Building Climate-Smart Villages

Five approaches for helping farmers adapt to climate change

ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

1. Watershed management approach

Rehabilitating ecosystems and building resilience of farming communities

Project:
Improving Rural Livelihoods through Integrated Watershed Management in Bellary District in Karnataka

Corporate Social Responsibility activity

Investor:
JSW Foundation

Partners:
DoA, Government of Karnataka; WDD; UAS, Raichur; JSW Foundation; Farmers Association and ICRISAT

2. Futuristic multi-model approach

Customizing adaptation packages to reduce vulnerability to climate change

Project:
Re-designing smallholder crop-livestock systems in semi-arid Southern Africa to address poverty and enhance resilience to climate change: stakeholder driven integrated multi-modeling research

This work is being undertaken as part of the

CGIAR Research Program on Climate Change, Agriculture and Food Security CCAFS; CGIAR Research Program on Dryland Systems

Investor:
AgMIP receives major support from UK Aid, USDA, USAID, Bill & Melinda Gates Foundation

Partners:
Wageningen University, Germany; ICRISAT

3. Agricultural and digital technologies approach

Integrating climate information and eco-conservation technologies

Project:
Developing Climate-Smart village models through integrated participatory action research at site in West Africa

This work is being undertaken as part of the

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

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

Partners:
INERA, INRAN, ISRA, IER, CSIR, AEDD, CONEDD, CNEDD, CIFOR, RPL West Africa, ICRISAT

4. Met advisory and farm systems approach

Using climate information to build resilient agroecosystems

Project:
Disseminating learning agenda on resilient-smart technologies to improve the adaptive capacity of smallholder farmers in Mopti

This work is being undertaken as part of the

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

Investor:
United States Agency for International Development (USAID), Accelerated Economic Growth Program (Add on), Global Climate Change (GCC)

Partners:
The World Agroforestry Centre (ICRAF), Aga Khan Foundation, World Vision Mali and ICRISAT

5. Climate and crop modelling approach

Cropping advisories based on seasonal forecasts

Project:
Tailoring climate information for farmers' cropping decision-making

This work is being undertaken as part of the

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

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

Partners:
Regional Agricultural Research Station (RARS), Nandyal under Acharya N G Ranga Agricultural University, (ANGRAU) and ICRISAT.

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Photo credits: *ICRISAT*

Contents page: At the launch of the Joint Agro-Meteorological Services Incubator (JAMSI) in Mali participants are introduced to an automatic weather station.

Photo: Oumar Diop, AMAP

All dollars are in US$.

Citation: Building Climate-Smart Villages: Five approaches for helping farmers adapt to climate change. 2016. International Crops Research Institute for the Semi-Arid Tropics. Patancheru 502 324, Telangana, India: 28 pp.

Introduction

To assist farmers cope with climate change ICRISAT has been working on different approaches. The thrust, lessons learnt and the impact of five main models used for building climate-smart villages have been compiled as part of a feature in the ICRISAT Annual Report.

Working for over 40 years in the semi-arid tropics, with varied partners, ICRISAT has developed climate resilient dryland crops and a pool of climate-smart technologies that are used in all of its climate-smart project interventions.

Put together, the approaches focused on equipping farmers to use climate-smart scientific interventions and innovations, use climate information for cropping decisions, diversify livelihoods, link to markets, make agriculture profitable, rehabilitate and restore their environment and influence policy makers.

The five approaches highlighted for building climate smart villages include:

The **watershed management approach** focuses on rehabilitating agroecosystems and deploys a pool of climate-smart agricultural practices developed by ICRISAT which have resulted in increasing crop yields and incomes of farmers. This approach which is gaining momentum in India is also favored by companies for their corporate social responsibility activities. The success of this approach has led to efforts to replicate it in sub-Saharan Africa.

The **futuristic multi-model approach** uses computer simulated scenarios to give policy makers in Zimbabwe the climate scenario up to the year 2050. The result was renewed support for promoting dryland cereals – sorghum and millet and greater support for groundnut value chains. With the support of the Government of Zimbabwe, ICRISAT imported 20 tons of groundnut seed from Malawi which was distributed to farmers for seed multiplication and testing.

The **digital technologies approach** has helped farmers from the Doggoh community in remote Ghana to adopt climate-smart agricultural practices and take up agroforestry in a big way. Farmers who had never used a phone are now using mobiles for climate information to make cropping decisions. About 90% of the farmers find the weather alerts useful and 64% of them also make use of the helpline when needed.

The **metrological advisory and farm systems approach** used in Mopti, Mali, demonstrated that climate change adaptation is achievable by using eco-friendly methods and climate information. Close to 76,000 women and 94,000 men representing all stakeholders in the value chain reported using climate information in their decision making.

The **climate and crop modelling approach** helped farmers who followed crop advisories in the drought-prone district of Kurnool in Andhra Pradesh, India, to earn 20% more than those who did not. The success of this pilot project has led to its expansion in other villages of Andhra Pradesh and the neighboring state of Karnataka.

To know more about our climate-smart village approaches read the ICRISAT Annual Report 2015.

For the interactive version see http://annualreport2015.icrisat.org/

Download PDF http://www.icrisat.org/wp-content/uploads/Annual-report-2015.pdf

Building Climate-Smart Villages
ICRISAT's approaches

Different approaches are being undertaken to assist farmers adapt to Climate Change. Here are some of the main models being developed by ICRISAT specifically for adaptation at village level. The detailed description of each approach is available at
http://annualreport2015.icrisat.org

1 Watershed management approach

A pool of climate-smart agricultural practices equips farmers in the mining belt of Karnataka, India, to rehabilitate their ecosystem and earn up to 12% - 27% better crop yields even in uncertain weather. *Page 6*

2 Futuristic multi-model approach

60% of farm households in Nkayi, Zimbabwe, will be exposed to greater vulnerability by 2050 due to climate change. Computer simulated on-farm future scenarios and solutions serve in guiding policy makers. *Page 10*

3 Agricultural and digital technologies approach

81% of farmers in a remote Ghana village rely on climate based cropping advisories on mobiles for on-farm decisions. They also use new agricultural technologies to increase farm productivity. *Page 16*

4 Meteorological advisory and farm systems approach

In 458 ha in Mopti, Mali, farmers demonstrated that climate change adaptation is achievable by using eco-friendly methods and climate information for managing crops, livestock and forest cover. *Page 20*

5 Climate and crop modelling approach

In Kurnool, India, farmers heeding the seasonal cropping advisory derived from climate and crop simulation modeling earned 20% more than others who did not. *Page 24*

Watershed management approach

Rehabilitating ecosystems and building resilience of farming communities

Community meetings to identify key interventions and implement capacity building

Climate

Entry point activity:
Watershed Committee formation

- Install weather stations, rain gauges and equipment to collect data on rainfall, air and soil temperature, monitor runoff rate, soil loss in watershed, etc.
- Train farmers to monitor and use data and make cropping decisions

