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Knowledge exchange and speed networking

Session 6: Training for researchers: Tools and approaches to System Analysis

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Biodiversity and Natural Resources Program

SGCI Academic Symposium
Gaborone, 15 November 2024

Agenda for today

Time	Item
09:30	Welcome
09:35	Ice breaker: We are all part of the system
09:55	Introduction to systems approach at IIASA
10:15	Short demonstration of the FABLE calculator
10:45	Break / group picture
10:55	Breakout group 1: Reflections on systems approach
11:15	Reporting back
11:25	Breakout group 2: Enhancing systems approach in Africa
11:45	Reporting back
11:55	Wrap-up
12:00	End

We are all part of the system...

Introduce yourself

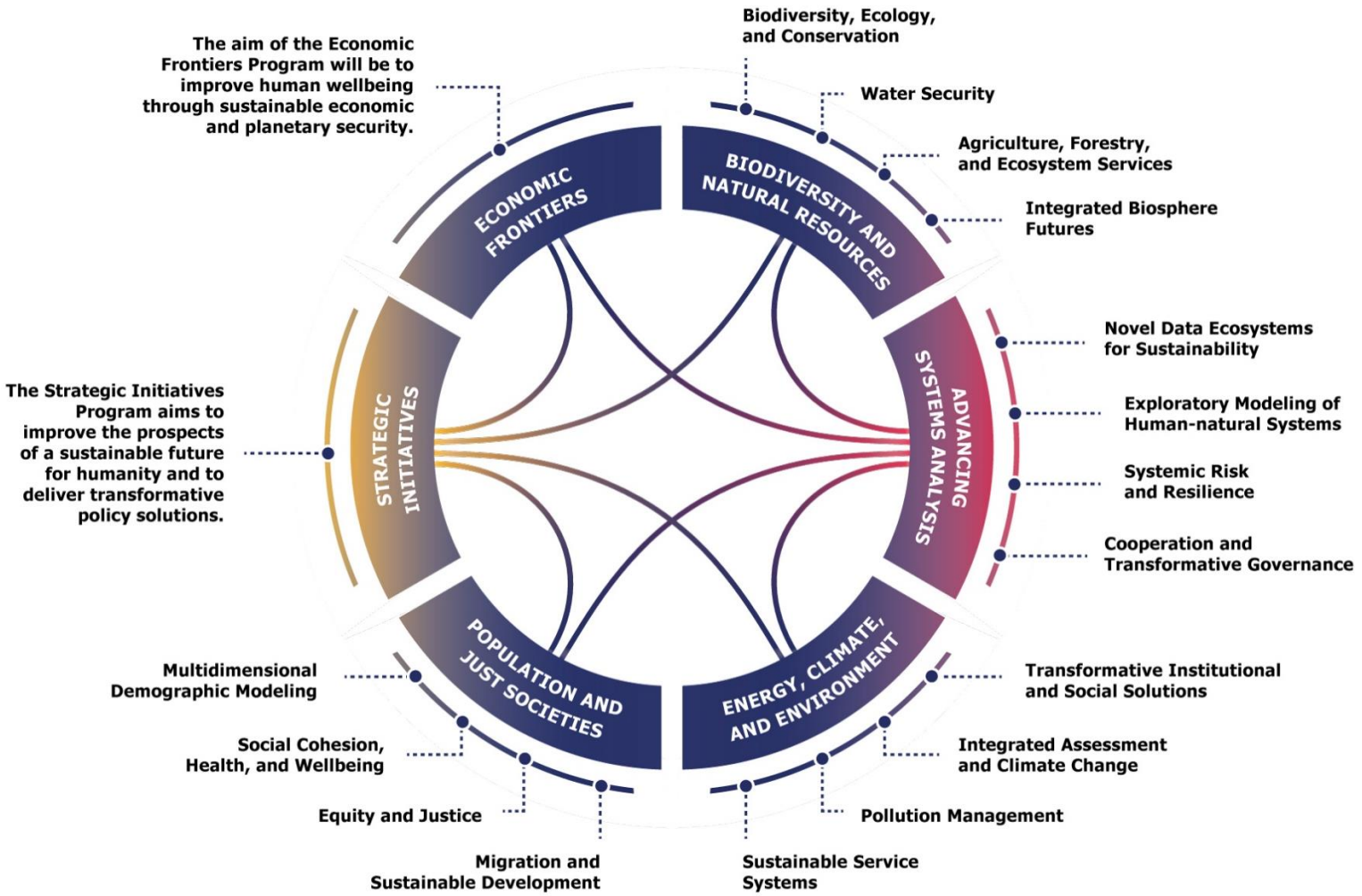
- Name
- Country / Affiliation
- Your main area of expertise/research (in 1 word)
- 1 fun fact

We are all part of the system...

