Approaching resilience

Practices and innovations supporting smallholder climate change adaptation

safbin

For Small Farmers Future

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Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN)

Approaching Resilience

Practices and innovations supporting smallholder climate change adaptation

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Building Resilience to Climate Change through Strengthening Adaptive Small Scale Farming Systems in Bangladesh, India and Nepal

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CONTENT

PREFACE

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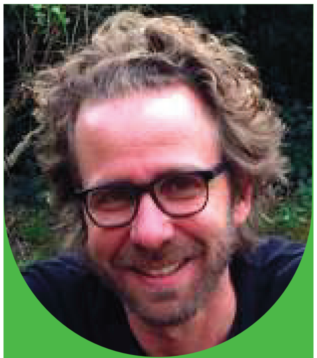
Worldwide, livelihoods of millions of small scale farmers are at risk from climate change. Many communities suffer from frequent and extreme floods, storms or drought; farming families are struggling with more unpredictable seasons. To prevent climate change pushing people more into poverty, Caritas organisations in India, Nepal and Bangladesh have been implementing the Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project over five years to support small scale farmers in 90 villages of their 3 countries to build resilience against the terrible effects of climate change. This program was co-financed by Caritas Austria and the European Commission and benefited from the scientific support of the Centre for Development Research of the University of Natural Resources and Life Sciences in Vienna.

This booklet illustrates good agricultural practices and approaches that have been tested and evaluated during five years of farmer collective led on-farm adaptive research and other SAF-BIN initiatives. This knowledge enables farmers in the region to adapt locally to climate change with appropriate technologies and to assure food security of their families. It gives examples on how joint efforts of many stakeholders can effectively and sustainably contribute to improve living conditions and resilience of smallholder farmers.

“One human family - food for all” is the worldwide campaign of the global Caritas network aimed at ending hunger by 2025 and to the SDGs. The SAF-BIN project is one of the many successful initiatives that can bring us closer to this goal. Hunger is today's most pressing challenge and climate change is one of the greatest global constraints to combating it.

I want to thank all those who contributed that the practices and approaches described in this compilation became reality - my colleagues from Caritas India, Nepal and Bangladesh, the European Commission for co-financing the program, the scientific consultants of BOKU and especially the farmers who are so much struggling to grow food for their families and who put all their energy into adapting to consequences of climate change.



FOREWORD

Michael Hauser
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We live in a world of unprecedented change in agriculture. Foreign direct investments, changing diets, and changing weather are critical drivers of such changes. Let's not misperceive the effects of such changes as 'local'. They express inherently unjust 'global' food systems. Smallholder farmers in precarious conditions are affected most.

Climate justice implies to empower farmers who have contributed least to climate change. Agro-ecological knowledge and the ability of farmers to experiment with agronomic practices are key ingredients of such empowerment. The SAF-BIN project has done so because resilience to climate change is the best insurance against food insecurity. Food security and sovereignty are the basis for stability and secure livelihoods. Farmers who lead adaptation to climate change reinforce their rights to a self-determined life.

This brochure provides evidence of the value of farmer participatory research and cross-boundary partnerships with civil society and research. Such partnerships encourage technological and institutional innovation, trigger course changing novelties, reinforce farmers' rights, and support the transition to sustainable agriculture and just food systems. In this regard, the SAF-BIN project, through facilitating innovation in farmers' fields, enforced a rights-based approach to agricultural development.

The five years of participatory research with farmers in India, Bangladesh and Nepal have not only fostered adaptation of farming to climate change. Equally important, the years of collaboration nurtured a novel alliance between BOKU and CARITAS. In future, such alliances will be more crucial than ever for transforming unprecedented changes in agriculture into opportunities for farmers.

List of Abbreviations

AES	Agro Ecosystems
AESA	Agri-Ecosystem Analysis
AEZ	Agroecological Zone (as per FAO)
AFPRO	Action for Food Production
ARD	Agricultural Research and Development
BADC	Bangladesh Agricultural Development Cooperation
BOKU	University of Natural Resources and Life Sciences Vienna
BPL	Below Poverty Level (as per Government of India)
BRRI	Bangladesh Rice Research Institute
CAUT	Caritas Austria
CBAN	Caritas Bangladesh
CIND	Caritas India
CLSB	Community Level Seed Banks
CNEP	Caritas Nepal
CSO	Civil Society Organization
DADO	District Agriculture Development Office
DLSO	District Livestock Service Office
DPO	District Project Officer
DSR	Direct Seeded Rice
EC	European Commission
EU	European Union
FFS	Farmers Field School
FGD	Focus Group Discussion
FO	Finance Officer
FPDCS	Food Production, Distribution and Consumption System
IAAS	Institute of Agriculture and Animal Science, Rampur Campus
ICAR	Indian Council of Agriculture Research
IDI	In-Depth Interview
IEC	Information, Education and Communication
IPM	Integrated Pest Management
KVK	Krishi Vigyan Kendra
LDO	Local Development Officer
LIBIRD	Local Initiatives for Biodiversity Research and Development

LIBIRD Local Initiatives for Biodiversity Research and Development

M & E	Monitoring and Evaluation
MoAC	Ministry of Agriculture and Cooperative, Nepal
MoEST	Ministry of Environment, Science and Technology, Nepal
MPSSS	Madhya Pradesh Social Service Society
NABARD	National Bank for Agriculture and Rural Development – India
NARC	Nepal Agriculture Research Council
NARS	National Agriculture Research System
NGO	Non-Government Organisation
OFAR	On-Farm Adaptive research
OFR	On-Farm Research
PC	Project Coordinator
PDS	Public Distribution System (India)
PM	Project Manager
PRA	Participatory Rural Appraisal
RC	Resource Centres
RO	Regional Officer
SACU	South Asia Coordination Unit
SAU	State Agriculture System
SDG	Sustainable Development Goals
SHF	Smallholder Farmers
SHFC	Smallholder Farmers' Collective
SHIATS	Sam Higginbottom Institute of Agriculture, Technology and Sciences
UODA	University of Development Alternatives
VRA	Village Research Assistant
VRC	Village Resource Centre

INTRODUCTION

HOW TO SUCCESSFULLY ADAPT TO CLIMATE CHANGE?

Barbara Stadlmayr

Background

Climate change is a global challenge and its negative effects are widespread, impacting the agro-ecosystems, agricultural production and human well-being. It hits areas highest, where people directly depend on agriculture for food and livelihood. In India, Bangladesh and Nepal, farming is primarily subsistence orientated with generally less than 2 ha of land. Smallholder farmers belong to the most vulnerable group in regards to food security. Among the reasons for that are the marginal landscapes they are living in. Most of the areas are rain-fed and hence extremely susceptible to rainfall variability, delayed onset of the monsoon, fluctuating temperatures and droughts. Moreover, due to little interest dedicated to smallholders by the national agricultural research authorities, there is limited availability of research outputs and extension mechanisms, making farmers vulnerable to climate change.[1,2,3,4,5]

How did the SAF-BIN project respond?

SAF-BIN stands for "Strengthening Adaptive Farming in Bangladesh, India and Nepal". It is an EU co-financed agricultural research for development project coordinated by Caritas Austria and implemented by Caritas organisations in Bangladesh, India and Nepal in cooperation with the University of Natural Resources and Life Sciences, Vienna as international partner, as well as with regional research and civil society partners[6] between 2011 and 2016. The overall aim of the project was to promote the local food and nutrition security through adaptive small scale farming in 90 rain-fed villages in South Asia.

Farmers have always been adapting and coping with local climate circumstances and shared traditional knowledge over centuries. In the course of time and with influence of the modern agriculture, traditional practices have started disappearing from their regular use. The SAF-BIN project enabled smallholder farmers to assess their existing food production, distribution and consumption systems (SHF-FPDCS) and test innovative adaptation strategies on-farm to mitigate climate change impacts. Hence, among the first steps was a diagnosis of the FPDCS, which also comprised the screening and documentation of local innovations and traditional practices used by the

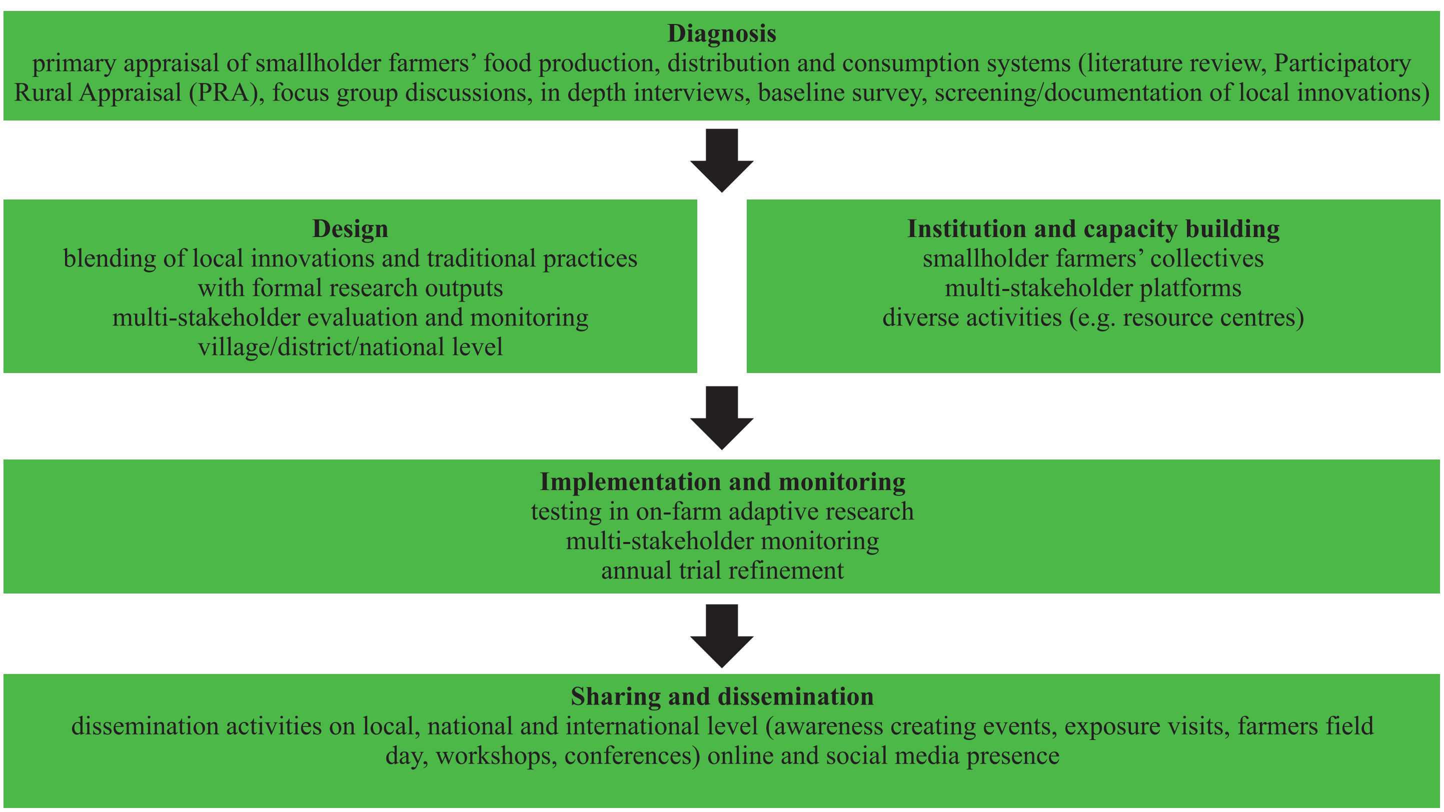

Figure 1: An overview of the major steps in the SAF-BIN research approach

[1] Bhatta, G., & Aggarwal, K. (2016). Coping with weather adversity and adaptation to climatic variability: a cross-country study of smallholder farmers in South Asia. Climate and Development, 8 (2): 145-157. | [2]Ericksen, P., Thornton, P., Notenbaert, A., Cramer, L., Jones, P., & Herrero, M. (2011). Mapping hotspots of climate change and food insecurity in the global tropics. CCAFS Report no. 5. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Retrieved from: www.ccafs.cgiar.org. | [3]FAO. (2016). Climate change and food security: risks and responses. Rome, Italy. Retrieved from http://www.fao.org/3/a-i5188e.pdf | [4] Hobbs, P., & Osmanzai, M. (2012). Important rainfed farming systems of South Asia. In P. Tow, I. Cooper, I. Partridge, & C. Birch (Eds.), Rainfed farming systems (p. 1336). Heidelberg, Germany: Springer. | [5] IFAD (2008). Smallholders, food security and the environment. Rome, Italy. Retrieved from http://www.unep.org/pdf/SmallholderReport_WEB.pdf | [6]Bangladesh Rice Research Institute (BRRI), Local Initiative for Biodiversity Research and Development (LI-BIRD), Sam Higginbottom Institute of Agriculture Technology and Sciences (SHIATS), Action for Food Production – New Dehli (AFPRO)

Initially, vulnerability assessment was carried out to identify the major problems affecting the farming community. It was followed by the process of screening and documentation of best practices and innovations, through focus group discussions and interviews of smallholder famers by SAF-BIN staff, in the beginning of the project. However, after the first year, it was decided to repeat this activity at the end of each cropping season. Hence, innovations and best practices were not only documented, but also arose in the course of the project.

In a second step, the traditional practices and local innovations were blended with formal research outputs through discussions at village, district and national level with multiple stakeholders, i.e. scientists, government officials, farmers and extension service staff. The feedback and suggestions were later on incorporated in the design of the on-farm trials to address local climate change-induced vulnerabilities.

What is this booklet about?

The booklet is a compilation of selected practices and innovations applied by smallholder famers to adapt to the local agricultural challenges caused by climate change. These practices and innovations were collected, and also developed during the SAF-BIN project and can be divided in three categories: (1) good agricultural practices, (2) technical innovation and (3) institutional innovation. Figure 1 gives an overview of the selected practices and innovations.

Within the SAF-BIN project they are defined as following:

(1) Good agricultural practices are practices that are adopted or practiced by the lead farmers, or were recommended to farmers e.g. through agricultural extension officers, NGOs or scientists. These practices might have been widely used in some parts of the countries, but were newly introduced in the study area through the SAF-BIN project, in form of field demonstrations or through the incorporation of the practices in the on-farm trials. Examples include the introduction of vegetable pools in Bangladesh to increase the dietary diversity at the household level, or the application of Amritpani, a natural pest repellent to control the infestation of rice bugs.

(2) Technical innovation are new ways of doing things developed by farmers themselves, earlier or during the process of the SAF-BIN project. In Nepal for example this includes seed priming to overcome winter drought. Usually this practice was only conducted in vegetables, but the farmers in Dumkibas village of Nawalparasi district tried to adapt this practice also to wheat.

(3) Institutional innovation are new ways of organizing, e.g. group formation and partnerships that emerged in the course of the project at village, district and national level. This includes the establishment of community level seed banks to increase the access of quality seeds, or the formation of resources centres at village levels, but also the multi-stakeholder partnerships that evolved in the project.

The collection aims to contribute to increase the understanding and use of documented innovations and practices in rain-fed SHF-FPDCS as pro-poor research and policy options towards adaptive food security and climate change mitigation.

FARMER COLLECTIVE LED ON-FARM ADAPTIVE RESEARCH - A PROMISING APPROACH

Sunil Simon

Agricultural Research in South Asia – a short overview

National agricultural research systems (NARS) in South Asia are characterised by a focus on large scale agriculture and market influenced development and extension approaches. Little emphasis is given to the issues of smallholder farmers, although they represent the majority of farmers (e.g. 96% in Bangladesh, 81% in India and 93% in Nepal)[1] in South Asia. Results of the prevalent top-down, scientist-led research have so far not been effective on the small, highly diverse farms[2]. Smallholder farmers remain among the most vulnerable groups in regards to agricultural risks and climate change. Among the main reasons for that is the limited capacity of NARS in South Asia to provide locally applicable solutions[3]. Similarly, the national agriculture extension systems lack capacity and approaches to effectively support smallholders. The Indian extension system which is strongest in the region, for example lacks operating resources, has a narrow focus and suffers from insufficient capacities to cooperate effectively with farmers[4]. There is an evident disconnection between agricultural research, extension and education systems[5]. Donors, policymakers and civil society organisations (CSOs) have been demanding for some time, that a transformation of formal agricultural research and development is necessary. They advocate for a change towards more relevant research outputs for smallholder farmers[6,7].

Alternative approaches

A valuable tool for the necessary transformation of agricultural research and development efforts are participatory approaches. These concepts include a range of stakeholders like non-scientists, laypeople, or citizens[8] with the aim to enable all involved actors to jointly benefit from the research results and outputs[1]. Farmer-led research is one example of these approaches. It should bring farmers and support agents (e.g. extension, researchers, small businesses) together to improve local livelihoods based on agriculture or natural resource management[5]. Farmers´ field schools (FFS), established in the 1980s, as a reaction to detrimental effects of abundant chemical fertilizer application in Indonesia were among the first alternative approaches supporting farmer-led research in contrast to conventional top-down research[9]. Nonetheless all efforts, to date farmers' involvement in research is still minimal in South Asia.