Soil

Entry point activity:
Soil Health Test

- Improve fertility:

1. Reduce synthetic fertilizer
   - Use prescribed dosage of chemical fertilizers
   - Green manure
   - Vermicomposting
   - Tank silt
2. Moisture conserving techniques
   - Broad Bed Furrows
   - Zero tillage

Crops

Entry point activity:
Farmers interviews

Introduce climate-smart crops and varieties that are drought and heat tolerant, disease resistant, early maturing, nutrient rich, improve soil health and augment income

Water

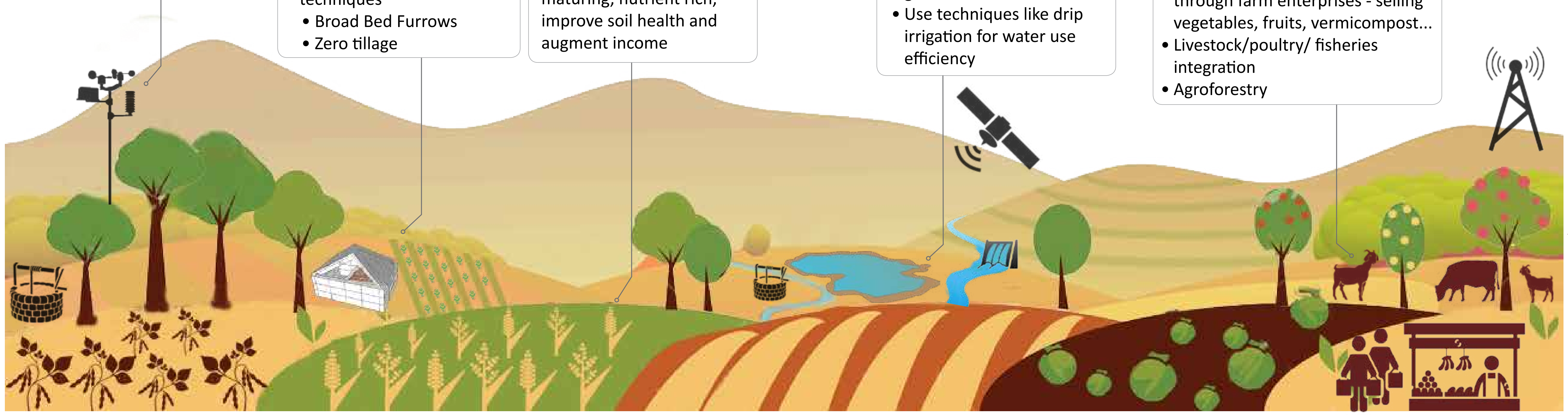
Entry point activity:
Geospatial analysis

- Build structures to harvest rainwater and increase groundwater levels
- Use techniques like drip irrigation for water use efficiency

New livelihoods & Market links

Entry point activity:
Self-Help Group formation

- Livelihoods diversification through farm enterprises - selling vegetables, fruits, vermicompost...
- Livestock/poultry/ fisheries integration
- Agroforestry



Monitoring, Learning & Evaluation

ICRISAT records and analyzes climate, crop data and increase in farm incomes

CROSSCUTTING ISSUES: • Integrating gender • Attracting youth • Nutrition • Communication • Partnerships

ICRISAT's pool of climate-smart agricultural practices is equipping farming communities in the mining belt of Karnataka, India, to restore their ecosystem and get better crop yields and incomes even in uncertain weather.

The challenge

Bellary district of Karnataka, India, is a hotspot of water scarcity, land degradation and poverty.

Youngsters are employed in mining and related industrial activities and agriculture is taken up by older men and women folk. Shortage of labor, falling returns due to **low crop yields** and **price constraints** have impacted agriculture negatively, resulting in **food insecurity** and **poor nutrition** of humans and cattle in the region.

A **temperature rise of 2°C** or more, **dry spells** and **unseasonal rains**[1] are predicted for Bellary district for 2021-2050, escalating future farming risks.

ICRISAT along with the Karnataka State Department of Agriculture, District Watershed Development Department, NGOs and the local community has undertaken watershed interventions in four villages near JSW Steel plant covering 7,000 ha.

[1] BCCI-K (2011). Karnataka Climate Change Action Plan; Final Report

Interventions

Climate

Automatic weather station

Rainfall measurement at watersheds quantifies moisture availability in different phenophases of crop growth. It helps farmers schedule irrigation. For the purpose, data on rainfall, air and soil temperature, solar radiation and wind velocity and direction is collected. Additional data is collected from rain gauges.

Hydrological gauging station

The automatic runoff recorder and sediment sampler monitor the runoff rate and soil loss.

Groundwater level monitoring

Trained farmers monitor groundwater levels at selected wells at fortnightly intervals.

Soil and Water

Structures for water management and harvesting such as check dams, field bunds, farm ponds, percolation tanks, bore-well recharge pits and waste water treatment tanks were built. Desilting of tanks was also undertaken.

2015 IMPACT

Total water impounded:

Water harvesting structures constructed in the watersheds resulted in:

18,500 m^3
Net storage capacity

45,000 m^3
Gross water conserved due to refilling in rainy season

L to R: Farmers grow improved variety of groundnut; water conservation structure; automatic weather station; azolla as nutritional feed for cattle.

Crops

Productivity enhancement

Replacing missing micronutrients: Based on soil health tests, farmers applied the prescribed dosages of fertilizers such as gypsum, zinc sulphate and borax to their fields.

2015 IMPACT

Recommended fertilizer usage increases yields

↑ 19% Groundnut

↑ 27% Maize

Improved cultivars: Participatory varietal trials were conducted for the following

- Pearl millet (ICTP 8203) - 2
- Pigeonpea (ICPL 87119) - 11
- Groundnut (ICGV 91114) - 2
- Foxtail millet (HMT100-1) - 2
- Maize (Hytech Seed)

2015 IMPACT

Incremental yield due to improved cultivars as per participatory trials

12% Pearl millet

26% Pigeonpea

24% Groundnut

25% Maize

13% Foxtail millet

New livelihoods & Market links

Agroforestry

To control dust from mining activities, avenue plantation was done and 18,100 horticulture plants were planted.

Livestock development

Animal health programs were taken up. Three farmers are growing azolla (aquatic fern) as nutritional feed. A Bhoochetana experiment showed that feeding cows with azolla increased milk yield and higher fat content.

Income-generating activities

Activities include vermicomposting, nursery plantation and small enterprises that make use of locally available produce.

Crosscutting Issues

Integrating gender

On International Women's Day, ICRISAT Development Center launched its Nutri-kitchen Gardening program. About 115 women received seed kits and learnt how to grow fruits and vegetables to meet nutrition needs.

Communication

In partnership with Digital Green, an NGO, farmer-to-farmer videos were shown by Farmer Facilitators using battery-operated Pico Projectors.

Watershed committee training programs, exposure visits and field days were conducted for farmers and women Self-Help Groups and 3,500 farmers benefitted.

