CLIMATE SMART AGRICULTURE INSIGHTS FROM PRACTICE

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CLIMATE SMART AGRICULTURE
INSIGHTS FROM PRACTICE

MINISTRY OF AGRICULTURE
IMPROVING FOOD SECURITY
BOTSWANA

BITRI
BOTSWANA INSTITUTE FOR TECHNOLOGY RESEARCH AND INNOVATION

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TECHNOLOGY SOLUTIONS FROM YOU TO US FOR YOU

Design and layout Kgomotsego Motlopi

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THE PROJECT PARTNERS

Botswana Institute for Technology Research and Innovation -BITRI

The Botswana Institute for Technology Research and Innovation (BITRI) is a parastatal under the Ministry of Tertiary Education, Research, Science and Technology, established in 2012, to conduct needs-based research and development in focused areas. The Mandate of BITRI is to identify, develop and/or adapt appropriate technology solutions that provides sustainable innovative solutions through co-creation and collaboration in line with national priorities and needs of Batswana. The technologies will as much as possible maximize the use of local materials to ensure efficiency and affordability. BITRI will harness its institutional capacity as well as collaborate with other organizations and institutions.

The Global Environment Facility/ Small Grants Programme (GEF/SGP) Implemented by United Nations Development Programme

Established in 1992, the year of the Rio Earth Summit, the GEF Small Grants Programme embodies the very essence of sustainable development by "thinking globally acting locally". By providing financial and technical support to projects that conserve and restore the environment while enhancing people's well-being and livelihoods, SGP demonstrates that community action can maintain the fine balance between human needs and environmental imperatives.

Ministry of Agricultural Development and Food Security -MADFS

The Ministry of Agricultural Development and Food Security was established to develop on a sustainable and competitive basis the agricultural sector by improving farm incomes, generating employment opportunities and raw materials for agricultural businesses; conserving agricultural natural resources through the promotion and adoption of appropriate technologies and management practices.

Smallholder farmers: Kgalagadi South and Barolong Sub Districts

In Botswana, small holder farming is still the dominant livelihood activity in rural areas, and a substantial source of employment, food and income. These farmers typically need continued assistance in capacity building to adapt their farming methods to Climate Change challenges.

ACRONYMS

BITRI	Botswana Institute for technology Research and Innovation
CSA	Climate Smart Agriculture
GEF	Global Environment Facility
ICT	Information Communication Technology
IEC	Information, Education Communication
LLM	Lessons Learned Manual
SGP	Small Grants Programme
TOT	Training of Trainers
UNDP	United Nations Development Programme
VCA	Vulnerability and Capacity Development
MoADFS	Ministry of Agricultural Development and Food Security

PREFACE

The **Climate Smart Agriculture Insights from Practice** manual based on a three-and-a-half years project, involving Ministry of Agricultural Development and Food Security (MoADFS) Extension Staff and BITRI Researchers working with smallholder dryland arable farmers in Kgalagadi South and Barolong sub districts.

It benefits from interactions with 45 smallholder farmers comprising of 29 Females and 16 males, from these districts, both in controlled workshop environments, meetings and out in their natural environment; the field/ farms. The interactions were facilitated through support of the GEF Small Grants Programme implemented by UNDP under the project; **"Climate Variability and Change Risk and Management, Development of Decision support systems for Dryland Small Scale Arable Farmers"**

We particularly acknowledge the contributions of Professor. Nnyaladzi Batisani who provided oversight and direction throughout the project implementation.

Project managers and final writers: Kgomotsego Motlopi (Lead writer), Koketso Mannathoko.

CHAPTER 1

Introduction

Agriculture is the dominant livelihood activity in rural Botswana. However, because the sector is predominantly rainfed it is highly vulnerable to the impacts of climate change and variability. The increased in frequency, and severity of droughts and also of within-season dry spells and heat waves are especially eroding smallholder farmers' livelihoods and food security aspirations.

Botswana Institute for Technology Research and Innovation (BITRI) together with Ministry of Agriculture and Food Security, with funding assistance from Global Environment Facility/ Small Grants Programme implemented by UNDP embarked on a Climate Smart Agriculture project "Climate Variability and Change Risk and Management, Development of Decision support systems for Dryland Small Scale Arable Farmers." The purpose of this project was to determine risk factors to the attainment of food security by smallholder dryland arable farmers and subsequently co-develop with farmers promote the use of climate smart technologies to increase productivity and farmers' resilience. The project benefitted 29 female and 16 male smallholder farmers (45) and 43 district agricultures managers and extension officers directly and more than 500 farmers indirectly through farm walks and field days.