Identifying a suitable method for the local context

Based on this background and following an international research call on 'Global Programme on Agricultural Research for Development' initiated by the European Commission, a group of stakeholders from the agricultural research and development arena in South Asia came together in 2009. This group included Pranab Ranjan Choudhury (consultant and independent researcher on watershed management, forestry, livelihoods, farming System and Inter-disciplinary issues), Augustin Baroi (Caritas[10] Bangladesh), Sunil Simon (Caritas India), Manindra Malla (Caritas Nepal), Fr. Mathew Vattakuzhy, (MPSSS[11]), Dr. Anish Chatterjee (AFPRO[12]), Govinda Sharma (consultant – sustainable agriculture, organic farming and permaculture) and Dr. V. R. Haridas (Caritas India). During the planning workshop in New Delhi, India this group was looking for an innovative approach for agricultural development and extension. The group discussed possible approaches and identified on-farm research as a valuable (OFR) tool for involving farmers in the whole process of agricultural research. OFR is simply defined as *'research carried out on farmer's fields and in a farmer's environment'*[13].The group critically evaluated this approach and assessed that often it only allows a limited involvement of farmers in the decision making processes. All stakeholders agreed take the approach a step forward and give priority to the needs and decisions of farmers in all stages. On-farm adaptive research (OFAR) comprising three key characteristics (1) full farmer participation in all phases of the process; (2) direct contact between researchers and farmers and (3) a concerted multi-disciplinary investigation in which farmers can articulate their needs[14] was found a suitable concept. Based on its conceptual framework, the group developed a concept that would fit the local context and specific requirements.

[1]Thapa, G. and Gaiha, R. (2011): Smallholder Farming in Asia and the Pacific: Challenges and Opportunities. Conference paper: IFAD Conference on New Directions for Smallholder Agriculture (https://www.ifad.org/documents/10180/1055d470-65d1-48d0-815e-02d62ea87d86) | [2] Goma, H. C., Rahim, K., Nangendo, G., Riley, J., & Stein, A. (2001). Participatory studies for agro-ecosystem evaluation. Agriculture, Ecosystems and Environment, 87, 179–190 | [3] Hazell, P. B. . (2008). An Assessment of the Impact of Agricultural Research in South Asia since the Green Revolution. Rome. | [4] Mruthyunjaya & Ranjitha, P. (1998). The Indian Agricultural Research System: structure, current policy issues, and future orientation. World Development, 26(6), 1089–1101 | [5] Simon, S. (2014): Smallholder farmers Collective Led On-Farm Adaptive Research: A promising approach to mainstram smallholder agenda in the agricultural education, research and extension systems and policies in India, Souvenir, Brainstorming Workshop on Family Farming, SHIATS, 47-49 | [6] McNie, E. C. (2007). Reconciling the supply of scientific information with user demands: an analysis of the problem and review of the literature. Environmental Science and Policy, 10, 17–38. doi:10.1016/j.envsci.2006.10.004 | [7] Waters-Bayer, A., Kristjanson, P., Wettasinha, C., van Veldhuizen, L., Quiroga, G., Swaans, K., & Douthwaite, B. (2015). Exploring the impact of farmer-led research supported by civil society organisations. Agriculture & Food Security, 4, 1–7. doi:10.1186/s40066-015-0023-7 | [8] Lengwiler, M. (2008). Participatory approaches in science and technology. Historical origins and current practices in critical perspective. Science, Technology and Human Vaules, 33, 3, 186-200. | [9] Braun, A., & Duveskog, D. (2008). The Farmer Field School Approach – History , Global Assessment and Success Stories. IFAD Rural Poverty Report 2011. Rome. | [10] Caritas Bangladesh, India and Nepal are non-governmental organisations (NGOs) working in disaster response, relief, rehabilitation and development | [11] MPSSS is the Madhya Pradesh Samaj Seva Sanstha: the social work wing of the Catholic Bishops Conference of Madhya Pradesh, India (http://www.mpsss.org) | [12] AFPRO stands for Action for Food Production and is an Indian NGO | [13] Tripathi, B. R., & Psychas, P. L. (1992). The AFNETA alley farming training manual - Volume 1: Core course in alley farming (Volume 1., Vol. 1). Ibadan: Alley Farming Network for Tropical Africa, International Institute of Tropical Agriculture. Retrieved from http://www.fao.org/wairdocs/ilri/x5545e/x5545e00.htm#Contents | [14] Subair, S. K. (2002). Improving Extension-Research Linkages through On-Farm Adaptive Research (OFAR) Philosophy in Southern African Countries. Journal of International Agricultural and Extension Education, 9(1), 85–91. doi:10.5191/jiaee.2002.09110

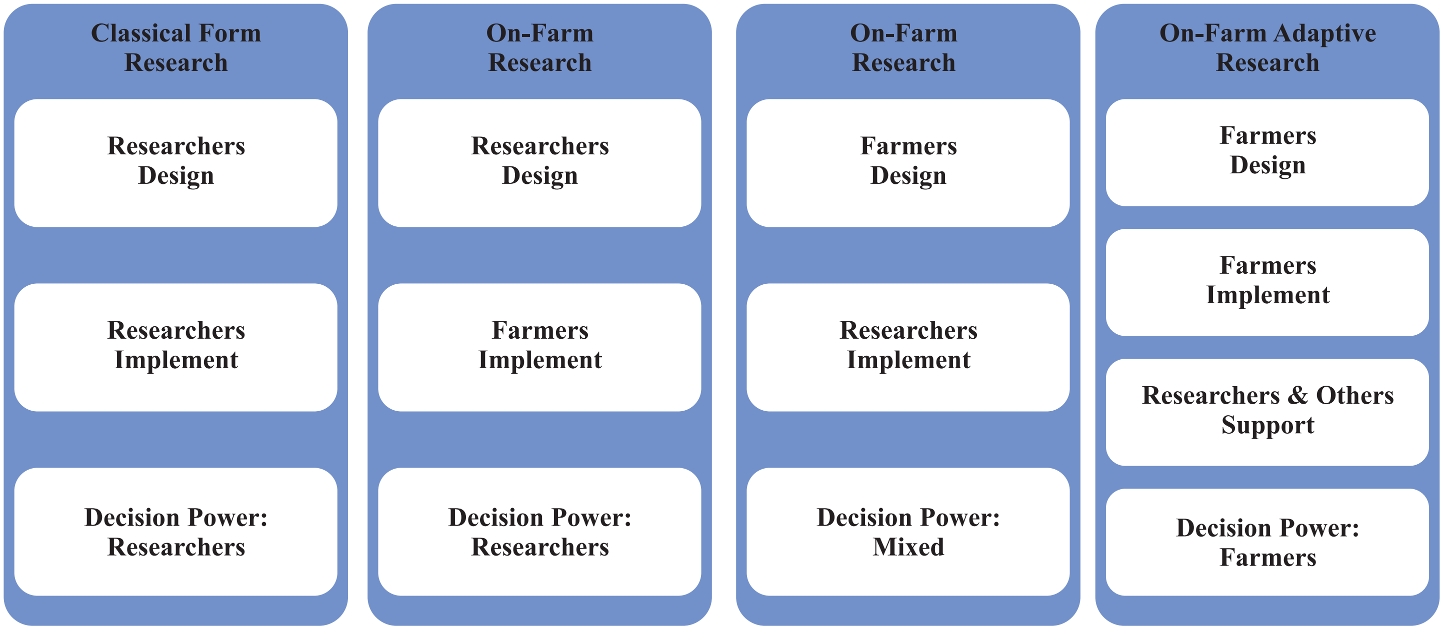

Figure 2: Different levels of farmer/researcher involvement in a range of research approaches. Decision power shifts to the farmers in the OFAR approach

Farmers´ collective-led on-farm adaptive research (OFAR)

The overall aim of the farmers´ collective-led on-farm adaptive research is the empowerment of farmers. Farmers organized into small sub-village level collectives are at the centre. The highest priority is that farmers have the leadership and make all vital decisions in the research process considering their needs, requirements and capacities. Initial support is provided by external facilitators (e.g. NGOs) that assist in group formation and strengthening, establish linkages with research and extension and provide the technical and institutional knowledge needed. These external facilitators are expected to exit the process as soon as farmers are enabled to manage it on their own. The approach is flexible and adaptive to the changing demands of the farmers.

Steps of farmer collective led on-farm adaptive research followed in SAF-BIN

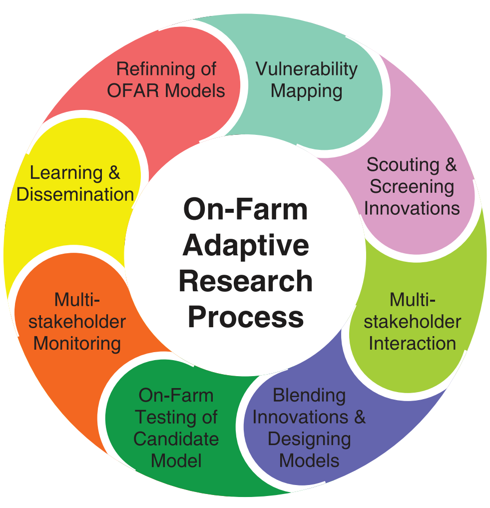

Figure 3: OFAR process in SAF-BIN

The base of the approach is a vulnerability mapping to gain a thorough understanding of the local agricultural vulnerabilities, challenges and its effect on the food security in the climate change context. South Asia Coordination Unit (SACU)[15] of the programme developed a participatory tool to assess the vulnerabilities and identify the problems of climate change, which is effecting the food production sustainability and hence local food security. Vulnerability assessment tool consists of information on the effect of varying climate on each physiological stages of the main food crop and its impact on growth, production and food security. It also map the extent and coverage of the problems and its effects in the village. This tool enabled farmers in assessing their own situation and also in acquiring the necessary skills to investigate jointly define own problems.

Assisted by facilitators at the initial stage the scouting and screening of innovations step was used to assess the availability of local or traditional solutions or agricultural practices for addressing emerging crop productions problems. This process repeated soon after the vulnerability assessment, to help farmers to revisit their traditional practices and innovations within the village as potential adaptation strategies to address climate change induced vulnerability.

In the multi-stakeholder interaction stage farmers collaborate with other farmers, villages or external stakeholders (e.g. extension, researchers) and are exposed to external knowledge or promising solutions for the problems they have defined at the initial stage. This newly acquired knowledge is taken into the blending innovations and designing models stage. Based on the various solutions identified for the problem, farmers come together at the village level to identify the most promising set of solutions which is easy for them to practice. These solutions are

[15] South Asia Coordination Unit (SACU) was established under the SAF-BIN programme for overall coordination and guidance to the partners in South Asia

selected based on the factors like ease of input availability, use of local materials, low cost, time and labour requirement, environment friendliness, cultural and social acceptability etc. These solutions are then weighted and validated with the support of experts and scientists during the multi-stakeholder meeting at district level. Based on the feedback, the candidate models are finalised by the farmers. However, in the technology blending and refinement process, role of power, particularly those of the key stakeholders like NGO, Scientists, Extension workers and farmer leaders, were noted to influence the final model, based on their perception of adaptation element (viz. variety, practice etc.) they prioritized and output (viz. increased yield of grain, of system productivity, stability etc.) they anticipated.

The resulting candidate models are tested to identify the best solution for the local context by laying out on-farm adaptive research trials in a small area of land identified by farmers from various collectives in their own fields, side by side their ongoing practices.. This enables the communities to create their own database for informed decision making based on experimental observation of comparative growth and yield between model treatments as well as that with their on-going practices. Farmers from the collective get together at the trial plots every 15 days or based on the requirement to compare the effects of various solutions and generate learnings. This testing stage is supported by multi-stakeholder monitoring after harvesting, in which farmers, researchers, scientists from other villages and districts participate and share their observations and suggestions. Student researchers (Master's Student from Agriculture Universities) were also involved in OFAR also visit the trial fields and frequently interact with the farmers to generate knowledge.

During the learning and dissemination stage farmers bring together the learnings generated from the trials conducted in their own villages and share it within the collectives as well as with farmers and other stakeholders. A learning and dissemination session is organised at village and district levels, after each cropping season, to further discuss and generate learning from the experiments conducted by the farmers. The learnings are generated for refining the OFAR (candidate) models in the next agricultural season. At the beginning of the agricultural season next year, farmers come together and follow the same process. During this time, farmers' also consider the learnings generated from the trials conducted during the previous year. For example, new problems and solutions could be identified annually and tested practices could be adapted throughout the growing season to fit seasonal conditions.

Putting farmers' collective-led OFAR into practice

In the context of the EU-funded Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project the farmers' collective-led on-farm adaptive research approach was tested as innovative approach for the selected locations. Ninety villages were selected from 10 districts in 3 countries[16]. The aim was to build resilience to climate change in order to promote local food and nutritional security through adaptive small scale farming rain-fed agro-ecosystems of South Asia. The low capacity of local farmers to adapt their food production, distribution and consumption systems to climate change needed to be addressed. The general steps of the approach were implemented in the following manner:

1. Vulnerability mapping : general context climate change and food security
    - Identification of challenges and problems
    - Assessment how major crops are affected at different growth stages
    - Assessment of impact on food security situation
    - Tools applied: Vulnerability mapping tool is used for this purpose

Figure 4: SHFC members engaged in establishing OFAR trials in Nepal (SAF-BIN/CARITAS Nepal, Chintan Manandhar, 2012)

[16] Bangladesh: Rajshahi, Natore and Naogaon districts; India: Mandla, Sagar and Satna districts of Madhya Pradesh State; Nepal: Bardiya, Kaski, Nawalparasi and Surket

Figure 5: SHFC members engaged in monitoring of OFAR trials in Bangladesh (SAF-BIN/CARITAS Bangladesh, 2013)

2. Scouting and screening of innovations
   - o Identification of local innovations and best practices used by farmers to mitigate climate change challenges
   - o Tools: Innovation and best practice matrix tool is used for this purpose
3. Multi-stakeholder interaction
   - o Identification of innovations and best practices recommended by the scientific community and other stakeholders suitable as solutions to the climate change challenges identified
   - o Capacity enhancement and learning sharing
   - o Tools: Participatory workshops are organised to generate feedback
4. Blending innovations and designing models
   - o Final trial designs: Farmers with the support of VRAs (Village Research Associates) use the research design format to finalise the trial designs.
   - o Planning the trial implementation: Farmers also identify the resource farmers who will implement the trials (candidate models) as per the finalised specifications
5. On-farm testing of candidate models
   - o Implementation of OFAR trials: The farmers identified within the collectives implement the trials in a small plot in the farm. In many cases, during subsequent years, farmers started taking up trials in bigger plots, almost 50% of the total plot, keeping aside other half for their on-going practices. Farmers mostly use their own resources for taking up the trials. However, additional support is provided from the project for seeds, farm implements and solutions which is not available in the village to share the farmers' risks.
6. Multi-stakeholder monitoring
   - o SHFC internal monitoring of progress by farmers
   - o Joint monitoring by farmers and other stakeholders like student researchers, scientists, local government representatives from various agriculture related departments, representatives from civil society organisations.
7. Learning & Dissemination
   - o Learning sharing workshops: Learning sharing workshops are held at village and district levels. Farmers bring together the learnings generated from the trials conducted in their own villages and share it within the collectives as well as with farmers and other stakeholders. Learning sharing workshops are organised to further discuss and generate learning from the experiments conducted by the farmers.
   - o Dissemination of final learnings: The learnings from the trials are documented in posters and case studies etc. and shared with farmers and other stakeholders for replication.
8. Refining of OFAR Models
   - o Use of learnings from the previous trial season for refining OFAR trials: The learnings from the OFAR trials are used for refining the OFAR (candidate) models in the next agricultural season. Farmers follow the same process of identifying problems and while identifying the solutions, they also consider the learnings generated from the trials conducted during the previous year.

Results

4,180 smallholder farming families were directly engaged in farmer collective-led on-farm adaptive research, through laying of trials plots in their own field, in the SAF-BIN project. Their ability to conduct on-farm research was established and their systematic skills around methods of scientific investigation, assessment and appreciative enquiry enhanced. Farmers have learned to collectively understand climate challenges. Through the cooperation with stakeholders from research and extension farmers can now have access to more options to mitigate climate change effects. These options include improved varieties, technologies and know-how but also institutional capacities. Participants have identified innovative and effective solutions and improved their capacity to address the challenges of climate change. Farmers have started research in additional crops outside of the initial project focus. Their capacities to interact and negotiate with the government official and other stakeholders have improved. Moreover a social capital has been built in these villages with enhanced access to stakeholders working around agricultural adaptation, which is enabling better services access and delivery. The institutional mechanisms, networks and stakeholder partnerships have a good change to create a lasting impact and sustainable improvement beyond the duration of the SAF-BIN project. The approach was appreciated by the farmers and other involved stakeholders for being focused on farmers and actively involving other stakeholders.

Challenges in the implementation of the farmer collective-led on-farm research approach

As in all new approaches, not all experiences were positive and some challenges were met. The important thing is to learn from challenges and problems to improve the approach.

Due to the high expectation of the farming community to receive resource support, the initial facilitation among them mere for knowledge sharing was the major challenge. The community was not united and it took some time for the team to bring the farmers together to initiate concerted action. The high expectation of the smallholder farmers had to wait till the end of first season to get favourable results and another season to gain confidence to upscale it within their own farm. Influence of scientists, researchers and development officials were high in many cases. They influenced the trial designs and in some cases prescribed solutions only by considering the conventional research. Farmers and the VRAs had difficulty in identifying the innovations and traditional practices as viable options to address the issues of climate change. This process was again facilitated by the district teams.

Farmers' preference for already available solutions provided by external actors (e.g. research, extension) led an emphasis on the testing and adoption of outputs from formal research (e.g. improved crop varieties). The different adaptation pathways chosen be the individual countries were an advantage. However, it was also a major challenge to bring coherence in research, though it reemphasized the need of local relevance and potential of diversity in enhancing climate change adaptation. It was difficult for farmers to handle the large formats of data collection during the cropping season required for detailed analysis. The project adapted to the requirements and simplified the analysis done by farmers limiting it to a few parameters.

