CCARDESA
Centre for Coordination of Agricultural Research & Development for Southern Africa
Centre De Coordination De La Recherche Et Du Développement Agricole De L'afrique Australe
Centro para a Coordenação da Investigação e Desenvolvimento Agrário na África Austral

SOUTHERN AFRICAN DEVELOPMENT COMMUNITY
SADC
TOWARDS A COMMON FUTURE

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Training on "Tackling Climate Change in Agriculture: Approaches to Adaptation and Climate Smart Agriculture in the SADC Region"

Facilitation: Catalina Berger and Dr. Wiebke Foerch

Organiser: Shane Hardowar, University of Mauritius

18 – 22 June 2018

Réduit, Mauritius

Our group

Programme

Monday	Tuesday	Wednesday	Thursday	Friday
• Welcome and opening • Presentation of participants • Outline of the seminar • Agenda	• Presentation: CSA practices in Mauritius • Presentation: Overview of Climate-smart Agriculture	• Presentation: Nutrition-Sensitive Climate-Smart Agriculture • Module A: Presentation of results	• Recap of excursion • Presentation: Strategies in sustainable intensification of livestock	• Presentation: Carbon footprint in agriculture • Presentation of the CP group work results
• Presentation: Thematic introduction: Climate change, adaptation, mitigation • Presentation: CC projections and impacts in SADC	• Exposé: concept and steps of Climate Proofing • Case study, Module A: Evaluating present and future vulnerabilities-current situation • Action learning: risk functions	• Action learning: dimensions of adaptation options • Case study, Module B: Identifying adaptation options	• Case study, Module C: Selecting adaptation measures	• Feedback on CP approach • Elaboration of action plans
Lunch break				
• Presentation: Agriculture - victim, culprit and potentials for adaptation and mitigation	• Case study, Module A: Evaluating present and future vulnerabilities-future situation	• Excursion to Plaine Magnien	• Case study, Module C: Selecting adaptation measures – ctd. • Presentation: Protected cultivation - an alternative for farmers	• Presentation: CCARDESA's ICKM System • Evaluation of training • Certificates • Closure
• Presentation of case studies and composition of working groups	• Presentation: Climate change and marine environment • Presentation: Perception of CC by the Youth in Mauritius		• Preparation of final presentations • Presentation: CC with a value chain perspective	

Objectives and participants

The overall objectives of the training were:

- to train participants on the Climate Proofing (CP) approach with a focus on Climate Smart Agriculture (CSA)
- to enable them to apply the concept in their individual working contexts
- getting to know concepts of climate change adaptation and CSA for agricultural extension services
- to enable the participants to apply such concepts in their extension work
- to use feedback and lessons to further improve the training for future application in the region

Participants:

- 20 participants from agricultural extension services, research and the private sector
- Country: Mauritius
- Institutions: University of Mauritius UOM), FAREI (Food and Agricultural Research and Extension Institute), private enterprises
- Gender balance: 8 women, 12 men

Day 1 - Overview

- Welcome and opening
- Presentation of participants
- Presentation 1: Thematic introduction: climate change, adaptation, mitigation
- Presentation 2: CC projections and impacts in SADC with focus on Mauritius
- Presentation 3: Agriculture - victim, culprit and potentials for adaptation and mitigation
- Presentation of case studies and composition of working groups

Day 1

- During the opening ceremony, the welcome address was given by Mr. **Shane Hardowar**, Senior Lecturer at the Faculty of Agriculture (FoA) at the University of Mauritius (UOM). He welcomed the participants and the panellists to the training course.
- The Dean of the FoA, Associate Professor **Daneshwar Puchooa**, welcomed and congratulated CCARDESA and the FoA for the upcoming training.
- Subsequently, a welcome address and the launching was given by Professor **Dhanjay Jhurry**, CSK, Vice-Chancellor at the UoM.
- This was followed by the keynote speech by Dr. **Wiebke Foerch**, GIZ-ACCRA programme on the "Regional Agricultural Policy – RAP".
- After the official opening the training began by a self-introduction of the **course participants.** During the presentation, participants had the opportunity to present themselves, their professional background, experiences with CCA and CSA as well as their expectations for the training course.
- **Key expectations** raised were to gain more knowledge on CC adaptation (CCA) and mitigation strategies, to learn new tools and approaches, and to improve knowledge in CSA practices.
- The thematic part of the course started with a presentation on **climate change basics**, by Catalina Berger, consultant. This was followed by presenting **CC projections in SADC with a focus on Mauritius**, by Prof. Sunita Facknath, FoA, UoM.
- During a third presentation, participants learnt about the role of the **agriculture as victim and culprit** of climate change at the same time. The presentation was given by Dr. Wiebke Foerch.
- The day was closed by the presentation of the **case studies** and the **composition of working groups** for the Climate Proofing (CP) approach.

Welcome Address by Shane Hardowar, Senior Lecturer, FoA at the UoM

Mr. Hardowar, initiator and main organiser of this training course, warmly welcomed the participants and the panellists to the opening session of the five days Climate Proofing and CSA training.

He mentioned the objectives of the training, namely to understand the Climate Proofing tool and to get familiar with the Climate Smart Agriculture (CSA) approach.

Further, Mr. Hardowar thanked the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA), the Dean of the UOM as well as all the presenters who prepared presentations for the week's training.

Address by Associate Professor Daneshwar Puchooa, Dean of the FoA, University of Mauritius

Associate Professor Daneshwar Puchooa welcomed and congratulated CCARDESA and the FoA for the upcoming training. He underlined that the Food and Agriculture Organisation (FAO) stated that the agriculture sector undergoes changes and challenges to feed an increasing world population and to ensure food security worldwide. Climate Change (CC) exacerbates and reduces agricultural production, but CSA is one key to globally increase the agricultural production.

The FoA responded to this challenge through the governments' policy and incorporated Adaptation to CC. Another key to increase production lies in the domain of agri-science and technology. The FoA therefore strives to prepare their graduates for the science and private sector and updates its programmes to meet the needs. Further, the FoA embarked on the challenges of CC and CSA to support the agricultural sector to combat CC and to better adapt. In cooperation with the FAO, programmes on CSA have been developed. To further improve the performance of the sector, bio-agriculture is prompted in Mauritius. The Dean expressed the expectation that the CP training will enhance capacity building. He thanked CCARDESA and Mr. Hardowar, who make this training happen and reminded the audience that agriculture and land use change are a prominent source of greenhouse gases (GHG) and urged to look for opportunities to mitigate these. He concluded his address with a citation of Emmanuel Macron, President of France: *"Let us face it, there is no planet B."*

Welcome address and launching by Professor Dhanjay Jhurry, CSK, Vice-Chancellor of the UoM

Prof. Jhurry welcomed everybody to the workshop and stated that CC is a reality and a major cause of concern, not only in the agricultural sector, but also in the public and private sector. During the Conference of the Parties (CoP) 21 at Paris, the first binding agreement to reduce GHG has been negotiated by the parties (Paris Agreement).

CSA is recognized as crucial to increase food productivity. The FAO acknowledges the importance of CSA. Both adaptation to CC and also mitigation strategies to reduce Greenhouse Gases (GHG) require enabling policies, but there are still barriers for adaptation, e.g. correlated to social aspects.

Prof. Jhurry reminded the audience that the world needs to shift to a more sustainable use of resources to reduce GHG and thus protect the biodiversity of the planet. This asks for more investment for research and development. Food supply chains also need to be linked to urban markets and require a sound price policy. Capacity building is needed to effectively respond to these challenges. The UoM already stablished poles for bio-farming and CSA. The private sector, academia and research are needed to look for CSA technologies and to join forces.

He is looking forward to working together on these important topics and wishes a fruitful training.

Keynote speech by Dr. Wiebke Foerch, GIZ-ACCRA programme

Dr. Wiebke Foerch, Advisor at the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) programme on Adaptation to Climate Change in Rural Areas (ACCRA) gave the keynote speech on behalf of Dr. Simon Mwale, Acting Executive Director of CCARDESA who could unfortunately not attend.

She started her presentation with a situational overview of the SADC region with respect to CC, stating that the region is **extremely vulnerable to CC**. Esp. the **agricultural sector**, which comprises **70% of the work force**, is affected. Climatic conditions is SADC are getting harsher and more unpredictable, extreme weather events (droughts, heavy rainfall etc.) are increasing.

SADC Regional Policy Frameworks were developed to address CC in a strategic manner. These frameworks comprise the:

- Revised Regional Indicative Strategic Development Plan 2015-20
- Comprehensive Africa Agriculture Development Programme (CAADP)
- SADC Regional Agricultural Policy (RAP)
- SADC Regional Agricultural Investment Plan (RAIP)

Wiebke explained the **RAP** more in detail, which's overall objective is the contribution to s**ustainable agricultural growth and socio-economic development** in SADC. CC is covered under Specific Objective (iv) of the RAP - Reduce social and economic vulnerability. RAP recognises effects of droughts, floods and temperature change on the agriculture sector.
She concluded her keynote speech by presenting **CCARDESA** as the **implementing** organisation for the **Comprehensive Africa Agriculture Development Programme (CAADP)** and CCARDESA's mandate to coordinate agricultural research and development in the SADC region.

Presentation 1: Climate Change, adaptation and mitigation by Catalina Berger, consultant

The thematic introduction elaborated about climate change in general and adaptation and mitigation in particular.

It started with the explanation of the term **mitigation**, which is determined as **emission saving**/reducing measures**.** The presenter also explained sources of Greenhouse Gases (GHG) as well as the most important GHG who contribute to global warming.

The main sectors of anthropogenic GHG emissions are the **energy sector** (66%) and **land use change/ agriculture** (26%). **Signals of climate change are** sea level rise, change in temperature and precipitation patterns. The impact chain of the climate signal "sea level rise" was explained from loss of land to **bio-physical** and **socio-economic impacts.**

To manage the unavoidable, **adaptation** is needed to adjust to actual or expected climate and its effects. Both mitigation and adaptation are complementary strategies for a climate-compatible development.
The presenter reminded the audience that the Climate Proofing training focuses on adaptation measures, but that the mitigation potential of adaptation measures will also be determined.

The presentation concluded with the basic definitions on **weather, climate, climate variability** and **climate change** to make participants understand the terminology and differences.

Q&A

- How were levels of GHG concentration pre-industrialisation determined?
  - Through proxy indicators – permanent ice in the arctic is drilled and in these cores, concentrations of GHG at different points in time can be determined in the lab
- Is the concentration of GHG in the atmosphere the same across the globe?
  - Yes, more or less – though volcano eruptions, etc. have an effect
  - Measures in the observatory in Hawaii
- What makes CO2 retain heat?
  - Physical barrier. The sunrays touch the earth, get reflected back as heat but can not radiate back into the universe
- Are there any countries that have zero emissions?
  - No, all countries have some level of agriculture, transport or industrialisation
  - In most countries emissions per capita have been increasing (an example of reduced emissions was in eastern Germany after reunification due to closing of coal mines, etc. – but this has reversed again)
- Implications of population growth
  - Depends on context – countries like Niger have high population growth but low level of economic development – impossible to discuss – Versus China, there is more awareness and measures in place to reduce emissions – shift in economy is slowly trying to happen, but a question of resources and power – BUT China still argues the emissions per capita position at UNFCCC (total emissions per country high in China, but in terms of per capita emissions in China are low)
- How do we measure emissions?
  - Carbon dioxide equivalent – the different GHG have different potencies, being compared to CO2 – this is now also being converted into the carbon footprint
- Sea level rise has a lot of effects, not just on land loss and biodiversity on land but also on marine ecosystems
- Mitigation – a good example of complementary benefits with adaptation is the use of biodigesters where emissions are saved, as well as adaptation achieved

Presentation 2: CC projections and impacts in SADC with focus on Mauritus by Prof. Sunita Facknath, FoA, UoM

Prof. Facknath reminded that Southern Africa has always been among the regions in the world most affected by extreme shifts between droughts and floods. The region is expected to experience **higher land and ocean surface temperatures**, which will affect **rainfall, winds, and the timing and intensity of weather events.** These changing parameters have severe **impacts on agriculture and food production**, e.g. changes in crop phenology, reduced crop and animal yields, increase in pests and diseases, reduction in soil health and fertility. To respond to these impacts, SADC has developed and is coordinating a **weather and climate monitoring** programme. In 1990, the **SADC Climate Services Centre (CSC)** was created with the main objective to reduce negative impacts from climate extremes, such as droughts and floods. CSC generates medium-range and long-range climatic outlook assessments that are disseminated to all Member States. **Early Warning Units** were established in 12 Member States to collect, analyse, and disseminate early warning information covering seasonal rainfall and crop development, harvest forecasting, import and exports, food stocks, price and market monitoring.