The Lessons Learned Manual

This Lessons Learned Manual (LLM) is a formal deliverable under the project. It showcases the benefits of Climate Smart interventions in sustaining armers production in the midst of climate change. Furthermore, the manual identifies several challenges, barriers, and problems encountered in efforts to increase adoption of Climate Smart Agriculture (CSA) practices and technologies among smallholder farmers in the two districts. Therefore, this LLM could be used as a field manual on upscaling CSA by extension officers and for planning purposes by agricultural managers.

The LLM drew heavily from the wealth of Indigenous Technical Knowledge, Scientific Technical Knowledge and experiences accumulated through interaction with District Managers, Extension Officers, Small holder Farmers' and review of literature.

> ***"The purpose of this project was to determine risk factors to the attainment of food security by smallholder dryland arable farmers and subsequently co-develop with farmers promote the use of climate smart technologies to increase productivity and farmers' resilience"***

The approach used to generate information for the manual was evidence based research and data collection through participatory implementation of project as (Figure 1 and Table 1).

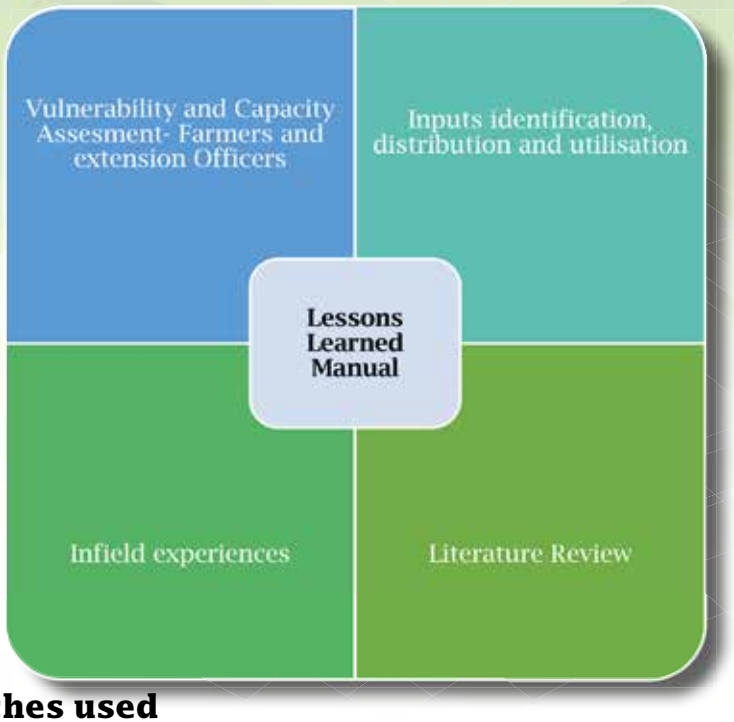


Figure 1. Approaches used

DISSEMINATION	IMPLEMENTATION	KNOWLEDGE MANAGEMENT
Engagement with community, Agriculture Managers, Extension and Field Officers'	Capacity Building, Input provision, Planting and crop management, Community wide learning and Livelihood Diversification	Lessons Learnt and Project Evaluation.

DISSEMINATION & PROJECT AWARENESS

Engagement with Agricultural Managers and Extension Officers

Climate adaptation projects implemented by developments agents based outside the project area run the risk of being temporary and unsustainable if they are not mainstreamed in the local development agenda. Hence, under the BITRI GEF/SGP supported project, proposals were shared with agricultural district managers and Extension Officers well before project inception and roll out.

Through sharing project goal and design, district authorities were given the platform to focus the project, incorporate it into their annual plans and avail resources such as staff, time and vehicles to be utilised in its implementation. This approach was a critical step in ensuring continuity beyond the project lifetime.

Fostering such a relationship ensured that farmers were availed for participation in the project and that the project proponents were viewed as partners in the quest to heighten adoption of CSA practices and technologies.

Agricultural Managers at a Capacity Building workshop

Engagement with community and their Leaders

The project intended to heighten understanding and adoption of climate smart technologies and practices by farmers; therefore it anchored its activities around the community. The project's multiple stakeholder engagement strategies involved; public information, public consultation and Public deliberations.

Information,Education and Communication (IEC) Materials were used for public information provision on the science of climate change, its impacts and adaptation. While public consultation was engaged to upraise the community about the intended project approach, objectives and activities. Follow-up public deliberation meetings provided the community with an opportunity to communicate a collective view of climate change and recommendations.