Project locations in India and Nepal were about 100 km from the project office. It was a challenge for the staff to provide frequent mentoring support. Frequent staff turnover was also a challenge to orient the new staff on the various approaches and the project processes. Although, scientific analysis of the trials was not a major priority, there was a lack of staff, capacities, suitable instruments and resources in the project team to sufficiently check that trial data was systematically recorded and managed. This led to insufficient quality of datasets and led to delays, sometimes even making it difficult, to conduct scientific analysis.

Sufficient manpower and a strict process management are necessary. Also field staff needs to be trained better on these aspects. VRAs and farmers collecting the data could have been trained better to collect quality data from the field. Stakeholder management was a major challenge as each stakeholder had their own priority. Slowly all of them started appreciating the process and contributed actively. However, many stayed away.

Chances resulting from this approach

There is a viable chance that a fair percentage of farmers who were involved in the farmer collective-led on-farm adaptive research will continue to practice on-farm adaptive farming at the local and district level. Farmers' network needs to be expanded and strengthened beyond the duration of the SAF-BIN project. The chance to continue the momentum created through this approach can be continued, by motivating famer leaders to disseminate and share their experiences and learnings with others. Civil society organisations can play a crucial role to operate at local levels by facilitating the necessary activities and partnerships. Collaboration with research and extension organisations in a multi-stakeholder manner can lead to a replication of this approach in other areas and sectors and contribute to sector development.

MULTI-STAKEHOLDER PARTNERSHIPS IN SAF-BIN PROJECT

Sunil Simon

Highlights

- Mutual respect and increased appreciation among stakeholders
- Increased options for exchange of perspectives, knowledge and experience

Background

Stakeholder partnerships significantly influence the action and results of any initiative. The involvement of different groups brings a plethora of knowledge, capacities, perspectives and experience to a process. Ideally, scientists, government officials and the community together are the basis of action for change. However, up to date there is limited opportunity in South Asia for farmers, particularly smallholder farmers to effectively interact with scientists, researchers and the agriculture extension system. A top down approach instead of a participatory approach is prevailing the agricultural sector and smallholder farmers, due to their vulnerabilities, constrained bargaining power and limited risk taking capacities have often been left out. The lack of involvement of farmers has led to under-representing their concerns and has jeopardised the progress in agricultural research and extension (e.g. a difficulties in technology transfer, unsuitable adoption practices for famers, lack of ownership of the processes of farmers and in a delusion of ideas).

Based on this background, the Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project aimed among others, to establish innovative multi-stakeholder partnerships. The objective was to enhance dialogues among smallholder collectives, civil society organisation, agriculture research, extension agencies, academic institutions and policy makers, leading to a more inclusive and responsive policy as well as small-farmer-friendly research and actions. SAF-BIN was implemented by local Caritas organisations and research partners to build resilience of the smallholder farmers to climate change through adaptive farming.

How were the partnerships formed?

The involvement of multiple stakeholders in the SAF-BIN project has been an integral part of the project design. In 2009, Caritas organisations in Austria, Bangladesh, India and Nepal came together with the University of Natural Resources and Life Sciences (BOKU) Austria and associate partners, including Action for Food Production (AFPRO) India, Sam Higginbottom Institute of Agriculture, Technology and Sciences (SHIATS) India, Bangladesh Rice Research Institute (BRRI), Bangladesh and Local Initiative for Biodiversity and Research and Development (LI-BIRD) to address the food security and climate change challenges of smallholder farmers in rain-fed areas of South Asia (see Figure 1). Additionally, during the course of the project, partnerships were actively promoted at village, district and national level in Bangladesh, India and Nepal to collectivize and strengthen smallholder famers´ institutions and to interface them with relevant stakeholders to influence the national research and policy agenda and actions (see Table 1).

PROJECT MANAGEMENT STRUCTURE

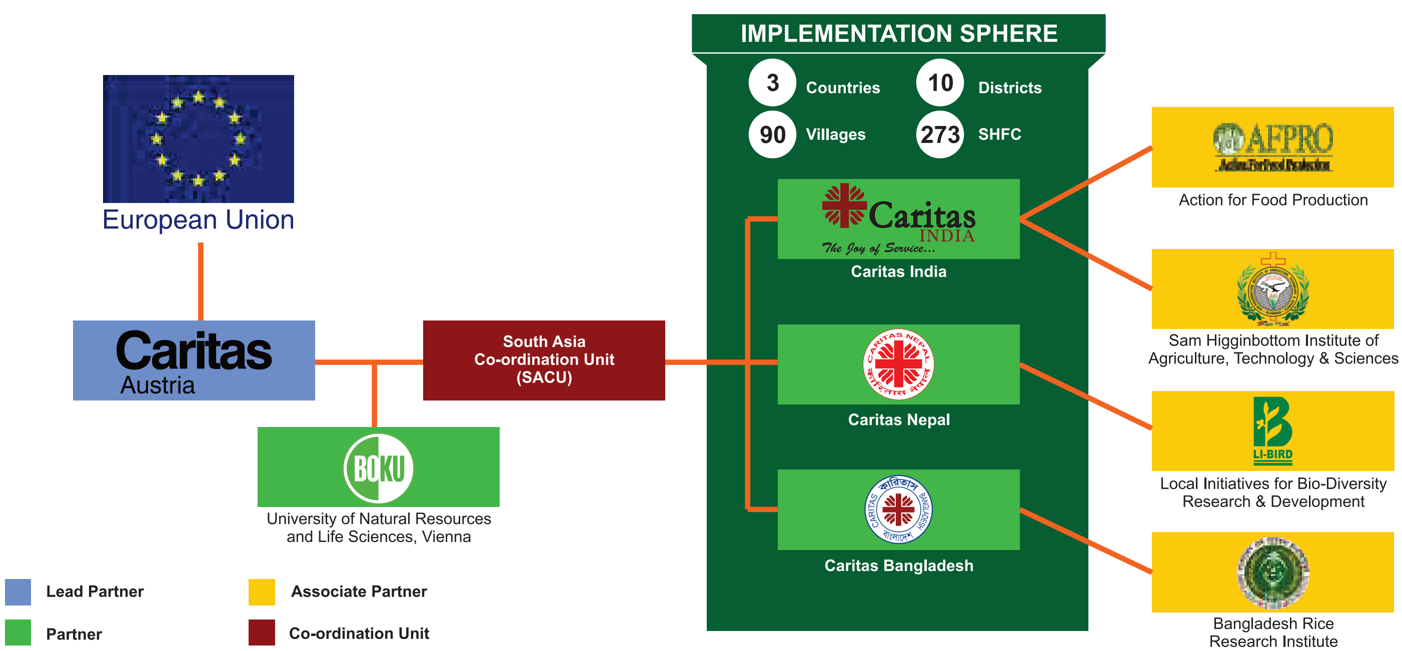

Figure 6: Overview of project management structure

Table 1: Overview of stakeholder forums and partnership establishments at various levels

Village level	
Village research assistants (VRA)[1]	VRAs have been selected to facilitate two-way information exchange at the village level and connects SHFC with other outside institutions/stakeholders.
Smallholder farmers´ collectives (SHFCs)	SHFCs connect farmers at village level. Farmers themselves select members for the three collectives in each village through village workshops, organized by the SAF-BIN team and local government representatives in the respective country. Each SHFC is organized in a democratic manner and representatives are selected by the members of the collectives. The main function of the SHFCs were to identify vulnerabilities at local level, suggest traditional options and access and refine solutions by conducting On-Farm Adaptive Research (OFAR) trials.
District level	
District farmer forums	District farmers' forums are a federation of farmers from various SHFCs at the district level[2]. In case of India, farmer representatives from other parts of the district were also brought together to enhance the learning experience.
District project officer (DPO)	DPO´s facilitated the formation of the forum and provided support in establishing linkages and capacity building.
Partnerships with government departments and research institutes	Farmers´ forum members developed linkages with the government departments and research institutes in the respective district. Representatives from these institutions also participated in monitoring the on farm adaptive research (OFAR) and generated learnings.
District multi-stakeholder forums	Potential stakeholders for the multi-stakeholder forums have been identified by the Caritas organisations in each country. Multi-stakeholder forums at the district level consist of members of the farmers´ forum, representatives from civil society organisations, government and research institutions in the district. Special focus was given to develop linkages with the government departments. Linkages were also developed with NGOs working in the project area and other major development programmes in the region. Both district farmers´ forum and the multi-stakeholder forums were facilitated by the local Caritas organisations in the district.
National level	
Partnerships with government departments and research institutes	SAF-BIN team members visited the government departments in their countries and shared information on the project. Hence, officials from different government departments were from the beginning of the project involved in the process. Additionally, SAF-BIN staff actively contacted research institutes and sought their involvement. Formal partnerships have been worked out in some cases while in others the roles and responsibilities were developed by its members. Local NGO´s and government officials assisted in identifying project villages. Partnership between the partners and associated partners within the country was crucial in achieving the results of the programme.
International level	
Partnerships with government departments and research institutes & International organisations	Unique partnerships among the Caritas Organisations, BOKU in Europe and nine Universities in South Asia were developed by the project teams to ensure that the learnings and issues of smallholder farmers receives priority in education, research and the extension agenda. The teams also developed linkages with the international network like Agrinatura[3] and other European union co-financed programmes in the region to take forward the farmers learnings for larger level policy changes.

[1] One VRA is selected in each village for facilitating the project processes | [2] Smallholder farmers from the project villages | [3] The European Alliance on Agricultural knowledge for Development (Agrinatura). Website: http://agrinatura-eu.eu/

Results[4]

Partnerships, including farmer to farmer and multi-stakeholder collaborations, have emerged as a major strength in the SAF-BIN project (see Figure 2).

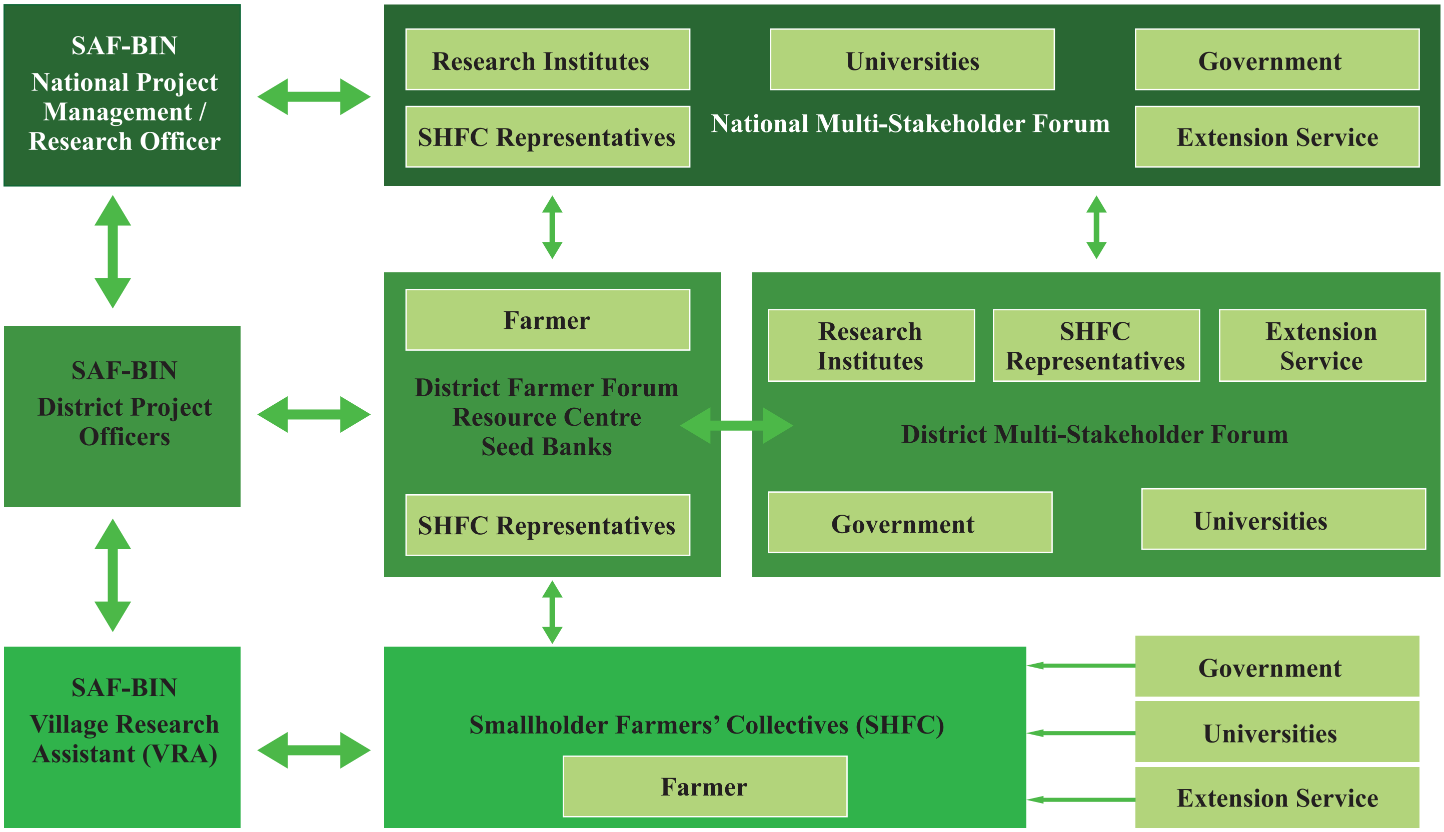

Figure 7: Overview of the multi-stakeholder partnerships in the SAF-BIN project

Farmer to farmer partnership

Village level

273 smallholder farmers' collectives (SHFCs) are functional in the SAF-BIN project area. One SHFC comprises on average 15 farmers, and 3-4 SHFCs were usually established in each village. The collectives are linked with the district farmer forum and other stakeholders like gram panchayat (India), VDC committee (Nepal), agricultural department, horticultural department, livestock department, fisheries department, Krishi Vigyan Kendra (KVK) etc. at district level.

- The SHFCs provide a platform for information sharing and discussion for farmers. Famers are developing and implementing action plans for agriculture and reviewing the findings after the season together. They mutually identify solutions to common problems through a participatory approach and generate a sense of ownership.
- Through the SHFC the community is able to address issues of food security and climate change manifested in agriculture and is able to access government schemes, programs and policies.
- Next to agricultural activities, SHFCs are undertaking collective saving and credit activities, e.g. SHFC have opened bank accounts in India
- In Nepal the SHFC received formal recognition through the registration at the District Agriculture Development office (DADO).
- In India the SHFC at the village level is registered with National Agricultural Bank for Rural Development (NABARD) and receiving support in its activities. Madhya Pradesh State Organic Certification Agency has approved organic certification for the SAF-BIN farmers.

The SHFC strengthened the capacity of the famers through analysis of their local circumstances, challenges, but also potentials to actively take decisions on changes. SHFCs are the community-level mechanisms for promoting village level leadership and community-level reflection and joint action on adaptive farming.

District level

Ten district farmers' forums were established in the three countries through the SAF-BIN project. The forums act as

[4] SAF-BIN annual reports (2011-2014).

change agents, where issues of farmers are taken to the forum and access to information and solutions is giving back to the farmers. Moreover, the forums are engaged in dialogues with government officials.

Resource centres were developed at district and in case of India at village level. These centres provide information and communication material (IEC) on climate change as well as resources required for agriculture (e.g. farming equipment's are available for farmers at reasonable rates). Hence, the centres increase the knowledge base of farmers and help farmers in thinking beyond the existing agricultural practices. Seed banks were developed as part of the resource centre and enhance the availability and access of seeds to the farmers and thereby reduce their dependency to external inputs and bad credits. Farmers are using and maintaining seeds banks and farm equipment's.

Multi-stakeholder partnerships

The involvement of various stakeholders provided confidence and ownership to the processes and outcomes. In Bangladesh and India multi-stakeholder forums were established at district level and in Nepal at national level. While multi-stakeholders at the district level are engaged in trials (e.g. review and monitoring process), the forum at national level is more of advisory in nature (i.e. members are invited to visit and provide feedback). Multi-stakeholder forum meetings are held before and after the cropping season. All stakeholder of the SAF-BIN team take part in these meetings, where the farmers share their results and experiences based on the previous trials and seek input for the following season. In these meetings also government plans and schemes are shared. The forums have helped farmers to generate linkages with the district and national agricultural system, as the stakeholders are regularly visiting the on-farm trials and are also actively engaged in the process.

Farmers and scientist/researcher partnership

Involving researchers from universities and research institutes in the SAF-BIN project has benefited both, researchers and farmers. It helped researchers to sensitize them on the various issues faced by the smallholder farmers and has generated appreciation on the issues of the famers. Master students engaged through Universities, gained insight in the famers´ needs and acquired skills to conduct on-farm adaptive research. Concurrently the involvement and inputs from the researchers during the process has helped farmers to generate options to cope with climate challenges and researchers the much required perspectives of farmers. The international collaboration with the University of Natural Resources and Life Sciences Vienna (BOKU University) was established, from the beginning of the project. e.g. BOKU was actively involved in the SAF-BIN project to give support and advice to the partners in the development of research methodologies, dissemination of learnings and capacity building. BOKU also ensured the participation of other stakeholders including student researchers in the project and was strongly engaged in producing outputs and dissemination of learnings.

