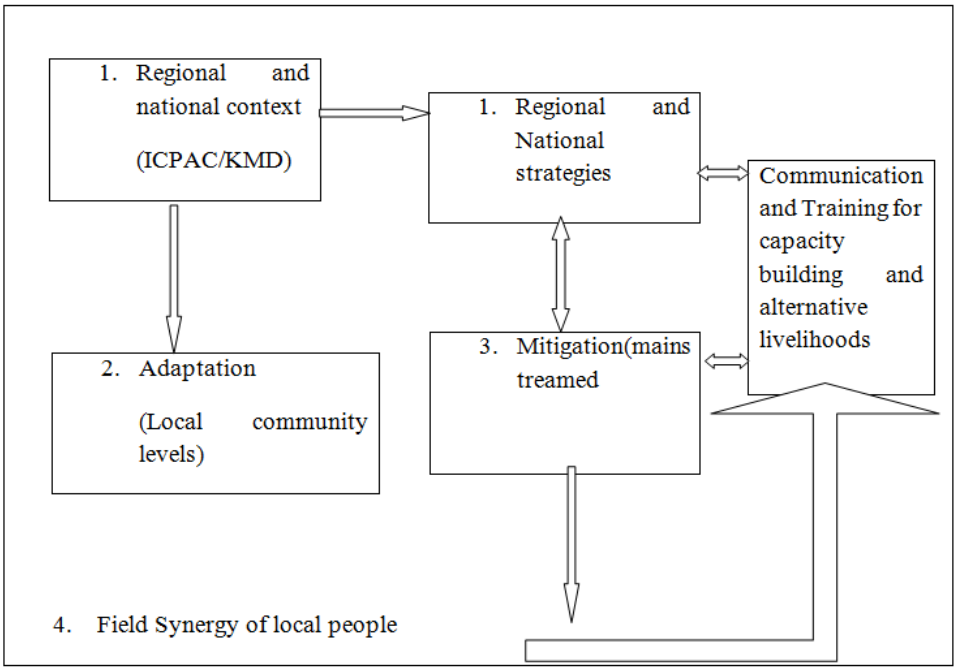

Fig 4:1 CCA Knowledge generation and sharing chart in Nganyi community

the community. The entire community has universal rainfall/drought indicators which they had relied upon over the years. Some of the indicators cited include high night temperatures; termites coming out of the ground; elderly men and women complaining of heaviness in the chest; and many caterpillars were seen on certain tree plants symbolized the approach of heavy rains. The croaking of frogs and the presence of dark and thick clouds predicted impending onset of heavy rains. On the other hand, singing of certain birds and warm evenings heralded drought. Climate change is marked with emerging diseases like dry coughs, eye infections, increased diarrheal frequencies; early foliaging of certain trees like flamboyant which are conserved within the observatory shrines. SCF and IFS results were consistent during the three years of study and were used to inform the community when to prepare their farms and when to plant crops. Most members of the community used both SCF and IKS to make agriculturally related decisions while about 40% still had more confidence in their indigenous knowledge system and were skeptical with integrated prediction products. During the project lifecycle there were four integrated consensus predictions and it was found that subsequent predictions were taken into livelihood production planning with satisfactory adaptive measures taken by the community members. Even after the project activities ended the Nganyi community and KMD as core sources of prediction knowledge have continued to have consensus seasonal predictions. This is a positive indicator that the knowledge sharing initiated by PAR bought in the community commitment. There has been incremental demand for use of both SCF among the more educated members of the community compared to the less educated members of the community. The research further established that the Nganyi community IK prediction is discriminative in terms of gender. The women are not customary practitioners in the prediction process so capacity building targeted building their capacity to enterprise operation and maximization of quick maturing crops. Modern prediction techniques aimed at facilitating adaptation intervention of early warning information to all members of communities. While the two types of knowledge systems are approached differently, PAR approaches established the unique opportunities for the two knowledge systems to work together to enhance local communities, resilience to climate change through use of consensus early warning information packages. For example, the case studies demonstrate how PAR was instrumental in generating CC information and knowledge sharing between institutional structures from regional to local level as shown on Fig 4.1. The research capacity building bonded structures of integrating scientific prediction and the IK prediction to come up with consensus rainfall prediction, improved agricultural yields and initiated alternative livelihoods as adaptive strategies. Participatory advisories were developed in terms of adaptive strategies which are consistent with the predicted outlook for all sectors of the economy. To enhance wider dissemination the advisories are translated into local language and shared through public meetings (*Baraza*). Question and answer sessions followed the delivery of each advisory for further clarification. During the last consensus prediction the farmers reported that their yields had improved by up to 30%.