> ***"The project's multiple stakeholder engagement strategies involved; public information, public consultation and Public deliberations"***

Community Members attend a Kgotla meeting for project information dissemination

PROJECT IMPLEMENTATION

Extension Officers during Training

Training of Extension Officers and Field Assistants

Agricultural Extension Officers are principal stakeholders for engaging farmers and guiding them on approaches to increase productivity, especially during uncertain climate conditions as a result of climate change. However, most went through their training during a time when climate change education was not taught as a subject or even a topic in curriculum. Hence, Extension Officers and Filed assistants were therefore trained to enhance their knowledge and awareness of climate change science, its impacts and what can be done about it. Special training was undertaken on the climate science, various adaptation strategies available, how to select the most appropriate and to communicate adaptation and resilience building strategies to the farmers. The emerging use of ICT as a key tool in adaptation dissemination was highlighted. Twenty (20) Extension Officers benefitted from the training, comprising of 11 males and 9 females.

> ***"The emerging use of ICT as a key tool in adaptation dissemination was highlighted"***

Training of Farmers

The 45 farmers; (29 females and 16 males) selected to participate in this project were smallholder dryland arable farmers whose livelihoods rely a great deal on the worsening risky rainfed arable agriculture due to the impacts of climate change.

The following trainings were offered throughout the project implementation.

- Understanding forecasts
- Moisture conservation
- Soil fertility management
- Crop type and seed selection
- Weed and Pest Managemen
- Crop Husbandry
- Implementation selection and use
- The Human Touch (Farmer presence)

Infield demonstrations were some of the methods used to train farmers on CSA approaches

Training of farmers and input distribution

The project supported peer learning platforms. Farm visits were undertaken to all farms under the project, Other platforms included 6 farm walks and 2 Field days that were held during project period across the two districts. It is through these platforms where farmers could observe and hear from their peers on how to overcome common problems.

Through this approach the project was able to instill knowledge and cultivate interests in participating farmers and the wider community.

These experiences resulted in increased requests for participation by non-direct beneficiaries, impressed by the accounts of conquests provided by the host farmers.

A host farmer giving an account of experiences of the project impacts on his farm and his family

Some of the products produced my female farmers who underwent training on food processing display at a local Agricultural fair.

Livelihood Diversification

Most smallholder farmers are not able to produce consistently enough quality and quantity to meet their dietary needs and modern markets demands. However, there is opportunity created by changing diet patterns for traditional food such melon jams, melon chips and relish. The project provided an opportunity for 23 female farmers who were interested in training on food cleanliness, processing and storage by the National Food Technology Research Centre in Kanye. Women were identified as the most fitting beneficiaries of this training due to their inherent poverty because of their status as primary care givers and head of households.

These farmers continue to sell in small batches and attend agricultural shows where they show case their abilities. This development is a stepping stone towards value-addition within the food value chains in local communities

> ***"The project provided an opportunity for 23 female farmers who were interested in training on food cleanliness, processing and storage by the National Food Technology Research Centre in Kanye"***

LESSONS FROM IMPLEMANTATION

LESSON 1

Climate Change as a Development Issue

Climate smart interventions at different districts are planned nationally, without proper engagement with farmers or Extension Officers on the ground, to enable effective climate change adaptation. In addition, projects implemented focus solely on climate induced challenges forgetting that climate change is a stress multiplier of preexisting livelihood challenges.

What

Development agents and government can formulate more targeted CSA interventions if accurate information about challenges faced by smallholder farmers and barriers to their adoption of climate resilient solutions are teased out at inception through livelihood analysis.

Why

Climate smart interventions must evolve from dialogue with grassroots, district and local level. In this way they can significantly integrate needs of farming communities and other local actors in programmes and projects.

This inclusive approach has a better chance of achieving agricultural sector resilience and attainment of food security. Hence the project used the Vulnerability and Capacity Assessment approach (VCA) to engage the community.

VCA's are effective in gathering, organizing and analyzing information on the vulnerability and adaptive capacity of farmers. It provides guidance and tools for adaptation planning and promotes coordinated climate change engagement. The VCA exercise also increases the technical capacity of extension workers.

This process is participatory, scenario-guided, and engages stakeholders at every level; from grass roots to top management through dialogue about climate.

Different tools such as Risk and Hazard Maps were used to highlight key issues for consideration when mapping farmer's vulnerabilities.