From production economics and modeling single decision-making units (i.e., farmers) to systems analysis and approaches

Linking models and methodologies

IIASA Research Programs and Groups



My Program: Biodiversity and Natural Resources

Climate

General Circulation Models (GCMs)
Euro-Cordex combined with
IPSL-CM5A-LR, HadGEM2-ES, NorESM1-M, GFDL-ESM2

Daily
Δ temp,
Δ precip

Biophysical

3 global gridded crop models
EPIC,
Biophysical impact on irrigation water availability
CWatM

Annual
Δ yield
Δ input

Economic

Scenarios: SSP, Mitigation, Policies & Shocks

GLOBIOM

Outputs: area, yield, trade, consumption, prices

Biophysical Toolbox

G4M

EPIC

ECHO

G4Mm

GLOBIOM

Downscaling

Land Use

Systematic and extreme climate events

- Extreme climate events affect rice production and availability in Africa
- Effects to be decomposed to different actors based on household survey data

Markets and production

- Increased market access and agricultural intensification remain crucial to achieving food security and climate objectives.
- Country-specific analysis provides further insights.
- Need to extend regional studies to larger African Economies (i.e., Nigeria, South Africa

Health and consumer heterogeneity

- Urbanization is associated with dietary changes, which has impacts on agricultural production and biodiversity losses but are often overlooked.
- Enhancing consumer heterogeneity allows us to assess the impact of dietary change scenarios on the different groups of the population


nature food

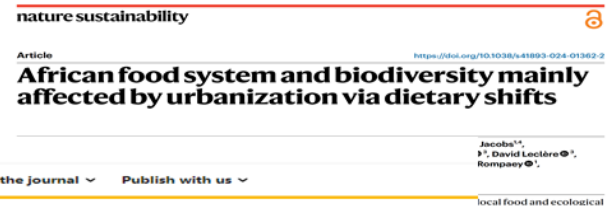
Article

Rice availability and stability in Africa under future socio-economic development and climatic change


IIASA POLICY BRIEF #36
JANUARY 2023

Securing sustainable and resilient food systems for The Gambia


Food System Adaptations in Changing Environments AFRICA


nature sustainability

Article

African food system and biodiversity mainly affected by urbanization via dietary shifts


nature climate change

ARTICLES

Global hunger and climate change adaptation through international trade


ARTICLES

nature food

A sustainable future for Africa through continental free trade and agricultural development

nature food

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nature > nature food > comment > article

Comment | Published: 19 November 2020

Long-term impact of West African food system responses to COVID-19

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Food System Adaptations in Changing Environments AFRICA

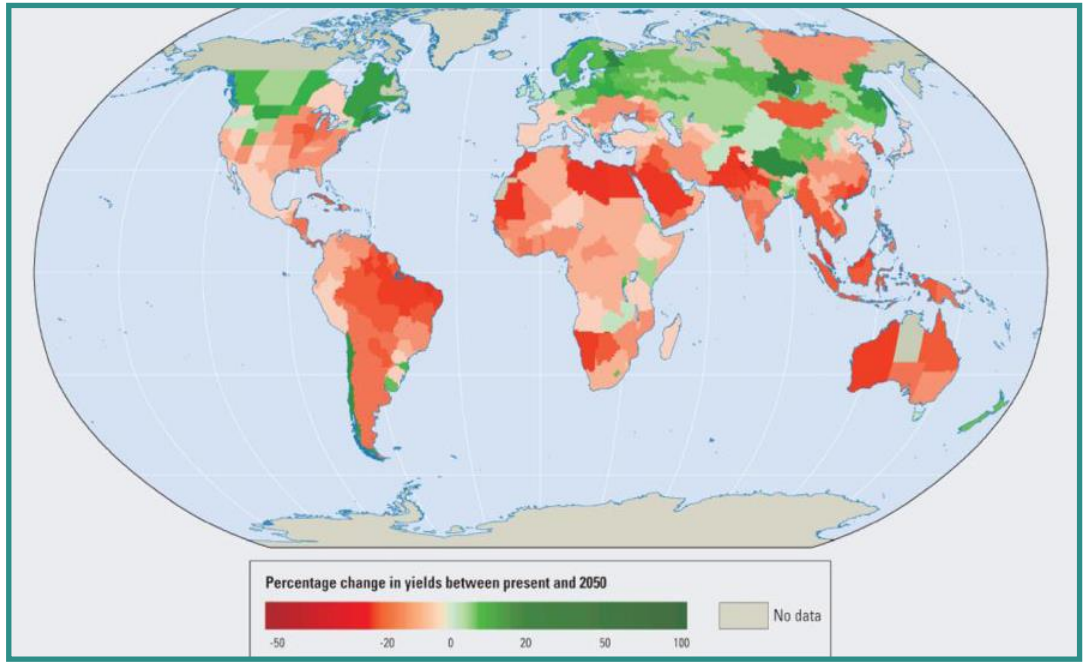
Explore the food system in Gambia using FABLE Calculator