On **CC in Mauritius**, the presenter stated that **average temperatures** have risen by 0.74°C over mainland, compared to the 1961-90 mean. **Rainfall** is becoming more erratic and the overall **precipitation** has decreased by 8% (1950 and 2008). The frequency of **extreme events** is increasing and **cyclones** are intensifying much faster. Between 1998 and 2007, the local mean **sea level** rose by 2.1mm per year. Regional **impacts** observed are the droughts in 1999 and 2011, flash floods in 2008 and 2013, coral bleaching and accentuated beach erosion. In order to address climate change, the Republic of Mauritius is developing a pragmatic approach to develop its **resilience**. Mauritius is developing an **early warning system** that will give three days notice of possible storm surges and improving its capacity to evacuate people from vulnerable areas.

CSA is the key to enhance agriculture productivity under changing climatic conditions. The presenter gave examples of CSA related activities and studies elaborated by the Faculty of Agriculture.

Q&A

- Global risks report 2018. Download path for the report: http://www3.weforum.org/docs/WEF_GRR18_Report.pdf
- Study on climate smart technologies for Rodrigues – targeted at farmers, have a look
- Are there existing studies on the impacts of climate change on specific value chains and crops?
  - Yes, within the faculty and beyond
  - There is no one place to find all the available studies – it would be good to check directly with the climate centre which exists for this purpose – though we are lacking an effective mechanism to collect newest information from research

Link to the CSC:

https://www.sadc.int/sadc-secretariat/services-centres/climate-services-centre/

Presentation 3: Agriculture - victim, culprit and potentials for adaptation and mitigation by Dr. Wiebke Foerch, GIZ

Wiebke summarized the **effects CC** will have **on agriculture**, whereby she stressed that the sectors **suffers** from CC but at the same time also **contributes** to global warming (by the release of GHG). **Ca. 10%** of the global GHG emissions are stemming from the agricultural sector (soil, fermentation, rice cultivation, energy, manure management and other) and **14%** from the **change of land use**.

She then presented an overview on different types of ecosystems and their **CO_2 storage capacity**. It became clear that not only tropical forests but also cold temperate forests and grasslands store large quantities of carbon. **Wetlands** have got the highest CO_2 concentration in their soils.

Examples for **mitigating GHG** in agriculture and land use change were shown, amongst them tree planting, appropriate fertilizer application, planned land use change, reducing post harvest losses and food wastage.

Adaptation in agriculture is a multi-dimensional and multi-level process from farm to community to the public level. Wiebke illustrated each level with examples and closed with criteria for **sustainable agriculture**.

Q&A

- Synergies between adaptation and mitigation: when you say measure, some adaptation measures are costly, so we better go with mitigation? Adaptation is costly

- It depends on the context. Sometimes in drylands it is difficult to mitigate and create a co-benefit. It comes down to context. We need to adapt to make the systems more resilient. There is no one solution which fits in all problems/regions. Also not in the same systems of interest in different countries. Climate proofing is the tool to find the best adaptation options.

- We need to do something about population growth! Adaptation is the main focus, but we must look at each case different

- The issue of population growth can be debated in all kinds of settings. For example Ethiopia had an increase in its population from 20 mio in the 1980s to 100 mio now. Esp. if you combine it with consumption patterns, it becomes a big challenge.

- Maize/coffee cultivation: shrinkage of suitable area can be attributed to CC. Overuse of fertilizer and pesticides. How to stabilize an ecosystem? With CSA or conventional agriculture?

- It is clear, that CC does change suitability of crops in certain areas. In many parts of the globe we are operating in systems which are not sustainable. We need to use our resources more sustainable. CSA: it brings the climate element in the center of the debate. A lot of overlap. Maize as a C4 crop will not perform any more above a certain temperature. You see it with a lot of staple crops in the region (temperature and rainfall as main parameters). Coffee only grows in a certain altitude and under a certain temperature regime.

Presentation of case studies and composition of working groups

Four case studies were prepared beforehand by the Food and Agricultural Research and Extension Institute (FAREI) and Mr. Shane Hardowar to work on through the Climate Proofing approach.

- Livestock
- Litchi
- Tomato
- Potato

Each participant was asked to choose the one case study he/she is most interested in.

Finally, the case studies on **livestock, litchi and tomato** were chosen to be climate proofed. Equally numbered sub-groups of 6 participants per case were formed.

Day 2 - overview

- The day started with the presentation of Shane on "**CSA practices and technologies with a focus on Mauritius**" and was complemented by an "**Overview of Climate-smart Agriculture"** held by Wiebke
- This was followed by an exposé about the **Climate Proofing** approach and an explanation about the objectives, steps of implementation as well as the modules covered during the training.
- Afterwards, the three sub-groups started to work on Module A of the case work, which is split into two parts. The group work started with part **1: Assess the risk – current situation**
- The following **action learning** introduced the risk terminology as it is used according to the 5th Assessment Report of the IPCC
- The groups worked through Part 2: **Assess the risk – future situation**
- The group work was followed by two presentations: the first one was on the "**Impacts of CC on marine systems**" by Dr. Satyam Bhoyroo, the second one about the "**Perception of CC by the Youth in Mauritius**" by Julia Carpouron

Presentation 4: CSA practices and technologies in Mauritius, by Shane Hardowar, FoA

Shane started by giving the FAO's definition of CSA : CSA sustainably **increases productivity**, resilience (adaptation), **reduces or removes GHGs** (mitigation) and enhances the achievement of **national food security and development** goals (development).

Mixed cropping

The FAO calls these the **three pillars of CSA**. CSA promotes **best practices** such as crop rotation, mulching, integrated crop-livestock management, conservation agriculture, improved grazing and improved water management, intercropping, improved seeds and fertilizer management practices.

Shane then presented **past projects and research done on CC and CSA in Mauritius** followed by an **overview of adaptive and CSA measures** practised by Mauritian farmers. Among these he cited techniques like Conservation Agriculture (soil conservation, soil and nutrient management), water harvesting, crop diversification, intercropping and mixed cropping, improved seeds and feeds, irrigation system and use of traditional knowledge. On a lot of these examples he showed pictures taken in various regions of Mauritius.

Mulching

Q&A

- A lot of these practices we are already doing – so what is climate smart and what is not?
  - Yes, this is a struggle – we are already doing it….
  - We need to define what modern CSA systems in Mauritius are and what technologies are included
  - There are also indigenous practices that are adaption options

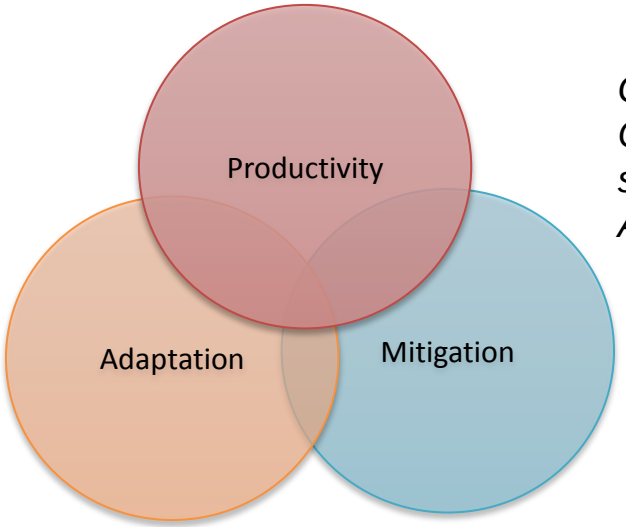
- Can we have a list of what CSA practices are?
  - No, because these practices are always context-specific, but there is a whole portfolio of CSA practices which will work in different places
  - No silver bullet and no blue print
  - There are limitations of practices also in terms of costs, for example

- Do we know the costs of shifting to CSA?
  - No, we need to undertake cost benefit and feasibility analyses to make the case for certain CSA practices in specific locations

- How do we deal with the slow onset of profit – some practices take time to bear fruit?
  - Yes, this is difficult – need to look at longer time frames to strengthen sustainability
  - Need a range of stakeholders involved and need institutional support

Presentation 5: CSA overview by Dr. Wiebke Foerch, GIZ

Wiebke presented the challenges for agriculture by **2050**, namely to **double world food production** on the same amount of land, make farms, fields and landscapes more **resistant** to **extreme weather**, while massively **reducing GHG**.



Goals of Climate-smart Agriculture

These challenges can be targeted with **CSA**, the presenter gave an overview of the CSA portfolio of concepts and technologies. But also CSA faces many **challenges**, like many **different practices**, **many goals** and also many **contexts** in which to apply the practices. She explained, that many practices can be **CSA somewhere**, but none are likely **CSA everywhere.**

Wiebke then gave an overview of CSA in different sectors: **soil and water conservation, agroforestry, (post) harvest losses and food losses, indigenous varieties/breeds, integrated pest management and biological pest repellents, agricultural risk insurance.**
On every topic she showed examples and more in-depth information.

Q & A

What is Coppicing? A traditional method of woodland management which exploits the capacity of many species of trees to put out new shoots from their stump or roots if cut down. (Source: Wikipedia)

What is wind winnowing? An agricultural method developed by ancient cultures for separating grain from chaff. It is also used to remove hay and chaff or other pests from stored grain. Threshing, the loosening of grain or seeds from the husks and straw, is the step in the chaff-removal processed into the air so that the wind blows away the lighter chaff, while the heavier grains fall back down for recovery. (Source: Wikipedia)

- For the farmers it is not profitable to pay people for harvesting and to carry yields to local markets. Market prices are very low.

- CSA does not operate in a vacuum. Think beyond in the value chain and marketability of crops

- How to take agricultural risk insurance? Smart is in the center. Productivity and mitigation/adaptation can be overlapping.

- Study from C. Lamanna (World Agroforestry Center) provides evidence, which practices are climate smart. Agroforestry can give you better yields in one, but not in the other setting. Context-specific, which is a challenge. More evidence (CBA, feasibility studies) are needed. We know enough about the options, to know which are robust and are likely to be good.

- The micro-climates in Mauritius is a challenge.

- A key challenge for adoption of CSA. There is a certain risk for the farmer involved.

The Climate Proofing approach – Introduction and steps

Introduction: the Climate Proofing approach

Climate Proofing:
A methodological approach aimed at incorporating issues of climate change into development planning. It enables development measures to be analysed with regard to current and future climate challenges and opportunities presented by climate change.

http://www.saaiks.net/blog/mshare_ressource/tackling-climate-change-in-agriculture-approaches-to-climate-change-adaptation-and-climate-smart-agriculture-in-southern-africa/

Module A
Assess the risk Part 1: current situation

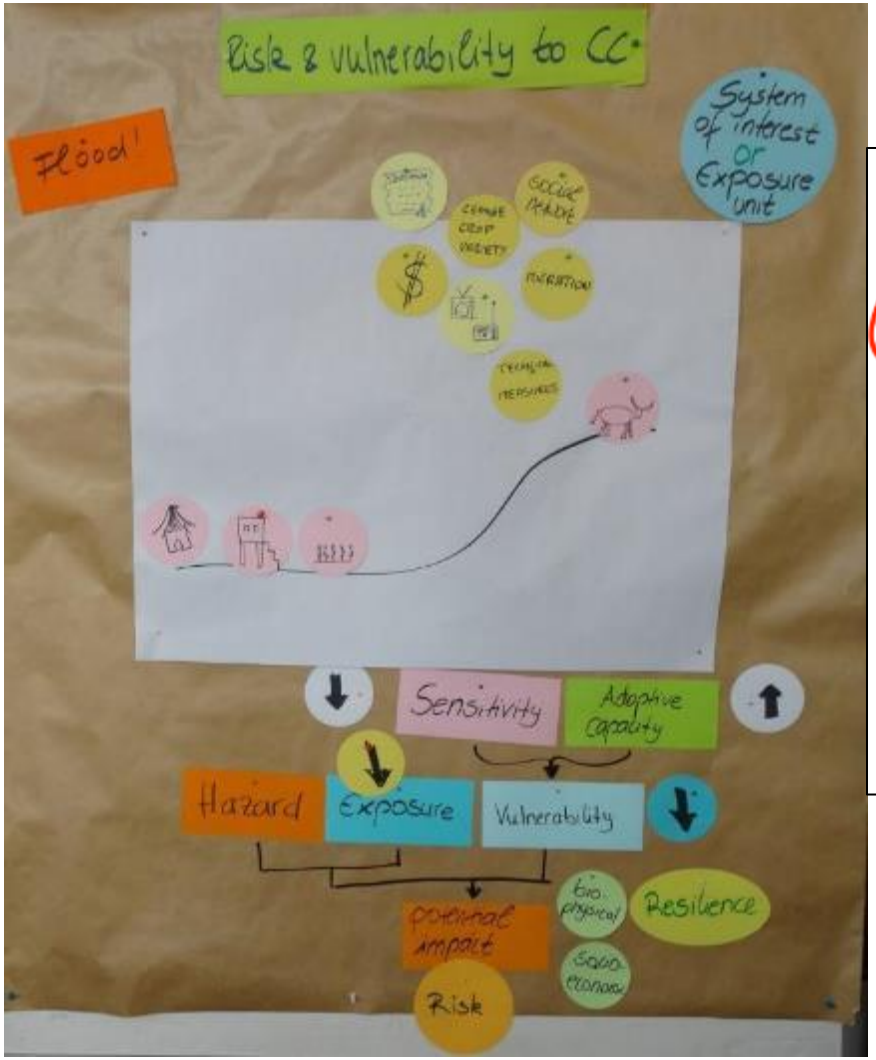
Learning objectives:

