A participatory approach to identify diversification options for climate adaptation

Gennifer Meldrum, Dunja Mijatović, Rose Robitaille, Harouna Coulibaly, and Stefano Padulosi

Climate Smart Agriculture Conference South Africa

In partnership with:

Diversification is a key climate change adaptation and resilience strategy

- The Green Revolution has led to a simplification of farming systems, which increases their fragility to environmental change and uncertainty
- Diversification is called for as a means to build resilience and support adaptation to climate change
  - Diversity provides an 'insurance effect' that provides greater stability of outputs of the agroecosystem (e.g. harvest and income security)
  - Biodiversity in the landscape provides ecosystem services that support greater resilience (e.g. soil fertility maintenance, erosion control, water retention, wind barriers, pest suppression, etc.)
  - In the long-term genetic diversity enables crop adaptation

Inter alia. Lin 2011, Mijatovic et al 2013, Nguyen et al 2013, Reiss and Drinkwater 2017

Diversification practices at landscape species and variety levels

Diversification of the farm landscape

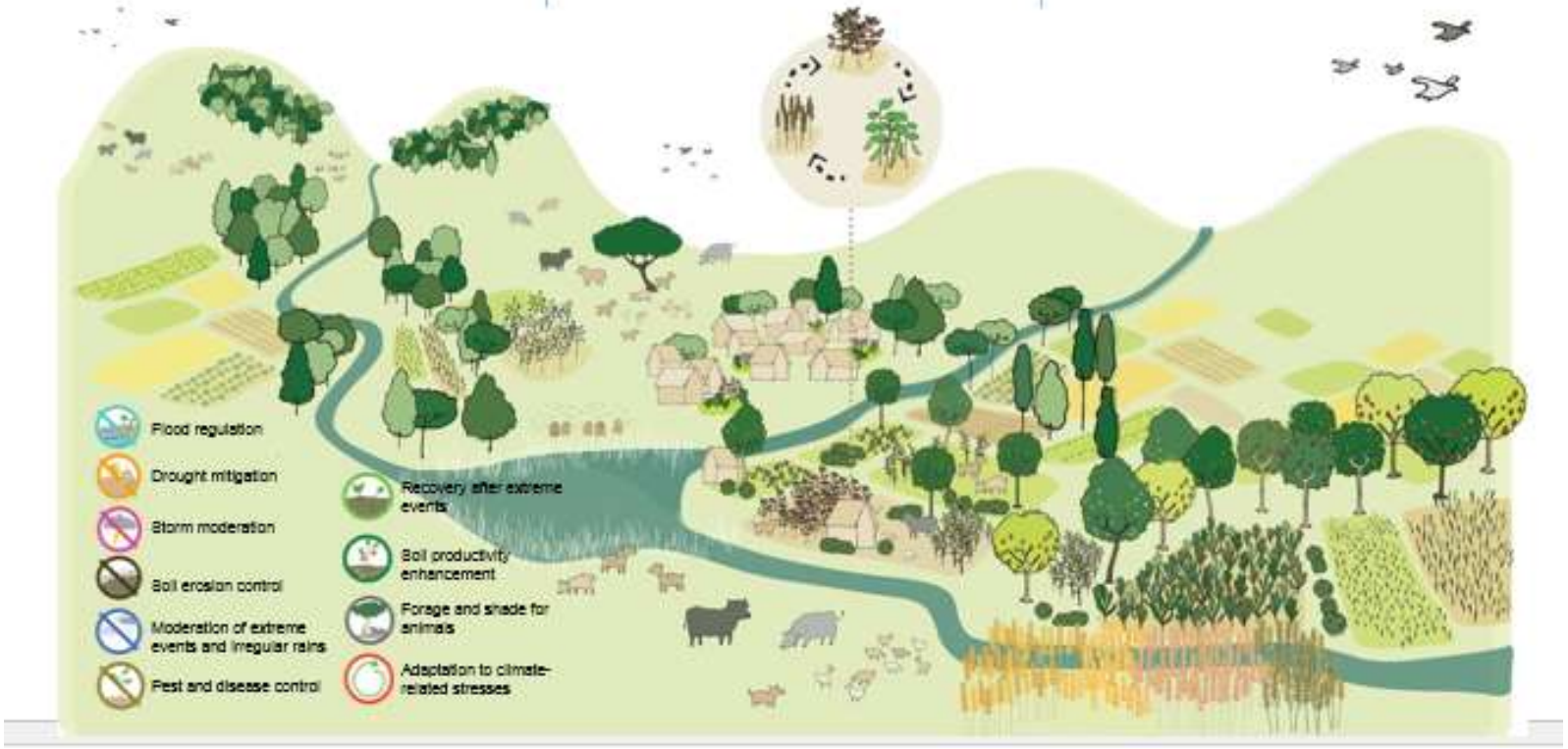
- Land-use mosaic
- Community institutions for ecosystem protection (wetlands, forests, riparian zones), for example, sacred forests
- Grazing and fishing plans
- Restoration activities (for example, tree planting)