Project:
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JSW FOUNDATION
Corporate Social Responsibility activity

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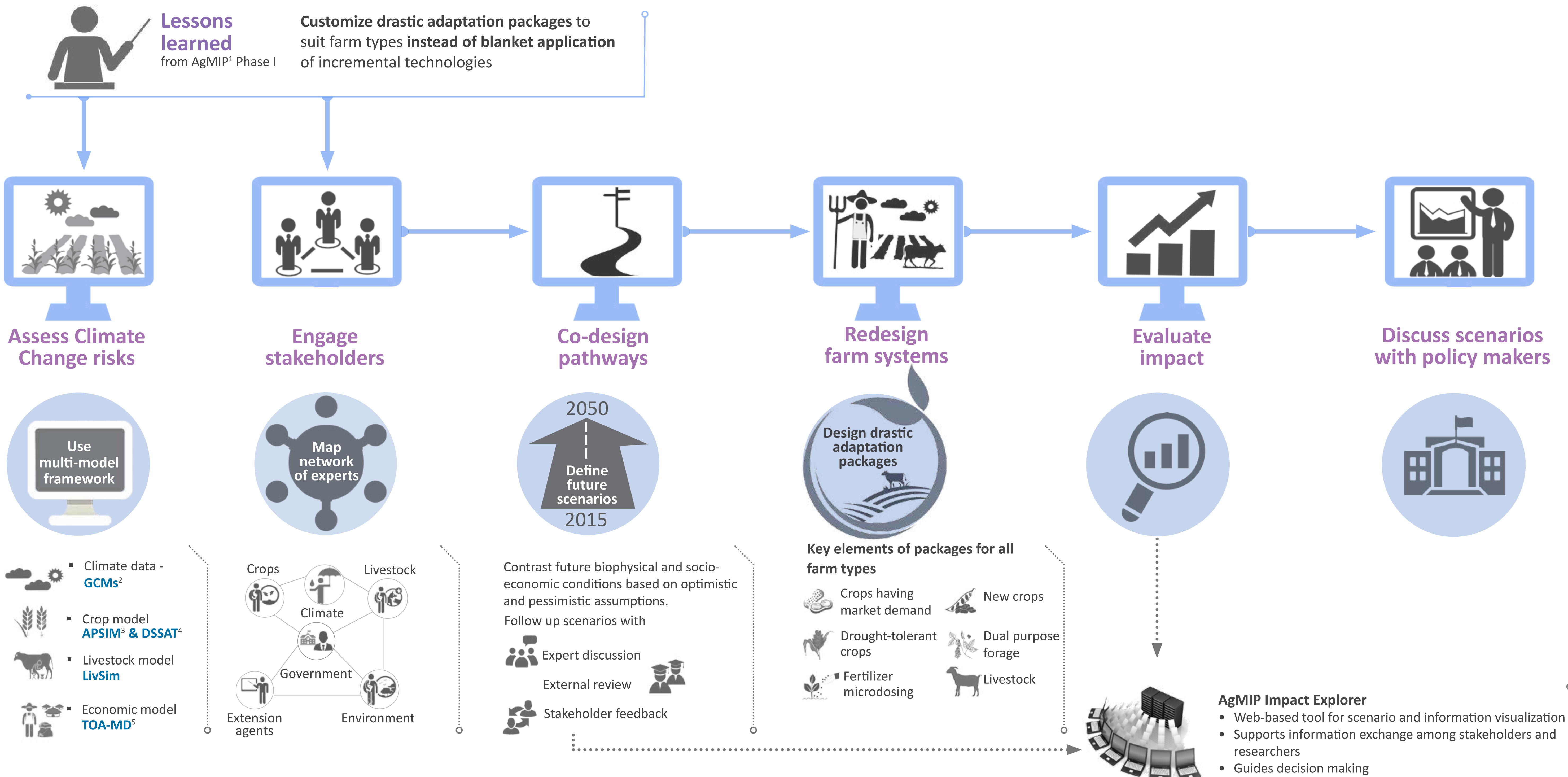
Futuristic multi-model approach

Customizing adaptation packages to reduce vulnerability to climate change



[1]Agricultural Model Intercomparison Project; [2]Global Climate Models; [3]Agricultural Production Systems sIMulator; [4]Decision Support System for Agrotechnology Transfer; [5]Trade Off Analysis - Multi-Dimensional model

Using a multi-model framework for climate, crop, livestock and socio-economic simulation, customized climate change adaptation packages were developed for farmers in Nkayi, Zimbabwe. The computer-simulated scenarios are helping policy makers to make crucial decisions to support farmers.

The challenge

Hit by two **consecutive droughts**, farmers in Zimbabwe are reeling under the impact of **unpredictable climate**. The situation is much worse in Nkayi district, one of the sites of this project. Statistics show that this district has the **highest poverty prevalence** in Zimbabwe.

Future scenarios predict that 60% of farming households will be exposed to greater vulnerability due to an estimated **2 -3.5°C rise in temperature***. Researchers say that the time to begin equipping Nkayi farmers to face a grim 2050 climate scenario is now.

Building on the lessons learnt from Phase I of the project, the Phase II interventions aimed at tailoring drastic adaptation packages to suit farm types. To substantiate the benefits of this package over the blanket technology packages in use, the following interventions were made.

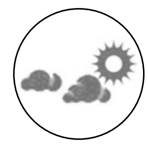
Interventions

Assessing vulnerability to Climate Change

Researchers modeled scenarios for
1. Incremental Change package
2. Radical Change package for three farm types

A multi-model framework with climate, crop, livestock and socio-economic components was used to create scenarios and compare them.

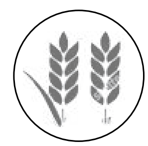
Climate data - GCMs



Historical (1980-2010) Mid century (2040-2070)

Projected changes in temperature, precipitation

Crop model - APSIM & DSSAT



Crop management: fertilizer, rotation, varieties,...

Effects on on-farm crop production; rangeland grass production

Livestock model - LivSim

On-farm feed production; rangeland biomass

Effects on livestock production (milk, off-take, mortality rates)

Economic model - TOA-MD

Household characteristics, agricultural production prices, costs

Economic effects of climate change and adaptations on entire farms

Source: Alexander C. Ruane, NASA/AgMIP

(Left) In the face of climate change, the most appropriate and profitable crops, based on robust research information, must be promoted at the local and national scale. (Right) Some farmers have already shifted from maize to more drought tolerant sorghum.

Establishing stakeholder networks

Stakeholder networks were mapped to bring together expertise on crops, livestock, markets, environment, climate change, agricultural extension and rural development.

Communication channels were designed at national and sub-national scales for leveraging synergies from improved access to markets, technologies and subject expertise.

Co-designing pathways - define future scenarios

Information exchange among stakeholders and researchers was through AgMIP Impact Explorer, a web-based tool used for scenario and information visualization and documentation. Together they defined future biophysical and socio-economic conditions that were contrasted based on optimistic and pessimistic assumptions.