Figure 8:District forum meeting in Naogaon, Bangladesh (SAF-BIN/CARITAS Bangladesh, 2014)

Figure 9: Shri. Nitin Gadkari, Union Minister, Government of India releasing the knowledge product during South Asia Conference organised by Multi-Stakeholder Collaboration of 15 Civil Society Organisations & SAF-BIN partners (SAF-BIN/CARITAS India, Patrick Hansda, 2015)

There has been an efficient partnership of SAF-BIN programme with 8 Universities in Austria, Bangladesh, India & Nepal, which produced 46 masters and bachelors level research theses on on-farm adaptive research. The involvement of research scholars, scientists and academicians helped in sensitizing them on the issues and challenges of the smallholder farmers. Students generated practical on-farm learnings and participatory approaches. The Universities involved in the SAF-BIN programme are:

- University of Vienna, Austria
- University of Natural Resources and Life Sciences, Vienna, Austria
- University of Development Alternative (UODA), Bangladesh
- University of Rajshahi, Bangladesh
- Sam Higginbottom Institute of Agriculture, Technology and Sciences (SHIATS), India
- Tribhuvan University, Nepal
- Agriculture and Forestry University, Rampur, Nepal
- Kathmandu University, Nepal

Conclusion

Successful partnerships, like those established in the SAF-BIN project benefit from the core competences and experiences of the individual partners and together create something new. However, effective stakeholders´ engagements require regular efforts. Mutual interest of the partner is a major factor in sustaining the partnership. It was quite a challenging task for the district teams to bring together all the key stakeholders at one point to discuss on the issues of smallholders. Due to diverse priorities of the stakeholders, facilitation is required to ensure that all the stakeholders on board are effectively contributing to the common goal. Some partnership, e.g. with the associate partners AFPRO and LIBIRD remained, however, due to limited role of common interest, could not work effectively. It was also difficult at the initial stage to bring the representatives of government and research on board to provide leadership to smallholder farmers. This could be overcome by regular interactions and sharing among the stakeholders. SHFC's and district farmers forum will continue to interact with various stakeholders at the community and district level. They have developed good linkages and mutual appreciations. The partnership at the regional level will continue due to the affiliation among the Caritas organisations and they are committed to work together on the issues of smallholder farmers.

INSTITUTIONAL INNOVATION

Establishment of community level seed banks (CLSB) to ensure availability and access to quality seeds for smallholder farmers

Highlights

- Increased access to quality and diversity of seeds for farmers
- Increased food security through local management of seeds
- Empowerment of farmers and increased in dependency of farmers from external seed suppliers

Figure 10: Masud Rana, member of the community level seed bank in Batasmolla village, Rajshahi district, presenting mungbean seeds – one of the many seed species stored in the seed bank (SAF-BIN /Caritas Bangladesh, Md. Taibur Rahman, 2014)

Background

Seeds are the basic input for agriculture and the availability and access to quality seeds is key for food security. Many actors, at international and national level, including famers, seed growers, private companies, traders, research institutes and civil societies are involved in seed supply[1]. In Bangladesh, the Bangladesh Agricultural Development Cooperation (BADC) was the official seed supplier until the 1990s[2]. To date the majority of the seeds is supplied by the private sector, including national and international companies and traders. Their seed prices are often beyond the financial ability of small holder farmers. Moreover, the adaptability of these seeds to local conditions are uncertain, as frequently imported high yielding varieties are traded instead of traditional seed varieties that would better resist the environmental stress caused by climate change.

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As a first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. Lack of availability and access to seeds at the village level was identified as major issue by many farmers in all three project districts (Natore, Naogoan, Rajshahi). The idea of establishing seed banks at the village level by farmer groups resulted from discussions among farmers, SAF-BIN staff and local agricultural extension officers. Among the objectives of the SAF-BIN project was also to collectivize and strengthen the small holder farmers´ institutions. Hence, 2-3 small holder farmers´ collectives (SHFC), comprising on average 15 farmers each, were initiated in the 30 villages of the three project districts for various project activities, like the community level seed banks (CLSB).

[1] www.fao.org/seeds/en/ (Accessed February 2016)
[2] Razzaque M.A and Hossain M.G (2007): Country report on the state of plant genetic resources for food and agriculture, Bangladesh. The second report on plant genetic resources for food and agriculture of Bangladesh – The State of Activities. Agricultural Research Council Ministry of Agriculture. FAO, Rome Italy.

Figure 11: Example of a community level seed bank in Batasmolla village, Rajshahi district Bangladesh (SAF-BIN/Caritas Bangladesh, Md. Taibur Rahman, 2014)

Steps for setting up CLSBs – based on the SAF-BIN project in Bangladesh

1. During farmer group meetings (e.g. small holder farmers collectives), interested farmers and skilled/resource farmers that can manage seed banks as well as places, where the seed bank can be set up are identified.
2. Officers from the local agriculture extension departments are contacted to provide technical support.
3. Famers participating in the seed bank collect containers for the seed storage (e.g. plastic drums, tin containers, gunny bags, plastic bags, and earthen pots) and provide a variety of quality seeds (e.g. field crops and horticulture) for the CLSB.
4. An observation and monitoring committee is formed among the members and they set norms and regulations for seed exchange. Examples:
    a. Member can exchange different kind of seeds (e.g. rice seeds against wheat or eggplant seeds), but it has to be the equal amount of seeds.
    b. If they do not have seeds, they can buy the seeds from the stock.
    c. After each harvest, farmers provide a certain amount of seeds to the seed bank, which is recorded by the farmer who is managing the CLSB.
    d. The quality of the seeds is tested by the manager of the seed bank through germination tests.
    e. The manager of the seed bank is also allowed to sell the surplus seeds in the local market or distribute them to poor farmers.
5. The manager of the seed bank records data on the seeds through a stock register and informs the members on a regular basis on the status quo.

Results

The local availability of and access to seeds (local farmer´s varieties and improved varieties) has been increased through the establishment of the seed banks at the village level. A total of 94 CLSBs, reaching more than 3600 famers are now functional in 30 villages of the three SAF-BIN project districts, Natore, Naogaon and Rajshahi. On average 400-500 kg seeds from different species and their varieties (e.g. rice, wheat, mungbean, lentils, grass pea, sesame, barley, chickpea, mustard, bottle guard, sweet guard, cucumber, and eggplants) are preserved per seed bank. Farmers can obtain the seeds at a fair price and the rights to their own the seeds is secured. Moreover, famers are now better equipped against the negative effects of climate change, e.g. when floods or droughts damage their crops, they can use the seeds from the community seed banks for the following season.

INSTITUTIONAL INNOVATION

Gaining access - Village Resource Centres in India

Highlights

- In-situ access to knowledge on adaptive farming practices
- Constant, increased access to quality seeds
- Community managed learning and exchange platform

Figure 12: Farmers conducting meeting outside village resource centre, Sagar Distrct (SAF-BIN/ CARITAS India, Manish Kumar, 2013)

Background

Farmers in the remote parts of India have limited access to knowledge on improved agricultural practices, improved technology, suitable farming equipment and quality seeds. As per the primary assessment of SAF-BIN there is an increasing dependency of farmers on external actors due to the market-led extension process. As farmers are depending on the external actors for the inputs, this results in limited access to the necessary farming inputs. Moreover, to ensure the sovereignty of farmers it is critical that they gain some control over provision of knowledge and resources. Especially in agriculture local access and timely availability of farming resources and knowledge are crucial to overcome rapidly changing challenges. This becomes even more important through the growing impact of climate change in the country.

Methodology

The *Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN)* project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. Smallholder farmers' collectives (SHFCs) comprising of an average of 15 farmers each were initiated in 30 project villages in 3 districts of Madhya Pradesh for various project activities by the implementing organization Caritas India. One of the planned project activities was the establishment of smallholder farmers resource centres at district level in all 10 project districts. The purpose of these centres was to create a physical space to 1) act as secretariat for the district farmers' forum initiated by SAF-BIN, 2) host information material for smallholder farmers related to agricultural practices, climate change and food and nutritional security and 3) be the access point for entitlements, services and farming inputs made accessible by SAF-BIN. These centres were established by the second project year in India. In discussions with the project participants, starting already during the initial participatory rural appraisal (PRA) stage of the project, the farmers expressed their wish to establish resource centers at village level to ensure easy and timely access to knowledge and farming inputs to enable them to increase their production and food security.

Figure 13: Farmer's displaying equipments and communication materials available in the village resource centre (SAF-BIN/CARITAS India, Patrick Hansda, 2015)

Steps of establishing village resource centres

1) Facilitated by the SAF-BIN team representatives of the 3 SHFCs operational in each project village jointly identified a suitable location for the establishment of the VRC. Suitable rooms were selected either in the house of a progressive farmers or of the village research assistants[1].
2) The owners of the selected rooms agreed to provide the rooms free of charge.
3) For each VRC a management committee, comprising of respective SHFCs members, were formed to maintain and manage the VRC.
4) Rules and regulations for managing the VRCs were jointly developed and agreed on by the SHFC members. These rules and regulations were recorded in the minutes registers[2].
5) The VRCs were stocked by SAF-BIN project with information, education and communication materials (e.g. manuals on agronomic practices, information on government schemes), farming equipments and seed banks[3].
6) Farmers were encouraged to continuously contribute information material from alternative sources to enable knowledge sharing within the community.
7) Management systems for each resource were developed and controlled by the management committees.
8) Registers were established to track the use of the VRCs.
9) A small user fee for the use of farming equipment was fixed to cover maintenance and replacement cost. This fee was recorded in the SHFCs in minutes registers.
10) Farmers obtaining seed from the VRC seedbank agreed to return the double quantity after harvest.

Future plans and challenges

After the phase out of SAF-BIN project, the maintenance of the centres and administrative issues like the location and collection of user fees will be left to the communities. The resource centres are maintain at the houses of the resource farmers or VRA's. It has been a challenge to allocate space by the panchayats[6] for VRCs. SHFCs are in discussion with them to allocate a common space for establishing this centre. There are plans to connect the centres to other initiatives such as online or mobile phone access to market, weather or crop information through linkages with governmental and non-governmental agencies. In order to maintain a democratic process, farmers have started to approach the local governance systems to provide land and buildings for establishing the village resource centres.

Results

During the first three years of the project Village Resource Centres were set up in all SAF-BIN project villages. On an average 45 SHFC members in each village have easy and timely local access to knowledge, farming equipment[4]. 30 seed banks managing locally preferred varieties of rice, wheat, kodo millet, maize and black gram seed. This creates local constant, local availability and accessibility of quality seed. 1410 farming families in 3 districts benefit from these centres access points. Village resource centres are also accessible to the non SHFC members from the villages and people from neighbouring communities. SHFCs have also prioritised to distribute seed to the neighbouring farmers. The Village Resource Centres have been established as institutionalized platforms to facilitate, manage and sustain on-farm adaptive research processes initiated through the SAF-BIN project[5]. Sustainability and self-reliance of the VRCs is attained through community based collective management practices. Beyond SAF-BIN project, 10 VRCs have been established in the 'Agrarian Prosperity Programme' of Caritas India in Jharkhand state.

[1]Village Research Assistants were employed by the SAF-BIN project and trained to facilitate project activities at village level. | [2]Minutes registers are the documentation of decisions maintained by the SHFCs | [3]seedbanks located in the VRCs were used by the members of the SHFCs to store seed of varieties tested in on-farm research trials conducted during the SAF-BIN project. They were managed by the communities. | [4]1680 implements in total e.g. seed drum, cono weeder, sprayers, seed grader, honey bee extractor etc. | [5]Seed used in rice, wheat, blackgram, maize and kodo trials as well as farming equipment for on-farm research trials was managed through the village research centers. | [6]Panchayats are the local administrative units of the self-governance system

INSTITUTIONAL INNOVATION

Zilla Kisan Manch (District Farmers Forum) – A federation of smallholder farmers

Figure 14: District Farmer's Forum meeting in Sagar (SAF-BIN/CARITAS India, 2012)

Highlights

- farmer-led institution for multi-stakeholder learning
- sharing and exchange platform for smallholder farmers
- stepping stone for farmer-led federations at higher levels

Background

The national agricultural research system in India is mainly focusing on exploring and providing solutions to large scale agricultural producers that comprise only 22% of the farming sector. Smallholder farmers with less than 2ha of farmland, comprise 78% of India's farmers, own only 33%of the total cultivated land on which they nonetheless produce 41% of the country's food-grains[1]. These farmers require a completely different set of solutions compared to larger producers. Especially in rain-fed areas these diverse production systems have varied and distinct challenges for which top-down research has rarely led to improvements[2]. But not only technologies and know-how are in high demand. There is an absence of platforms for smallholders that facilitate collective action, policy advocacy as well as access to knowledge and inputs. Available platforms at district and state levels are dominated by large farmers and do not address smallholders' issues. This gives limited space for knowledge sharing to overcome context specific development challenges. Hence there is a high demand of smallholders and civil society actors to address this issue and establish such platforms.

Evolution of zilla kisan manch

The 'Strengthening Adaptive Farming in Bangladesh, India and Nepal' (SAF-BIN) project was a research and development project funded by the European Commission between 2011 and 2016. To achieve its aim of building resilience to climate change for smallholder farmers in the project countries SAF-BIN worked on a number of levels. According to the operational guideline smallholder farmers' collectives (SHFC), each consisting of 10-15 farmers, were established to implement field activities in 30 project villages across 3 districts of Madhya Pradesh, India in 2011. The SHFCs from each village were federated in a village level committee for each project village[3].

In 2012, a federated district farmers' forum was established in all three project districts. All SHFC members were de-facto members of the forum. The executive body of the forum comprised of representatives selected through joint decisions within each SHFC. This selection took part during village meetings and was facilitated by village research assistants. Each district farmers' forum was headed by an elected committee. The forum

[1]FAO (2002) Smallholder Farmers in India: Food Security and Agricultural Policy, FAO, Bangkok, Thailand (ftp://ftp.fao.org/docrep/fao/005/ac484e/ac484e00.pdf) | [2]Goma, H. C., Rahim, K., Nangendo, G., Riley, J., & Stein, A. (2001). Participatory studies for agro-ecosystem evaluation. Agriculture, Ecosystems and Environment, 87, 179–190 | [3]these village level committees have later been re-organised and registered with the National Agricultural Bank for Rural Development (NABARD)

Figure 15: Multi-stakeholders forum meeting cum dissemination workshop in Sagar, India (SAF-BIN/CARITAS India, 2014)

engaged in designing and monitoring of on-farm adaptive research trials implemented at SHFC level. Additionally, it served as platform for the interaction between farmers and other sector stakeholders (e.g. extension, government institutions).

The platform envisaged by the SAF-BIN project evolved. During a learning-sharing workshop held in Sagar district in 2014, a district farmers forum member decided to invite smallholder farmers from other areas of the district to engage them in sharing and dissemination of project learnings. Under the leadership of Manav Vikas Santha Sagar[4], farmers from other blocks[5] of Sagar district join the district farmers' forum committee and office bearers were selected by this extended group during its initial meeting. Through this integration of farmers and stakeholders from outside SAF-BIN project villages, Zilla Kisan Manch, translating to 'district farmers' forum', took form.

Aims and objectives, rules, regulations of the function and the composition of the Zilla Kisan Manch were developed by the elected representatives. A representative of Manav Vikas Santha was included and entrusted with the role of a facilitator of meetings and host of the secretariat.

Zilla Kisan Manch meets every three months. Members discuss issues of smallholder farmers across the district. They share best agricultural practices, opportunities and linkages developed locally to strengthen the smallholder farming community. They also discuss opportunities of coming together as producers and engage in marketing their produce.

Future plans and challenges

With the completion of the SAF-BIN project Zilla Kisan Manch faces the challenge of remaining operational without the financial support of the project. The forums need to develop a sustainable revenue model to generate income for its' operational expenses. An affiliation of the Zilla Kisan Manch to district governments would be beneficial. A long term development could be federations of smallholder farmers on state and national level.

Results

Zilla Kisan Manch has created spaces for mutual learning among smallholder farmers at district level. As an institution it enables farmers to get in contact with line departments. It puts the problems faced by local smallholder farmers into the spotlight and engages in policy advocacy for a target group, which was so far overlooked. After the evolution of Zilla Kisan Manch in Sagar district the other project districts followed with similar initiatives. This was mainly achieved by initiatives of the local Caritas organisations to spread the SAF-BIN project learning to other areas of the districts as well as by the demand of farmers themselves. The farmers' forum at village level continues to function and engages with the local stakeholders to strengthen linkages and share learnings. At the end of the SAF-BIN project, three Zilla Kisan Manch were functional in the project districts Sagar, Satna and Mandla. In Sagar Zilla Kisan Manch is managing a biolab which is engaged in producing bio-fertilisers and growth promoters to improve local agricultural practices. These farmer-led institutions are generating learnings and establish linkages with district level government officials to increase their attention to issues of smallholders. Beyond SAF-BIN project, this farmer institution has also been initiated by 5 communities in Jharkhand state which shows its' applicability to many different contexts.

[4] Manav Vikas Santha Sagar is a local NGO (Diocesan Social Service Society) of Caritas India | [5]Block: a governance unit in India comprising a cluster of villages

INSTITUTIONAL INNOVATION

Resource farmers promote farmer to farmer extension in Nepal

Highlights

- **180 resource farmers active**
- **Resource farmers are models for improved agricultural production**
- **Resource farmers become market oriented producers**

Figure 16: Farmers learning about nursery management for off-season vegetable production in from resource farmer Bishnu Pun in Machhapuchhre-1, Kaski district, Nepal (SAF-BIN/CARITAS Nepal 2014)

Background

Agricultural extension services in Nepal have many weaknesses like insufficient infrastructure, lack of appropriate programme planning, minimal budget flow to disadvantaged farmer groups, insufficient set up at grassroots level and the promotion of 'blanket recommendations' when it comes to technology dissemination[1]. This affects the small and resource poor farmers the most, as their access to knowledge and control over resources is further marginalized. Farmer to farmer extension has been implemented in many contexts since the 1980s. It can be a very effective approach for agricultural extension if implemented suitably[2].