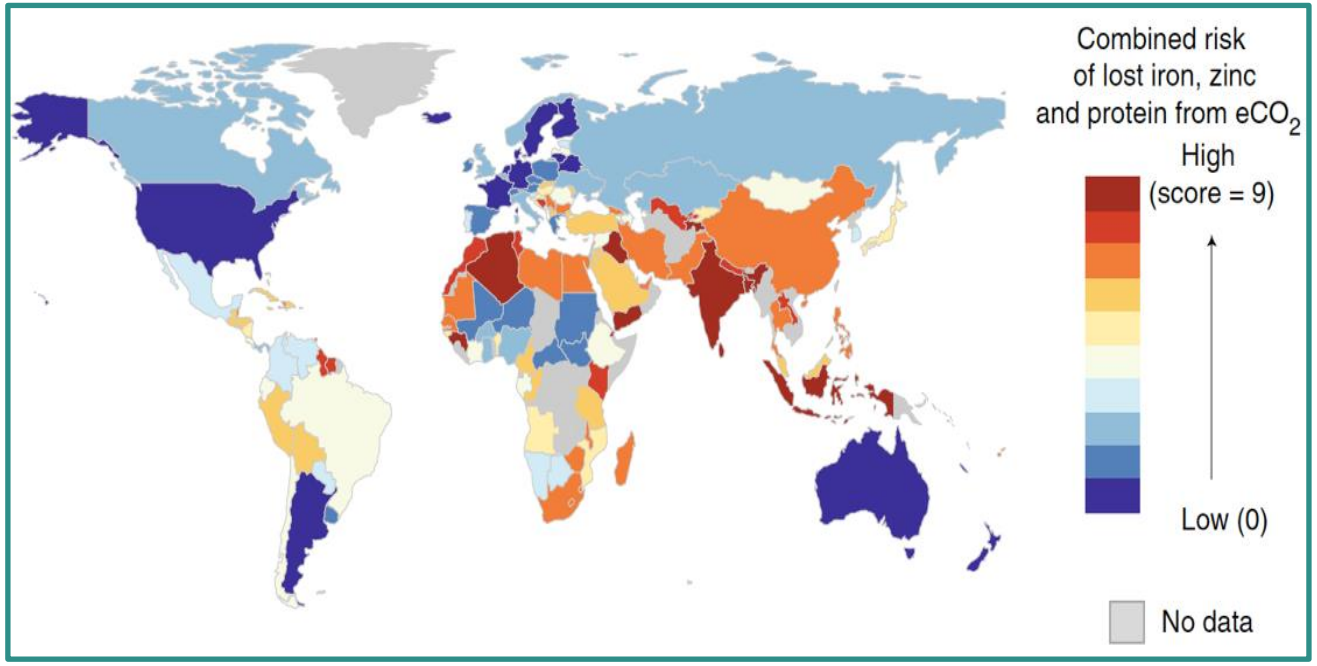
Why study climate change and food?

Food System Adaptations in Changing Environments AFRICA

- **Cereal yields** projected to decline in many major food-producing regions of the world due to increased temperatures

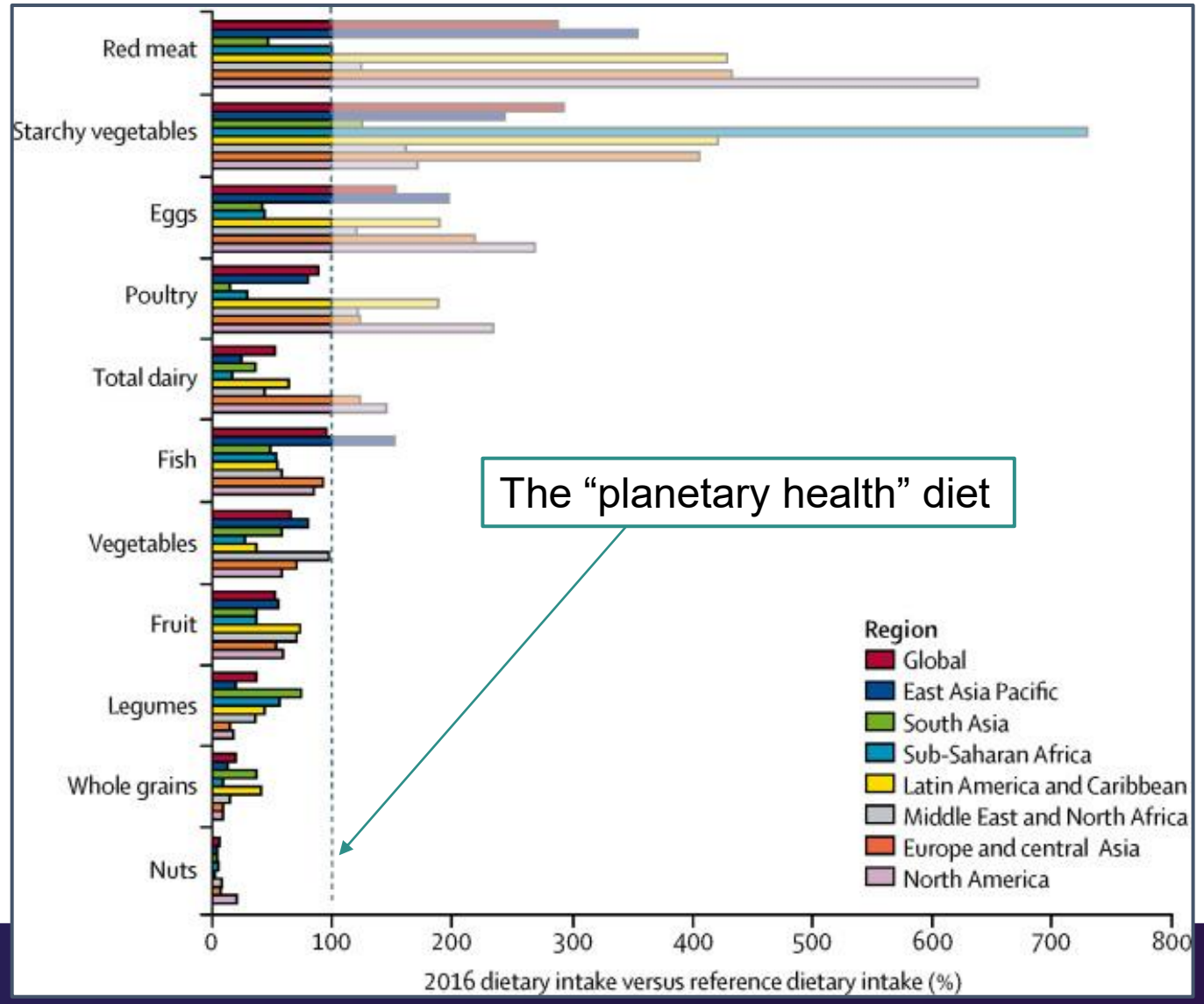
- **Cereal quality** also projected to decline in many of the same areas due to higher levels of CO_2 in the atmosphere – fewer nutrients available