Scenarios were followed up with expert discussion, external review and stakeholder feedback to design the adaptation package.

Future scenarios

Optimistic

Estimated productivity growth rate of key drivers

40% maize

35% other crops

30% cattle

25% small ruminants

Agricultural produce:

↑ 5-20% price growth

Cultivated land:

↑ 60% increase

Small ruminants:

Poor farmers would double flocks

Pessimistic

60% of farming households exposed to greater vulnerability

Very Poor will lose up to 9% of net returns and others a smaller portion

Adaptation package

Adaptation packages were designed for the below three categories:

- **Very poor:** Farm size 1.3 ha; no cattle
- **Poor:** Farm size 1.8 ha; 8 cattle or less
- **Better-off:** Farm size 2.5 ha; more than 8 cattle

The key features of the packages are -

1. Crop diversification:

- Less maize and more **groundnuts** for better soil fertility, family nutrition and income
- Drought-tolerant **sorghum** for 'Very poor'
- Dual purpose forage ***mucuna pruriens*** to support livestock and improve soil fertility
- Other crops: **Common beans** (for Very poor), **Banagrass** (for Better-off).

2. **Fertilizer microdosing:** For increased yields

3. **Livestock:** More cattle and small ruminants for economic gain

4. **Milk production:** Protein rich fodder from *mucuna* and groundnut haulms increases milk yield.

For incentivizing farmers for adoption of the adaptation package large-scale measures need to be taken by policy makers and key stakeholders for linking farmers to markets and integrating crop and livestock production.

Increase/decrease in adaptive package when compared to farmers' practice in three farm types

	Maize	Sorghum	Groundnut	Beans	Mucuna	Banagrass	Fertilizer	Cattle/small ruminants	Milk production
	(% of cropland)						kg N/ha	Offtake rate	Liter/day/cow
Very poor No cattle, 1.3 ha	↓ 3 times	↑ 1.4	↑ 3.8	↑ 25	-	-	↑ 6.7	↑ 0/3	n.a
Poor < / = 8 cattle, 1.8 ha	↓ 2.8 times	↓ 1.4	↑ 3.3	-	↑ 33	-	↑ 6.7	↑ 2.5/4.2	↑ 1.9
Better-off > 8 cattle, 2.5 ha	↓ 3.5 times	↓ 3.2	↑ 2.5	-	↑ 25	↑ 25	↑ 6.7	↑ 2.9/5	↑ 1.5

Drought and disease tolerant fodder legume mucuna pruriens *enriches the soil in nitrogen and provides valuable protein-rich fodder resources for the farmer.*

AgMIP projections show that poverty will reduce significantly if climate smart technologies are adopted; yet many, especially those without livestock will remain poor.

Evaluated impact of drastic adaptation packages on net returns:

Very Poor: Will double their returns

Poor & Better-off: Will increase by 50-75%

Entire community: Will see an **86% increase on net returns** as compared to 72% for incremental technologies

Projected impact

Increase in farm net returns (%)		
	Drastic packages	Incremental change
Very Poor	120	50
Less Poor	>50	20
Better off	75	<20

Farmers below poverty line (%)		
	Drastic packages	Incremental change
With large cattle herds	35	65
With small cattle herds	75	>90
Without livestock	100	100

- Poverty levels might remain high, even after drastic economic changes and tailored investments.
- Substantial change in poverty rates will be for those with large cattle herds.

2015 IMPACT

The impact of climate change is hard to quantify and policy makers find it difficult to estimate the cost of the interventions needed to combat it. In this case computer-simulated scenarios gave policy makers a picture of what was ahead helping them make necessary decisions.

Greater support for groundnut value chains

With the support of the Government of Zimbabwe, ICRISAT **imported 20 tons of groundnut seed from Malawi**, which was distributed to farmers for seed multiplication and testing.

This was in response to Nkayi farmers demand for quality certified seeds and also in line with scientists' recommendations for reviving groundnut cultivation given its high market demand and its use as nutritious feed, fodder and soil enriching properties.

More at: http://www.zimnewsnow.com/node/704#sthash.g3lGW5sY.dpuf

Promoting sorghum and millet

Recognizing the need to promote more drought tolerant crops, the Government of Zimbabwe has set the **purchase price for sorghum and millet to equal maize**.

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Agricultural and digital technologies approach

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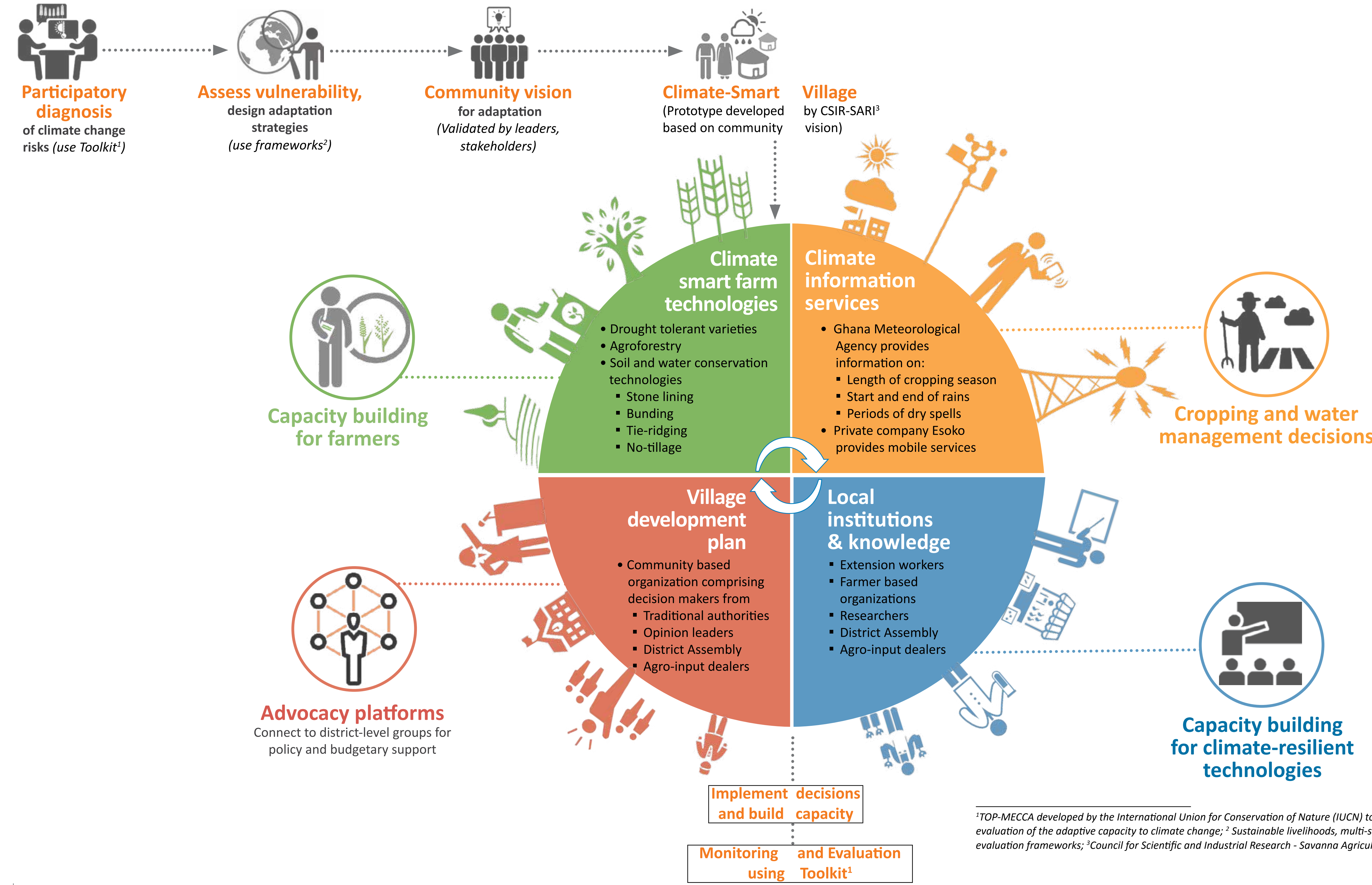