> ***"This inclusive approach has a better chance of achieving agricultural sector resilience and attainment of food security"***

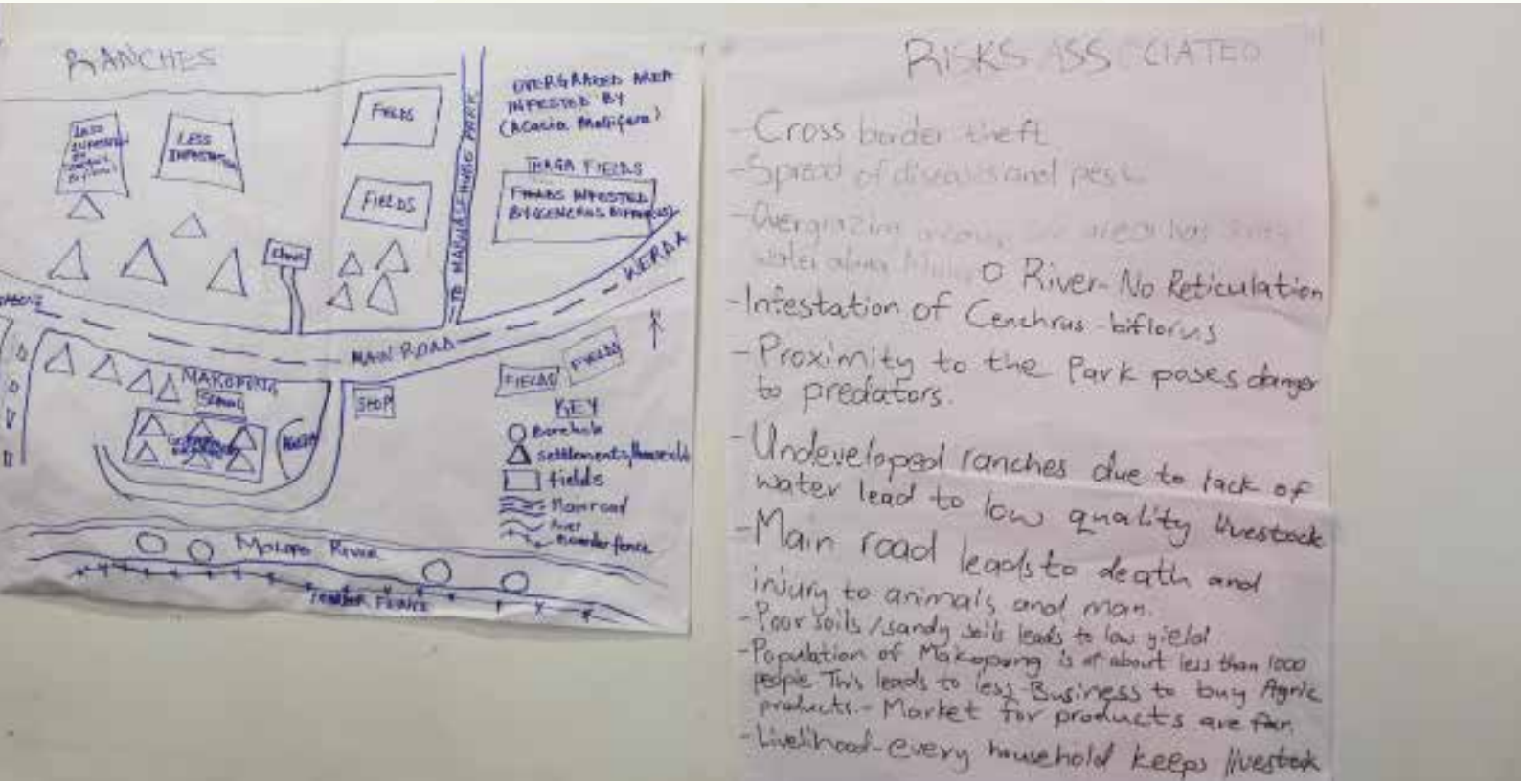
VCA prioritises local knowledge on climate risks and adaptation strategies neglecting development challenges. Neglecting existing development challenges could make the CSA intervention meaningless.

The VCA approach, risk mapping exercise should allow for identification of risks throughout the production value chain. This holistic approach would contribute to building smallholder farmers' resilience.

Prioritization of risk factors can then be used in deciding the sort of intervention needed.

Developmental Challenges

Some of the challenges that were outside the climate change radar but naturally tied to increasing production on the farm were; lack of draught power, labour, lack of market for produce, lack of transport for extension officers and additional non-extension mandates for extension officers.