Methodology

The *Strengthening Adaptive Farming in Bangladesh, India and Nepal* (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. Smallholder farmers' collectives comprising of an average of 15 farmers each were initiated in 30 project villages in 4 districts[3] of Nepal for various project activities by the implementing organization Caritas Nepal. Three collectives were initiated in each project village. The main activity for these collectives was on-farm adaptive research facilitated through village research assistants[4] and supported by the project with agricultural inputs. In every village some farmers were willing to take more risks than the average. These farmers emerged as resource farmers, from the smallholder farmers' collectives.

How to identify resource farmers

Resource farmers are rather likely to experiment with new approaches and adopt new technologies. They are more effective than their peers in the ways they use available inputs. Resource farmers are enthusiastic to engage in capacity building activities. They are natural leaders and actively engage in the dissemination and sharing of knowledge and practices among other farmers. Resource farmers are willing to welcome other farmers on their land. Their farms become resource centres for their communities.

[1] Thapa, T.B.(2010): Agricultural Extension Services Delivery System in Nepal. FAO, Pulchowk, Nepal | [2]Franzel, S. et al. (2015) Note 7: Farmer-to-farmer extension. GFRAS Good Practice note for extension and advisory services. | [3]Nawalparasi, Kaski, Surkhet, Bardia | [4]Village Research Assistants were employed by the SAF-BIN project and trained to facilitate project activities at village level

Figure 17: Farmers of Hemja-8, Kaski district, Nepal cultivating vegetables at the farm of resource farmer Yaku Maya Adhikari (SAF-BIN/CARITAS Nepal, 2015)

Promoting resource farmers

The capacities of resource farmers were promoted by the SAF-BIN project. They were invited to participate in trainings and workshops at district and national level. This increased their capacities concerning improved agricultural practices and awareness of climate change. SAF-BIN facilitated linked resource farmers to government organizations, such as the district agriculture development offices (DADO), Nepal agriculture research council (NARC), and other service providers. This resulted in technical and input support for resource farmers from DADO, NARC and the SAF-BIN project. Through this support resource farmers equipped their farms with improved facilities, such as improved cattle/buffalo sheds such as improved cattle/ buffali sheeds, plastic poly houses, compost / vermi compost pits, waste water collection drums, drip irrigation kits etc. They also applied innovative practices like year round production of nutritious

Challenges

The positive development of resource farmers towards a more market oriented production is hampered by often difficult access to markets, the power of middleman and brokers, lack of farm input and other risk related to climate change. To sustain the resource farmers in their roles as facilitators it is important that their linkages to governmental stakeholders and service providers are sustained. This has been reached by the inclusion of village research assistants into the registered farmer groups. A promising strategy to advocate for collective action and increase the chances that local farmers improve their farms and develop into agricultural entrepreneurs.

Results

Before the SAF-BIN project, many farmers in the project area were pessimistic about continuing farming in rain-fed areas due to a lack of irrigation options and challenges caused by climate change. Initially it was challenging to convince farmers of adaptive farming. Resource farmers have been a valuable support to convince their peers to be open and experiment with improved farming practices. This approach has been an innovation for the communities involved. Resource farmers can be fostered in small-scale farming communities in general and those in remote areas in particular. Through the SAF-BIN initiative a pool of 180 resource farmers was created. These individuals are now able to conduct farmer to farmer extension in a low-cost, local and sustainable manner, share planting material, disseminate information about climate change and share improved agricultural practices via group meetings. Most resource farmers emerging from the SAF-BIN project are women due to men being abroad as migrant workers. This leading role has empowered many women in the villages. One example is Sabitra Paudel, from Dhikurpokhari village of Kaski district who turned into a commercial farmer through tomato cultivation in plastic tunnel supported by the SAF-BIN project. Although her husband is a migrant worker, she is now able to support her family through the earning from her farm. Her success has inspired other women in her village also started vegetable farming. Similar to this example 50 other farmers have evolved and become farm-entrepreneurs through the commercial production of vegetables. Linkages to government organisations have been formalized through official registration farmer groups including the resource farmers.

GOOD AGRICULTURAL PRACTICE

Effective traditional practices of insect and disease management

Figure 18: Farmers engaged in preparing pest repellents by using local resources in Mandla, Madhya Pradesh (SAF-BIN/CARITAS India, Sunil Pandey, 2013)

Background

One impact of climate change on agriculture is the increased occurrence of insect pests and crop diseases. This has resulted in significant crop losses affecting a large proportion of farmers across agro-ecological systems[1]. The use of pesticides, herbicides, fungicides, rodenticides etc. to address these problems is often dangerous and poses severe health hazards on the population due to increased residues in food[2]. Yet access to safe and nutritious food is essential in the subsistence oriented food production systems of smallholders. Effective, locally manageable solutions to these new and emerging problems are scarce.

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As a first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. During a vulnerability assessment conducted with the participating communities, smallholder farmers identified the increase of certain types of insects and diseases as a major manifestation of climate change. SAF-BIN project team collaborated with smallholders, agricultural experts, and civil society representatives to screen traditional agricultural insect and pest management practices, and identify effective, locally acceptable solutions. From a pool of solutions collected during this process, farmers identified the practices that were easiest to manage, environmentally friendly, cost effective and prepared from locally available materials to be tested in farmers collective led on-farm adaptive research trials[3]. The goal: enable increased crop production. Based on the validation of these practices through a number of consecutive trial seasons those able to effectively address insect pests and diseases in a range of major crops can be recommended and were re-introduced into the farming communities as good agricultural practices.

Practice description

Most of the practices adopted by the farmers are prepared from locally available materials. The combination, proportion, preparation and application rates vary according to the crop, location and intensity of the problem. Detailed descriptions are available from www.safbin.org/Publications.

Highlights

- **Re-introducing traditional knowledge**
- **Alternative to chemical pesticides**
- **Cost effective preparations from local materials**

[1] Climate-related transboundary pests and diseases, Technical background document from the expert consultation held on 25 to 27 February 2008, FAO, Rome | [2] Chemical pesticides to address these problems is often dangerous and poses severe health hazards, Protecting workers' health series n 1, 2001, WHO, Rome | [3] Detailed results of these on-farm adaptive research trials are available from SAF-BIN project (www.safbin.org) and upon request from Caritas India

Figure 19: A farmer from Sagar district, India with chilly crop recovered from leaf curl disease (SAF-BIN/CARITAS India, Sunil Simon, 2015)

Seed treatment:

Seed treatment ensures healthy plants, controls seed borne diseases, can improve germination and growth. The most popular, cost effective and simple seed treatment methods for SAF-BIN farmers are:

- Bijamrit[4]: protects against seed and soil borne diseases as well as enhances germination.
- Rhizobium culture: applied to legumes to enhance their nitrogen fixation capacity
- Trichoderma culture: enhance germination and prevents seed borne diseases in cereal crops
- Phosphate Soluble Bacteria (PSB) Culture – used for soil and seed treatment, enhances phosphorous availability to the plants

Pest repellents

These pest repellents do not destroy the pest but chase it away due to their strong odor yet, unlike inorganic methods, are not harmful for humans or the environment. Farmers identified the most suitable and cost effective options:

- Lamit ark[5]: used to control flying insects and larvae.
- Dashparni ark[6]: controls all kind of insects and pests.
- Fish tonic[7]: controls all kind of insects and pests and adds nutrients to the soil
- Cow urine: controls all kind of insects, pests and fungal infestations

Results

After three years of testing these practices in a variety of field trials, across a number of crops and regions these practices have been widely adopted by smallholders in the project area. Around 1400 farmers are preparing and applying these pest repellents on their farms. 1400 farmers are practicing seed treatment to address seed borne diseases. The local production of pest repellents reduced cultivation cost and ensured the availability of safe food for the local smallholder families. Some farmers in each village have even started selling the pest repellents to others. This is creating small income generation opportunities in the local communities. Organic pest management practices contribute, together with soil nutrient management, to increased local crop production.

Challenges

The preparation of these botanicals is labour intensive and sometimes there are cultural barriers like use of non-vegetarian waste, rodent's etc. as ingredients to the solution. Sufficient availability of the necessary ingredients and preparation of these organic products for larger farms can be difficult.

[4]Download Bijamrit description from: http://www.safbin.org/publicationdetails__93
[5]Download Lamit ark description from: http://www.safbin.org/publicationdetails__94
[6]Download Dashparni ark description from: http://www.safbin.org/publicationdetails__95
[7]Download Fish tonic description from: http://www.safbin.org/publicationdetails__96

GOOD AGRICULTURAL PRACTICE

Amritpani an organic alternative to control rice bug

Figure 20: The farmer, Sree Prem Das Halder, applying Amritpani on his rice plot to control rice bug in Mohimapur village, Naogaon district, Bangladesh (SAF-BIN/CARITAS Bangladesh, Md. Abul Bashar Mollah, 2013).

Background

Rising temperature and reduced rainfalls, as a consequence of climate change favour the environment for pest insects. In Bangladesh rice bugs (e.g. Leptocorisa oratorius, Leptocorisa acuta) are common in rain-fed areas. These insects damage the rice by extracting the content of the developing grain[1]. Chemical pesticides are frequently used to control the insects. These chemicals do however, not only destroy the harmful, but also the beneficial insects, negatively impact nature and environment, lead to additional production costs and decrease crop yields in the long run[2].

Methodology

The *Strengthening Adaptive Farming in Bangladesh, India and Nepal* (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. In Bangladesh, the PRAs took place in 2011 in 30 villages of 3 districts (Natore, Naogoan, Rajshahi). The increased damage of rice crops due to insects such as rice bugs was stated as concern by many farmers. During screening exercises for best practices and key innovations, some farmers and Caritas Bangladesh staff members reported good experience with *Amritpani. Amritpani,* also known as *Amrit Pani*, is a mixture of natural materials and is predominately used as organic growth promoter in India. The practice was introduced to Caritas Bangladesh during an exposure visit to India in 2010. Thereafter, the practices was piloted in Bangladesh, less as organic growth promoters, but more as organic and cost-effective alternative to pesticides. In the SAF-BIN project, "*Amritpani*" together with other practices was tested in on-farm trials between July 2013 and December 2015, to identify the best option for a sustainable management of rice bug[3].

Highlights

- **Control infestation of rice bug**
- **Increased soil microbial activities and organic growth promoter**
- **Organic and cost-effective practice**

[1]Rice Knowledge Bank: Rice bug. www.knowledgebank.irri.org/training/fact-sheets/pest-management/insects/item/rice-bug (Accessed February 2016) | [2] Caritas Bangladesh: http://www.caritasbd.org/ | [3] Detailed results of these on-farm adaptive research trial is available from SAF-BIN project (www.safbin.org) and upon request from Caritas Bangladesh.

Figure 21: Ingredients used for preparing Amritpani by farmers in Bangladesh (SAF-BIN/CARITAS Bangladesh)

Practice description

Ingredients for Amritpani (for 0.01 ha rice cultivation)

- Earthen pot
- 1 kg cow dung
- 1 ltre cow urine
- 100 g pulse powder
- 100 g molasses
- 10 l fresh water

Preparation:

Put all ingredients required for Amritpani together, thoroughly mix them and keep them in an earthen pot for 5-7 days for decomposition and microbial action. When the solution turns yellowish, usually after 7 days, the decomposed solution is ready to be filtered with fine cloth. After the filtration, dilute the solution with fresh water (1:10).

Application:

Amritpani is sprayed twice at flowering to grain filling stage in an interval of 7 days. Spray the solution both on top and bottom of the crops, especially on the bottom, as it is a preferred place of insects.

Results

The application of Amritpani successfully controls the infestation of rice bugs as the smell of the solution deters the insects. The results from the on-farm trials showed that the organic alternative Amritpani is equally effective for controlling rice bugs as chemical methods (e.g. use of malathion)[4]. However, also if the introduction of the practice is very much possible, commitment is required to successfully implement it. Since *Amritpani* is more labour intensive (e.g. collection and preparation of solutions) and has a very intense smell, compared to chemicals, the latter have been often preferred. Through the SAF-BIN project, farmers experienced the additional benefits of using the organic alternative *Amritpani*, including its growth promoting characteristic, its microbial soil activities and the protection of beneficial insects, which would be destroyed by chemicals. Moreover, *Amritpani* is much more cost-effective. Thanks to the SAF-BIN project 359 farmers started using this practice.

[4] Detailed results of these on-farm adaptive research trial is available from SAF-BIN project (www.safbin.org) and upon request from Caritas Bangladesh.

GOOD AGRICULTURAL PRACTICE

Collection of floating debris to control Sheath blight disease of rice

Figure 22: Demonstration session on collection of floating debris by a village research assistant (SAF-BIN/CARITAS Bangladesh, Abul Bashar Mollah, 2013)

Background

Sheath blight disease caused by Rhizoctonia solani is a major problem in the rice production. It is mainly known as rice disease in intensive rice production systems, but can also occur as major threat in rain-fed ecosystem, particularly in the widely cultivated rice variety Swarna. R.solani is a soil-born pathogen, favouring the environment of growing plants and plant residue. Sheath blight disease is currently mainly managed through the use of expensive chemical fungicides, harming the environment. Hence, farmers require effective management options to control the sheath blight disease[1].

Methodology

The *Strengthening Adaptive Farming in Bangladesh, India and Nepal* (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As a first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. In Bangladesh, the PRAs´ took place in 30 villages of 3 districts (Natore, Naogoan, Rajshahi) in 2011. Sheath blight disease in rice was a concern of many farmers, raised in the problem matrix workshops of several villages in Naogaon district Farmers observed greenish-grey lesions on sheaths of lower leaves, close to the soil or water level of the plants, which gradually increased and infected the entire plant. Solutions to address this issue were identified through in-depth interviews with scientists from the Bangladesh Rice Research Institute (BRRI), by SAF-BIN staff. The collection of floating debris was regarded as good practice and was also tested for efficiency in trial studies in Rajshahi, Natore and Naogaon districts, during the transplanting aman seasons (July 2012 to December 2015)[2].

Highlights

- **Effective management practice to control rice disease**
- **Reduction of attractors of soil-born pathogen R.solani, without chemicals**
- **Increased quality and yield of rice**

[1]SAF-BIN Caritas Bangladesh (2013): OFAR Research report | [2] Detailed results of these on-farm adaptive research trials are available from SAF-BIN project (www.safbin.org) and upon request from Caritas Bangladesh

Figure 23: Collection of floating debris in Naogaon district, Bangladesh (SAF-BIN/CARITAS Bangladesh, Abul Bashar Mollah, 2013)

How to collect the floating debris

1. Plough the land once or twice, 15 days before final land preparation.
2. Construct bunds around the field.
3. Maintain standing water at 2-3 cm level for about 3-7 days, or until floating debris are soft

   Examples of floating debris:
   - small dead snails
   - weed seeds
   - floating sclerotia
   - live inoculum with previous crop residues, ratoon or volunteer rice[3]
   - grass weeds
   - pupae of different rice insects
4. Plough the field and level the land for collection of floating debris.
5. Collect the floating debris after final land preparation by sweeping fine mesh cloth. Thereafter, bury the collected material.

Results

The collection of floating debris reduces the attractors of R. solani, the pathogen causing Sheath blight disease. This practice is therefore well suited to control the disease, which in turn results in better quality crops and higher yield. The positive effect of the method could be shown in the trials conducted in the SAF-BIN project in 2012, 2013 and 2014 in 160 fields, where rice yield increased on average by 0.253 t/ha.

[3] ratoon or volunteer rice = after harvesting rice, grown from previous rice stem

GOOD AGRICULTURAL PRACTICE

Measuring Seed Germination for optimum yield

Highlights

- Measurement of seed germination, applicable for all kind of seeds
- Easy and practicable test of seed quality
- Indicator of how the seed will perform on the field

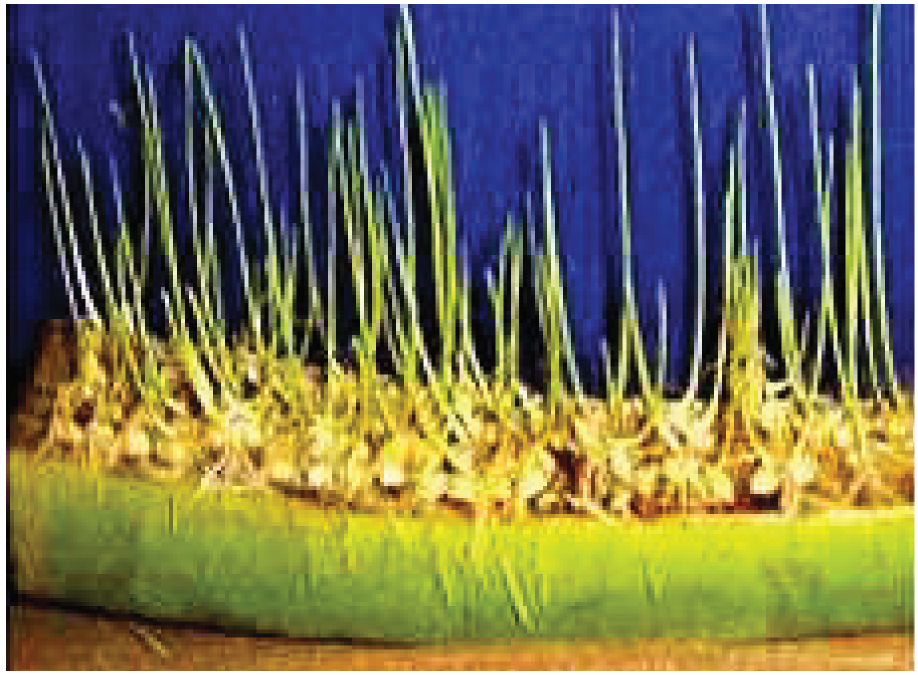

Figure 24: Seed germination test with banana leaf shoot, Naogaon Bangladesh (SAF-BIN/CARITAS Bangladesh, S.M. Zillur Rahaman, 2013)

Background

Seeds are the basis to produce any kind of crop. Hence, seeds must be grown, harvested, processed and stored correctly to achieve optimum yield and performance of crop production[1]. Practicable and easy tests, available for farmers, to assess if the seeds are suitable for planting contribute to prevent crop failure.