- **Populations** are increasing so we need to produce more food
- Increasing numbers of **shocks** to food system, e.g. extreme weather events and global conflict
- Food is one of the **biggest risks to human health** from climate change

Looking for solutions for the environment and health



- Food systems also need to change to **improve health** and reduce impacts on the **environment**
- Diets in sub-Saharan Africa are not as high in **red meat** as many other countries so have less impact on climate change
- However, they are on average much too low **in fruit and vegetables**, **legumes** and **whole grains**
- By changing both **what** is eaten and **how** it is produced we can improve resilience to climate change, help to meet net zero targets and have a healthier population

MRC The Gambia Unit

IIASA International Institute for Applied Systems Analysis

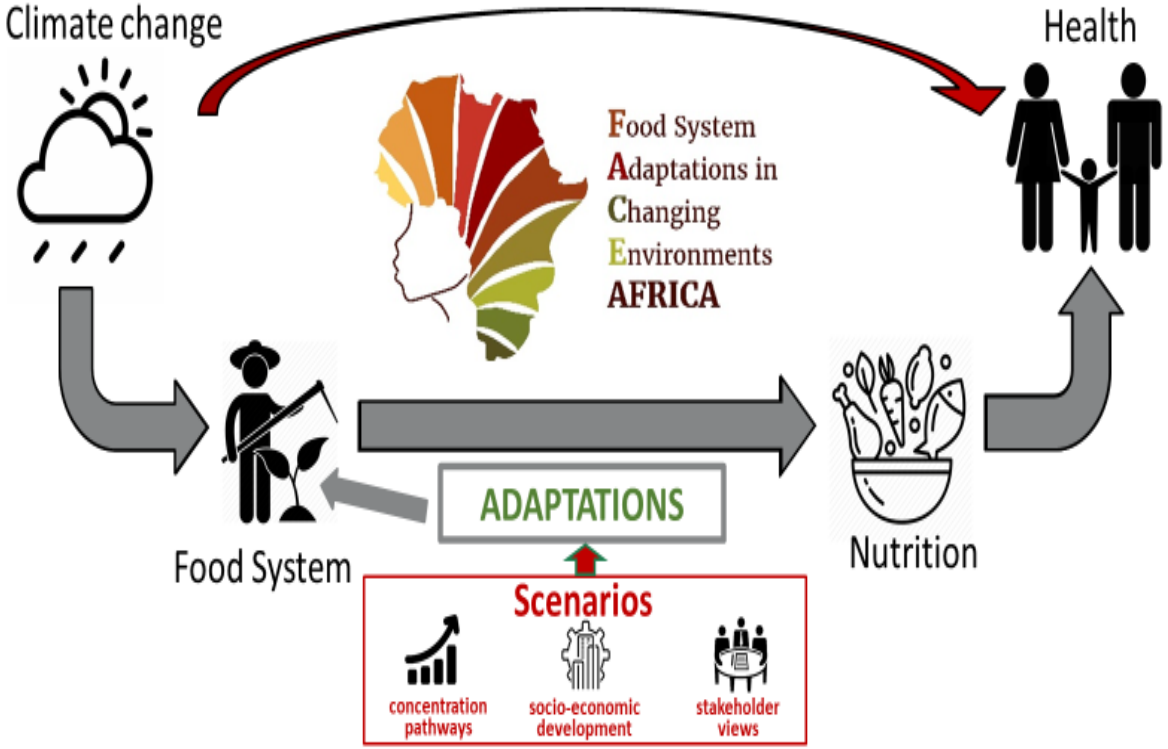
LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

Alliance Bioversity International CIAT International Center for Tropical Agriculture Since 1967 Science to cultivate change