Risk and hazard Map

Put This: Questions to consider for Programming

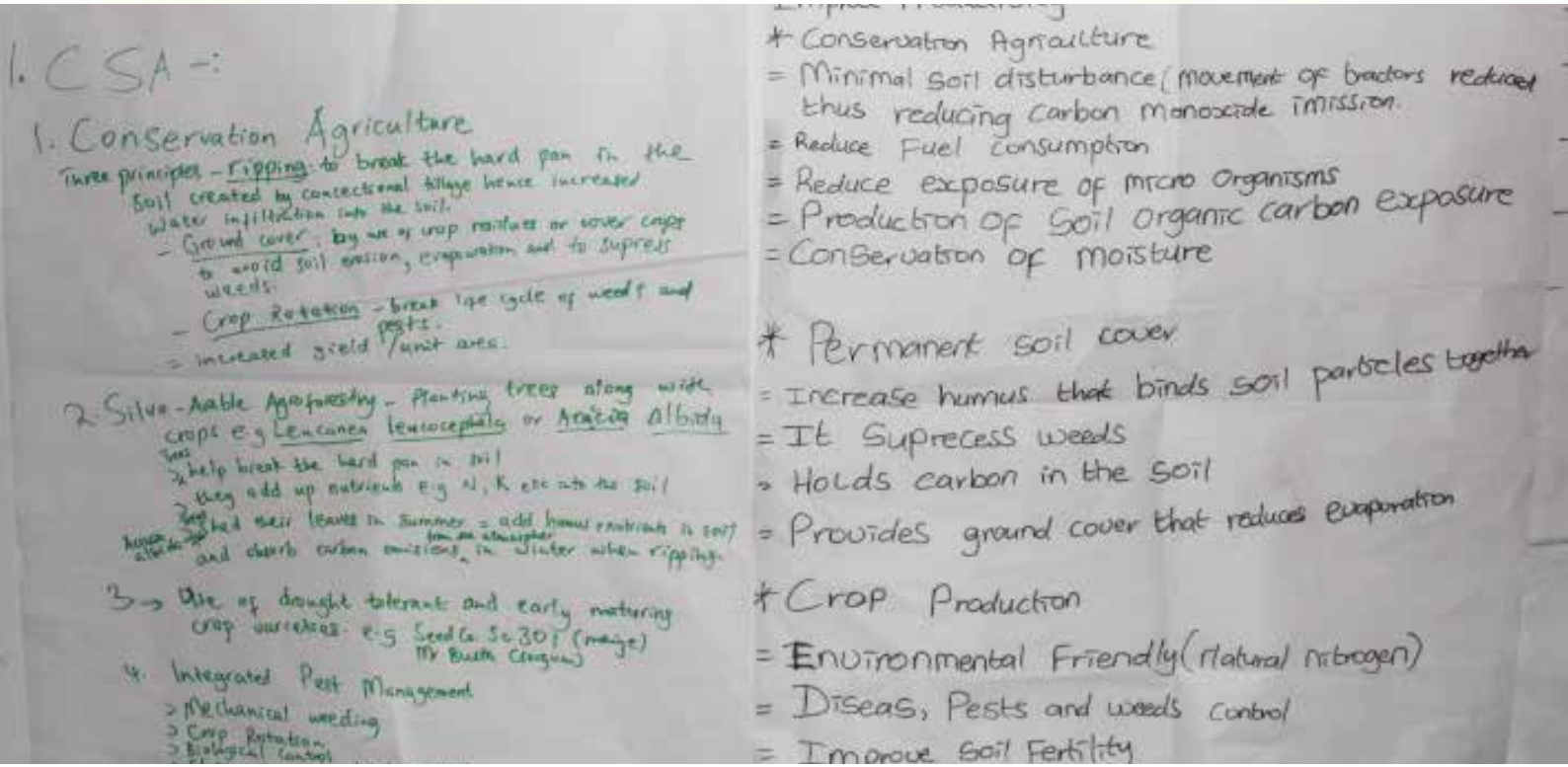
What Climate risks are Critical in the project area of interest?

What kind of programming is needed?

Diversification: Inclusion of a wider set of options to increase farmers' livelihood, farming and environmental management portfolios as a risk management strategy.

Climate-proofing: Specific interventions to make key stages of the value chain more climate resilient in ways that bring livelihood and resilience benefits to farmers.

Supply chain efficiencies: Actions that increase efficiency, deliver higher profitability (and hence higher adaptive capacity in a general sense) to farmers and small businesses in the value chain. Below is an example of group work submissions for training under this theme.



Group work results for CSA Prioritization of Interventions

KEY CONSIDERATIONS

Understand that vulnerability is deep seated

The best way to reduce vulnerability to climate change lies in building long-term resilience among farmers through incorporating some seemingly developmental aspects within the context of a changing climate.