Methodology

The *Strengthening Adaptive Farming in Bangladesh, India and Nepal* (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As a first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. In Bangladesh, the PRAs´ took place in 30 villages of 3 districts (Natore, Naogoan, Rajshahi) in 2011. The issue of low viability of seeds was identified during discussions with farmers in Batasmolla village of Rajshahi district. Through in depth-interviews of representatives from the agricultural extension department, by SAF-BIN research officers, seed germination tests were suggested as best practice for the quality check of the seeds to be undertaken prior to storage or sowing. Thereafter, in the course of the SAF-BIN project, the germination test was also applied to test the effectiveness of seed germination management options (priming, versus non priming) to increase wheat yield in on-farm trials in Rajshahi, Natore and Naogaon districts[2].

Practice description adapted from the Rice Knowledge Bank of the International Rice Research Institute (IRRI)[3]:

Sampling: Randomly collect samples from different parts of the container. Take samples from several containers, if the seed to be tested is kept in more than one container.

How many bags should be sampled? It is recommended to take as many seeds from a number of containers that represent the square root of the sample size. E.g. if the seeds to be tested are contained in nine bags, sample at least three bags.

[1]http://www.fao.org/seeds/en/ (Accessed February 2016) | [2]Detailed results of these on-farm adaptive research trials are available from SAF-BIN project (www.safbin.org) and upon request from Caritas Bangladesh. | [3]International Rice Research Institute (IRRI) Rice Knowledge Bank: Measuring seed germination, www.knowledgebank.irri.org/training/fact-sheets/management-of-other-crop-problems-fact-sheet-category/measuring-seed-germination-fact-sheet (Accessed, February 2016).

Figure 25: Seed germination test with earthen pot, Rajshahi, Bangladesh (SAF-BIN/CARITAS Bangladesh, Md. Taibur Rahaman, 2013)

Materials:

- Waterproof tray
  - banana leaf shoot
  - earthen pot
  - jute mat
  - water bottle, cut in half, along the length
- Water-absorbent material, e.g. paper towel, tissues
- Seeds to be tested
- Water

Procedure:

- Randomly select a small number of small samples (e.g. 200 g seeds/species) from the different containers
- Soak the seeds in water for 24 hours
- Arrange 100 soaked seeds on the water-absorbent material, e.g. paper towel
  - place the paper in a closed container or
  - cover the seeds with another moist paper towel roll it up and place the sample in a plastic bag
- Ensure that the paper remains moist
- Count the germinated seeds 3 to 5 days later and record how many have germinated
- Calculate the germination percentage (see below)

Measuring outputs: The germination percentage expresses the proportion of the total number of seeds that are alive. Good vegetable seeds have more than 80% germination rate, good rice seeds have more than 90% of germination rate. This means that out of 100 seeds, 90 are expected to germinate. If the germination rate is less than the standard percentage for the respective field crop, it is an indication of bad seed quality.

Germination (%) = (Number of germinated seeds/Number of seeds selection) x 100

Results

Application of good quality seeds leads to lower seed rate, better emergence (>70%), more uniformity, less replanting and vigorous early growth, which helps to increase the resistance against insects and diseases. As a result, yield can increase by 5−20%. Through the SAF-BIN farmers have been trained in applying the germination test and approximately 1400 farmers are now using this practice in Rajshahi, Natore, Naogaon.

GOOD AGRICULTURAL PRACTICE

Wet seedbed method for *t. aman* rice under rain fed conditions

Figure 26: Pulling the rice seedlings, Naogaon district, Bangladesh (SAF-BIN/CARITAS Bangladesh, Md. Abul Bashar Mollah, 2013)

Background

Bangladesh´s agricultural sector is highly sensitive to climate change. In North-west regions of Bangladesh, like Rajshahi Division, transplanted *(t.aman)* rice is the most important crop under rain-fed conditions. Intra-seasonal variabilities of monsoon rainfalls frequently lead to water scarcity in this area, at critical cropping stages. Delayed onsets of rain results in shorter growing periods of crops. *T.aman*[1] rice, planted during the monsoon season under rain-fed conditions is often affected by drought spells during various growth stages[2].

Methodology

The *Strengthening Adaptive Farming in Bangladesh, India and Nepal* (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. In Bangladesh, the PRAs´ took place in 2011 in 30 villages of 3 districts (Natore, Naogoan, Rajshahi). The low quality of rice seedlings due to irregular rainfall, was identified as major issue by many farmers. Through screenings of key innovations and best practices, solutions to combat this negative trend were identified and discussed with the farmers. The establishment of wet seedbeds was suggested by the Bangladesh Rice Research Institute and after discussion with the SAF-BIN team and farmers the practice was disseminated through field demonstrations. The aim of the practice is to enhance the rice yield, by reducing the exposure of T. aman rice crop to rainfall variability at the start of the monsoon season. The practice was tested in the rain-fed areas of Rajshahi, Natore and Naogaon districts, during the transplanting aman season from July 2012 to December 2015.

Highlights

- **Increased resilience of rice seedlings to drought**
- **Improved quality of rice seedlings (healthy and uniform)**
- **Increased yield of t.aman rice**

[1]The name "aman" refers to the growing season of the rice (mid-June to November) | [2]FAO: Technologies and practices for small agricultural producers (TECA), Alternative seedbed methods for t. aman rice under drought prone conditions, NW-Bangladesh. Available at http://teca.fao.org/read/6838 (Assessed February 2016)

How to prepare a seedbed? Practice description adapted from Agropedia[3] the Rice Knowledge Bank[4].

The seedbed is usually prepared 17 to 25 days before transplanting the rice seedlings.

(A) Raising wet bed seedlings:

Land where both, irrigation and drainage can be controlled is ideal. The method is prepared during the rainy season and irrigation is usually not needed. However, in case of delayed onset of the rain, irrigation is required, e.g. managed through ponds or canal.

1. Plough the seedbed area twice within 3-5 days interval either in dry or wet conditions and then puddle the field by ploughing it two or three more times. After 10 days the field is ploughed again two times and levelled.
2. Prepare beds (1 m width and a 10 m length). Raise the soil to 5-10 cm height.
3. Add organic manure (decompose) as basal dressing. This increases the vigour of the seedlings and allows easier uprooting for transplanting.
4. Construct drainage canals for proper water removal.
5. Broadcast pre-germinated seeds (soaks seeds in the water for 12–24 hrs or until small shoots appear at the end of the seed. Drain and dry the seeds in a bag for 24 hrs in a shady area where air can circulate around the bags) in thoroughly puddle and levelled soil.
6. The beds should be kept moist for some days, but should not be flooded. As soon as the seedlings reach a height if approximately 2 cm, cover the beds slightly with water.
7. Watch out for pests and diseases.
8. Transplant seedlings when they are 17–25 days old.

(B) Pulling the seedlings out of seedbed:

On average, seedlings should be transplanted 17 to 25 days after sowing. Older seedlings (> 30 days) require more recovery time, in case of stem or root injury and younger seedlings (< 17 days) are too short to be pulled from the soil.

The procedure is as follows:

1. Take two to three seedlings at once.
2. Hold the seedlings between the thumb and forefingers, close to the base.
3. Pull the seedlings gently and easily out of the soil (preferably: at an angle of about 30° on the horizon).
4. In case that too much mud sticks to the roots, wash the seedling by shaking the roots in water. Do not trash the plant roots against any object to remove the mud, as this will injure the plants.
5. Bundle the seedlings to a convenient size (5-8 cm in diameter) and tie them with a soft material and the seedlings should be protected from drying.

Results

The application of this practice resulted in strong, healthy and timely rice seedlings for the cultivation of rice. Moreover, it decreased the use of seed per unit area to 120-180g seeds/m^2, compared to 200-300g seeds/m^2 that farmers used without the wet seedbed. A total of 2000 farmers adopted this practice thanks to the SAF-BIN project.

Evaluation of wet seed beds[3]

+	-
Less seed is required per unit area.	Water supply is required, seedlings cannot withstand drought.
Possible to conduct at any type of soil, but quality will vary. Loam or sandy soil is the best for seedling production.	Heavy rainwater shortly after sowing can carry seeds away
Number of seedlings per hill can be specified, therefore seedlings are not wasted.	Labour-intensive
Can withstand salinity	More space is needed

[3]Agropedia (2009): Nursery raising (wet nursery method) in Paddy, available at http://agropedia.iitk.ac.in/content/nursery-raising-wet-nursery-method-paddy. (Accessed February 2016) | [4]Rice Knowledge Bank: http://www.knowledgebank.irri.org/step-by-step-production/growth/planting/how-to-prepare-the-seedlings-for-transplanting (Accessed February 2016)

GOOD AGRICULTURAL PRACTICE

Vegetable pool – a practice to provide households with more food diversity

Highlights

- **Increase the production and diversification of vegetables at the household level**
- **Improve nutrition through the diversification of diets**
- **Potential to increase income through selling surplus of vegetables**

Figure 27: Set-up of a vegetable pool in Darikadighi, Naogaon district, Bangladesh (SAF-BIN/CARITAS Bangladesh, 2012)

Background

Despite the abundance of a diversity of ecosystems, dietary diversity[1] remains poor in Bangladesh. Around 80% of the dietary energy supply comes from rice, whereas micronutrient rich foods are not consumed in sufficient quantity, particularly in rural areas[2]. Good agricultural practices that can easily increase the production and diversification of vegetables at the household level and are also applicable in drought prone areas, are important to improve dietary quality.

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. In addition screenings of key innovations and best practices were undertaken. In Bangladesh, the PRAs took place in 2011 in 30 villages of 3 districts (Natore, Naogoan, Rajshahi). Low diversification of food production and hence low dietary diversity was raised among the problems by the farmers. During screening exercises for best practices and key innovations, vegetable pools, were regarded as suitable practice to be introduced to the SAF-BIN project. They had already been successfully piloted in 2009 in drought prone areas of Northern districts in Bangladesh, by Caritas, after a field excursion of staff members to Sri Lanka in 2007, where the practices was seen. The practice was disseminated in the SAF-BIN project through kitchen garden demonstrations.

Technical practice description[3]

A vegetable pool is a bag located in the middle of a small round and elevated piece of land in which vegetables can grow close to the homestead. Irrigation water is only applied to a bamboo stick located in the centre of the bag which

[1]Dietary diversity defined as the number of different foods or food groups consumed over a given reference period. Ruel, M.T. (2003) Operationalizing Dietary Diversity: A Review of Measurement Issues and Research Priorities. Journal of Nutrition, 133: 3911S-3926S.
[2]Food Planning and Monitoring Unit (FPMU) Ministry of Food and Disaster Management Bangladesh (2008) National Food Policy Plan of Action (2008-2015), Dhaka, Bangladesh. | [3] http://agriwaterpedia.info/wiki/Vegetable_pool_-_Bangladesh

Figure 28: Harvest of vegetables from the vegetable pool in Darikadighi, Naogaon district, Bangladesh (SAF-BIN/CARITAS Bangladesh, 2012)

guides the water to lower parts of the bag and the surrounding vegetable patch. The technology is well suited for water scarce environments. The ideal soil is sandy loam but the technology may also be applied in any other type of soil.

The minimum land size for constructing a vegetable pool should be 4.1 m^2 (the circle area should have a diameter of 2.30 m = 7.5 feet = 90 inch). Materials required are a jute bag, farmyard manure, rope, a bamboo pole or stick, seeds and seedlings, rice straw or any other available organic material, and - if animals are freely roaming in the courtyard - fencing material.

Steps for preparation

1. Fill a jute bag (height: 1 m) with sandy loam soil and farm yard manure 2:1 ratio. Rice straw and or vegetable residues can be mixed with the soil-manure-mixture, if available.
2. Enter a 1 m bamboo stick in the centre of the jute bag.
3. After that, the jute bag with the bamboo pole inside is located in the centre of a circle on the ground which is approximately 4.1 m^2 in size (diameter of 2.3 m). Pile up sandy loam soil and farmyard manure (mixed in a 2:1 ratio) up to a height of 30 cm inside the circle.
4. Little holes can be cut into the sides of the jute bag where vegetables can be grown. When planting, creeper vegetables (e.g. gourds, cucumber), it is required to put them on the top of the jute bag and other seeds and seedlings should be placed in the holes of the jute bag and on the elevated area around the bag.
   - Examples of vegetable planting: Creeper vegetables (e.g. bottle gourd, sweet gourd, snake gourd, ridge gourd, cucumber) can be grown on top of the bag; Indian spinach, tomato, cauliflower, cabbage are suitable to be grown in holes at the side of the bag and red amaranth, stem amaranth, coriander, okra, long yard bean, chilli and eggplant are suitable to be planted on the round piece of land around the bag.

Results

A vegetable pool of approximately 4.1 m^2 in size (diameter of 2.3 m) can produce around 120 kg of vegetables per year. The production cycle depends on the climatic conditions of the region, where the technology is applied. In Bangladesh, there are two cycles per year: 4 winter months and 8 summer months. Initial investment cost for one production unit (as defined above) is US$ 5.70 (or BDT 450). Variable production costs occur for seeds, seedlings and the jute bag that has to be replaced approximately every year. The vegetable pool does contribute to diversify the production at household level and additionally can support the farmers to increase income generation, through selling the remaining vegetables.

The preparation time to set up the vegetable pool is about 4-5 hours. Thereafter, the vegetables require little attention, except for regular watering which is estimated to take 5 to 10 minutes per day. Even wastewater from washing utensils can be used to irrigate the vegetable pool.

'Nutritional Gardens' – enriching in-situ nutrition in India

Figure 29: Farmer using non-pressurised drip irrigation system in the nutritional garden in Mandla, Madhya Pradesh, India (SAF-BIN/CARITAS India, Sunil Simon, 2013)

Highlights

- **Nutritional security through crop diversification**
- **Enhancing the diversity and quality of local diets**
- **Additional income from the sale of surplus**

Background

According World Bank, South Asia hosts the largest number of malnourished children in the world. At national level, mortality rate under the age of five is estimated at 59% varying between 38% in urban to 66% in rural areas. Altogether more than 63 million children are suffering from malnutrition[1]. Madhya Pradesh has more than 60% malnourished or undernourished children below 5 years[2]. This percentage is even higher in rural areas where farmers depend on rain-fed agriculture. Under- and malnutrition in this area is mainly caused by recent changes in food habits, erosion of traditional farming practices and local climate change resilient varieties, limited access to good quality seeds, limited availability of safe food and high market price of vegetables in the market[3].

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented to build resilience to climate change through adaptive small scale farming. In order to understand the local context of climate change, food security and nutrition a Participatory Rural Appraisal was conducted in 30 villages in 3 districts (Sagar, Satna, Mandla) of Madhya Pradesh in 2012 by the implementing organization Caritas India. One of the exercises (food in/food out) revealed that farmers mostly depend on the market to purchase vegetables. They were also reporting a limited vegetable consumption in general with their food basket consisted on average of 10 items. Especially women and children were had very limited access to vegetables throughout the year, crucial to meet their nutritional requirement. Every family had a backyard garden near their house. However, due to lack of knowledge and resources, only a limited number of vegetables, particularly all season vegetables like beans, were grown. While further exploring causes and opportunities, farmers revealed that they were interested to grow more vegetables in their backyard gardens to overcome this problem and requested the SAF-BIN team to provide training on how to achieve better nutrition from their gardens.

Caritas India had been promoting the 'nutritional garden' as a strategy to ensure the access to nutritious food at household levels. The smallholder farmers' collectives initiated by SAF-BIN identified farmers interested in developing nutritional gardens. A

[1]Worldbank (2016). http://tinyurl.com/z372f97. accessed on 21.04.2016. | [2] MOSPI (2012) Children in India, 2012 - A Statistical Appraisal. Ministry of statistics and Programme Implementation, Government of India. http://mospi.nic.in/mospi_new/upload/Children_in_India_2012.pdf. access date 21-04-2016. | [3]Sunil Simon (2016) personal communication based on previous development project experiences and interventions of Caritas India

Figure 30: A nutritional garden in Mandla District, Madhya Pradesh, India (SAF-BIN/CARITAS India, Sunil Simon, 2015)

training was organised for women farmers in all the three SAF-BIN district to provide them the necessary information and practical knowledge on establishing a nutritional garden. To initiate the establishment, support in the form of vegetable seeds and gardening tools enabled farmers to use the space available in their backyard, or a small portion of the farm, to cultivate vegetables.