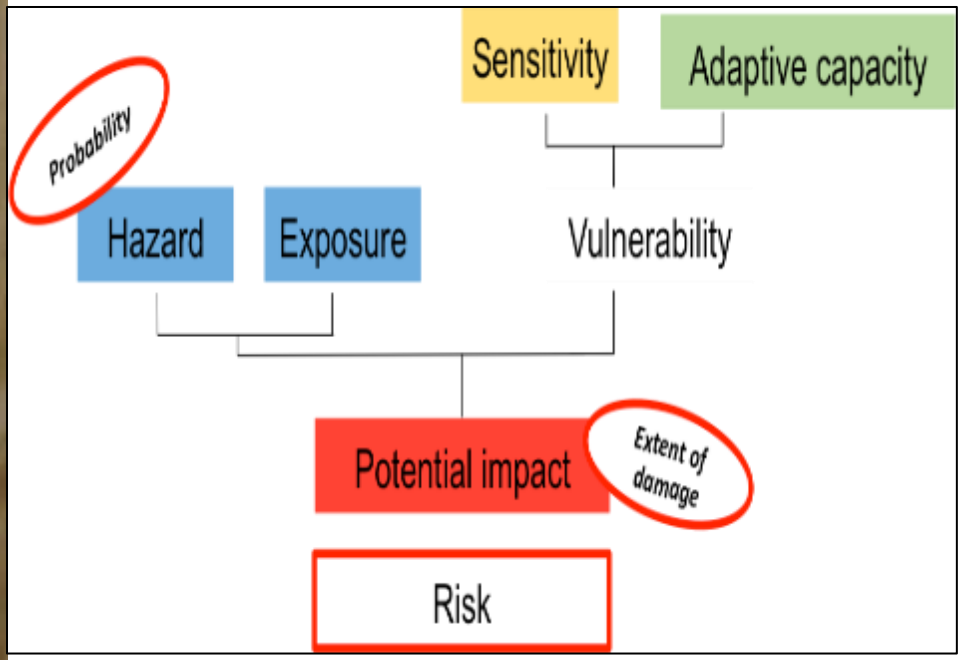
- Analyse the current risks and additional challenges caused by climate change in a defined system of interest
- Identify and handle the different factors contributing to “risk” in a system: sensitivity, adaptive capacity, basic vulnerability, hazard, exposure, and potential impacts
- Define the need for action according to the projected risk (the probability of climate hazards and the extent of damage) in the system

Steps:

- Discuss within your group the system of interest: the exposure unit you will assess during the training.
- List up to five key actors of the system of interest and also explore their roles and responsibilities.
- Explore further key elements of the system such as social, technical or natural components and give an estimate of their actual status quo on the tendencies.

Action learning
Risk function





IPCC 2014

Risk function Definitions

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the **interaction of vulnerability, exposure, and hazard**. In this sense, the term risk primarily refers to the risks of climate-change impacts.

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. In the IPCC AR5 report, the term hazard usually refers to climate related physical events or trends or their physical impacts.

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services and resources, infrastructure or economic, social, or cultural assets in places and settings that could be adversely affected.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Sensitivity: The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).

Adaptive capacity: The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Adaptation measures can 1. reduce sensitivity, 2. increase coping & adaptive capacity (and 3. potentially reduce exposure)

Module A
Assess the risk Part 2 - future situation - I

- Identify the **key climate related hazards** (observed & projected) of concern to which the system might be exposed. If possible, also note the frequency to which the system might get exposed to these signals.
- Consider next, if and how the system of interest's actors and assets are **sensitive** to climate hazards. Think of ecological and social sensitivity. Relate your assessment to the condition and trends of the system of interest. Take into consideration the actual situation and possible developments in the system (part 1).
- Note down the system's **current adaptive capacity** that would increase the adaptive capacity of a community. What is the adaptive capacity of institutions to support climate adaptation? Are national or local governments and organisations supporting planned adaptation?
- Now brainstorm the **potential impacts** of the climate related hazards to the system of interest.
  - First brainstorm the potential impacts to the **biophysical** part of the system by considering hazard in combination with the vulnerability factors.
  - Then brainstorm **socio-economic** impacts, resulting from the biophysical impacts.

Module A
Assess the risk Part 2 - future situation - II

In the last column, assess the probability of hazard and the extent for every potential biophysical and socio-economic impact. Discuss the column using the following questions:

- How relevant are the potential impacts to the development objective?
- Define a time horizon according to the objective of your analysis
- How likely is the impacts' occurrence?
- What is the extent of expected damage?
- Asses the level of risk (low, medium, high) of each impact by combining the likelihood of each biophysical impact with the severity of its socio-economic impact.

Module B
Identifying adaptation options

Task : Brainstorming “What could be done to respond to the challenges in order to be able to meet the development objective(s)?”

1. Find the selection of impacts you have rated as “high risk” from the previous module.
2. Brainstorm as many adaptation options as possible per impact to reduce the risk of climate change
3. Add adaptation options from policy, capacity development, technical or research
4. Finally, note as main actors whose contributions are necessary to implement the adaptation options.

Before the group work started, the facilitator led the participants through an action learning exercise on different levels and types of adaptation options (see next slide)

Levels and types of adaptation measures

	no-regret measures →		specific measures	
Categories of adaptation goals	Addressing drivers of vulnerability	Building response capacity	Managing climate risks	Confronting climate change
Type of intervention	*Goal: enhanced buffer capacity (individual/ community)*	*Goal: enhanced problem solving capacities*	*Goal: use climate information to take strategic decisions*	*Goal: reduce direct risks of climate change*
Policy		Enhancing local participation in land use planning	Mainstreaming of ACC into sectoral plans	Land use plans forbid settlements in flood prone areas
Technical measure	Implementation of a vaccination program to eradicate animal diseases	Revive traditional enclosures to encourage vegetation regeneration	Planning of eco-corridors on the basis of observed migration patterns	Construction of a dam to reduce the risk of outburst floods from a glacier lake
Capacity development	Alphabetisation Providing women with crossbred goats and instruction in graze-free feeding	Training local community in reforestation to combat flood-induced landslides	Training of administrative staff in using climate information	
Research			Providing regional climate data	Conservation of genetic variety in/ex-situ

Module C:
Select adaptation measures

1. Agree on the set of selection criteria
2. Discuss each option using the criteria and score them by using 1 – 5.
3. Do the overall score
4. If too many options have similar evaluations, try to be more specific by introducing another criterion or weighting the criteria.
5. Add an estimation of the mitigation potential for each measure

Climate Proofing of 3 agricultural systems

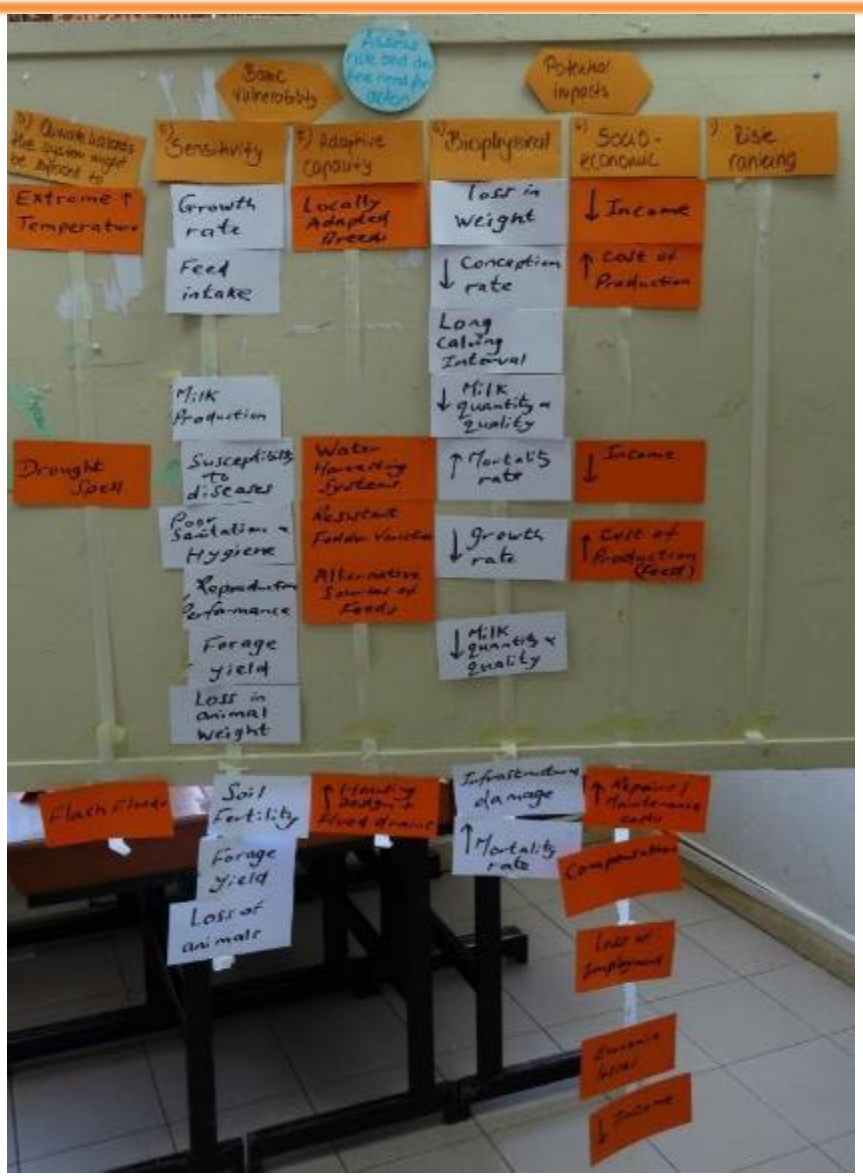
For a consistent overview, the results of the Climate Proofing exercise of the three cases studies are grouped together per case.

Results Case 1: Livestock

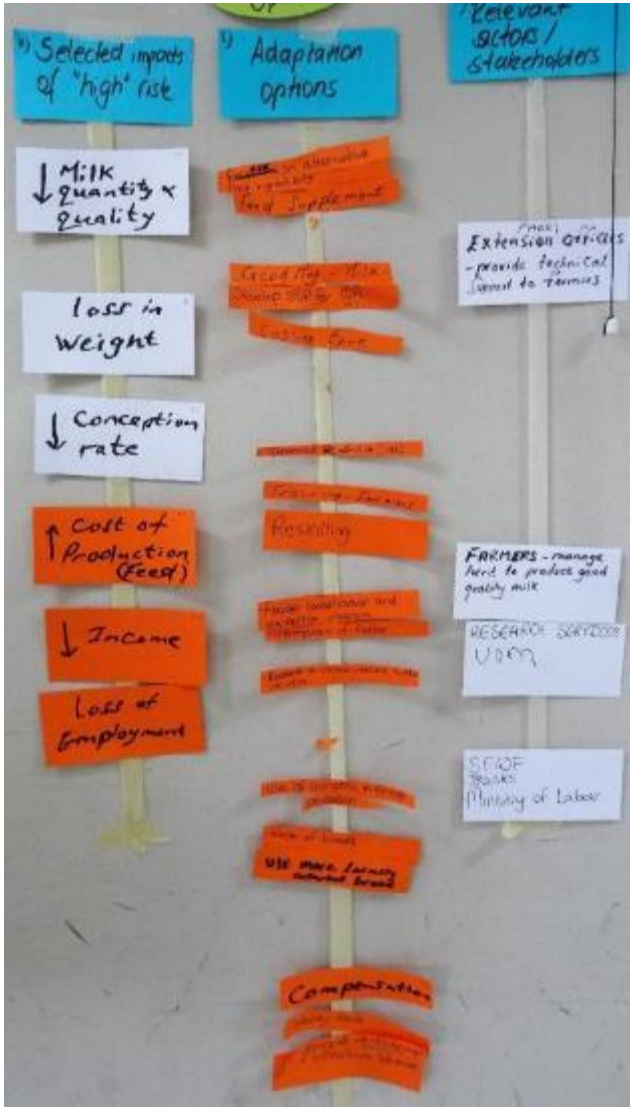
Livestock

Module A – current situation
Case 1: Livestock

Module A – future situation
Case 1: Livestock



Module B
Case 1: Livestock



Module C Case 1: Livestock

Presentation of final adaptation measures Livestock

Project
Small holder dairy farming in a humid livestock zone

Presentation from Livestock team

Outline

- Profile of dairy system of interest
- Development Goal
- Climate Proof Tool
- Potential Climate Hazards
- Adaptation Options identified