Increasing Funds and Project Timeframes

Donors/funders should consider increasing funds to facilitate more longer-term projects that can support some developmental aspects identified during the VCA exercise. Such will ensure that development agents do not trim projects to fit them to too short period without meaningful impact. It takes time for farmers to appreciate interventions enough for them to have a change in attitude and practice. Hence it is important for projects to be implemented beyond 5 years to realize sustainable impacts as envisioned.

Bottom -up approach to Planning

Central Government should provide guiding frameworks for development of locally relevant adaptation solutions, by district stakeholders as this would ensure that project activities are fully owned by each district group, making them more likely to be sustained over time.

LESSON 2

Consider beneficiary Characteristics

As development practitioners/agents especially in the agriculture sector the vision is always to advance the programme or project beneficiary. Once climate risk factors have been identified to the desired detail, the next step is to understand the programme or project beneficiaries.

What are their characteristics that may or may not hinder project achievement, or that would require special attention, so that when programming these details are addressed and impact communication considered and are reported on? A few critical ones are referenced in Table 2.

Table 2. Some key characteristics for consideration in Climate Smart Programming

Age of Farmer	The average age of farmers in the study areas was 58 years, indicating an aging agricultural labor force. This is the trend globally. Therefore there is need to consider adaptation approaches that are for this population alongside strategies to attract youth in to agriculture for continued food security.
Gender of Farmer	In all the two sub districts there were a higher number of females than males (29 females to 16 males). Traditionally arable farming was dominated by males, however the emerging dominance of women as primary farmers, has increased decision-makers on the farm. This new resposibility adds to the exisiting roles as home keepers, hence they experience higher time burdens that affects the amount of time they can spend in the farm, which could have a negative response to farm productivity. This development means that women's roles and work in agriculture need to be supported through well-designed and targeted projects, programs and policies. Agriculture extension services need to take account of the new managers on the farms and provide solutions tailored to their needs. Moreover, opportunities should be created for women farmers to move their production beyond the subsistence stage. Women farmers need access to higher-earning, downstream activities in agricultural value chains, specifically because of their role as care givers.

FARMER CHARACTERISTICS IN PICTURES

A Pictorial representation of the type of smallholder farmers who participated in the project

LESSON 3

Farmer innovation

Climate change adaptation requires farmers to adopt new technologies and practices in order to improve their yields. However, the challenge is that farmers often cannot afford the new technology being promoted. This is where farmer innovation, a creative process in which farmers jointly experiment and develop new solutions to tackle problems can be leveraged. This happens far away from agricultural research institutes, which have the mandate to improve farming practice.

This highlights the sustainability of farmers as the starting point for research, and experimentation to the farmers' observations and bringing in different perspectives for the sake of cross-fertilization of knowledge.

One of the participants from Kgalagadi South, Mr. Ditau repurposed an old moldboard plough into a ripper. With fine tuning this could start a whole revolution of innovation among farmers using existing resources, which is the focus for adaptation. Grass roots innovation like this needs to be leveraged, hence beyond this project the farmer will be connected to NGO's that can assist to develop the innovation further.

Mr. Ditau with the ripper fashioned from an old mold board plough

LESSON 4

Cultural practices and circumstances are key for adoption of interventions!

Across the country, interventions to promote CSA practices face low adoption rates. Research shows that CSA adoption could be affected by factors beyond the CSA practices themselves. Therefore, wholesale adoption of a precise intervention should never be assumed.

During this project it was established that product demand, culture and tradition have an impact in driving adoption. Some factors become important at farm level e.g. limited access to labour could make it difficult for some families to efficiently benefit from adoption of climate smart interventions.

For example, most of the farmers who participated in the project had an average age of 58 years, the interventions implemented resulted in increased yields for some farmers, but labour to harvest was in short supply, so some farmers only picked what they could manage, consequently not managing to benefit to the full extent of their inputs. Thus, in this manner labour became a key constraint to boosting agricultural production.

Another observation, made in Kgalagadi South sub-district, was the general refusal of farmers to grow sorghum, which has been identified as a suitable crop for the climatic conditions in the area. Farmers instead preferred planting maize. Discussions with farmers revealed that labour costs/needs associated with sorghum crop due to its propensity to attract birds made it a difficult crop to adopt despite the proven suitability. The preference for maize, in addition to being a lot less labour intensive, was heightened by the fact that it had a ready market available at government schools through the feeding schemes for students and local community members.