Diversification of cropping and production systems

- Intercropping, crop rotation, et cover crops
- Agroforestry
- Integrated crop-livestock production
- Cultivation of species with traits such as early maturing, drought tolerance, pest tolerance, and disease resistance

Increasing crop varietal diversity

- Planting multiple varieties
- Planting variety mixtures
- Cultivation of varieties with traits such as early maturing, drought tolerance, pest tolerance, and disease resistance



Practical guidance needed for locally-specific diversification strategies

We have been developing a simple framework/ workshop tool to

- Identify local crops, varieties and landscape features that provide resilience functions critical for climate change adaptation and risk management
- Reflect on how they may be better integrated and leveraged in the agroecosystem for improved resilience
- Assess major gaps in the resilience portfolio of farm systems

The end user envisaged for the tool are **farmers and rural advisors**

Workshop flow

1. Understanding perceptions and experience of climate change

- Climate change timeline, seasonal calendar, discussion of major challenges

2. Introduction of general diversification options

3. Assessing resilience functions at landscape, species, and variety levels

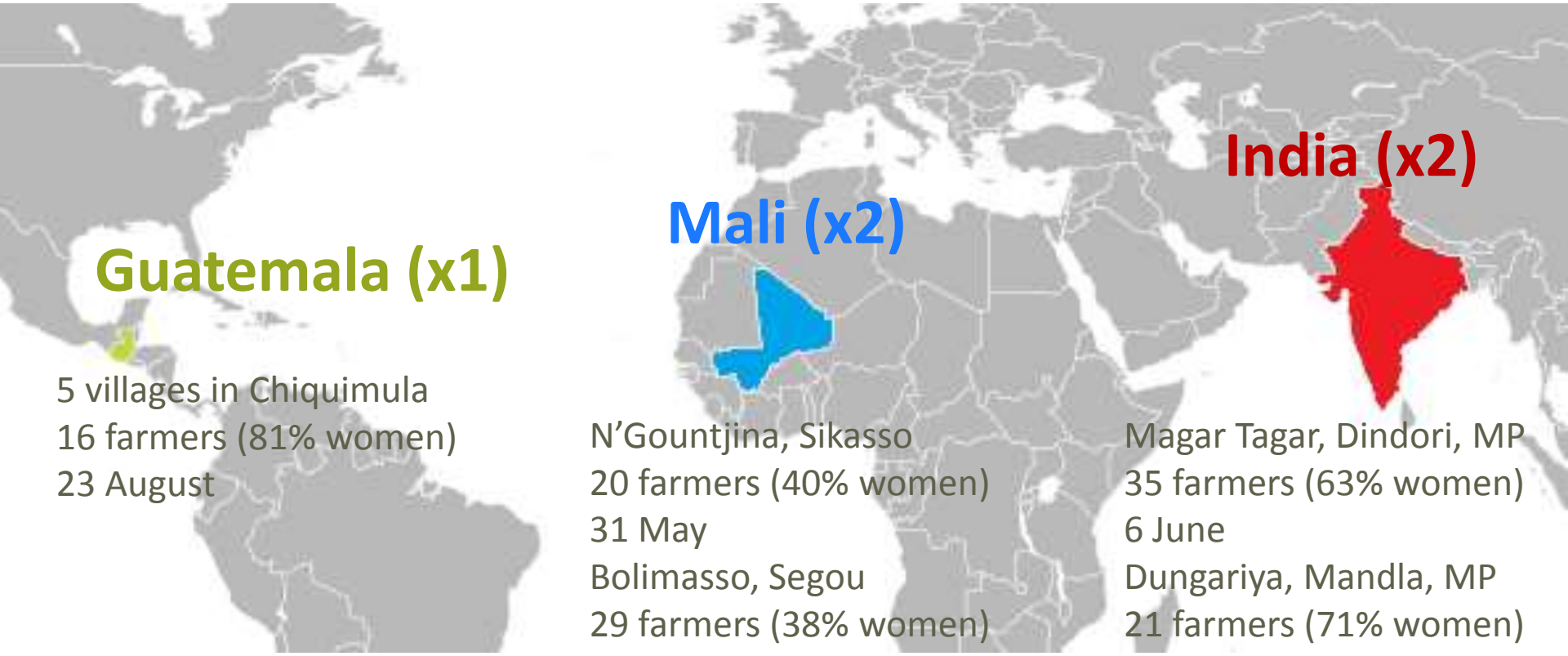
- Mapping land use, assessing species and variety portfolios for different food and functional groups