- Concluding Remarks

Profile of dairy system of interest

- Project site: Melrose
- Livestock zone set up in state Land (approximately 40 acres)
- Regroup 10 farmers (10 units)
- 10 cows (locally adated cross breeds) per unit – confined/cut and carry system
- Each unit 4 acres (0.5 acres for farm building)
- Integrated fodder unit (fodder grasses and legumes) of 3.5 acres per farm
- Target: 1000 litres per day
- Sale: pasterised milk to middlemen

Development goal

To improve productive efficiency and income

Climate Proofing Tool used

Steps followed:

1. Current and future climate risks assessed
2. Adaptation options identified and
3. Adaption measures selected

Potential Climatic Hazards

1. Extreme high temperature
2. Flash floods
3. Drought

Potential Impacts

Extreme high temperature	Decrease in Milk quantity and quality Animal performance (loss in weight, conception rate, long calving interval)	Decrease in income and increase in cost of production
Flash floods	Increase in mortality rate Damage to infrastructure	
Drought	Decrease in Milk quantity and quality Animal performance Increase in mortality rate	

Risk Assessment

- After observing the climate hazards, basic vulnerability and potential impacts, the risk rating was medium

Adaptation Options

11 adaptation options identified

Adaptation Options Identified

Adaptation Option	Overall Evaluation (/20)	Mitigation Potential
Good milking practices	18	0
Use of cooling tanks	18	0
SOP for Quality assurance	18	0
Training of farmers/reskilling	18	0
Use of compost in forage plantation	18	+
Use of locally adapted cross breeds	17	+

Adaptation Options Identified

Adaptation Option	Overall Evaluation (/20)	Mitigation Potential
Improved AI Service	14	+
Research on alternative feed ingredients/feed supplements	13	+
Fodder conservation and germplasm	10	+
Research on use of climate-resilient fodder varieties	10	+
Policy measures (compensation, insurance, etc)	8	-

Concluding Remarks

- 5 options have equal rating of 18/20
- Out of these 5 adaptation options only one shows mitigation potential
- Policy measures (compensation) give a low overall rating and –ve mitigation potential
- Out of 11 options, two adoption options have regret measures
- Climate Smart Project (P,R,M)
- Overall, the proposed project with the adaptation measures meet our development goal

Thank You

Q & A
Final presentation Livestock

- Normally in these CP contexts, would we get a different result if we talk to farmers? It is crucial that this is done with farmers because obviously this is now skewed towards what researchers perceive as important options
- Mitigation potential – this is based on best knowledge available in the group at the moment – important to maintain scientific rigour and make sure we have the evidence to support this
- Local context matters. We need to bring local knowledge into the picture, to complement the scientific perspective
- Mitigation potential: how do you get a positive mitigation potential through research activities? Think about the research, not necessarily the adoption of the research outputs
- Negative mitigation potential of policy measures – it is just a short term solution then farmers go back to their old practices, to business as usual
- Need more detail on your adaptation options – lacks elaboration
    - Need good milking practices to maintain high milk quality and avoid quality loss, especially under high temperatures this is critical – plus associated costs of implementation are minimal
- So which option to pick?
    - We need a portfolio of a few options which are synergetic with a higher probability of success, if in combination
- Policy incentives – these are primarily compensation of farmers after climate hazard have resulted into impacts
- Expensive options – research measures rather than adoption – research trials have to be implemented in the long-term and require the testing of new technologies
- Mitigation
    - Cooling (neutral) – requires energy …..
    - AI (positive) – focused on locally adapted breeds and improving the process

Action plan
Case 1 Livestock

Action plan : Livestock

Adaptation options	Activity	Until ...	Who ...	Where	Comment
Capacity Building	Training and teaching under grads and post grads	Ongoing	Academic staffs	University of Mtius (FOA)	Target group: Students
	Sensitisation campaigns	2020	Extension Officers (FAREI)	Training centers + Model farms + MBC (media)	farmers, officers, public
Raincoater harvesting system	Encourage use of system	Ongoing	Extension officers (FAREI)	Livestock farms	Technology already developed
Improved fodder varieties	Dissemination	Ongoing	Extension officers (FAREI)	Livestock farms	Technology already developed
Composting	Develop med & large scale Composting models	2020	Research Scientist	CLRS (FAREI)	Technology to be developed

Results Case 2

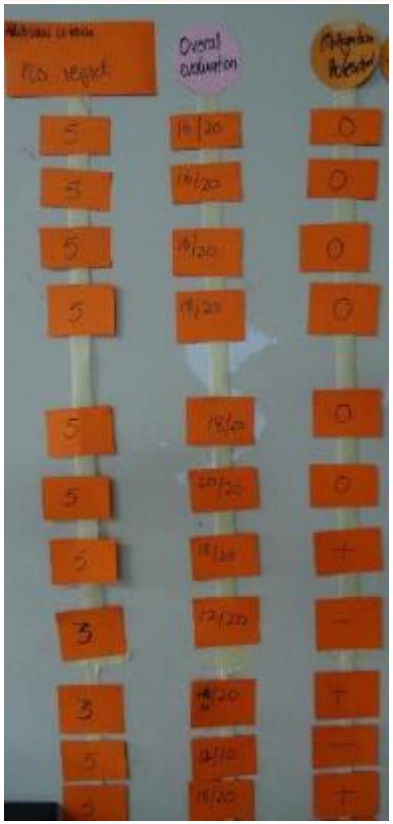
LITCHI

Module A.1 – current situation
Case 2: Litchi

Module A.2 – future situation
Case 2: Litchi

Module B
Case 2: Litchi

Module C - Case 2: Litchi



Presentation of final adaptation measures Litchi

“Tackling Climate Change in Agriculture: Approaches to Adaptation and Climate Smart Agriculture

Group Litchi

- 22th June 2018

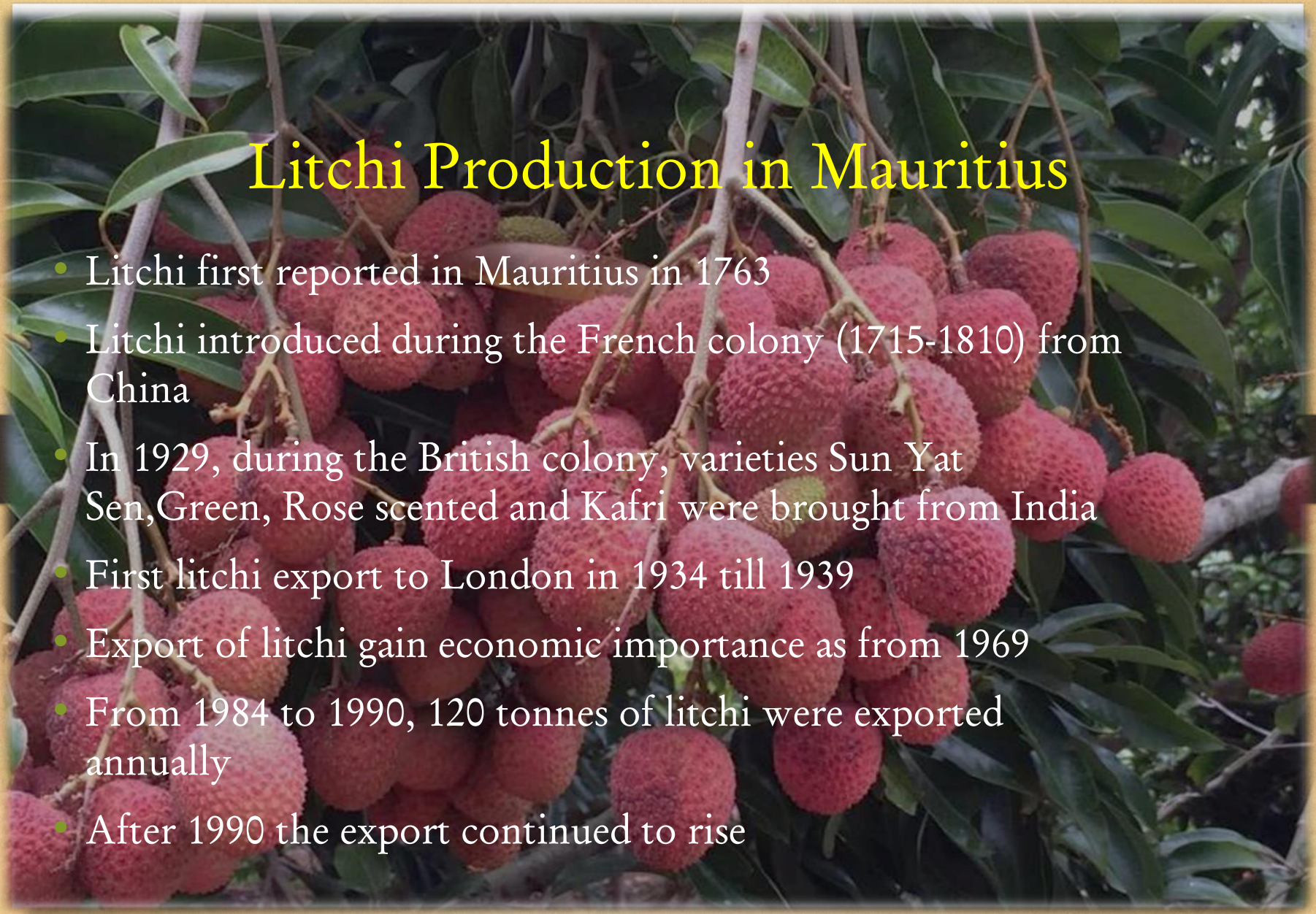
System of Interest

Litchi Orchard Management at Calebasse in the North

22th June 2018

Sustainable Development Goal

- **To increase productivity and income over a period of five years**



Litchi Production in Mauritius

- Litchi first reported in Mauritius in 1763
- Litchi introduced during the French colony (1715-1810) from China
- In 1929, during the British colony, varieties Sun Yat Sen,Green, Rose scented and Kafri were brought from India
- First litchi export to London in 1934 till 1939
- Export of litchi gain economic importance as from 1969
- From 1984 to 1990, 120 tonnes of litchi were exported annually
- After 1990 the export continued to rise

Current situation of the Litchi Industry in Mauritius

- Main variety - Tai So
- 346 litchi orchards covering a total area of 423 ha
- Fruit harvest season – early Nov. to early Jan.
- Export market: 250 to 300 tonnes annually
- Premium price for early season litchi
- Shift from backyard to intensive system of production over last decade
- Potential for regular bearing instead of every 2 yrs – through timely pruning, fertilization and irrigation
- 2017 ----- 70%

Climate Hazards the System might be exposed to

- Cyclone
- Heavy rainfall
- Drought / extended dry spells
- High temperature
- Erratic rainfall

Adaptation Measures

POLICY

- Soft loans
- Freight rebate scheme (FRS)
- MauriGap certification
- Development of a supply chain for processed litchi products
- Agricultural risk insurance

How do **policy** measures answer our goal?

- Policy measures will provide the necessary financial support (compensation and incentives) to help growers of the cooperative to face extreme climatic events (e.g FRS)
- MauriGap: Guarantee - Safe food and fetching premium litchi price i.e. higher grower income
- Processing - Added value of litchi products for higher income and extended product availability to consumers

Adaptation Measures

TECHNICAL

- Technical information dissemination (media, publication, SMS disease alert, Meteo, APMIS)
- Pest and Disease Management
- Timely fertilizer application

How do **technical** measures answer our goal?

- Early warning system will contribute to decision making
- Proper cultural practices, including timely fertilization will ensure annual fruit bearing and therefore contribute to sustained productivity

Adaptation Measures

RESEARCH

- Introduction of new varieties
- Extend the shelf-life for export
- Decrease post-harvest losses

How do **research** measures answer our goal?

- Introduction of early varieties to avoid the cyclonic season/heavy rainfall for a resilient system
- Tolerance of varieties to high temperature, pest & disease for a greater fruit yield and revenue
- Eco-friendly technology to extend the shelf-life of litchi products and extend period for product marketing

Adaptation Measures

CAPACITY BUILDING

- Water management
- Tree management
- Agro-processing
- Setting up of a model farm
- Flower induction techniques

How do **capacity building** measures answer our goal?