Extended dissemination was promoted through use of Brochures and Posters translated into the local Lunyole language and widely distributed to public places like schools, markets and churches within the project area. The forecasts were also disseminated through the local FM radio station. A team of indigenous and modern science experts would be hosted by the local FM radio to discuss and educate the community and other users on the new integrated climate risk management tools. One advantage of consensus forecast is the provision of a common platform for scientists to demystify the Nganyi community knowledge system and understand the scientific principles involved. It also enabled facilitated the Nganyi community buy into the scientific knowledge as active disseminators of the consensus products. An important spinoff of the consensus products of rainfall prediction and climate outlook forecasts was the long term working relationship between IK predictors and KMD. This resulted in KMD constructing a resource centre "Nganyi Community resource Centre for continued collaboration for consensus future prediction.

Case Study No. 2: Zambia and Zimbabwe

The study stakeholders' perceptions of climate change and variability and linked this perception with empirical evidence, documented IK indicators that are used to predict weather and climate, and explored how knowledge is shared among users and analyzed constraints and opportunities that affect reliability of the weather information. Farmers noted that timeliness of access to SCF was critical in informing their agriculturally related decisions. Through visioning and use of historic weather data, farmers were presented their agricultural related problems that they would want solved in the project to ensure sustainable food production under climate change – through adopting adaptive strategies. Rainfall variability and droughts were the major single factors which farmers attributed to food insecurity since they only get a good yield in between 2 to 3 years out of five years. Farmer no longer trusted their indigenous knowledge system which appeared to have failed them because of increased variability in the recent past years, probably because of climate change hence the need to integrate indigenous knowledge system with the scientific system.

There was impressive consistency between farmer predictions on seasonal rainfall using indigenous knowledge of environmental indicators and the meteorological-based SCF. Farmer's predictions were consistent with both the favourable 2008/09 SCF and the normal to below normal SCF in 2009/10. It was generally agreed from all the districts that the 2009/10 season would have below normal rains. Across the two seasons however, the forecasts were correct in 2008/09, but only partially correct in 2009/10 as this season eventually had very good rains in February and March as indicated by the total rainfall received in each season. Farmers had an opportunity to come up with adaptive strategies after presentation of both indigenous weather forecast and scientific weather forecast. From the discussions held with the farmers and the nature of the adaptive responses proposed by the farmers in response to the seasonal forecast (both modern and indigenous knowledge), it was evident that farming decisions are influenced by rainfall expectations. These included choice of crop and variety, tillage systems to use, planting date, and fertilizer amounts to use and when and how to weed depending on whether the year was predicted wet or dry using both IKS and SCF.

Case Study No. 3: Tanzania and Malawi

In Tanzania and Malawi, situation analysis and baseline surveys were conducted to collect background information on the perceptions of climatic change and variability, the impacts on food and agricultural systems; and also examining existing adaptation strategies to climate change adaptation. The information obtained later helped in identifying interventions required in addressing risks associated with climate change and variability within the urban-rural interdependence. Drawing from field based experience from Tanzania; integrative efforts of the research team members and key stakeholders helped in developing research themes and identification of potential focal communities in peri-urban areas. The research team further involved of multi-stakeholders' exploration of urban and peri-urban livelihood strategies and associated adaptation strategies; with a particular focus of agricultural systems. Through analysis of situation analysis findings, baseline surveys and multi-stakeholders consultation, it was found out that horticultural production is increasingly becoming a key livelihood strategy in areas that are well linked to urban areas; as such it was decided that the project focus its activities in the peri-urban areas. Two sites were initially selected from each country for conducting field based participatory action research in the semi-arid areas, which appeared to be much affected by climatic risks. The selected project sites were selected Ihumwa; a peri-urban village in Dodoma Region, located in the semi-arid Central zone of Tanzania; and Mtwana, a peri-urban village located in Chikhwawa District in Malawi. The project later expanded its project activities to the sub-humid zones of the countries; i.e. in Njombe located in the Southern highlands of Tanzania and Mulanje in Southern Malawi.

In this project, the core project team has worked collaboratively with the key stakeholders identified during the initial situation and scenario analysis in designing and implementing the project activities including monitoring and evaluation. These stakeholders key within the urban rural food and agricultural innovation systems include the local government officers (such as district agricultural and extension officers, nutritionists, community development officers, environmental officers, disaster preparedness officers, health officers, district planning director), agricultural researchers, micro-finance institutions, media and local communities, chief executive officer, relevant NGOs, climate change and meteorological services officers; including the National Consultative Group (NCG). Local government and village and district level extension workers were involved in the field action research at the learning plots. Other key stakeholders such as meteorological officers, Savings & credit institutions e.g. micro-finance organisations like SACCOS, stockists, media etc have been involved during CC science and adaptation training and exposure visits. Aspects of some of the experiments have been taken home to farmers own fields, and also copied by non-participating farmers.