4. Evaluation and discussion of diversification options and strategies

- Which crops stand out as resistant to climate change challenges? How could they be leveraged for adaptation?
- What are possible portfolios of crops and varieties that would ensure multiple resilience functions are covered
- Where are gaps in the resilience portfolio?
- What diversification actions can be taken at the landscape level to improve resilience?

Pilot test in three diverse countries

5 workshops between May and August 2017
Mixed groups of 16-35 participants (38% - 71% women)



Guatemala (x1)

5 villages in Chiquimula
16 farmers (81% women)
23 August

Mali (x2)

N'Gountjina, Sikasso
20 farmers (40% women)
31 May
Bolimasso, Segou
29 farmers (38% women)
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India (x2)

Magar Tagar, Dindori, MP
35 farmers (63% women)
6 June
Dungariya, Mandla, MP
21 farmers (71% women)
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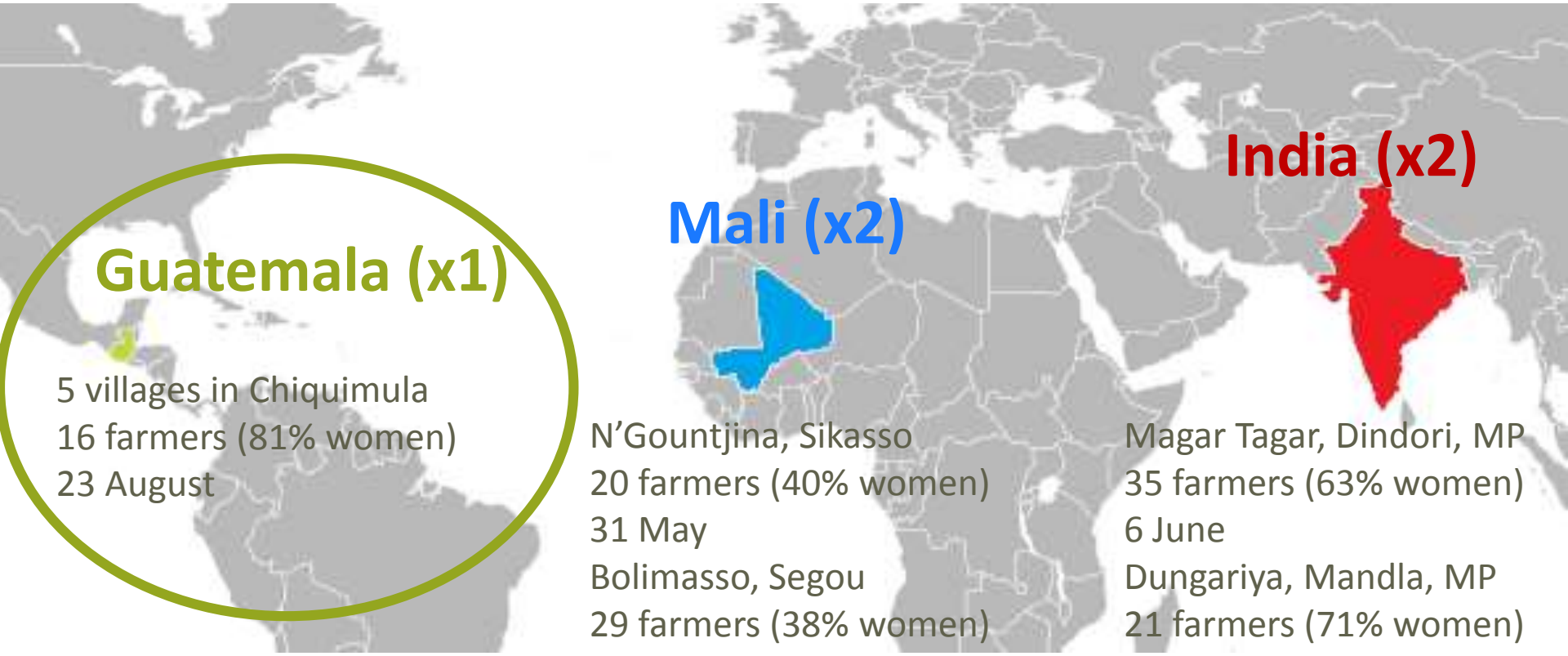