- Empower growers to improve flowering, fruit set, and quality product
- Improve water use and fertilizer efficiency
- Create opportunity for value addition through processing
- Increase grower awareness about new production practices and increase production skills

Mitigation Potential

- **Reduction in GHG through:**

1. The judicious use of fertilizers, and pesticides (IPM)
2. Mulching,
3. Increase in the carbon sink capacity (healthy canopy development),

"Tackling Climate Change in Agriculture: Approaches to Adaptation and Climate Smart Agriculture

Litchi Group

- Keshav
- Patricia
- Satish
- Yogeeta
- Giantee
- Rajiv

22th June 2018

Thank you for your attention!

Q & A Litchi

- Litchi is at high risk to climate hazards – it requires a multi-level approach
- Measures implemented during the project could then also be scaled up to other areas of the island
- Productivity focus of the measures, not clear where is the climate risk reduction of adaptation
    - We are addressing the changes in rainfall by inducing flowering and giving farmers guidelines plus use of new varieties which can better deal with the climatic changes
    - Introducing new varieties takes time, though – at least 6 years to have them productive

- What would a climate smart litchi farm look like, and at what cost?
    - We need the model farms to build farmer's skills in more adapted litchi management
    - Efficient fertiliser use, height of trees and spacing, girding to induce flowering, etc.

- Gender sensitivity is key to projects – how many women are involved and what are the benefits for women?
    - The president of the cooperatives is a lady
    - 25 members, 10 of them are women – in an orchard work load is less than in the field and women manage well – only putting the netting in place is a challenge
- Harvesting is done mainly through casual workers – sorting and packing as well
- Local buyers come to the orchard to buy in bulk. Exporters come at fruit setting to essentially ear mark which fruits/trees he will buy and he takes responsibility for the tree
- Bats and birds cause huge harvest losses - netting and wires with tent are placed to minimise bat invasions

Action Plan Case 2: Litchi

Action plan: Litchi

Adaptation option	Activity	Time	Who	Where
1. MAURIGAP CERTIFIED	TRAINING	ON-GOING	FAREI/ MAIFS	ORCHARDS
2. FLOWER INDUCTION TECHNIQUES	TRAINING	PRIOR TO FLOWERING PERIOD (Apr/May)	FAREI	ORCHARDS
3. IND TO NEW VARIETIES	RESEARCH	7 YEARS	FAREI/UOM	FAREI RES. ORCHARDS
4. ORCHARD MANAGEMENT PRACTICES	DEMONSTRATION TRAINING	ON-GOING	FAREI	MODEL FARMS ORCHARDS
5. Value Addition	PROCESSING	NEXT HARVEST	FARMER	APRC FAREI
5				
6. Insurance	Registration	On-going	FARMER	SFWOF

Results Case 3

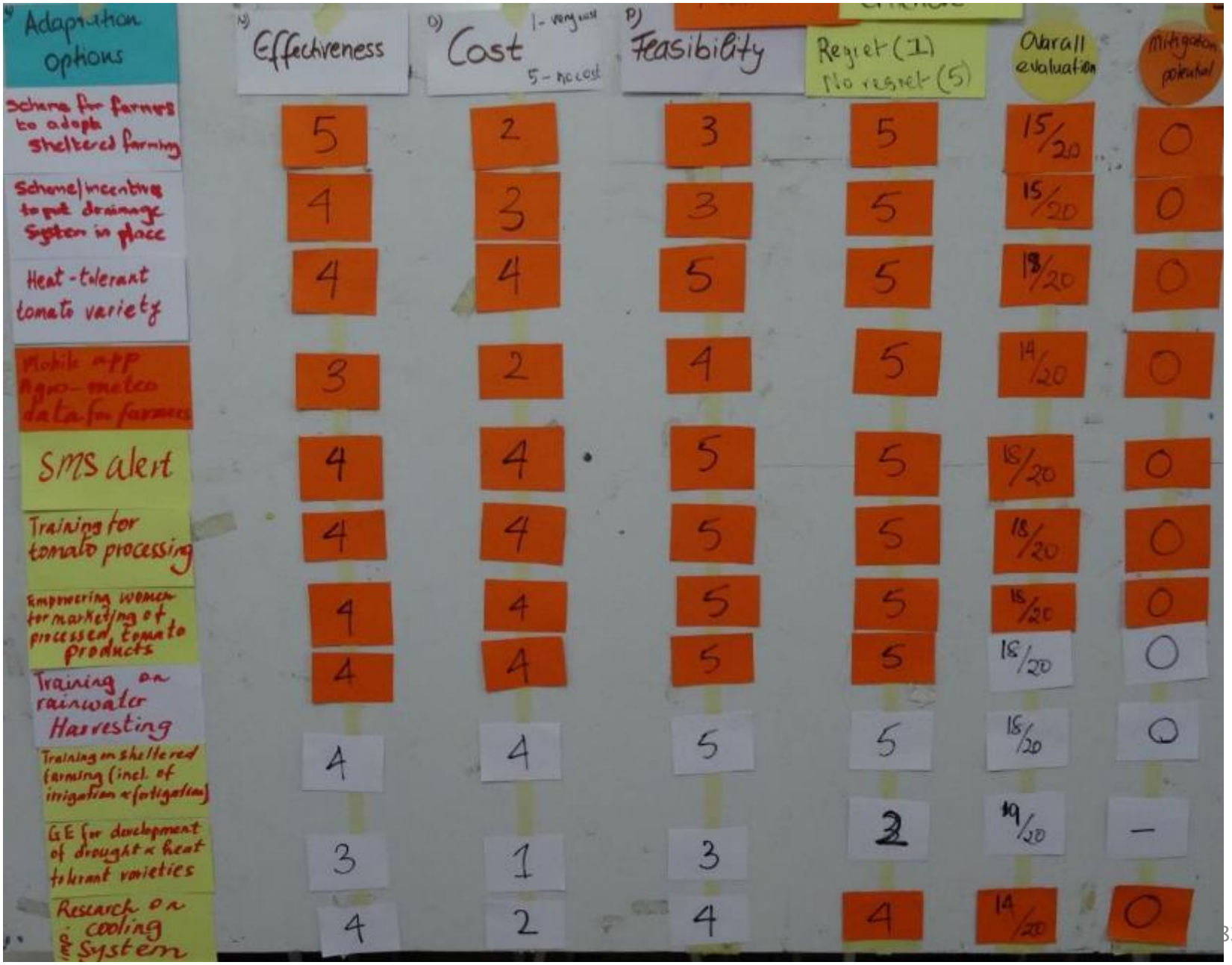
Tomato

Module A.1 – current situation
Case 3: Tomato

Module A.2 – future situation
Case 3: Tomato

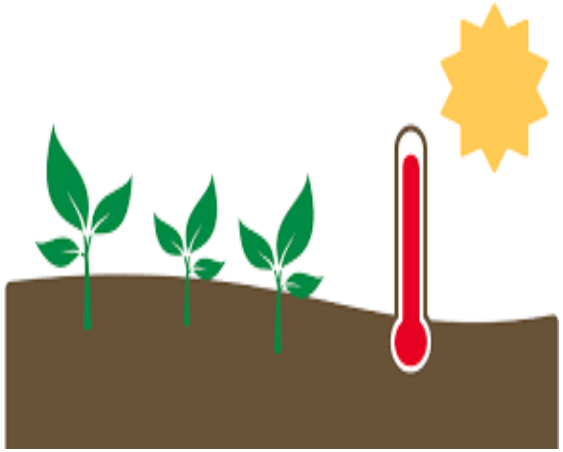
Module B - Case 3: Tomato

Module C - Case 3: Tomato



Presentation of final adaptation measures Tomato

Case Study: Tomato



Tackling Climate Change Workshop

Case Study Group Presentation

22/6/18

By: Ram, Hudaa, Shemida, Julia, Gerard, Appadou

What is our system of interest?

Open-field tomato cultivation in the North of Island of Mauritius

What is our development goal?

To maintain tomato production during rainfall season and drought period

Assessing the risk and defining the need for action

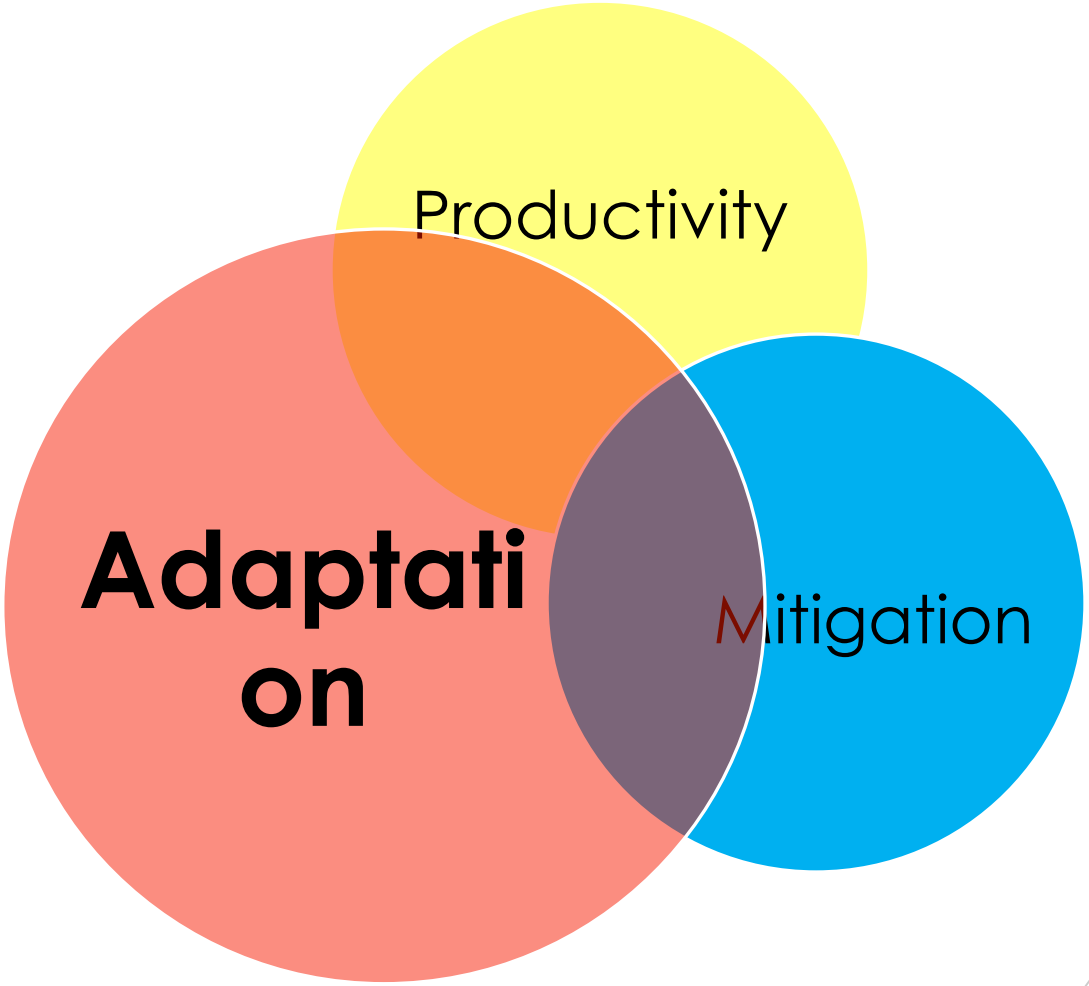
What are the climate hazards to which tomato cultivation in the North is exposed to?