[1]TOP-MECCA developed by the International Union for Conservation of Nature (IUCN) to analyze and perform monitoring and evaluation of the adaptive capacity to climate change; [2] Sustainable livelihoods, multi-scale and integrated monitoring and evaluation frameworks; [3]Council for Scientific and Industrial Research - Savanna Agricultural Research Institute

Faced with frequent unpredictable dry spells, farmers rely on mobile climate advisories for critical and timely information to decide when to sow crops and when to store or release harvested rainwater in a village in Ghana.

The challenge

In Jirapa district, the distribution of rain within the season is so erratic that it is difficult to predict for any cropping year.

Farmers often plant seeds two or three times before rains set in reliably.

Long spells of drought often punctuate the wet season, leading to partial or total crop failures. When this happens, it causes **severe household food shortages** and therefore **acute malnutrition among children and women**.

The region has extremely challenging conditions for farmers with high temperatures, erratic rainfall and eroded soils resulting in lower crop yields.

Climate change in Ghana is expected to take the form of **more frequent and intense drought, increasing rainfall variability, and higher temperatures** – from between 2°C to 4°C by 2100, or about 1.5 times higher than the global average (Nii et al. 2011). These changes are expected to affect crop yields and resource availability in a region already characterized by scarcity.

To address the problem the following interventions were made:

Interventions

The development of the climate-smart village (CSV) starts with participatory diagnosis using a Toolkit for Planning, Monitoring and Evaluation on Climate Change Adaptive capacities (TOP-MECCA) developed by the International Union for Conservation of Nature (IUCN) to analyze and perform monitoring and evaluation of the adaptive capacity to climate change (Somda et al. 2011).

The project team

- Assessed the vulnerability and adaptation strategies in the Doggoh community in Jirapa district using the sustainable livelihoods, multi-scale and integrated monitoring and evaluation frameworks;
- Defined a vision in the community which was then validated by actors during the Jirapa district workshop involving various stakeholders identified by Doggoh community members;
- Based on the vision developed by the community, the Council for Scientific and Industrial Research - Savanna Agricultural Research Institute (CSIR-SARI) team and its partners developed a climate-smart village prototype with the following components.

Climate information services

Ghana Meteorological Agency (GMET) provides information on –

1. Length of the cropping season
2. Starting and ending of rains
3. Periods of dry spells

From this information, farmers in the region –

- **Prepare land in time for planting** depending on the prediction for onset of rains
- **Harvest water** for use in anticipation of prolonged dry spells in the months of June and July
- **Prepare for heavy rain risk** by adopting dam management – release harvested water if needed well before the peak of rainy season.

In 2015, an **agreement was signed with Esoko a private mobile service provider** for disseminating climate information and answering farmers' queries.

2015 IMPACT

Mobile Climate Information Services –

90% household heads **received weather alerts** from Esoko

90% of those that received weather alerts, said they **used** it

Use of Esoko farmer helpline –

64% call the helpline. Half of them call once or twice a week, others call once a month

Climate Smart Agriculture technologies

The community tested the following:

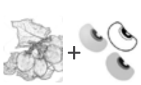
- **Crop rotation** (maize and cowpea) to increase maize production and income;
- **Water conservation** techniques (tie ridge, bunding, zaï pits) to increase rainwater productivity and soil amendment;
- **Minimum or no tillage** (with soybean and maize) to increase soil productivity;
- Application of **mineral and organic fertilizer**;
- Use of **drought tolerant varieties** (maize), to increase crop productivity;

2015 IMPACT

Climate Smart Agricultural technologies identified, validated and available for dissemination

Three appropriate **drought tolerant varieties** of **maize**

Indigenous **water conservation practices:** zai pits, bunding, tie ridging and no-tillage



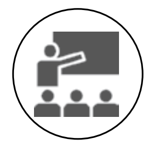
Sustainable agroforestry system of intercropping **Jatropha** with **cowpea**

- **Tree planting** and **intercropping of jatropha with cowpea** to (i) improve rural incomes (ii) diversify and intensify farming systems; (iii) support farmers to add value through carbon credits; (iv) improve access to rural renewable energy
- Some of these technologies were combined for **integrated soil fertility management**.

Capacity building trainings included

- Integrated water management options (100 farmers)
- Anti-bushfire squads (146 farmers)
- Compost preparation (146 farmers)
- Land reclamation and soil fertility management practices (234 farmers)
- **Women Climate Smart Groups** were trained in soybean production and post-harvest losses reduction.

Local institutions and knowledge



With the support of CCAFS, International Union for Conservation of Nature (IUCN) and in partnership with local partners in Ghana like Council for Scientific and Industrial Research - Savanna Agricultural Research Institute (CSIR/SARI), Ministry of Food and Agriculture (MoFA), CSIR-Forestry Research Institute of Ghana (CSIR-FORIG) and Langmaal Centre for Rural Development Initiatives (LACERD) efforts were made to **develop capacity of national institutions and community organizations** in the region.

Village development plan

The plan reflects the vision of the community for CSV. The CSV is connected to platforms to catalyze the development plan at the district level. One of the specific objectives of these platforms is to **advocate for policy and budgetary support for climate change**, agriculture and food security adaptation and mitigation action.