In Tanzania, others villagers have established new groups to enhance collective learning. Participating farmers indicated that plots applied with farmyard manure gave the first plucking for Chinese cabbage in 39 days as opposed to 45 days based on traditional practices. They also indicated that vegetables

produced had better healthy and better establishment of plants as compared to the past, which ensure easy marketability. Similarly, learning group farmers, in Malawi claim their produce is doing well at the market due to quality leafy produce as well as presentation. The participatory learning and evaluation of learning plots were done collectively by all relevant boundary partners (including farmers, crops and extension workers, researchers), project team, village leaders and non participating farmers. This helped to identify lessons for scaling up of successful strategies for resilient horticultural intensification capacity. It is assumed that people adapt better if they monitor and evaluate their own adaptation, either formally or informally. The farmer learning groups received training on process documentation and are keeping records of their experiments, the learning that resulted and their ideas for further experiments. This approach helped to capture the key issues in terms of focus of interventions and justification, challenges, opportunities and lessons learnt. The project team has been involved in regularly supporting and monitoring the field activities, and is also documenting the learning from their own perspectives. This process has assisted in reflecting and re-planning project activities.

Lessons Learnt

- A number of key lessons emerged from the synthesis of research findings from the three cases that were universal and instrumental to social learning and capacity building for enhancing community adaptation.
- It was established that shared learning is better enhanced when there is easy and frequent communication adaptation to climate change. This supports a strong need for ensuring well resourced activities for local level partners. Active participation of multi-stakeholders engagement and effective monitoring and evaluation are essential prerequisites of successful social learning. These will ensure ownership and sustainability of adaptation interventions beyond the project cycles. PAR appears to enhance social learning and multi-stakeholders capacity building though could be time consuming in reaching consensus on decisions regarding various interventions.
- Traditional forecasting knowledge enables farmers to make use of local indicators to determine onset of rainfall and when rainfall is expected at any time during the growing season. With changing climatic conditions which are affecting the flora and fauna, IK is under threat and its sustainability would require tangible conservation interventions. This justifies a need for integrating the traditional and conventional methods/mechanisms to make it possible for traditional communities to establish a continuum between scientific and traditional forecast, which combines the scale, and time of the onset of rainfall. The case studies from Kenya, Zambia and Zimbabwe clearly illustrate this.
- The PAR approach is appropriate for addressing communities' interdependencies in the context of climate change and variability, application of skills competencies including indigenous knowledge in enhancing community resilience and adapting to climate change. It is suitable within social learning contexts, where multiple actors collectively construct meanings (problem definition, objectives) and work collectively toward solutions. Thus, it is a process of social learning and change carried out by development actors themselves through field testing of various adaptation interventions as illustrated by the Tanzania and Malawi case studies. PAR facilitated harnessing and capturing experiences and priorities with regard to required adaptive interventions for climate change and variability from various perspectives of relevant stakeholders. However, participatory collaborative work is well-known to be costly in terms of time and resources. Ownership, management of and decision making regards the use of the projects resources by the different stakeholders is crucial.

Conclusion

This chapter has explained how institutional adaptation can be strengthened through participatory action research for effective knowledge sharing and the associated challenges and gaps which need to be addressed. All the case studies have demonstrated that local institutions help in shaping the adaptation to the effects of climate hazards in various important ways. The findings from Kenya, Zambia and Zimbabwe have further revealed that collaboration between local community rainfall predictors and climate scientists in target communities brings many gains in knowledge sharing when both parties work together with a motivation of learning from each other on establishment of common ground of understanding. Social learning provided a common platform for meteorological scientists, decision makers and policy makers, civil communities and end-users of adaptive interventions in integrating Indigenous Knowledge with Conventional methods in Kenya Zimbabwe and Zambia. Likewise in Tanzania and Malawi PAR demonstrated how multi-stakeholders learning plots on horticultural interventions contributed to enhancing adaptation while local institutions facilitated transfer of knowledge among community members.

The findings lead the conclusions that participatory action research approaches provide room for experimentation/ experiential learning and, multi-disciplinary working patterns, local ownership, and opportunities for experimentation with and feedback on institutional change. Through PAR, process documentation facilitates monitoring and evaluation of adaptation interventions and progress of project activities. Systematic observation and documentation of change processes helps both to facilitate lessons learning ("research") and adjustment of the facilitation process itself ("action" or "change"). In Tanzania and Malawi it was found that local institutions help in shaping the effects of climate hazards in various important ways. They influence how urban and rural people define climatic risks and impacts; how they shape the ability of urban and rural people to respond to climate impacts and pursue different adaptation practices; hence they mediate the flow of external interventions for climate change adaptation. In Kenya, Zimbabwe and Zambia, local institutions provided the structures of generating adaptation knowledge and sharing it embracing the core values of locals for sustainability.

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