- (i) Heavy rainfall
- (ii) Flooding
- (iii) Drought
- (iv) High summer temperature

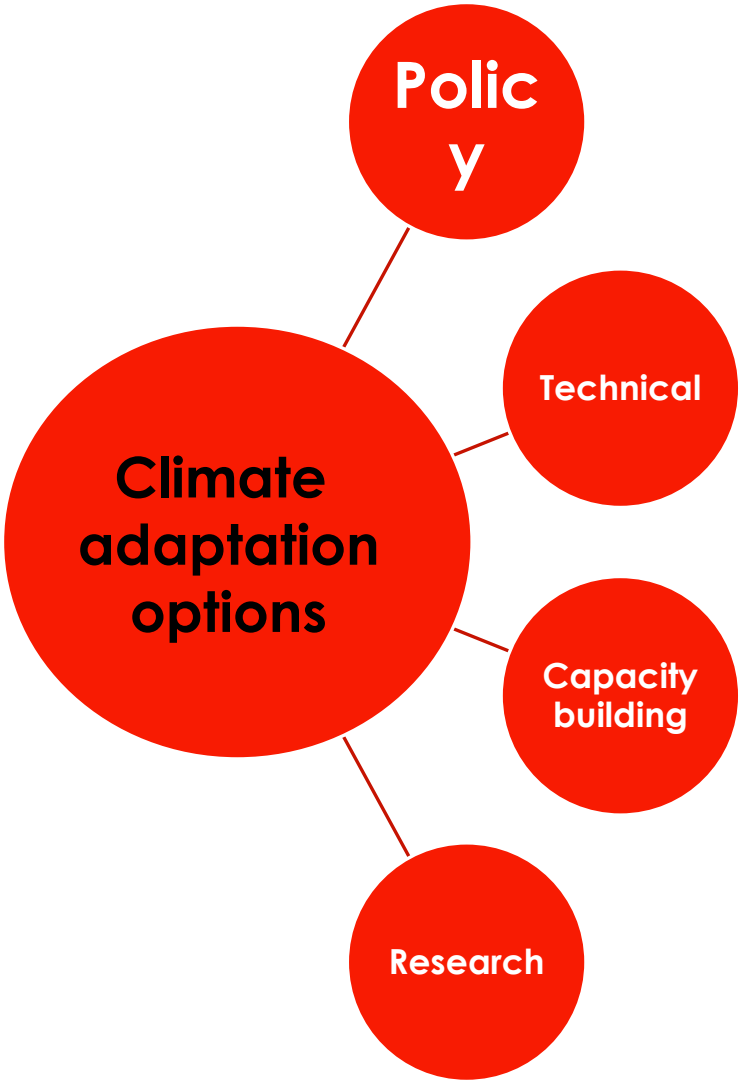
What are the high risk impacts on tomato cultivation in the North?

- **Biophysical damage:**
  - Leaching of nutrients to aquifers and water bodies
  - Eutrophication of water bodies → Harmful algal blooms
  - Heavy crop damage
  - Impairment of tomato quality
- **Socio-economic damage**
  - Severe yield decrease
  - Loss of farmers' income

Can climate-smart agriculture approaches be adopted for the tomato crop?



What are our adaptation options?



All possible adaptation options!

Policy	**Scheme for farmers to adopt sheltered farming**	**Scheme/incentives to implement efficient drainage system in-field**	
Technical	**Adoption of heat-tolerant variety of tomato by growers**	**Provision of an agro-meteorological mobile application for farmers**	**SMS (Short messaging Service) Alert**
Capacity-building	**Training on sheltered farming including sheltered structures, cultivation practices, irrigation and fertigation**	**Training on roof-top and surface rain-water harvesting**	**Training on tomato processing** **Empowering women for value-addition of tomato**
Research	**Genetic engineering to develop drought- and heat-tolerant tomato varieties**	**Research and development on smart cooling system**	

What are the best adaptation options for tomato cultivation in the North?

Short-listed adaptation options	Effectiveness	Cost	Feasibility	Regret/No regret	Overall evaluation	Mitigation potential (+/0/-)
Scheme for farmers to adopt sheltered farming	5	2	3	5	**15/20**	0
Scheme/ incentives to implement drainage efficient system in fields	4	3	3	5	**15/20**	0
Adoption of drought & heat-tolerant varieties	4	4	5	5	**18/20**	0
SMS (Short messaging service) Alert	4	4	5	5	**18/20**	0

Best adaptation options	Effectiveness	Cost	Feasibility	Regret/No regret	Overall evaluation	Mitigation potential (+/0/-)
Training on sheltered farming including cultivation practices, irrigation and fertigation	4	4	5	5	**18/20**	0
Training on rain-water harvesting	4	4	5	5	**18/20**	0
Training on tomato processing	4	4	5	5	**18/20**	0
Empowering women for value-addition of tomato	4	4	5	5	**18/20**	0

So, why should GCF fund this project?

- Climate change effects on our crop cultivation are unavoidable and already palpable!
- Tomatoes feature among the four main foodcrops in Mauritius in terms of volume of supply on the local market.
- Tomato cultivation is negatively affected by the following climatic variables: (i) precipitation and (ii) temperature
- The main climatic hazards for tomato cultivation in the North are (i) heavy rainfall, (ii) flooding, (iii) drought and (iv) high temperature

So why should GCF fund this project?

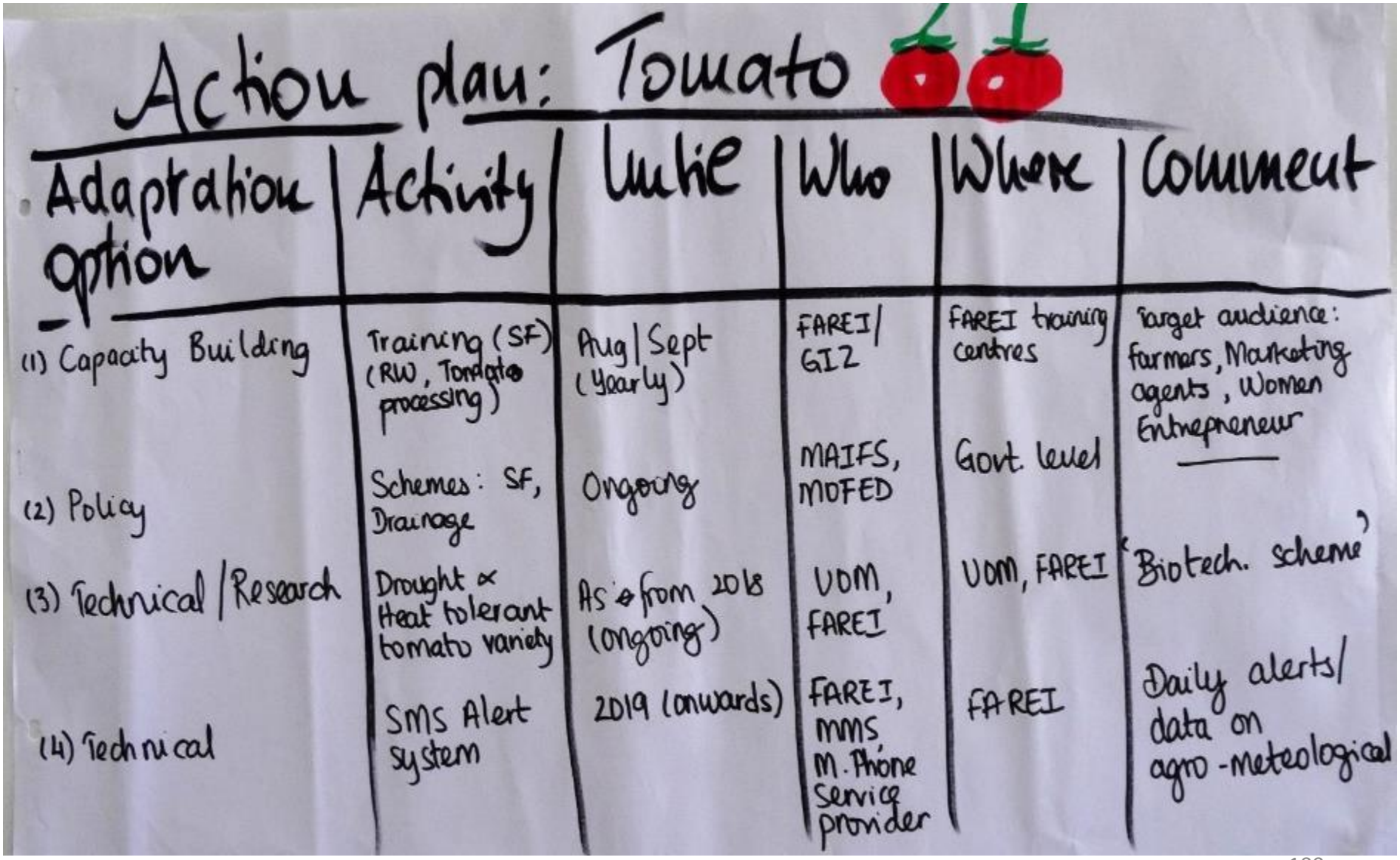
- **In order to climate-proof tomato cultivation and maintain the same level of productivity under adverse climatic conditions, we need to invest in a multi-pronged adaptive approach**
- **This four-pronged approach involves investing in technical measures and research, putting in place an enabling policy for tomato growers and building in capacity in all actors involved in the tomato value chain.**


Thank you for
your attention

Q&A Final presentation
Tomato

- Incentives here are tied to adopting certain practices – that is good, rather than just giving incentives with a goal (as in the lychee case)
- Keen to see value for money – how many people with benefit
- With drought and temperature tolerant varieties – would the mitigation potential not be positive? You use pesticides and fertiliser. ….
  - No…..
- Do we have the right varieties already?
  - These varieties do not yet exist – they are not yet performing well enough in the field – these are still to be developed
- SMS alert – meteorological data needs to be bought from the met services, FAREI already provides disease alerts, why not use that system
- We already offer trainings in the way that you are suggesting, so what is new?
  - We need to do this in a more timely manner

Action plan Case 3: Tomato



Action plan: Tomato

Adaptation option	Activity	When	Who	Where	Comment
(1) Capacity Building	Training (SF) (RW, Tomato processing)	Aug/Sept (Yearly)	FAREI/ GIZ	FAREI training centres	Target audience: farmers, Marketing agents, Women Entrepreneur
(2) Policy	Schemes: SF, Drainage	Ongoing	MAIFS, MOFED	Govt. level	
(3) Technical/Research	Drought & Heat tolerant tomato variety	As from 2018 (ongoing)	UOM, FAREI	UOM, FAREI	'Biotech. scheme'
(4) Technical	SMS Alert system	2019 (onwards)	FAREI, MMS, M. Phone Service provider	FAREI	Daily alerts/ data on agro-meteological

Reflecting the overall Climate Proofing process by participants

- In Module C more criteria can be introduced (e.g. gender or urgency) to proof the adaptation options
- Positive effects could be emphasized during the Climate Proofing
- More clarity on the mitigation potential was needed (e.g. do we focus on immediate measures or are we looking beyond?)
- More information needed on “underutilized” crops esp. for their nutrition benefit
- The multi-criteria analysis embeds a certain subjectivity → there are more tools to analyse options (cost-benefit and cost-efficiency-analysis)
- How to manage different stakeholders in the CP process? The more perspectives you include, the better (multidisciplinary, from policy to farm-level)
- Use “mitigation potential” as an additional criteria or give more rating levels? The criteria will also depend upon the development goal chosen for the system of interest
- Include farmers and the policy level as participants in the course
- Strong wish for networking of the CP Mauritius group (Facebook/WhatsApp)

Presentation 6: Climate change and marine environment by Dr. Satyam Bhoyroo, FoA

The presentation started with facts about climate change like the increasing global temperature and a map showing the surface temperatures of the world‘s oceans. The presenter then explained a map showing the average sea surface density. In dense regions, the surface water becomes dense enough to sink and joins the deep ocean currents (Thermohaline circulation). This circulation has a strong effect on the Earth's climate, influencing the Gulf Stream, El Niño events, and both past and future climate shifts.
Oceans remain the largest sink of CO_2 which leads to a phenomenon called ocean acidification. By the uptake of CO_2 from the atmosphere, the pH of the ocean decreases. Both, increasing ocean temperature and acidification have negative impacts on sea life (coral bleaching, decrease of zooplanktons, habitat of mangroves, algae bloom). These bio-physical impacts result in socio-economic ones like negative effects on aquaculture and on artisanal fisheries. The loss of mangroves has direct impact on coastal fisheries due to loss of breeding ground and nursery for reef fish, prawns and shrimps. Coral bleaching is a threat for 850 million people dependent on reef-based ecosystems for food security and livelihood. Close to 100 countries benefit from coastline protection, tourism and fisheries, supported by the biodiversity hosted by coral reefs. And a quarter of the 100 countries benefitting from coral reefs depend on tourism for more than 15% of their GDP.

Q&A

- Can we use artificial corals in our lagoons?
  - fish enjoy the new corals (food ground). Normally, corals need to grow in the best conditions, sensitive to temperature.

Presentation 7: Perception of CC by the Youth in Mauritius by Julia Carpouron, Student at the UoM

Julia presented the results of a survey undertaken by her and a team of UoM students on the perception of climate change by the youth in Mauritius. The primary goal of this research was to capture the understanding, views, beliefs, attitudes of the youth in Mauritius, and the action they take to tackle the impacts of climate change. 120 respondents aged between 13 and 25 years answered the questionnaire. 95.08% of the candidates acknowledged that climate change is happening. 77.05% showed an understanding of the term "climate change", but only few identified CO_2 and other GHG as the main cause for CC. Knowledge on the impacts of climate change showed a weak positive correlation with age. Knowledge on the impacts of climate change showed no significant correlation with gender and academic qualification. Asked what they have done to reduce the impacts of CC, most of the respondents answered "nothing yet". 11% are not aware of mitigation measures.