How to establish a 'nutritional garden'

1. select a plot neat to the house and/or a water source like a well or pond
2. Prepare the selected plot by ploughing, harrowing and preparation of a seed bed or plantation bed
3. Apply measures like green manure, composit, application of farm yard manure, jivamrit, fish tonic, vermi-compost to improve soil fertility in the garden plots
4. If necessary use local, organic insect and pest management practices (e.g. Lamit ark, Dashparni ark) to save the crops from pests and insects
5. Establish a nursery or seed bed (size depends on the selected crop and garden size) to prepare seedlings for the garden in a shade location close to a water source
6. Use local seed selection and preservation processes to identify healthy seeds. This ensures stable, timely access to good quality seed. Sale of seeds can generate additional income as well.
7. Transplant seedlings from the nursery only if sufficient water is available
8. Select crops that have water requirements matching the available resources
9. Apply smart water management methods
10. Adapt irrigation method and frequency is to the planted crop
11. Recycle household waste water for irrigation of the nutritional garden
12. Harvest 3-6 times a year depending on vegetable crop used.

Apart from the technologies

In the trainings offered to farmers the benefits of using local resources (e.g. seed varieties, organic waste, waste water etc.) was emphasized. The cultivation of at least two vegetable crops per year was demonstrated to be able to fulfill a substantial part of the nutrient requirements at family level. The participants were encouraged to give preference to household consumption of the produced vegetables. Also the opportunity of selling surplus vegetables on local markets was discussed.

Future plan and challenges

Managing and marketing of surplus from the nutritional gardens is an aspect that needs to be addressed. A model for collective vegetable cultivation that has been piloted during the project duration and could be up-scaled.

Results

Nutritional gardens can: increase and diversify the local food basket, improved access to locally preferred food varieties, recycling organic waste and waste water, reduced dependencies on market and expenses for food and create additional income from sale of surplus. Women farmers are now producing at least two vegetable crops per year in 1350 'nutritional gardens' across in 30 villages across three districts of Madhya Pradesh. 11 vegetable types[4] have been added to their food baskets. This provides them with sufficient vegetables to increase the diversity and the quality of their diets. Chemical free cultivation practices applied ensure safe, healthy food. The dependency of these families on markets has reduced. The cost and time formerly needed to source vegetable from the market can now be invested in other enterprises. This practice could be adopted by any family interested in locally growing nutritious and chemical free vegetables near their homestead.

[4]Chilly, brinjal, cabbage, cauliflower, spinach, bitter gourd, coriander, onion, carrot, radish, turnips

GOOD AGRICULTURAL PRACTICE

On the edge – growing tubers with the ridge and furrow method

Figure 31: A close up view of ridge and furrow method (SAF-BIN/CARITAS India, Sunil Simon, 2014)

Highlights

- **Increases potato yields**
- **Minimizes the risk of potato rot**
- **Practice applicable to a variety of tubers and other crops**

Background

According to the farmers, the cultivation of major cereal crops like wheat in Mandla district of Madhya Pradesh during Rabi season (October to March) is often not possible due to limited facilities for irrigation. This is one of the main reason why almost all households in Mandla district cultivate potatoes during this phase. The locally practiced potato cultivation is done on the plain field without maintenance of certain crop geometry or other advanced cultivation practices. A characteristic of the rain-fed agro-ecosystem in this area is the hardening of the soil. This restricts the growth of the tubers like potatoes which results in low productivity. The locally practiced irrigation includes phases of to water logging which leads to rotting of potatoes grown in the plain fields. This causes crop loss for the smallholder farmers. These factors contribute to the status of Madhya Pradesh as potato growing state with low yields and low yield variability[1].

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. Smallholder farmers' collectives comprising of an average of 15 farmers each were initiated in 30 project villages in 3 districts of Madhya Pradesh for various project activities by the implementing organization Caritas India. During the vulnerability assessment conducted in Mandla district during the year 2012, farmers in Mandla discussed the problems in potato cultivation. Participating farmers reported that the low productivity of their potato crops led to loss of income. During further discussions, farmers identified 'ridge and furrow' method[2] as an effective practice to improve income. At first a few collective members tested the method in a demonstration plot.

[1]Saxena, R. and Mathur, P. (2013): Analysis of potato production performance and yield variability in India. Potato Journal 40 (1); 38-44 http://epubs.icar.org.in/ejournal/index.php/PotatoJ/article/view/31805 | [2] See details on this method here: Brouwer, C., Prins, K., Kay, M. and Heibloem, M. (1989) Irrigation water management: Irrigation methods Trainian Manual No 5. FAO. http://www.fao.org/docrep/s8684e/s8684e04.htm#3.5%20planting%20techniques

Figure 32: Potato cultivation by using ridge and furrow method in Mandla, Madhya Pradesh (SAF-BIN/CARITAS India, Varghese Mathew, 2015)

How to do it

The field is prepared by deep ploughing and levelling. Ridges and furrows are prepared with a ridge to ridge distances of 60 cm each. (see Figure 43). Potatoes selected as planting material should have at least one eye. This helps to minimize seed requirements. The selected potatoes are planted about 5 cm deep into the top of the ridge at a plant-to-plant distance of 30 cm (1ft). This helps plants in attaining good growth. The ridge allows loose soil structure at the crop roots which facilitates higher growth of the tubers. If available, drip irrigation methods are the most efficient means of irrigation. Ridge and furrow methods also facilitate higher tuber growth. Recommended organic insect, pest and nutrient management will help in attaining optimum yield.

Suggestion: see also the cited source for more graphs

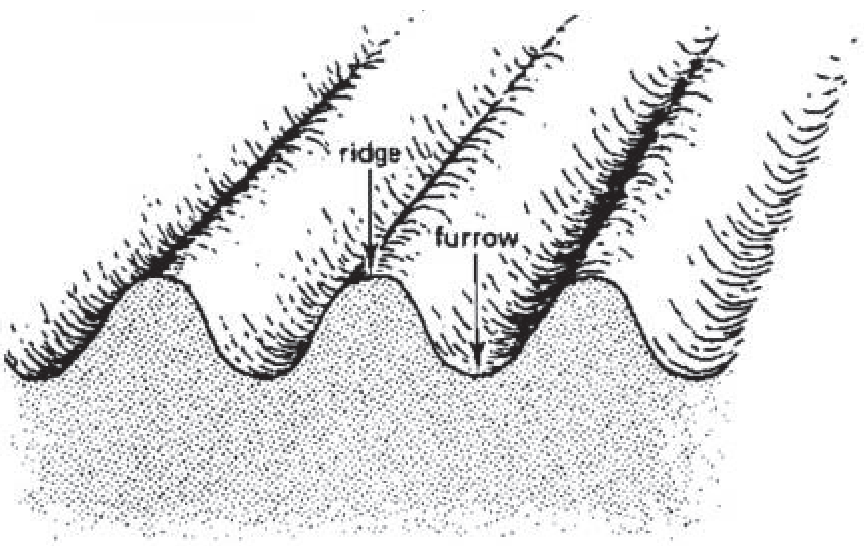

Figure 33: Schematic structure of a field prepared for the ridge and furrow method (Brouwer et al, 1989)

Results

Farmers testing this technology have increased their potato production by adopting the ridge and furrow method. The initial trials led to the uptake of this technology in a systematic on-farm adaptive research trial. After witnessing the production increase, all smallholder farmers' collective members have adopted this methodology. During a learning exchange visit from 2013 onwards this practice was shared with smallholder farmers of Satna and Sagar districts. These farmers, also participants of SAF-BIN project, have also adopted the ridge and furrow method of potato cultivation. This is a promising technology for all tuber crops.

Future plan and challenges

With the completion of the SAF-BIN project Zilla Kisan Manch faces the challenge of remaining operational without the financial support of the project. The forums need to develop a sustainable revenue model to generate income for its' operational expenses. An affiliation of the Zilla Kisan Manch to district governments would be beneficial. A long term development could be federations of smallholder farmers on state and national level.

GOOD AGRICULTURAL PRACTICE

The magic of producing healthy soils

Figure 34: Farmers in Satna District, Madhya Pradesh, India preparing organic solution for nutrient management (SAF-BIN/CARITAS India 2013)

Background

Food production systems suffer from additional pressure through the impact of climate change. This makes it increasingly difficult to satisfy the global demand for food[1]. Climate change also has an impact on land degradation. In India land degradation has been enhanced by inappropriate cultivation practices including excessive and unbalanced use of inorganic fertilizers. Hence, mitigation strategies are needed to foster sustainable soil management as land degradation is expected to affect the country even more severely in the future[2].

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. Smallholder farmers' collectives comprising of an average of 15 farmers each were initiated in 30 project villages in 3 districts[3] of Madhya Pradesh for various project activities by the implementing organization Caritas India. The issues of soil degradation and low productivity were discussed during collective meetings in 2012 and the farmers were keen to address this issues. Hence, farmers and the SAF-BIN team jointly identified traditional soil nutrient management practices.

Practice description

The project districts have a moderate climate with extreme weather conditions and diverse soils ranging from rich clay to gravel soils. Hence, at the beginning, the SAF-BIN team recommended to takeup soil testing to assess the exact status of soil health. The samples were collected together and the soil testing was done at the nearby Government / private facility. After that the SAF-BIN team organized a series of trainings for farmers in the villages on soil nutrient management based on low cost, locally available environmental friendly resources. These practices like application of vermi-compost[4], jeevamrit[5], machli khad[6], NPK ghol[7], hara khad[8] etc. helped farmers to significantly improve the soil health.

Highlights

- **Low cost and environmentally friendly soil management practice**
- **Improve soil health and soil bio-diversity**
- **Sustainable soil health management**

[1] FAO (2011): Climate change, water and food security. FAO water reports No. 36. Turral, H., Burke, J. and Faures, J.-M. Retrieved from http://www.fao.org/docrep/014/i2096e/i2096e.pdf (Accessed, February 2016) | [2] Bhattacharyya, R., et al. (2015): Soil degradation in India: challenges and potential solutions. Sustainability 7 (4): 3528-3570. | [3] Mandla, Sagar and Satna | [4] Kechua Khad - SAF-BIN GAP: http://safbin.org/publicationdetails__97 | [5] Jeevamrit - SAF-BIN GAP: http://safbin.org/publicationdetails__98 | [6] Machli Khad - SAF-BIN GAP: http://safbin.org/publicationdetails__96 | [7] NPK Ghol - SAF-BIN GAP: http://safbin.org/publicationdetails__100 | [8] Hara Khad - SAF-BIN GAP: http://safbin.org/publicationdetails__101

Figure 35: Vermi compost prepared by farmers in Mandla district to improve soil health (SAF-BIN/CARITAS India, Pradipta K. Chand, 2015).

Future plan and challenges

Some of the practices like preparation of local micro-organisms and composting turned out to be labour intensive. The application of organic solutions and practices at larger scale needs access to suitable organic resources, which can make up-scaling of these practices difficult. Apart from these inherent challenges these practices are applicable to a variety of agricultural contexts. They can contribute to sustain soil health, make sufficient nutrients available and improve soil bio-diversity.

Figure 36: IEC materials prepared from the experience of SAF-BIN farmers for improving soil health (SAF-BIN/CARITAS India, 2015)

Results

The soil management practices identified by farmers were evaluated based on costs and locally available, environmentally friendly resources. Various practices were tested by farmers in different locations. During the learning sharing meeting, these practices were compared and evaluated among each other. The best and most effective practices were adopted by the farmers and practiced in their agricultural system. Learning from the fellow farmers the practices spread also among the village and beyond the project villages. The soil tests at the end of the project period revealed that the application of these practices contributed to higher organic matter and micro-nutrient content in soil. Farmers reported substantial yield increases.

The practices were also adopted by farmers from the neighbouring villages.

[1]FAO: Irrigation water management: Irrigation methods. Available at: www.fao.org/docrep/s8684e/s8684e04.htm#3.5%20planting%20techniques

[2]Nayava, J.L., Singh, R. and Bhatta, M.R., 2009. Impact of climate, climate change and modern technology on wheat production in Nepal: a case study at Bhairahawa. Journal of Hydrology and Meteorology, 6(1), pp.1-14.

TECHNICAL INNOVATION

More soil moisture through dew harvesting in Nawalparasi district

Figure 37: Farmers sowing wheat seed in furrow (created to absorb moisture from dew) in Dumkibas, Nawalparasi District, Nepal (SAF-BIN/CARITAS Nepal, 2012)

Background

Wheat is among the major staple food crops in Nepal, nevertheless, the productivity of the wheat in Nepal is one of the lowest in South Asia. One of the reason for declining productivity is that most of the wheat growing areas in the country is rain-fed and because of unpredictable and low winter rainfall the productivity has been declined. Wheat is grown in Nepal in winter season (November - April) when only 2-5% of rainfall occurs[1]. Therefore, there is a lack of optimum soil moisture for wheat seed germination and hence wheat cultivation.

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As a first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. PRAs´ took place in 30 villages of 4 districts (Kaski, Nawalparasi, Bardiya, Surkhet) in 2012 by the implementing organization Caritas Nepal. Limited wheat growth due to lack of soil moisture was identified as major issue in villages of the Terai, like Dumkibas in Nawalparasi District. Farmers explained that the soil moisture was particularly low during seed sowing. Water scarcity at this stage negatively affects the wheat seed germination. During the screenings of key innovations and best practices one farmer in Dumkibas village shared his idea to adapt dew harvesting on wheat cultivation. By ploughing the field in the evenings and covering the soil in next morning before the sun shine for 3 - 4 consecutive days helps soil moisture to increase. Through this practice, dew is absorbed during the night and provides the soil with moisture throughout the day. Based on this idea, the SAF-BIN team in Nepal conducted a dew harvesting trial for wheat cultivation involving 30 farmers in Nawalparasi district. The trial was however, not continued in the following years, as farmers were not interested to upscale the practice, due to the labor-intensive work, i.e. ploughing the soil by hand.

Highlights

- **Increased soil moisture content in rain-fed areas**
- **Enhanced soil moisture and hence, better wheat seed germination and more yield**
- **Labor-intensive, recommended when mechanical equipment for ploughing is available.**

[1] Nayava, J.L., Singh, R. and Bhatta, M.R., 2009. Impact of climate, climate change and modern technology on wheat production in Nepal: a case study at Bhairahawa. Journal of Hydrology and Meteorology, 6(1), pp.1-14.

Figure 38: Field with successful wheat seed germination, due to dew harvest in Dumkibas area of, Nawalparasi District, Nepal (SAF-BIN/CARITAS Nepal, 2012).

Technical practice description

1. Plough the field in the evening during winter season (ditch).
2. The following morning before sun shine, cover the soil again with earth (building ridge), in order to maintain the water in the soil.
3. Repeat this practice for three to four days during winter time, so that the soil moisture content is high enough for seed germination.
4. Sow the wheat seed (line sowing) in furrow and cover it with soil.

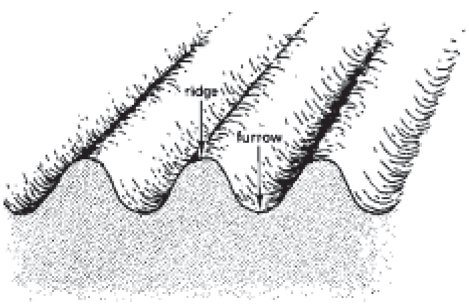

Figure 39[2]: Soil preparation: furrow and ridge

Figure 40[2]: Planting of seed in furrow, when water is scarce

Conclusion

In rain-fed areas, dew harvesting can be one option to increase soil water content. This practice is, however, not recommended when the soil tillage is done manually, as it is very labor-intensive. Dew harvest might be more successful in areas where mechanical equipment is available.

Results

The practice of dew harvest increased the soil water content and enhanced wheat seed germination. Based on the results of the on-farm trials, wheat yield increased due to enhanced soil moisture and hence improved seed germination. However, due to the lengthy work, i.e. manually ploughing and covering the soil, the practice could not be successfully disseminated.

[2]FAO: Irrigation water management: Irrigation methods. Available at: www.fao.org/docrep/s8684e/s8684e04.htm#3.5%20planting%20techniques

TECHNICAL INNOVATION

Multiple seed-beds for optimal rice seedling age

Highlights

- More rice seedbeds increase adaptive capacity
- Optimal seedling age for optimal rice productivity
- Cheap, easy risk minimization for small rice farmers

Figure 41: Multiple seedbeds of different ages in Dhikurpokhari, Kaski district, Nepal (SAFBIN/ CARITAS Nepal, 2012)

Background

The rainfall pattern has changed rapidly in recent years in Nepal because of Climate change[1]. Irregular rainfall causes the late onset of monsoon. Especially in rain-fed areas this creates uncertainty and challenges for rice farming. Deciding on the optimal timing for the transplantation time of rice is a crucial step in rice cultivation[2]. Optimal seedling age of 20 to 30 days at transplantation is one of the major factors for productivity and linked to food security. However, farmers in Kaski district of Nepal used to transplant older seedlings (more than 50 to 60 days old seedings) due to prolonged drought or late monsoon. There was also the traditional belief that old seedlings would escape the drought and the plants would achieve higher yields. Yet it had not been tested in the farmers' fields to prove the legacy of this traditional practice.

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As a first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. During the PRA with around 30 participants[3] in Dhikurpokhari and Lumle Village Development Committees (VDCs[4]) produced a problem ranking matrix with problems related to rice farming at village level. Especially the problem of rice seedling transplantation due to late onset of monsoon was discussed. Following this assessment on-farm adaptive research (OFAR) trials in which smallholder farmers collectives (SHFC[5]) tested different seedling ages were initiated for 2-3 consecutive years (instead of seasons)[6]. These OFAR trials led to the development of the practice described below.