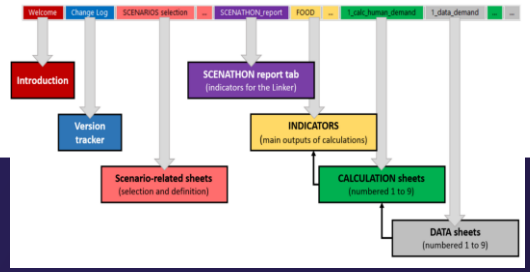
IIASA

Malnutrition
Low productive agricultural systems
Climate vulnerability

Modelling the future Gambian food system and health outcomes



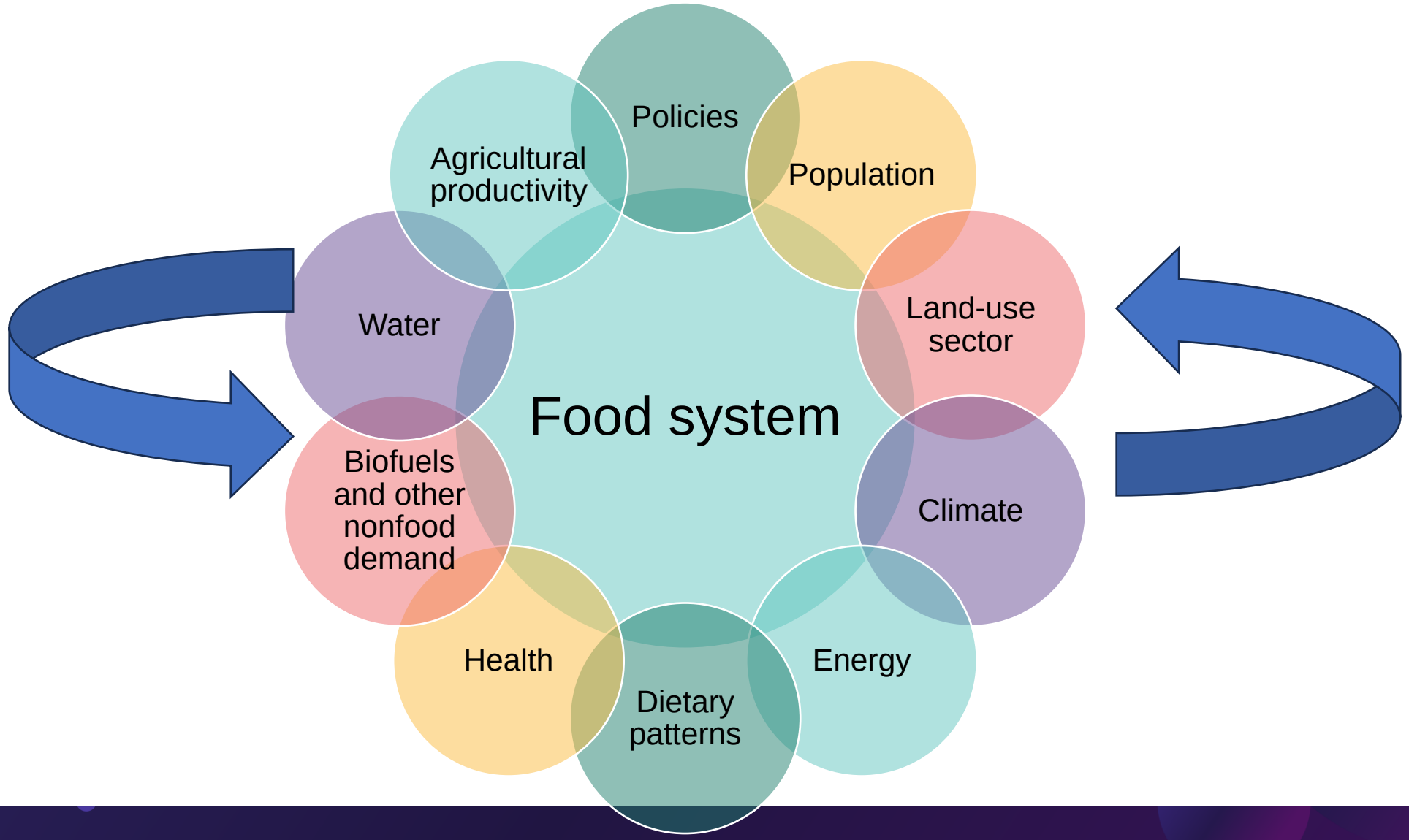
FABLE Calculator



Stakeholder Engagement

- Over 30 stakeholders from over 15 participating institutions
- **Validate** model assumptions
- **Improve** data and model parameters
- **Introduce** policy- and Gambia-relevant dimensions

Food systems interplay with selected sectors



Access to the FABLE model

- Short link for FABLE Calculator – this way people can open on their computer vs their phones: bit.ly/FABLEcal

- **Short link to all info**: https://bit.ly/IIASAatSGCI

What is the FABLE Calculator

- The tool has been developed within the framework of the Food, Agriculture, Biodiversity, Land-Use, and Energy (FABLE) Consortium, a collaborative initiative, operating as part of the Food and Land Use (FOLU) Coalition

- The FABLE Calculator ("the Calculator") is an **Excel accounting tool**
  - Studies the potential evolution of food and land-use systems over the period 2000-2050.
  - Agriculture is the main driver of land-use change
  - **UNDERLYING ASSUMPTION:** Human demand is the **key driver** of change in food and land-use systems.
  - Test the impact of different policies and changes in drivers ("if" assumptions) through the **COMBINATION OF SCENARIOS**.