What It Means

For CSA interventions to give the envisaged results, understanding of factors that drive or constrain farmers to adopt them in the first place needs to be investigated. Some factors that could encourage adoption include the value or potential benefit of the proposed intervention. E.g. promotion of lablab as fodder crop would reducing livestock feeding costs during drought and subsequently using the saving to purchase food.

> ***"The preference for maize, in addition to be a lot less labour intensive, was heightened by the fact that it had a ready market available at government schools through the feeding schemes for students and local community member"***

The picture below shows a crop of maize and lablab grown under the same conditions, lablab, a fodder crop, did much better than maize as can be observed in the picture. As farmers in Kgalagadi South are predominatly pastoralist, thus often experience high mortalities during droughts, it is more rationale to promote adaptation by promoting and supporting lablab seed distribution.

A lablab crop grown beside maize thrives while maize struggles under the the same conditions.

LESSON 5

Invest in soil and land health

Prolonged cultivation of soil over the years has resulted in reduced soil fertility in most of smallholder farmers' arable fields. Tests on all the 45 fields in the project indicted very low fertility levels, erosion and a general poor structure, hence investing and promoting soil health must be part of the solution to produce food, address climate change and repair the environment. The minimum tillage approach implemented as part of the project introduced farmers to sustainable approach to moisture conservation, which further increases productivity and ensures that carbon is kept in the soil.

A freshly ripped sandy field in Kgalagadi South

LESSON 6

Support Farmer-to-Farmer and Community-Wide Social Learning

In order to increase farmer's awareness to the benefits of climate Smart agriculture, farmers were taken through exposure visits to other successful participating farmer's fields, often called Champion Farmers.

Such exposure was meant to increase interest and demonstrate the value of CSA.

Farmers who took part in these farm walks and/or field days reported being inspired to emulate that farmer's approach, beyond government interventions and assistance. Such champion farmers are still quoted by farmers in other areas where projects to upscale CSA are being implemented.

This is an indication that indeed peer learning is an effective way to disseminate CSA knowledge.

Farmer to farmer engagements have a social multiplier effect.

The Ministry of Agriculture Development and Food Security Agents should consider designing projects that will identify, grow and capacitate a deliberate cadre of champion farmers at clusters around extension areas to champion CSA practices.

These farmers will in addition to promoting CSA adoption provide data to further guide the adoption and implementation of projects.

Rationale for the proposal

The presence of a local champion to spearhead the dissemination and demonstration of CSA can be more beneficial and enhance self-reliance and reduce pressure on the limited Extension workers and resources.

Involving farmers as active learners and disseminators carries great potential to increase the adoption of CSA at scale.

> ***"Such champion farmers are still quoted by farmers in other areas where projects to upscale CSA are being implemented"***

The picture below shows a farmer engaging other farmers on how they were able to get a good results despite the long dry spells that followed the rains in the district.

Mr. Sello, a farmer supported under the project, engaging other farmers through farmer to farmer teaching during one of the field days held at Tlhareseleele.

LESSON 7

Re-engaging Extension Officers in new extension methods for Climate Smart Agriculture

New technologies require new skills

New technologies/practices can create new lines of work. The advent of Climate change has necessitated new approaches to production, hence the advent of programmes to improve their adoption in production. However, these programmes fail to invest in the required parallel capacitation of extension officers to adapt their skills and knowledge to match the new approaches.

Proposals for more a conducive Environment

Extension workers are instrumental in increasing production. However, the environment for them to unleash this potential is limiting, issues such as, lack of resources, heavy workloads coupled with frequent reassignment of extension officers' and focus on activities beyond extension work affects impact.

Under the project, extension officer to farmer contact was heightened, and their presence was verbally appreciated by the farmers. Comments such;

"We now meet our Extension Officers more since the project started and my farm is doing well, and I promise I will carry the education with me forever"

This dictates that effective promotion of adoption of CSA practices to farmers needs an active priming of the resource environment that would facilitate it.

Climate change has increased the need for heightened farmer to extension officer contact due to the uncertainties created by its impacts.

The diversity of issues that arise such as new weeds, plant diseases, and generally new varying concerns and experiences need considered decision making by the farmer.

Development partners and government must design CSA projects that seek to facilitates viable environment for success.

One of the activities under the project involved ongoing training of Extension Officers on emerging issues in climate change and how these can be communicated to the farmer for maximum impact. Below is some of the sessions held with the Officers.

Agricultural Managers during some training sessions held under the project

LESSON 8

The Importance of Climate information

Through their established Indigenous Technical Knowledge (ITK), smallholder farmers have established ways to predict weather, such as observing the behavior of animals, plants, clouds and stars. However the advent of climate change and the uncertainty that has come to represents these methods has increasingly made it difficult for farmers to rely on these methods solely.