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Challenges of climate change

Climate change timeline and annual calendar exercises revealed:

- Changing seasonality, rains more unpredictable
- More drought (e.g. 2010-2017)
- More hurricanes, stronger rains, landslides
- Increasing pest and disease pressure
- Changing climate has interacted with deforestation such that water sources are now more scarce, streams and wells are running dry
- Soil erosion is a major concern

Cereal species and varieties

Species	Variety	Resilience functions					
		Drought tolerance	Tolerance to intense rainfall events and storms	Pest resistance	Disease resistance	Adaptability to poor soil	Soil fertility enhancement
Maize	Blanco		✓			✓	
	Amarillio		✓			✓	
	Negro		✓			✓	
	Majoca		✓			✓	
	Zaspeno		✓			✓	
Sorghum	Blanco	✓	✓	✓	✓	✓	

Pulse species and varieties

Species	Variety	Resilience functions					
		Drought tolerance	Tolerance to intense rainfall events and storms	Pest resistance	Disease resistance	Adaptability to poor soil	Soil fertility enhancement
Rice bean		✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Cowpea	Negro	✓✓	✓✓	✓✓		✓✓	✓✓
	Blanco	✓✓	✓✓	✓✓		✓✓	✓✓
	Rojo	✓✓	✓✓	✓✓		✓✓	✓✓
Common bean	Chapa	✓✓	✓✓	✓✓		✓✓	✓✓
	Ostua	✓✓	✓	✓✓	✓✓	✓✓	✓
	Arbolito	✓✓	✓✓	✓✓	✓	✓	✓✓
	Tineco		✓	✓✓	✓✓		✓✓
	Pando	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
	Borbon	✓✓	✓	✓✓	✓✓	✓✓	✓✓
	Chiapaneco	✓✓	✓	✓✓	✓✓	✓✓	✓✓
	Chajan Octubre	✓✓	✓	✓✓	✓	✓✓	✓✓
	Chajan Diciembre	✓✓	✓	✓✓	✓	✓✓	✓✓
	Chajan Cabranza	✓✓	✓	✓✓	✓	✓✓	✓✓
	ICTA Ligro						✓✓

4 additional varieties of common bean (vania negra, vania morada, blanco and amarillo), as well as ice cream bean, were not characterized for lack of time

Livestock

Livestock	Breed	Resilience functions					
		Drought tolerance	Tolerance to intense rainfall events and storms	Pest resistance	Disease resistance	Adaptability to poor soil	Soil fertility enhancement
Cattle	Dairy		✓	Botfly, ticks, Chata,	Blackleg		✓
	Meat		✓	Botfly, Chata,	Blackleg		✓
Goat			✓	Ticks, Chatas	Diarrhea		✓
Sheep			✓	Garrapates, Chatas	Blackleg, diarrhea	✓	✓
Pig				Lice, sand flea, parasites		✓	✓
Rabbit						✓	✓
Chicken	Meat			Vaccinated	Cough, diarrhea, fowlpox	✓	✓
	Laying			Lice	Fowlpox, puspos	✓	✓
Duck			✓			✓	✓
Turkey				Lice	White poop, diarrhea	✓	✓
Pigeons			✓	Lice	Cough, diarrhea	✓	✓

Landscape evaluation

Land uses/cover	Resilience functions					
	Water sources	Food, fodder, medicine	Drought mitigation	Flood regulation	Soil erosion control	Pest and disease control
Tree stands	More water	More medicinal plants and more tree varieties	No issue with drought	No issue with floods	No issue with erosion	Reduces pests and disease
Humid soils		Many foods to eat for humans and for animals	Little issue with drought	Little issue with floods	Erosion level will reduce	Few pests
Drylands	No water sources	Food decreases, sources of employment decrease	We have to have time available to look for water	No issue with floods	Make ditches or barriers	Fumigate with homemade pesticides
Hardpan soils	Water shortage	Little food produced	Do not cut **native trees**	Lots of water in the rainy season	There is soil erosion	By **planting more trees**
Soft and sandy soil	Little water	Only planted in winter, are lands suitable for afforestation	Taking water from another side, rerouting	No issue with floods	By **planting trees**	By **planting trees**
Rocky terrain	Little water	Can make other types of crops: bean, rice bean, cowpea, squash	Do not burn the crop residues	No issue with floods	No issue with erosion	Few pests