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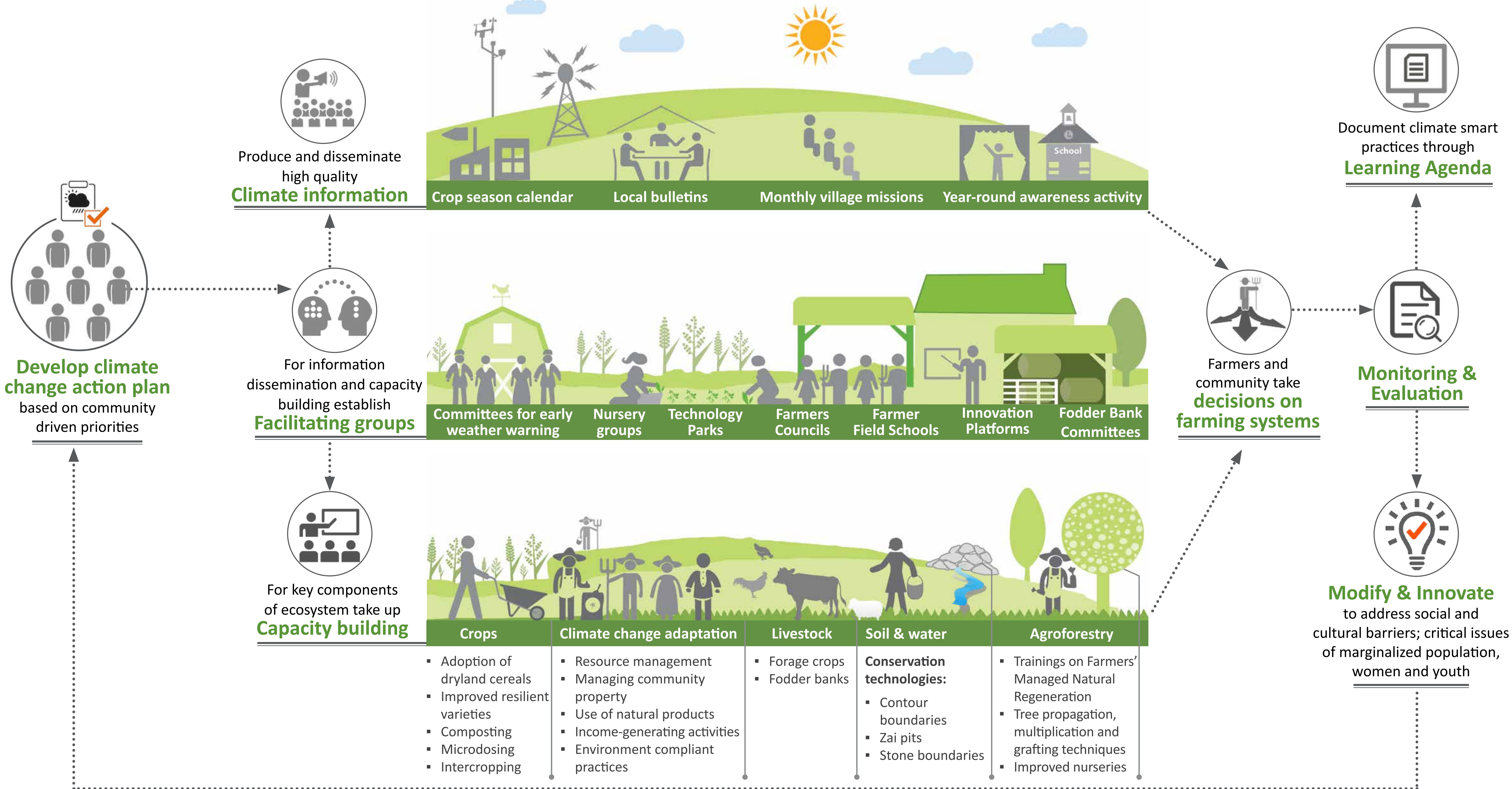
Met advisory and farm systems approach

Using climate information to build resilient agroecosystems



In Mopti, Mali, farmers are combating climate change by adopting ecosystem conservation methods and using high quality climate information for agroforestry, crop, livestock management decisions.

The challenge

Frequent recurrence of dry years since 1968 and **prolonged drought** have been the bane of the Mopti region in Mali. Inter-annual rainfall variability is very high and the region is **exposed to both flooding and drought**[1].

Increasing soil degradation and erosion has worsened the situation affecting on-farm productivity and food security.

Nearly 40% of households have a poor or **limited food consumption score** (2013). The average rates of stunting stand at 46.5%. Levels of wasting are also very high at 14.7%[2].

Climate change predictions for 2025 point at an average **temperature increase of 2.71°C to 4.51°C**.

Rainfall is predicted to decrease by 11%. Crop yields may decrease by 5.5% and forage yields may fall by 20%.

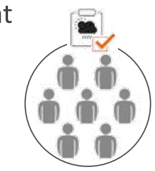
Non climate-driven problems such as rangeland management, increasing population pressures, lack of capital for investment and incentives for sustainable rural development, are likely to be greatly aggravated by climate change.

Source: [1]FAO, [2]USAID

Interventions

Innovative climate-resilient technologies developed specifically for Mopti, Mali, were implemented in 458 ha to demonstrate that climate change adaptation is achievable.

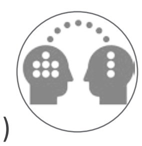
Participatory planning



This activity resulted in an action plan that tapped local knowledge and emphasized on strong community linkages to take collective action and generate internal answers to common issues.

To implement the action plan the following activities were implemented.

Establishing facilitating groups/institutions



- **Groups for dissemination of climate information** such as Groupes Locaux d'Assistance Météorologique (GLAM), Groupes Communaux d'Assistance Météorologique au Monde Rural (GCAM) and committees for early warning such as Comites Locaux d'Alerte Precoce (CLAP) were set up.
- **Innovation Platforms** were set up to provide a forum for science and technical service providers, farmers, herders, fisher folk and decision makers. Information shared enables stakeholders to provide community level recommendations and influence decision making through village planning meetings, farmers' local committees, and farmers' councils.
- **Technology Parks** were established to support innovation diffusion and uptake of improved practices that have been tested on farmers' fields. Nursery groups and Rural Resource Centers for agroforestry production and market linkages have also been set up.
- **Farmer Field Schools** (FFSs) provided training on resilient technologies and other innovative practices specific to the village.
- **Fodder bank management committees** ensured growing high-protein forage crops like legumes and trees like baobab that make for good leafy food banks.
- **Farmer's Council** (Conseil d'Agriculture) managed community areas.

Capacity building

Capacity development was based on locally driven needs and applied local adaptation approaches.

In the **crop sector**, the training included innovative horticulture systems and dryland cereals technologies such as improved varieties, soil fertility management, and crop/legume systems.

Crop and **livestock** systems have been supported by fodder banks. For composting activities, farmers' groups were provided with tools and materials.

In **agroforestry** systems, the training included grafting, tree food banks, exclusion of areas from direct production to rehabilitate degraded land, and farm-based natural regeneration.

Trainings on **soil and water conservation** techniques like contour boundaries, zai pits and stone boundaries were taken up by FFSs.

Diffusion of high quality climate information

Crop season calendar
The calendar shows water availability for cropping decisions, available grasslands and forest area for herders, and status of ponds and rivers for fisher folk. It is prepared by Mali Meteo, Mali's agrometeorological advisory program.