What is the FABLE Calculator

- It includes **76 raw and processed agricultural products** from the crop and livestock sectors
  - Relies on the FAOSTAT (2020) database for input data.
  - **Click around in the *datasheets* to check the databases used in the calculator**

- For every 5-year time step over the period 2000-2050, the Calculator computes **INDICATORS**
  - The level of agricultural activity
  - Land use change
  - Food consumption
  - Trade
  - Greenhouse gas (GHG) emissions
  - Water use
  - Biodiversity conservation

- Flexible: **YOU** can replace data from global databases with national or subnational data.

What is the FABLE Calculator - What it can do

- It can **identify major imbalances** in and **threats to** national food and land-use systems using a less **complex tool**
- It can **run on almost any computer** since Excel is one of the most widely used programs
  - Newer versions are backwards compatible with older Excel files.
- Because all the **data is visible,** and the structure of the **Excel functions is clear**
- The Calculator contains **no hidden "black-box"** to hide its weaknesses.
- Users can quickly **select alternative combinations of scenarios** and **see the impacts on the main indicators**.
  - This is an advantage when interacting with stakeholders : **Assumptions can be changed easily and transparently.**

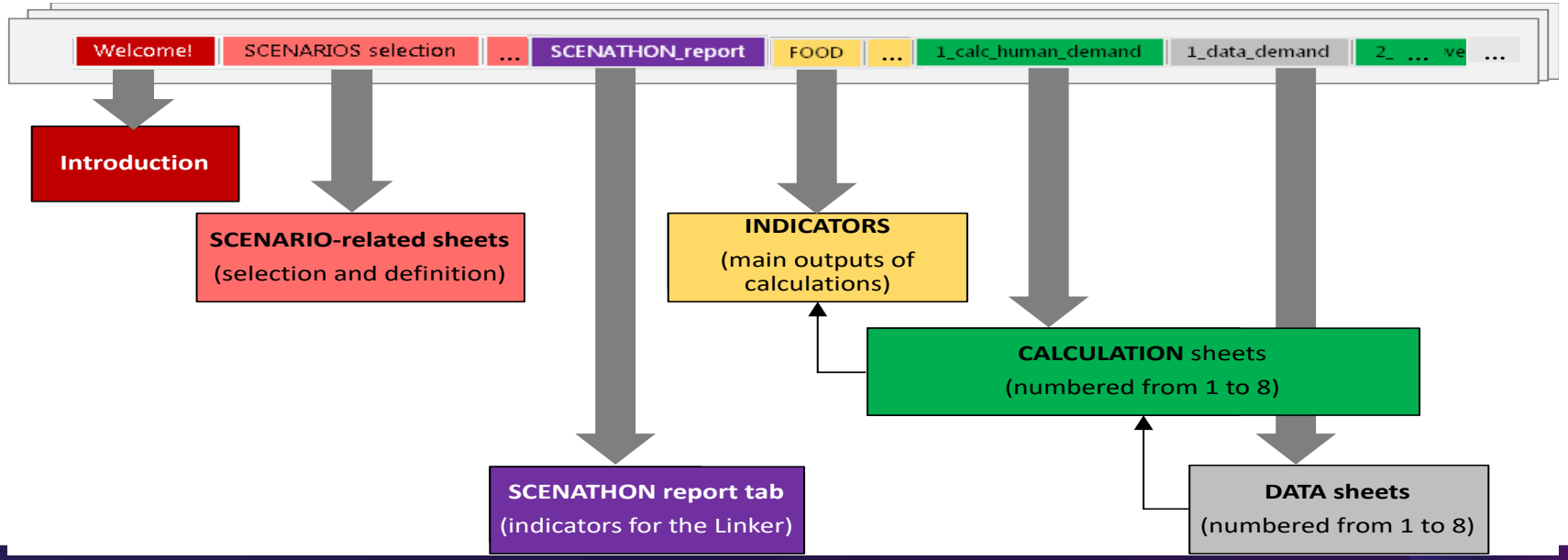
What is the FABLE Calculator - What it can't do

- The Calculator is **NOT an optimization tool.**
- Prices are only used ex-post to compute production and trade values. Therefore, **prices do not influence the results** and **results do not influence commodity prices**, contrary to economic models.
- There is **no detailed representation of production practices and/or technologies**.
  - technical feasibility nor the economic feasibility of the pathway cannot be evaluated within the FABLE Calculator.
- The **forestry sector is not yet considered**.
  - Parts of **AFOLU GHG emissions/sequestration** are not covered i.e., GHG emission/sequestration in managed forests and woody products are not represented.
- The emissions from agriculture can only be reduced by **lowering production volumes** or **increasing productivity**.
  - Other mitigation options for agriculture, such as improved rice management, animal feed supplements, fertilization techniques or anaerobic digesters are not yet represented.
- **Water availability constraints** are not represented.
- Even though the Calculator is an Excel file and the formulas are transparent, **fully understanding the computations** and being able to make changes **require some time**.