Scientific climate forecasts with its ability to make more accurate predictions are increasingly becoming sought out sources of climate information for farmers as it enhances ITK indicators. This complementarity was used in the project to help farmers understand how they could benefit from weather forecasts and to help forecasters to communicate weather information in a way that would be understood by the farmers.

Methods of Delivery

During the farmers' training Meteorologists' were brought in at the beginning of each of the three seasons to share the forecasts with the farmers. The face to face delivery of weather information assisted the farmers to appreciate the probalistic nature of forecasting. Farmers started listening more and more to radio weather forecasts and asking questions on what they had heard. This increased their faith in the forecasts and enhanced their decision making.

Face to face with Forecasters was a hit with the farmers because they could share their frustrations and appreciations.

Way Forward

The project has undertaken to engage the Meteorological services together with Ministry of Agriculture Development and Food Security to develop a community agro-meteorological advisories' or weather outreach program, where prior to every ploughing season Meteorologists' in the 10 Districts will organize awareness workshop to share climate information face to face.

> ***"This complementarity was used in the project to help farmers understand how they could benefit from weather forecasts and to help forecasters to communicate weather information in a way that would be understood by the farmers"***

LESSON 9

Private Sector key to upscaling climate smart agriculture

The private sector is a key stakeholder in climate change adaptation for arable sector in Botswana due to its resource base and technology ownership. Therefore, their involvement in upscaling climate smart agriculture could aid the attainment of food security among the resource poor smallholder farmers

The plight of government to improve CSA adoption continues to increase with the worsening impacts of climate change on arable farming. This has resulted in additional stress on an already limited extension work. Development partners and government should consider involving all stakeholders in this endeavor, especially agricultural private sector.

At present, the private sector plays a role limited to supply and sales of inputs such as seeds, fertilizer and pesticides. Yet the private sector is well-placed to boost adoption of these technologies. Projects geared at upscaling adoption of CSA technologies and practices should deliberately engage private sector on the knowledge that they can offer.

The involvement of private sector in this way could create sustainable linkages for adaptation between public and private sector. Private sector can play a huge role in climate smart agriculture and this must be acknowledged and mainstreamed into project design. Being the owners of technology, their influence goes beyond just sales, into investment research and development. Through adopting clusters, public events, marketing and social corporate responsibility intervention private sector can hype up and support such uptake.

“The plight of government to improve CSA adoption continues to increase with the worsening impacts of climate change on arable farming”

During the project Implementation efforts were made to involve private sector as a player in advancing climate change adaptation. Below is a member of the private sector who was involved in the project through offering ongoing technical advice and donation of inputs such as fertilizers' and pesticides. It was during this interaction that the potential to involve private sector better and meaningfully was born.

A member of the private sector promoting a technology among the smallholder farmers.

CONCLUSIONS & RECOMMENDATIONS

Climate change risks are expected to continue to increase and their effects on food security to be even more threatening. This calls for more targeted focus on adaptation interventions. The implementation of this project demonstrated that climate change is a development issue that requires Vulnerability and Capacity Assessments and practice that engages farmers, Extension Officers and policy makers, in order to benefit from the myriad of knowledge and experiences of these stakeholders. The project implementation journey resulted in key lessons that would guide adaptation programming and any upcoming future adaptation projects. Following these lessons the project makes the following recommendations;

Recommendations

- Climate change impacts in agriculture should be considered within the context of development and never as a standalone, in order to facilitate development of holistic climate adaptation programmes, with defined roles by different sectors.
- Extension Officers should be considered for further training in climate change science and its implications, so that they can provide informed information about climate change adaptation to farmers.
- Climate Change is an emerging concern for smallholder farmers, and there is need to create awareness of the phenomena among them in order to heighten the potential for adoption of Climate smart technologies.
- Ministry of Agriculture Development and Food Security should consider establishing a fund that would support nurturing and dissemination of Smallholder farmers Innovations.
- Evidence based research is needed to highlight the contribution of innovative farmers in agriculture and related intellectual property.
- The Ministry of Agriculture Development and Food Security should consider undertaking a country wide soil fertility investigations and come up with soil fertility status maps/ atlases and fertilizer type recommendations, to compliment CSA interventions across the country.
- Ministry of Agriculture Development and Food Security should consider developing a private sector engagement strategy for climate change adaptation.
- Ministry of Agriculture Development and Food Security should consider developing community agro-meteorological advisories in all 10 districts.
- Extension workers should work with farmers to develop their succession plans through incentive program for youth envolvement.

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NOTES

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