Local bulletins
Local groups use the crop season calendar to prepare bulletins for farmers for radio transmission every 10 days over the season.

Monthly missions
Committees for Early Warning convey monthly information through village assemblies for improving planning of agricultural activities.

Year-round activity
Climate Change awareness is spread through radio, theatre, public conferences, school debates and inclusion in curricula; sharing of knowledge between stakeholders through various fora.

Mainstreaming gender into activities

Efforts were made to include women in all activities. The participatory planning discussion had 46% women. The CLAP has 33% women. Volunteer women farmers have taken up resilient farming practices and have shown interest in intercropping cereals and legumes, and horticulture.

To increase Climate Change awareness among women, radio programs are broadcast at times that are convenient for them.

The 'learning agenda': The learning agenda is a research effort designed to inform the United States Agency for International Development (USAID) projects about how to build a more effective climate resilient agricultural sector in Mopti.

2015 IMPACT

Stakeholders with increased capacity to adapt to impacts of climate change	372,770
Stakeholders implementing risk reducing practices/actions to improve resilience *3,089 women; 5,411 men*	8,580
Stakeholders using climate information in their decision making *76,000 women; 94,000 men*	170,000
Stakeholders with increased knowledge to adapt to the impacts of Climate Change *102,276 women; 92,005 men*	194,281
People receiving training in Global Climate Change adaptation *2233 women; 2734 men*	4,967
Institutions with improved capacity to address Climate Change issues	32
Number of hectares under Climate Change improved technologies /management practices	458

Project:
Disseminating learning agenda on resilient-smart technologies to improve the adaptive capacity of smallholder farmers in Mopti

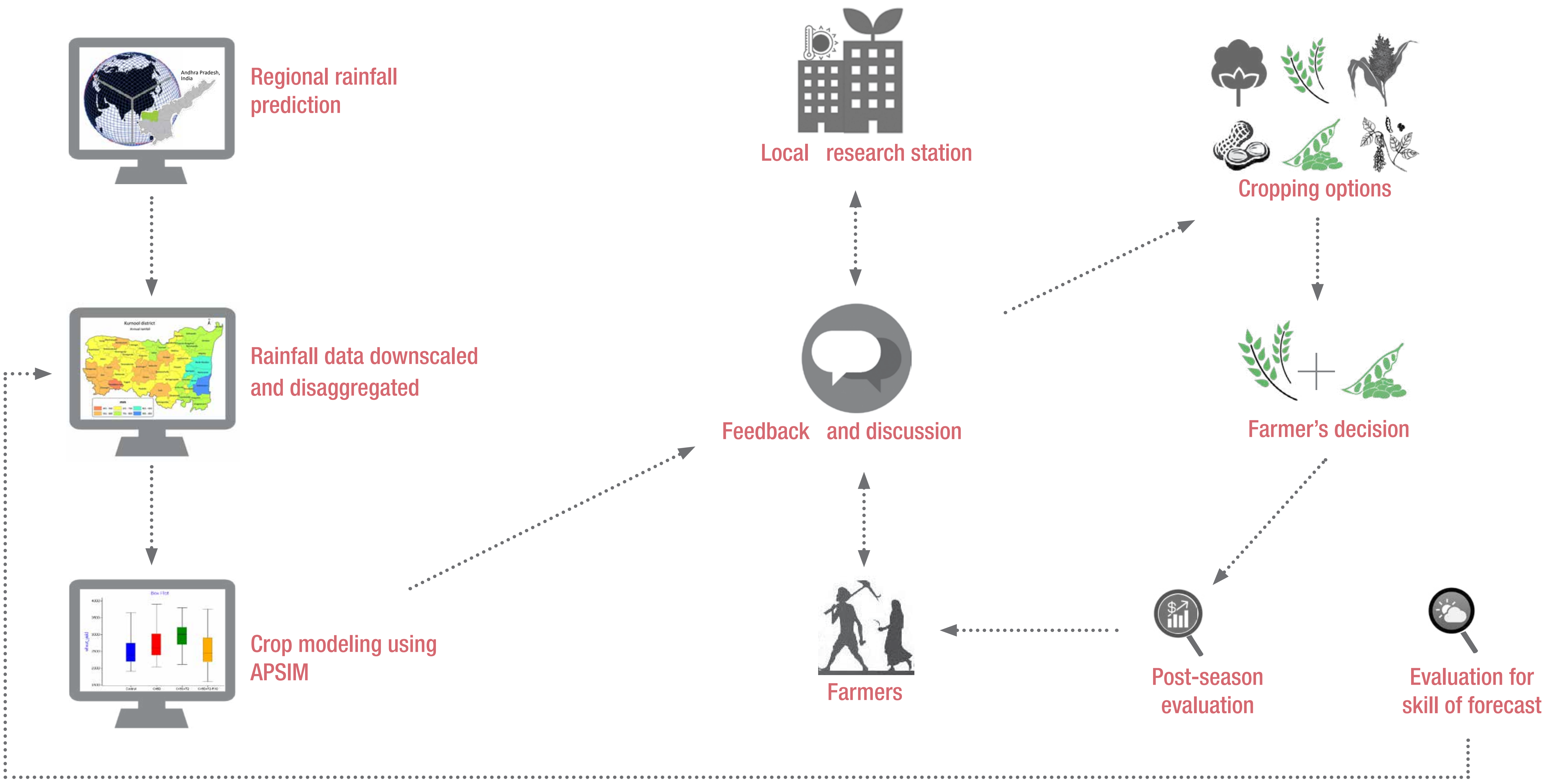
This work is being undertaken as part of the CGIAR Research Program on Climate Change, Agriculture and Food Security CCAFS

Investor:
United States Agency for International Development (USAID), Accelerated Economic Growth Program (Add on), Global Climate Change (GCC)

Partners:
The World Agroforestry Centre (ICRAF), Aga Khan Foundation, World Vision Mali and ICRISAT

Climate and crop modelling approach

Cropping advisories based on seasonal forecasts



In a pilot study conducted in South India, farmers who followed the cropping advisory derived from climate and crop simulation modeling earned 20% more than those who did not heed the advice.

The challenge

A majority of the farming community in Hussainapuram, Kurnool, Andhra Pradesh, India, live below the poverty line. Over 50% of the **cultivators hold less than two hectares** of dryland.

Twice in every five years the village experiences drought. **Recurrent droughts force migration** to nearby cities for employment.

In this region the deep black **soils are deficient in major and micro nutrients** like nitrogen, phosphorus, sulfur, boron and zinc.

Cotton, groundnut, sunflower and chickpea are the major crops in the region. Cotton growers have been the worst hit by changing rainfall patterns.

Climate forecast for 2015 season

2015 was an El Niño year and the forecasts were as follows:

- **June**: Normal onset and quantity of rainfall.
- **July - August:** Less than normal rain.
- **September - October:** More than normal rainfall.