As a conclusion of this survey, Julia summed up that:

- Mauritian youth is aware of the phenomenon of climate change
- Pollution to be the main cause of Climate Change according to them
- Lack of knowledge on mitigation measures

Day 3 – overview

- Directly after the opening, Dr. Simbarashe Sibanda gave a presentation about "**Nutrition-sensitive planning in agriculture under CC"**
- Subsequently, each of the working groups presented the **results of the Module A**. Questions and some corrections were made by the groups themselves and the facilitator.
- This was followed by an action learning exercise in plenary about **types and dimensions of adaptation options**
- The group then split into working groups again to work on **Module B: identifying adaptation options**
- After the lunch break, the group started to their **excursion to a sheltered farm in Plaine Magnien,** close to Mahébourg airport, about an hours drive from the training venue.

Presentation 8: Nutrition-Sensitive Climate-Smart Agriculture (NSCSA) by Dr. Simba Sibanda, Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN)

Simba started with the definition of Food and Nutrition Security by the FAO: "Food and Nutrition Security exists when **all people at all times** have physical, social and economic **access to food**, which is safe and **consumed** in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, **health services and care**, allowing for a healthy and active life."

He then gave examples of **malnutrition** and explained the triple burden of it (overweight & obesity, undernutrition and micro-nutrient deficiency). Malnutrition and diet are the biggest risk factors for the global burden of disease, responsible for over 70% of mortalities. Nutrition is central to achieve the **Sustainable Development Goals** (SDGs). At least 12 SDGs contain indicators that are highly relevant for nutrition. **Improved nutrition** has a positive impact on health, education, employment, female empowerment, and poverty and reduction of inequality.

Simba then explained the **link between agriculture to food and nutrition security**. Agriculture is fundamental to food production and the link to nutrition through food use via food availability and access is apparent (food production → food availability and access → diet food use). **Nutrition-sensitive Agriculture** is an approach that addresses disconnections between agriculture and nutrition, seeks to ensure the production of a variety of affordable, nutritious, culturally appropriate and safe foods, in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner. **CC** will have negative effects on **global food supply**, e.g. global agricultural production could fall by 2% per decade through 2050 and global food demand will be increasing by 14% each decade because of population growth, urbanization, and increased incomes. This calls for a the need for **Nutrition-sensitive CSA:** need to **integrate nutrition into CSA**, integrate the **traditional objectives** of agricultural development (production, productivity, food security and income) with nutrition. One can do this at various points along the **agriculture value chain.**

Q&A

- We need to be careful about what we produce in Mauritius since we do not have much land
  - We need to start looking at food systems which include looking at all processes required to meet food needs – Mauritius will never be food self-sufficient. Policy needs to provide guidance on what we should produce locally and what should be imported. E.g. fresh foods rather than staple. When we import, government needs to ensure that nutrition issues are also on the table when making decisions about what can be imported. There is a lot of power in regulation
- Vegetables on display are always the same, we don't have a lot of variety
  - Some disagreement in the group about this statement
- We should also give importance to food safety. We may have nutritious food but it is not safe
  - That is why these two go together: we aim for nutritious and safe foods. Yes, food safety control is important and part of the health component of nutrition
- Food we find on supermarket shelves are highly processed, we have a huge problem in Mauritius with this – on local production and imports. Consumer education is a huge issue, currently we accept what we have and this is not good.
  - Yes, consumer education is strategic but long term, this is what will make companies change
  - Globally FAO asked major companies to change what they produce in the next 3 years. Problem that global food companies are very powerful , there are only about 10 that produce the majority of our food. There is a huge potential though consumer choice to change things, especially with social media. But this requires investment in capacity development and awareness creation so that consumers can make effective demands for change.

Excursion to Plaine Magnien

Skills and Entrepreneurship Development Programme for Educated Youths

The project is an initiative of the Ministry of Agriculture aiming at modernisation of the local food crop production subsector as well as promotion of sustainable farming practices especially among younger segment of the population.

It comprises the setting up of a sheltered farming park on State Land at Plaine Magnien in the district of Grand Port. The whole park is intended to serve as facilities for promotion of sheltered farming systems and encourage, as well, venture of Mauritian youths in agricultural production as an economic activity.

The sheltered farming park comprises 10 modular units, covering each, a floor space of one thousand nine hundred and eighty-nine and seven-tenths square metres (1,989.7m2), equipped with irrigation / fertigation facility.

After an expression of interest and a selection process, the Ministry has enrolled, under the Programme, a group of nine Trainees and provided them with formal training in sheltered farming systems undertaken by the FAREI. Each Trainee has benefitted a modular unit within the park, where technical support and other handholding assistance are provided by the FAREI to enable them to undertake crop production activities on their own.

Training focused on adapted crops and production technologies (with emphasis on fertigation and vertical production) taking full advantages of the protected environment.

The conducive environment instilled during this incubation phase would expectedly see the Trainees gain skills and experience they need to create self-employment opportunities with decent revenue generation potential in the non-sugar agriculture subsector. Project is fully in operation as from early 2018 with the availability of irrigation water and electricity.

The Ministry is implementing the Programme jointly with the Food and Agricultural Research and Extension Institute (FAREI), in collaboration with the MyBiz and the Human Resource Development Council. The latter institution is funding the monthly stipend being provided to them.

Impressions

Day 4 - overview

- The day started with the **recapitulation of the excursion** within the plenary
- This was followed by a presentation about "**Strategies in sustainable intensification of livestock"**
- The group then split again in working groups to work on **Module C: Selecting adaptation measures**
- Then a presentation on **"Protected culture"** was given
- Afterwards, the working groups had time to prepare their **final presentation** on the climate proofing of the respective system of interest
- A presentation about "**CC with a value chain perspective**" concluded the day

Recapitulation of the excursion – I

1) What are the climatic challenges for the sheltered farms at the site?

- heavy rainfall and higher temperatures

2) How do these challenges influence the systems?

- Water logging → death of plants
- Higher temperatures → flower drops
- Impact on human health
- Pest and diseases
- Higher yields for beans (indirect effect)

Recapitulation of the excursion – II

3) What kind of adaptation measures did you observe?

- The shelter of the farm itself
- Inter-cropping
- Drainage system
- Plants/herbs outside the shelter to attract plants
- Vertical planting
- Drip irrigation
- Water storage
- Adapted varieties

4) Where do you still see room for improvement?

- Different shape of the roof (concave)
- Use different building material (replace mesh)
- Mesh on top to be replaced by a plastic roof (???)
- Collect rain water on top of the mesh (cost implication needs to be analysed)
- Mulching
- Structure of the sheltered farming itself (is it really appropriate for Mauritius or maladaptation?)
- Putting vertical nets to separate plant rows to avoid pest migrate from one row to the next
- Install bee hives inside the sheltered farm
- Improve the fertigation system

Presentation 9: Strategies in sustainable intensification of livestock production and its role in CSA by K. Boodhoo, FoA

The presentation started with background information on livestock - **70%** of the world's rural poor rely on livestock for their livelihoods. There are **600 million** poor livestock keepers in the world, around 2/3 are **rural women**. 3 livestock **production systems** are differentiated: grazing systems, mixed systems and industrial systems.

Livestock contributes to **16 SDGs** in terms of economic growth, equitable livelihoods, basic nutrition and health and sustainable ecosystems. But: animal production also has **environmental impacts** such as GHG emissions, nutrient excretion, land usage and energy expenditure through the use of fossil fuel. The speaker gave several examples on these impacts. He then linked **CC dynamics to livestock production**, explaining the manifold impacts on the systems. E.g. changes in rainfall impact on crop and pasture growth, water, pests and diseases. The presentation concluded with **areas of interventions** for **climate-smart livestock practices** and showed numerous strategies and potential for **emission saving and adaptation measures**.

Q&A

How to reduce carbon emissions from livestock systems?

- Become vegetarian
- It depends on the context – it is an important source of livelihood and animal protein in our part of the world, but definitely some parts of the world do need to reduce their meat consumption.

Presentation 10: Protected cultivation: an alternative for farmers to adapt to effects of CC by Navindra Boodia, FoA

The presentation started with the definition of **Protected Cultivation (or Sheltered Farming/SF**), which is a cropping technique wherein the **micro climate** surrounding the plant canopy is controlled partially or fully as per the requirement of the crop species. **Six types** of protected structures can be differentiated: mini cloches, mini tunnels, low tunnels, high tunnels shade house and insect-proof net house. These structures differ in the level **of climate control** that they confer, the degree of sophistication and in the costs. In Mauritius, farmers are encouraged to shift from traditional open field cultivation to sheltered farming system. 50% of investment costs (up to max. Rs 250,000) is granted.

Amongst the **advantages** of SF are: protection against winds, minimize the impact of heavy rain, prevent soil erosion, reduce leachates to the soil environment, reduced usage of crop protection chemicals.

Siting and design considerations have to be taken into account. Constraints for farming in the tropics are for example intense heavy rainfall (flash flood), storm, strong winds, insect pests, high daytime temperature. This results in a need for special requirements for tropical SF. Most of these have to do with the **site selection and design features**: covering materials, GH orientation & structural materials and set-up. For a site selection one has to avoid marshy land and flood-prone areas. A region with established **drainage systems** should be chosen as well as land that slopes down to nearby canals. **Natural wind-breaks** are positive, but shading trees need to be avoided.

The speaker then elaborated more on the technical details of the structures and the materials. In context of CSA, SF can serve as a means to implement **biological control**, **water harvesting** and **organic farming**.

Presentation 11: CC in agriculture with a value chain perspective by Dr. Brinda Ramasawmy, FoA

Brinda started her presentation with the **definition** of a **value chain (VC)**: the path by which a **product or service is created and marketed**. This path might include input suppliers, growers, transport and storage, processors, wholesalers, retailers and consumers, as well as governance and support institutions. **Agri-food** VCs are critical systems for delivering food security, contribute significantly to economic stability and add to consumer confidence. The **impacts of CC** are felt along the whole chain of actors that produce, handle, process and market agri-food products. **Adaptation** of a VC to CC is therefor key to sustain its competitive advantage in a changing climate. An adapted value chain is one where participating businesses, from farmers to retailers, are able to harness joint strategies to continue delivering value to the consumer, and as such, deliver value to the members of its chain. The speaker then presented **two case studies** on adaptation of VCs. She then brought up some **research questions for the Mauritian context**, namely:

- Are we taking a holistic approach to CC adaptation and mitigation by taking a whole-of-chain perspective?
- Are we considering CC impact on the agricultural sector only as a threat or as an opportunity to produce adapted products?
- Are we focusing our research at the farming level only and ignoring the flow-on effects across the agri-food VC?
- Do agri-businesses adapting to or mitigating CC factors take into consideration the needs of consumers?

She then showed **potential objectives** to promote adapted Mauritian agri-food VCs:

1. To **increase capability** of businesses to take effective adaptation action through awareness of the impacts of CC on VCs,
2. To **increase awareness** of new and relevant adaptation and mitigation options available for businesses to consider within their VCs,
3. To **enhance the capacity** of agrifood businesses to collaboratively evaluate and adapt to the impacts of CC.