Structure of the Calculator- Looking into the Calculator

The current version of the FABLE Calculator contains

- Country or regional historical data (e.g., the Gambia) in the **grey "DATA" sheets**
- Calculation formulas for the calculation in the **green "CALCULATION" sheets**
- Scenarios definition and selection in the **light red "SCENARIOS"** sheets
- Visualization of the main results in the **yellow "INDICATORS"** sheets



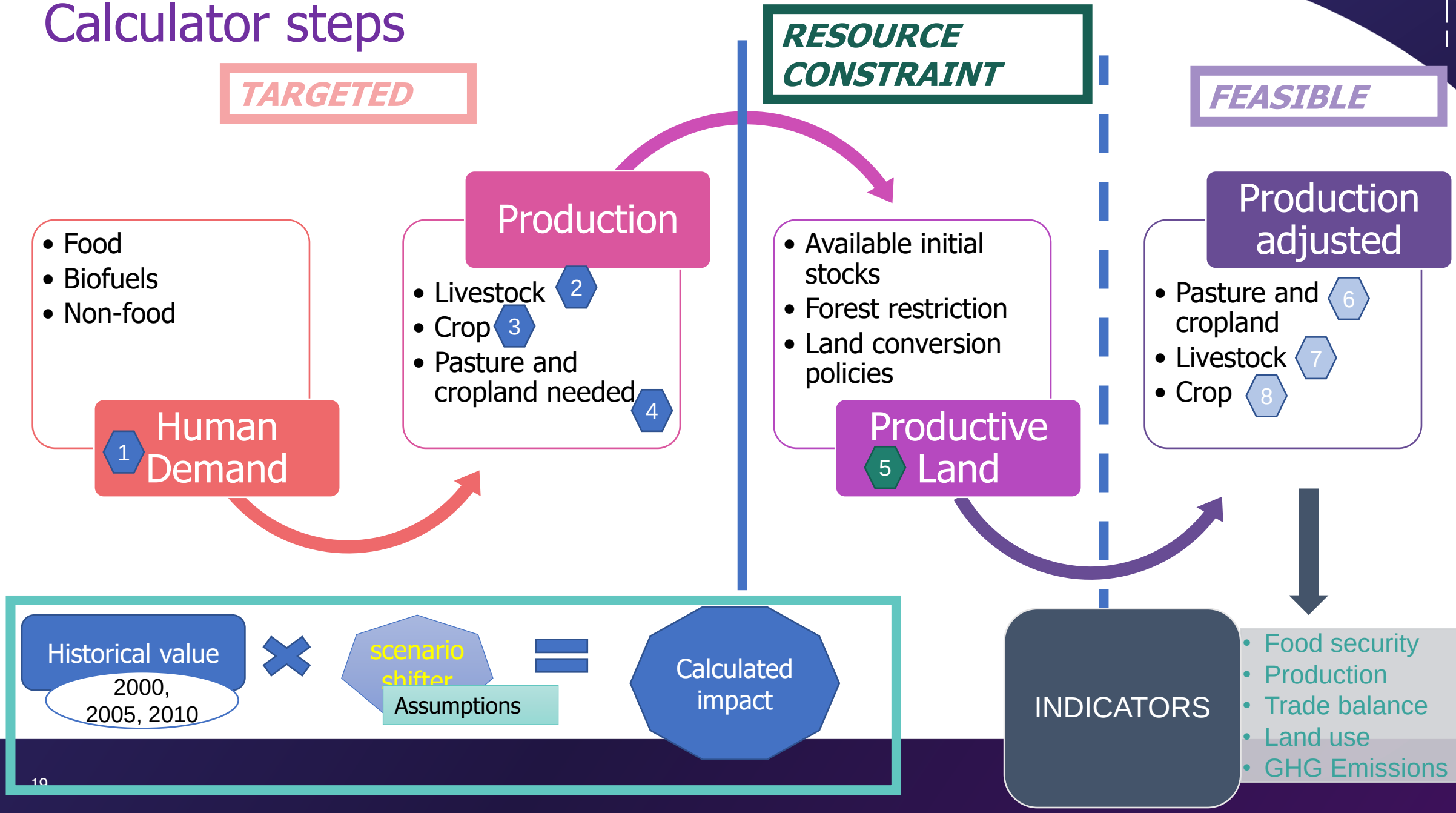
Using the calculator – Drivers

- Drivers are factors that influence the modeling objective.
- A **set of drivers** is established that can be changed through the **selection of different options**.
- Each driver and corresponding alternative scenarios are grouped by tables **(explore the calculator)**
- The Calculator has **16 drivers** that can be modified through scenarios,
  - each has between **2 to 17 possible alternative options**.
- Therefore, millions of possible combinations of scenarios lead to different pathways
- You can select **predefined scenarios** or **add new scenarios (locate this table in the calculator)**

One possible scenario pathway

Scenario on GDP	Scenario on Population	Scenario on Diet	Scenario on Food Waste Share	Scenario on Import Share	Scenario on Exports	Scenario on Livestock Productivity	Scenario on Crop Productivity
SSP2	SSP2	SSP2	Current	I1	E3	HighGrowth	NoGrowth
Scenario on Agricultural Land Expansion	**Scenario on Afforestation**	**Scenario on Trade Adjustment**	**Scenario on Population Activity**	**Scenario on Climate Change**	**Scenario on Protected Areas**	**Scenario on Post-Harvest Loss**	**Scenario on Biofuels**
FreeExpansion	NoAffor	No	Middle	NoChange	NoChange	NoChange	NoChange