A rainfall pattern like this cannot sustain the staple crops cotton and groundnut. Cotton grows for 150-165 days and needs 600 mm rainfall/irrigation from June to December, while groundnut grows for 105 -110 days, needs 450 mm rainfall/ irrigation and is sown anytime from mid-June to August.

(*Project baseline survey)

Intervention

In view of the recurrent droughts the village faced (twice every five years), crop advisories were developed using the following approach to minimize farmers' risk in seasons with less rainfall.

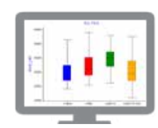
Regional rainfall prediction

The approach uses the Indian Institute of Tropical Meteorology (IITM) seasonal forecasts derived from GCM output and major ocean influences, and local weather patterns.

Rainfall data downscaled

The rainfall data is downscaled and disaggregated to multi-stational level by ICRISAT.

Crop modeling using APSIM



Using the APSIM simulation model with inputs of historical weather and crop productivity data for 40 seasons, scenarios are assessed for various cropping options for the season. This is the third year ICRISAT has assessed scenarios for the project.

Feedback and discussion with farmers and researchers

The scenarios are shared with the local research station and farmers. Based on the feedback the best cropping options are arrived at. The cropping advisory is shared in a village meeting in the month of May based on which farmers take their individual cropping decisions.

Cropping decision options

Scientists advise farmers on what crops or combination of crops to grow and when to take up sowing. Farmers are also warned that the rainfall may not be sufficient to grow certain crops.

For the 2015 season, farmers were advised to intercrop short duration legumes like green gram (70 days), black gram (90 days) or a cereal like foxtail millet (90 days), with a longer season legume like medium duration pigeonpea (150 to 165 days) which matures when good soil moisture is expected in the season.

Evaluation

Post-season evaluation for value of forecast in terms of benefit to farmer is done and the results are shared with the farming community to demonstrate the advantages of following weather-based crop advisories. Simultaneously the skill of forecast is evaluated to ensure greater accuracy in the future.

Future: The research has been extended to include some 150 farmers in Bijapur district, Karnataka, and more than 100 farmers in three other villages of Andhra Pradesh.

2015 IMPACT

20% more income

My economic benefit was 20% more than farmers who didn't take the cropping advice and grew cotton. Cotton crops suffered due to moisture stress at the boll development stage late in the season.

Mr K Venkata Subbudu, farmer

Mr Subbudu, farms 3 hectares of black soil at Hussainapuram near Kurnool. In 2015, he would have planted cotton as usual. However based on the advisory that the rains would come in late he chose to intercrop green gram and pigeonpea. He took up sowing two weeks early in September.

He harvested 0.5 tons per hectare of green gram and 0.8 tons per hectare of pigeonpea. Both legumes have high grain price in the market.

Farmers in Kurnool who adopted the seasonal forecast based practices obtained ₹ 15,000 additional income with much lower investment than those who grew commercial crops like cotton and chillies.

Weather-based cropping advisories are shared in a village meeting.

Intercrop of sorghum and pigeonpea.

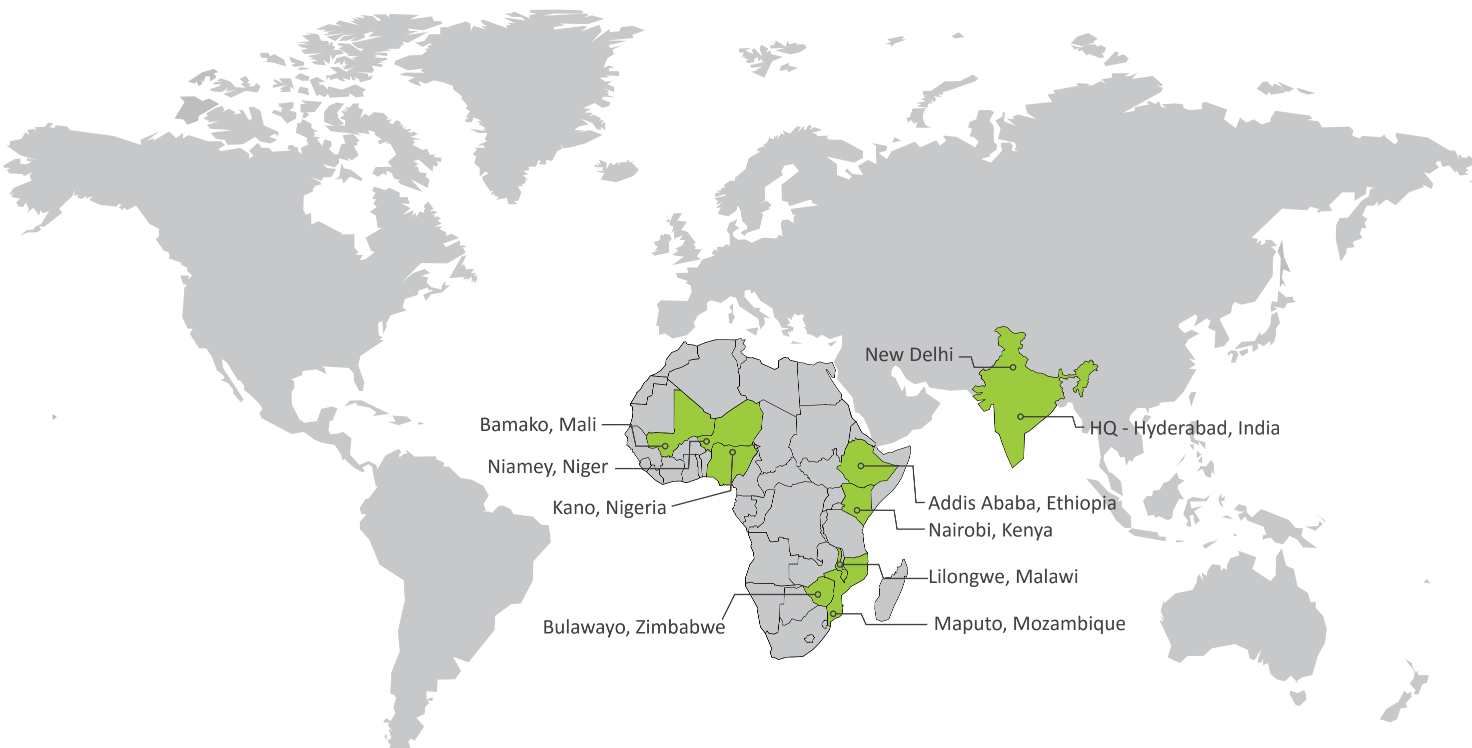
Project:
Tailoring climate information for farmers' cropping decision-making

This work is being undertaken as part of the CGIAR Research Program on Climate Change, Agriculture and Food Security CCAFS

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

Partners:
Regional Agricultural Research Station (RARS), Nandyal under Acharya N G Ranga Agricultural University, (ANGRAU) and ICRISAT.

ICRISAT locations



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