[1]IDS-Nepal, PAC and GCAP (2014). Economic Impact Assessment of Climate Change In Key Sectors in Nepal. IDS-Nepal, Kathmandu, Nepal. | [2]Lampayan, R.M. et al. (2015) Effects of seedbed management and delayed transplanting of rice seedlings on crop performance, grain yield, and water productivity. Field Crops Research 183; 303-314.| [3]representative from the National Agriculturist Research Institute, academician, SAF-BIN staff and farmers | [4]VDC in Nepal is the lower administrative part of its Ministry of Federal Affairs and Local Development. Each district has several VDCs.| [5]Smallholder farmers' collectives comprising of an average of 15 farmers each were initiated in 30 project villages in 4 districts of Nepal for various project activities by the implementing organization Caritas Nepal. | [6]Detailed results of these on-farm adaptive research trials are available from SAF-BIN project (www.safbin.org) and Caritas Nepal.

Figure 42: Multiple seedbeds of different ages in Dhikurpokhari, Kaski district, Nepal (SAFBIN/CARITAS Nepal, 2012)

Practice description

Through the OFAR trials farmers in Kaski defined the optimum age of seedlings for transplantation at 20-30 days. Farmers raise two, or more, seedbeds with sowing dates in interval of 15-20 days to ensure the availability of rice seedlings at the desired age for different types of monsoon season[7]. Rice seed-beds are prepared with the wet-bed method 24-30 days before transplanting. The seedbed is raised at 1-1.5 meter in width and as long as convenient in length. Between the seedbeds, drainage canals are built. 2 to 3 handfuls of seeds per m^2 are sown in smoothly levelled fields. Generally, 50kg/ha is required. Bunds are fixed in each seedbed to keep the water in place. Growth and condition of seedlings is monitored regularly to observe growth and seedling health. During normal monsoon season, farmer use the seedlings raised in the normal seed bed (generally sown at 1st week of May). If monsoons starts late, they use seedlings of 2nd (sown at 3rd week of May) or even third seedbed (sown at 1st week of June).

Conclusion

Their innovation grants the farmers of Kaski more options for transplantation. This increases their adaptive capacity towards climate change effects and increases their food security. Through this practice, they can transplant seedling with optimum age for the respective season. The practice was incorporated into further OFAR trials. 750 farmers participating in SAF-BIN have adopted this practice. This practice is also becoming popular among almost 200 farmers in neighbouring areas of the project sites. This practice is applicable to many rain-fed rice farming areas.

Figure 42: Farmers transplanting rice in Dhikurpokhari, Kaski district, Nepal (SAFBIN/Caritas Nepal 2012)

[7]A practice also introduced by Nepal Agriculture Research Council and Integrated Pest Management (IPM) program of Nepal

TECHNICAL INNOVATION

More bitter gourd though improved mulching

Highlights

- Conserve moisture through an improved a traditional practice
- Increase bitter gourd yield
- Generate additional food and income source

Figure 44: A bitter gourd plant growing in a plastic mulching trial plot (SAF-BIN/CARITAS Nepal, 2013)

Background

Vegetable cultivation in a relatively large area is not a common tradition in Nepal. Reasons are limited irrigation facilities, low access to quality seed and lack of good technical knowledge on vegetable farming. Problems are enhanced in rain-fed farming systems due to climate change which leads to decreased rainfall and a low production of bitter gourd (*Momordica charantia*) in Nepal. Yet bitter gourd is a locally acceptable vegetable crop that is quite hardy, produces yield for multiple seasons, withstands limited dry spells, generates income and can be consumed by farming families themselves. Farmers in Nawalparasi and Kaski districts have been facing cultivation problems. Traditionally these farmers' relied on locally available fresh mulching materials (e.g. weeds, crop residues) to conserve soil moisture and increase vegetable productivity. But this practice has negative impacts like the spread of diseases.

Methodology

The Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) project was implemented by local Caritas organisations and research partners to build resilience to climate change through adaptive small-scale farming. As a first step, participatory rural appraisal (PRA) workshops were conducted to understand, among others, the local challenges of farmers. One exercise was a village level problem matrix workshop conducted in 2011 in Kaski, one of the 4 project districts of Nepal[1]. During this process farmers stated their major concerns in relation to vegetables cultivation as well as adaptive measures they were applying. Farmers were advocating the use of plastic mulch during this workshop. They had heard of this technology from farmers not participating in SAF-BIN project. For the farmers the introduction of new technologies is risky. A risk they will not take, unless they see clear evidence that a new technology increase their crop yield. This led to a decision for the uptake of this traditional practice to conduct on-farm adaptive research trials. Advised by the SAF-BIN team, in consultation with the Nepal Agricultural Research Council (NARC), farmers tested improved mulching techniques.

[1] The other three project districts in Nepal were Nawalparasi, Bardia and Surkhet

Figure 45: Decomposition of straw mulch, additional benefit of this technology (SAF-BIN/CARITAS Nepal, 2013)

Practice description

The traditional mulching practice is adapted: instead of fresh crop residues or weeds, straw is used as mulching material. Mulching during drought periods is encouraged. Following mulching practices are compared:

1. No mulch
2. Thin mulch (15 kg dry rice straw / 8m^2 of plot)
3. Thick mulch (30 kg dry rice straw / 8m^2 of plot)
4. Black plastic material

Bitter gourd is planted in trial plots of 8m^2 under observation of regular crop geometry (1mx1m plant to plant and row to row). Mulching materials are applied evenly on top of the crop. In case of the plastic material holes are cut out for the bitter gourd plants to grow through (see photo above). As fertilizer 5-10kg/plant farm yard manure is applied and the plot is irrigated regularly in interval of 5 days of time[2].

Challenges

Although plastic material is costly, returns are higher than investments. As a downside plastic material is not environmentally friendly. This is why SAF-BIN project recommends thick mulching with straw as best alternative to plastic mulch. If other organic material is used (e.g. weeds), it should at least be dried before application to the bitter gourd plot.

Future plans

This practice has a very wide scope within Nepal and beyond and is applicable to all rain-fed bitter gourd cultivation areas suffering from low soil moisture. Additionally this practice is also applicable to other vegetable species.

Results

Among the tested mulching materials, plastic and thick straw mulching were most effective. Bitter gourd yields per each 8m² plot ranged between 66kg (plastic mulch), 55kg (thick mulch), 46kg (thin mulch) and 36kg (no mulch). With mulching fewer weeds occurred and water requirements reduced. This simple experiment adapting a traditional practice and conducting them in their own fields, convinced farmers of the impact mulching can have on bitter gourd yields. Due to the success following the first experiment, on-farm adaptive research trials on these technologies were conducted in the other project districts. 40 famers across all SAF-BIN locations are applying this practice. In Kaski it has also spread to 12 farmers not participating in the project.

[2] Detailed results of these on-farm adaptive research trials are available from SAF-BIN project (www.safbin.org) and Caritas Nepal.

CONCLUSION

ADAPTATION THROUGH LOCAL INNOVATIONS & GOOD PRACTICES – SMALLHOLDERS TOOL TO APPROACH RESILIENCE

Pranab Ranjan Choudhury

From an agro-ecological, socio-cultural and geo-political perspective, it is critical to promote and sustain smallholder farmers on their small farms. Their own traditionally strong adaptive potential is the key to help them to survive, sustain and successfully address their growing marginalization and alienation. SAF-BIN project was relying on this strong potential for adaptive innovations of small farmers, those developed by farmers alone or in partnerships with researchers, NGOs and other stakeholders, to address their food and nutritional security in the context of climate change.

The innovations and good practices observed during SAF-BIN described in this booklet have illustrated the interlinked nature of smallholder farming systems.

Farmers addressed weakening governance and loss of control concerning farming practices and research by engaging in new institutions like Zilla Kisan Manch (district farmers forum), farmer collective led on-farm adaptive research and multi-stakeholder partnerships. These initiatives have enabled linkage and exchange with National Agriculture Research Systems (NARS) in three countries

The lack of support institutions as well as poor access to extension services, knowledge and inputs led to the great acceptance for farmer participation in processes like Agro Ecosystem Analysis (AESA) in Nepal, the establishment of Village Resource Centers in India and the adoption of resource farmers to farmer extension in Nepal. These outcomes are enhanced by additional SAF-BIN activities like District Resource Centers and Farmer Fairs in Bangladesh or the use of linkages to existing Integrated Pest Management networks in Nepal.

Farmers have also shown awareness of the erosion of locally rooted, low cost, easy to use traditional practices to address human and plant health through their appreciation for traditional practices of insect, and disease management and nutritional gardens in India. This appreciation has also been expressed in other activities like the evaluation of crop varieties according to taste, milling quality and suitability for different cultural foods, trials on snails and the documentation of cultural food preparations in Bangladesh.

Ecological measures were highly appreciated by SAF-BIN participants reflecting their deep understanding of issues like reducing bio-diversity, disappearance of local, climate adaptive crops and agro-ecological practices. Practices adopted vary widely (from vegetable pools to traditional soil management and organic pest repellents) and even initiated further activities like the establishment of Biolabs in India and Bangladesh.

Of course the urge to improve the economic situation of their small farms, a focus on low-cost practices to enhance production and efficiency could be observed. Practices like seed germination and intensified cropping patterns in Bangladesh or bitter gourd mulching strategies in Nepal provide the evidence for this presented in this collection.

Contributing to innovation and practice adoption

It is interesting how different actors and stakeholders contributed to the way SAF-BIN innovations and good practiced emerged and expanded. It was important to take innovations and practices to a next level of refinement which assisted their expansion to more users. The following table summarizes actors and roles in this process within SAF-BIN:

ACTOR	ROLE
Smallholder Farmers' Collective	Source of innovations, practices, suggestions, experiments, evaluations and refinements as well as the end users. Also have taken lead to transmitting to neighbors, relatives and friends within and outside village
Village research assistant	The agents, to link and connect stakeholders, share and document information and results
Resource Farmer	Leaders of the process of suggesting and experimenting innovation; in most cases took the risk of testing, multiplying and distributing innovations and practices. In future they will be crucial to share knowledge and build capacities of other farmers
Village/District Resource Center	Key platform to introduce and discuss the innovations; place for dissemination through information, education and communication materials; centers to source the products of innovations (viz. seed, organic inputs, equipment etc.)
Scientists/ Researchers/ Extension Agent	Providers of information about new practices and products developed by formal research to address vulnerabilities to climate change; partners of farmers in blending, testing and refining of innovations and practices; more involvement in Nepal and Bangladesh than in India
SAF-BIN project team	Facilitator of linkages, assessor of vulnerabilities; developer of innovations; link to existing institutions (IPM network in Nepal) and innovations (botanicals from other projects in India).
Multi-stakeholder Platform	Platform for learning, blending and refinement of innovations and practices; sharing of information and experiences; discussions between scientist, farmers and NGOs

Convergence and dissemination

Practices and innovations applied in SAF-BIN were not only the products of internal efforts; neither have they remained within the target communities. SAF-BIN substantially gained from associations and partnerships with research institutes, Universities, other NGOs, extension offices and Caritas' own network, from where the knowledge, experiences and recommendations converged. Similarly, the tested and approved innovations and practices crossed the boundaries of the project villages and districts to get adopted by other farmers.

Figure 46: Farmers from Mandla district, India participating in the dissemination workshop (SAF-BIN/CARITAS India, Patrick Hansda, 2015)

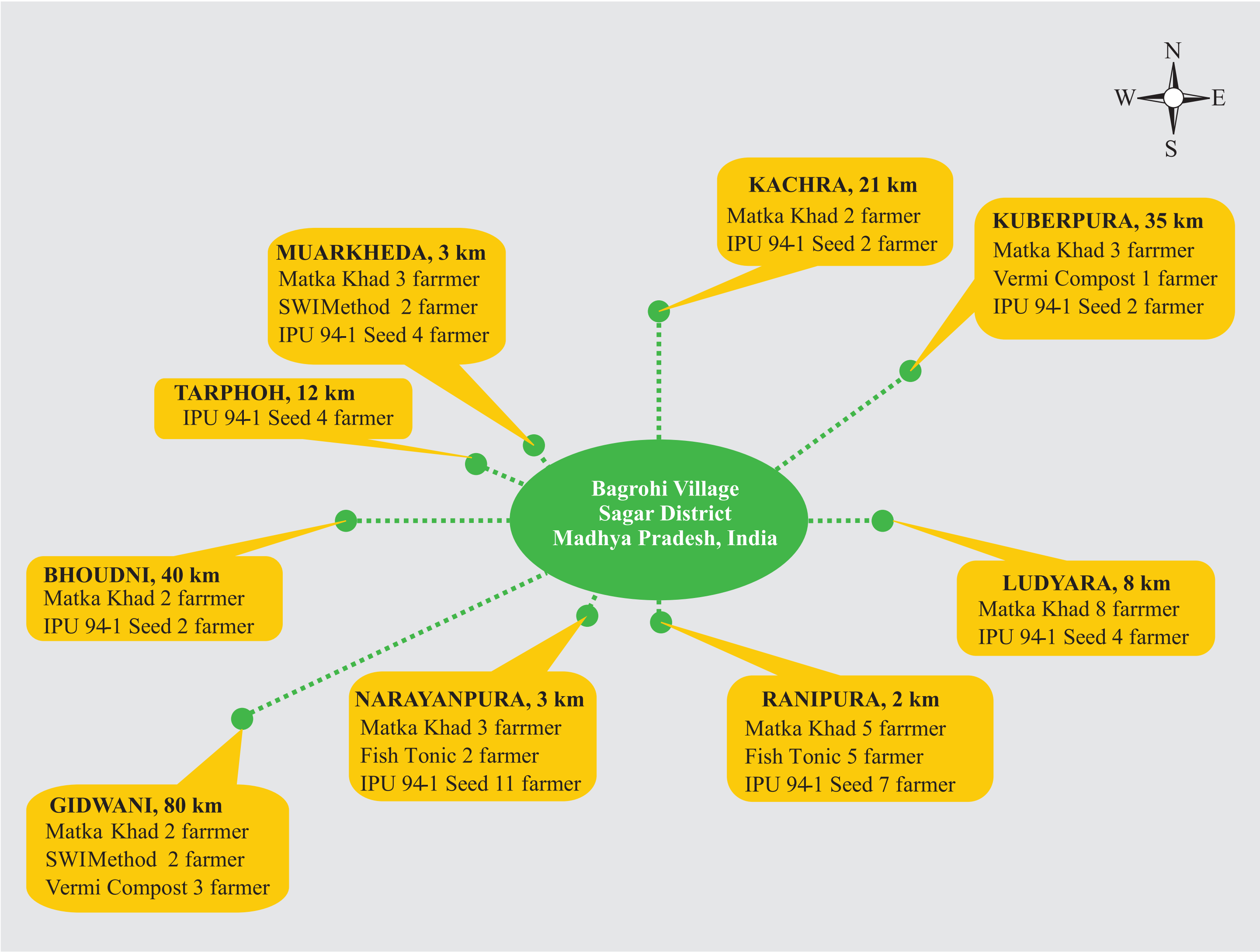

Figure 47: Dissemination map of Bagrohi Village, Sagar, Madhya Pradesh, India

This pattern of convergence and diffusion, underlines the importance of partnerships in innovation evolution and dissemination.

Last words

SAF-BIN was a journey for and by small farmers. It was designed and implemented to keep the focus on small farmers and let them lead. SAF-BIN attempted to create space for connecting disciplines, actors and technologies and building partnerships in villages and districts as well as nationally and internationally. It wanted to assist small farmers to innovate and address their increasing limitations, accentuated by the present development paradigm. SAF-BIN, after five years of implementation, touched the lives of about 4000 farmers directly and many more indirectly. It remains, a small initiative for small farmers in 90 South Asian villages. Considering the numbers of small farmers globally and their increasing vulnerabilities, many more SAF-BINs would be required across the world to help germinate more and more adaptive innovations and practices to benefit the small scale agriculture and help small farmers to resurrect, survive and sustain.

I hope, in that global crusade for small farmers, this small collection good practices and innovations compiled by SAF-BIN will be a useful accelerator.

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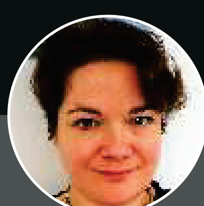

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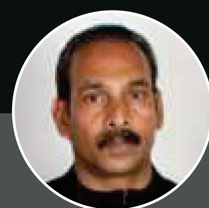

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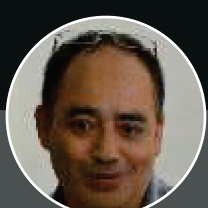

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For Small Farmers Future

Strengthening Adaptive Farming in Bangladesh, India and Nepal (SAF-BIN) is an action research program under the European Union Global Programme on Agricultural Research for Development. It is a multi-sectoral research programme that addresses the agricultural development challenges of developing and emerging countries. It is an initiative to promote local food and nutritional security through adaptive small scale farming in four rain-fed agro-eco systems in South Asia. The programme is headed by Caritas Austria; implemented by the Caritas organisations in Bangladesh, India and Nepal and cooperates with the University of Natural Resources and Life Sciences (BOKU), Vienna, Austria. Associated partners include Action for Food Production (AFPRO), India; Sam Higginsbottom Institute of Agriculture, Technology and Sciences (SHIATS), India; Bangladesh Rice Research Institute (BRRI), Bangladesh and Local Initiatives of Biodiversity, Research and Development (LiBIRD), Nepal. This initiative addresses the food security and climate change challenges of smallholder farmers living in rain-fed areas in South Asia.

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For Small Farmers Future

Approaching resilience

Practices and innovations supporting smallholder climate change adaptation

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