A good start

- **Which crops stand out as resistant to climate change challenges?** ✓
  - Workshop stimulated sharing of local ecological knowledge and seed exchange.
- **What are possible portfolios of crops and varieties that would ensure multiple resilience functions are covered** ✓
- **Where are resilience gaps in the portfolio?** ✓
  - Maize varieties all have similar traits, susceptible to drought and pests/disease
- **How could stress tolerant crops and varieties be leveraged for adaptation?**
  - Sorghum could provide an alternative staple
- **Some useful actions identified at the landscape scale**
  - Primarily planting and preserving trees

Portfolios to face climate change challenges

N'Gountjina, Sikasso Region, Mali

Type	Resilience functions							
	Drought tolerance	Tolerance to intense rainfall events and storms	Pest resistance	Disease resistance	Adaptability to poor soil	Soil fertility enhanc ement	Early maturation	Yield
Cereals	Maize (4) Sorghum (6) Fonio (3) Pearl millet (1) Fonio (3)	Maize (4) Sorghum (2) Rice (2) Fonio (3)	Maize(3) Sorghum (2) Rice (3) Fonio (3)	Maize (5) Sorghum (6) Rice (3) Fonio (3)	Maize (1) Fonio (3)		Maize (1) Rice (1) Fonio (3)	Maize (4) Sorghum (2) Pearl millet (1) Rice (3) Fonio (1)
Pulses	BGN (1) Cowpea (2)	BGN (1) Cowpea (2)	BGN (1)	BGN (1)	BGN (1) Cowpea (2)	?	BGN (1) Cowpea (1)	BGN (1) Cowpea (2)
Vegetab les	Aubergine Chili African eggplant Okra	Okra, African eggplant		Aubergine Chili	Aubergine Chili		Aubergine, African eggplant	
Fruits	Mango Lemon Orange	Mango Lemon Orange	Mango (local) Lemon	Mango Orange lemon				Mango Lemon Orange

BGN= Bambara groundnut

Portfolios to face climate change challenges

Dungariya, Mandla district, Madhya Pradesh, India

Type	Resilience functions					
	Tolerance to unseasonal rains	Tolerance to storms, high winds	Insect pest resistance	Heat tolerance	Frost tolerant	Income
Cereals	Paddy (6) Little millet (3) Foxtail millet (3) Kodo millet (2) Barnyard millet (2) Maize (1) Wheat (1) Pearl millet (1) Sorghum (1)	Paddy (4) Kodo millet (3) Little millet (2) Foxtail millet (1) Maize (1) Wheat (1) Pearl millet (1) Sorghum (1)	Paddy (6) Kodo millet (4) Foxtail millet (3) Maize (3) Barnyard millet (2) Pearl millet (1) Sorghum (1)	Paddy (5) Foxtail millet (3) Barnyard millet (2) Kodo millet (1) Maize (1) Sorghum (1)	All escape frost except for wheat, which is the only winter cereal	Little millet (3) Wheat (2) Kodo millet (1) Paddy (1)
Pulses	Lentil (2) Pea (4) Chickpea (6) Black gram (2) Cowpea (1) Lablab (1)		Pigeon pea (3) Lentil (2) Pea (4) Chickpea (6) Black gram (2) Grass pea (1) Mung bean (1) Cowpea (1) Lablab (1)	Pea (4) Lablab (1)	Pigeon pea (3) Lentil (2) Pea (4) Black gram (2) Cowpea (1) Lablab (1)	Pigeon pea (3) Lentil (2) Pea (4) Chickpea (6) Black gram (2)

More discussion and elaboration needed

More discussion needed on the feasibility of diversification options

- e.g To diversify with sorghum, how can it fit in the annual cycle? and crop rotations? Are there any trade offs for using this crop (labor, time, costs, yield, etc.)? Do they like the taste?
- We will be going back this year to develop the conversation further

Considering adding some different modules:

- Vegetables and fruits
- Egg, milk, and meat production
- Income
- Pollination services

More attention to use values

- e.g. good taste, good yield
- early maturation, good market/income
- popularity

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g.meldrum@cgiar.org

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