Q&A

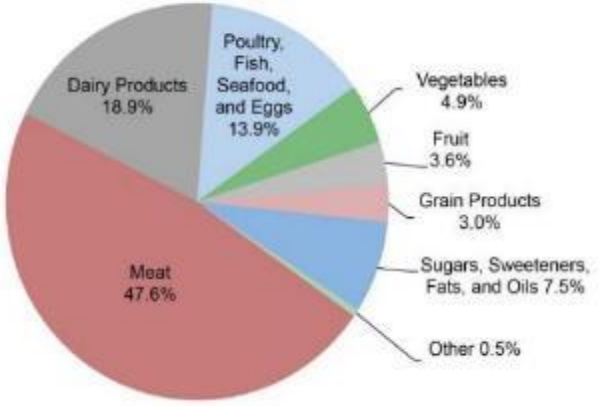
- I was thinking about the way we buy food – focus is on buying healthy food. For the consumer to go into adaptive products – are they aware of the climate impacts on the value chain? How can we improve this in the local context?
  - It comes down to consumer purchasing power – it is an issue in Mauritius – the richer consumers can afford to buy organic, healthy or other foods. We are putting emphasis on price, not quality. Consumers will say that they would buy the products if they have more money
  - Consumer education is important – more money does not mean consumers choose to invest in healthy or adapted food. They might buy a new TV instead
  - For electronic products, consumers buy energy efficient products – and it works for health consciousness to some extent
  - Not clear how adapted products will directly benefit the consumer
  - We could also have consumer contribute a small premium to support certain farming systems
- Companies change for their image – getting consumers to change takes time
- Mauritius' import regulations are not restrictive and we import all the processed foods – what are we feeding to our population is problematic

Day 5 - overview

- After the opening the first group held their **final presentation.**
- Before the 2nd and 3rd final presentation, a PowerPoint presentation on "**Carbon footprint in agriculture**" was given.
- After each presentation of the final adaptation measures, questions were asked by the audience and the **results discussed.**
- This was followed by a **reflection and conclusions** of the CP approach – what did you learn, how can you apply CP in your own work?
- Each group then drafted an **Action plan** with adaption measures, activities, a time frame and responsibilities to implement the selected measures.
- The presentation part ended with Wiebke giving an overview of CCARDESA's **Information, Communication and Knowledge Managment**
- The training ended with the evaluation and hand over of **certificates** and USB sticks to each participant

Presentation 12: Carbon footprint in agriculture by Prof. B. Lalljee, FoA

A **carbon footprint** is the recording of total GHG emissions (both direct and indirect) caused by an individual, event, organisation, or product, expressed as **carbon dioxide equivalent** (CO_e). Carbon footprints are used as a direct measure of the quantum of gases emitted into the atmosphere causing CC.
The Agriculture, Forestry and Other Land Use **(AFOLU) sector contributes about 25%** of human-generated GHG emissions, mainly from deforestation and agricultural emissions from livestock, soil and nutrient management. Reducing agriculture's carbon footprint **is central to limiting CC**. Moving to sustainable agricultural practices will play a key role in limiting global warming to no more than 2˚C.



GHGs from average food consumption

Methods of calculating the Carbon Footprint:
The traditional way of estimating a carbon footprint – so-called **'lifecycle assessment'** – involves adding up as many of the emissions pathways as is feasible.
An alternative approach is to use so-called **'input-output' analysis**. This aims to avoid missing out pathways by taking the total emissions of a country or region, dividing it into relevant sectors, and estimating the total emissions that each sector accounts for. Those figures can then be used to estimate the footprint of, say, each rupee spent in each activity in each sector.

The presenter concluded with some **CSA practices for reducing the carbon footprint**.

Q&A

- Landscape approaches – and many institutions do things but not coordinated – how do we move to a results, how do we better coordinate?
- FAO is funding a regional CSA centre in Mauritius which should bring the different sectors together – we need a cross-institutional focal point
    - Here, we also have more freedom in the system – there is not that much staff turnover and we work closely together already

Presentation 13: CCARDESA's ICKM System by Dr. Wiebke Förch, GIZ

Wiebke gave an overview on CCARDESA's main objectives, being the broker for regional knowledge dissemination on CSA. She then presented the key websites of CCARDESA's Information, Communication and Knowledge Management (ICKM) system. Further she explained to the audience how they can benefit and invited them to participate in the network.

The relevant websites are:

http://saaiks.net
www.facebook.com/ccardesa
www.twitter.com/ccardesaa
CCARDESA D-groups to join the D-Groups, please send an email to: dgroups@ccardesa.org
www.ccardesa.org

The **contact person in Mauritius** is:

Mr Chandrabose Sembhoo
Food and Agricultural Research and Extension Institute (FAREI)
Email: sembhoo@gmail.com

Final feedback round on how far the expectations of the *participants* were met - I

- Expectation of CC and diseases – that was my misunderstanding – happy about the things I heard about though
- Expectation of tools for planning, how to proceed – was expecting more technical detail of adopting detailed practices and technologies – but what I got was new and more at a planning level – so I can use my new skills for proposals
- Wanted to learn about CC and how we can help farmers to adapt – that was fully met
- Learn about CC and agriculture – that was well fulfilled, it was an opportunity to also discuss with each other / also wanted to learn about tools – this was met through the CP tool – overall, I got motivation to learn more and access additional resources
- Thanks for your time and energy – it was good to meet other players in Mauritius and exchange. I had expected to learn about CS concepts, crop management and analytical tools – I am happy to learn that a lot of good practices that we are already using or promoting are already in line with the CS concept. We learnt how to use a CP tool with all its strengths and weaknesses – and we can adapt the tool to our respective context and improve our own tools and processes. I will take it back to my colleagues
- Very enriching experience, my first workshop, get to know our local experts and other players in the country. My expectation was to understand CC in agriculture – this was fulfilled. I am happy that I can apply the CP tool also to my work in aquatic systems. That is more than I expected
- The didactic of the training was very new and it was a very good way to learn new things. I had expected computer modelling. I was keen on sugar cane, but we got other crops. Overall very happy though.

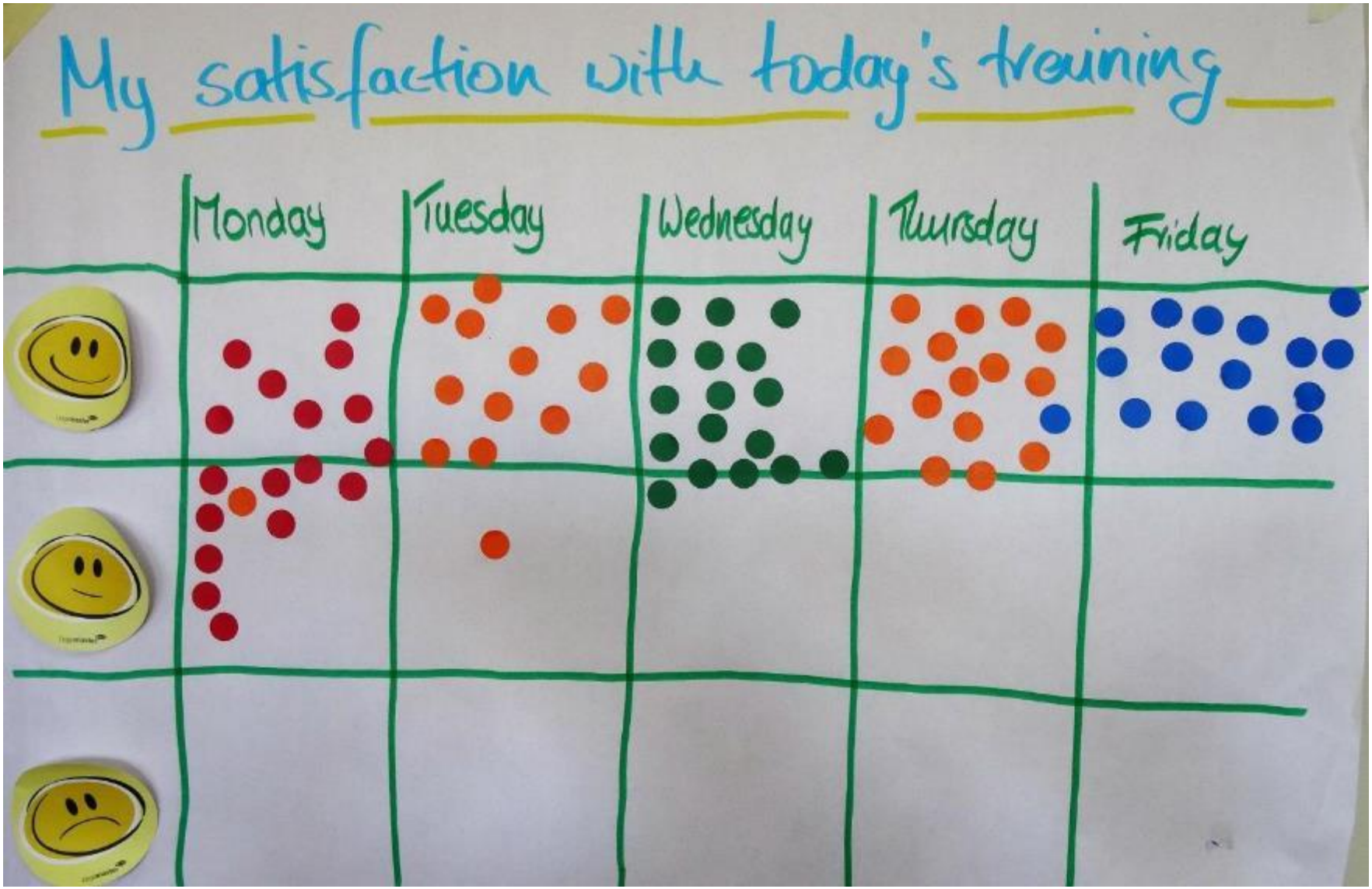
Final feedback round on how far the expectations of the *participants* were met - II

- Thank you! I wanted to know about adaptation and mitigation measures in agriculture – my expectation was met. I will use them in preparation for training materials for farmers. I will start with CSA materials next week.
- Thank you. Expected to gain information about mitigation based on other experiences. My expectations was met. The CP tool was very good. It will help me in my research work
- Expected to improve my knowledge to pass on to farmers. On Monday I have a meeting on CSA with farmers involved with the Ministry – so this will be a continuous action in my work. I also get called to participate in policy. Thank you, this will help me a lot. Thanks to all, it was fun!
- Expect to learn about mitigation and learn about new technologies for adaptation. This was met. The sheltered farming was also very good. I will apply this in my work
- Expected to improve knowledge about practices and what others are doing. I learnt some. But I was interested also in use of renewable energy in agriculture. Not much. But I was impressed with the method of teaching – easy to grasp and the knowledge stays with us. We have learnt to be more focused on climate hazards and how we can improve our work and be more focused
- I learnt a lot – coming from a completely different background
- Expected to gain practical knowledge and tools – I am happy that you shared an approach that can guide us in our thinking and our work. A tool that will help us to be focused, down to earth and broken down into pieces that are easy to understand. I was expected to get tools – but I had to do this myself. It has helped me to look at the basics and I will bring that into my work in the sugar cane sector. I liked the interactive and enriching approach

Final feedback round on how far the expectations of the *participants* were met - III

- Coming from marine science, I just wanted to learn about CC in agriculture. so I learned a lot about agriculture and about CC. it was really interesting. We had fun with this group of people.
- Expected to get new knowledge and how to face CC – I had been so focused on soil management and other things and a lot of new things have enriched my mind. I am more conscious how to adapt and take my new knowledge. The CP has impressed me – leading us to a solution. It was the first time in my many workshops that I got something useful out of it.
- Expected to get new tools that are practical, innovative and sustainable – I learnt many things in this group, the quality of people who excellent. The way the training was delivered was nice to the ear, easy to follow, no stress on the eye. Everywhere we go we usually get bombarded with PPT. See, my friend even brought a pillow ;-). Everyone noted the level of satisfaction with the course in the feedback. We have learned a lot and will excel! Thank you.
- Expected to discuss barriers to adaptation and mitigation – we discussed all this. But I would have had other expectations if I knew more about the course. The training was very useful, we knew only the topic in a haphazard way. Now we can position our knowledge clearer in our teaching. I enjoyed the action learning, it is hard to do in class but it is a good way to impart knowledge. We did not discuss the barriers fully. But in general I am very happy! We are all more sensitive to CC impacts now and will reflect on our behaviour
- Special thanks to all the presenters from the university to share their expertise
- Now it is up to us to apply our knowledge in our own personal and professional context – we can now take ownership and change our behaviour to be mindful of our carbon footprint….
- Catalina: I wanted to learn and work in a relaxed atmosphere. It was super working with you. You took a lot of burden off, everything was understood quickly and you were very organised, saving time, nice discussions in groups and in plenary. We managed with the facilities. I learnt a lot about agriculture in Mauritius.

Daily evaluation



For further information

- ✓ www.ccardesa.org
- ✓ www.africacsa.org
- ✓ www.fao.org/gacsa/en
- ✓ http://saaiks.net
- ✓ www.wocat.net
- ✓ www.agriwaterpedia.info
- ✓ www.fao.org/climate-smart-agriculture/en
- ✓ www.adaptationcommunity.net
- ✓ www.cip.csag.utc.ac.za
- ✓ https://csa-guide.ccafs.cgiar.org
- ✓ Join-climate-l@lists.iisd.ca
- ✓ www.worldbank.org (then search for climate change knowledge portal)

Tools for measuring sustainability on a farm:

Self-evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists (SHARP)
http://www.fao.org/in-action/sharp/en/

RISE – getting sustainability down to earth
https://www.hafl.bfh.ch/en/research-consulting-services/agricultural-science/sustainability-and-ecosystems/sustainability-assessment/rise.html

Sustainability Assessment of Food and Agriculture systems (SAFA)
http://www.fao.org/nr/sustainability/sustainability-assessments-safa/en/

Thank you!!!