Calculator steps



Calculator steps

TARGETED

- Food
- Biofuels
- Non-food

1 Human Demand

Population

GDP

Food waste

Diet

Biofuel

Drivers

Production

2

- Livestock

Animal food products

(Crop) Feed + Pasture

Livestock productivity

Imports

Exports

Drivers

Human demand

Feed demand

- Crop

3

Production

Crop productivity

Exports

Post-harvest losses

Imports

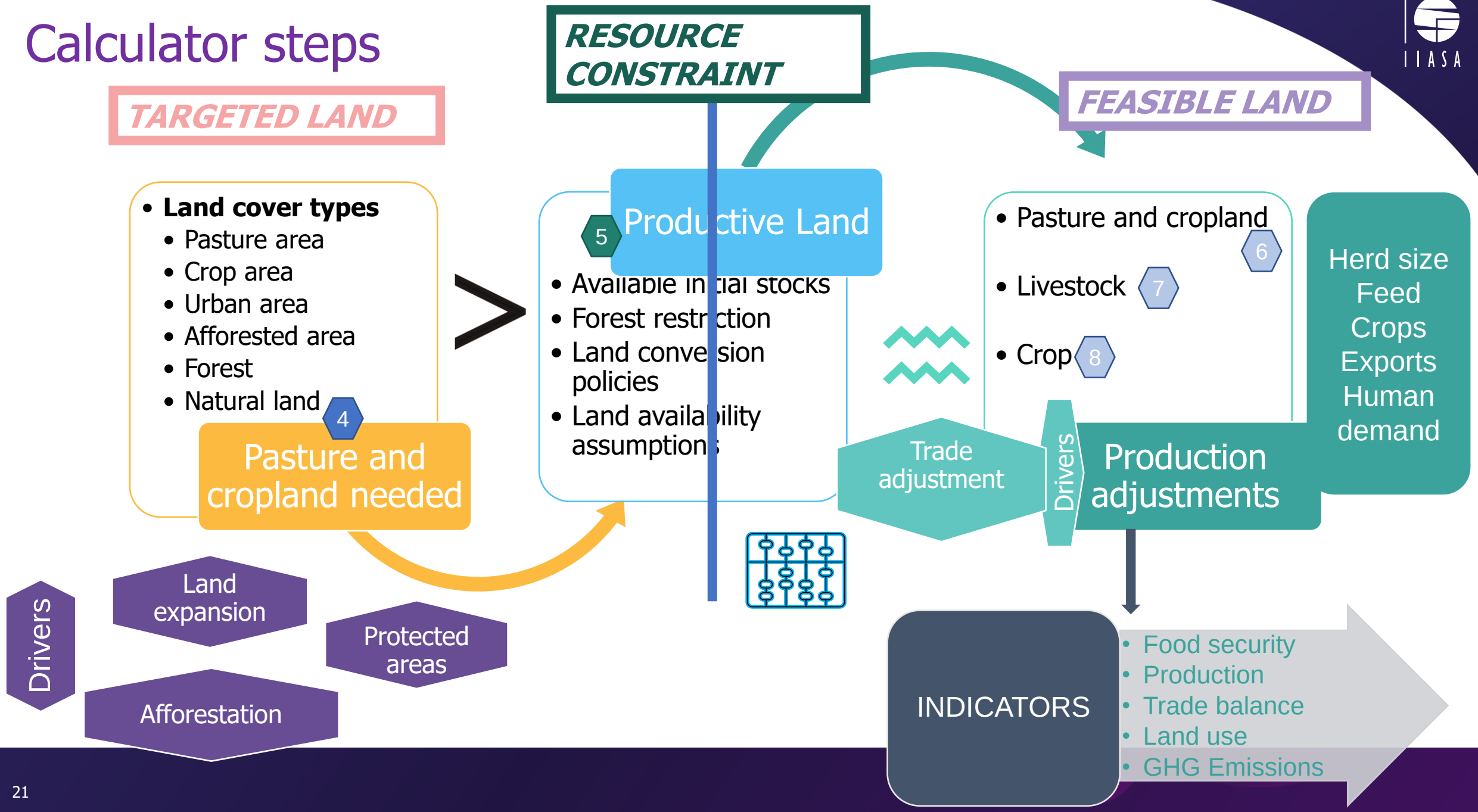
Climate change

Drivers

Production

- Pasture and cropland needed

Calculator steps



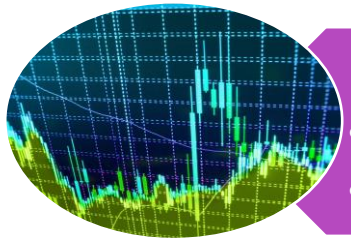
Indicators

FOOD & NUTRITION

- Composition of food
- Average calorie consumption / day

PRODUCTION

- Total value of agricultural production
- Changes in production composition

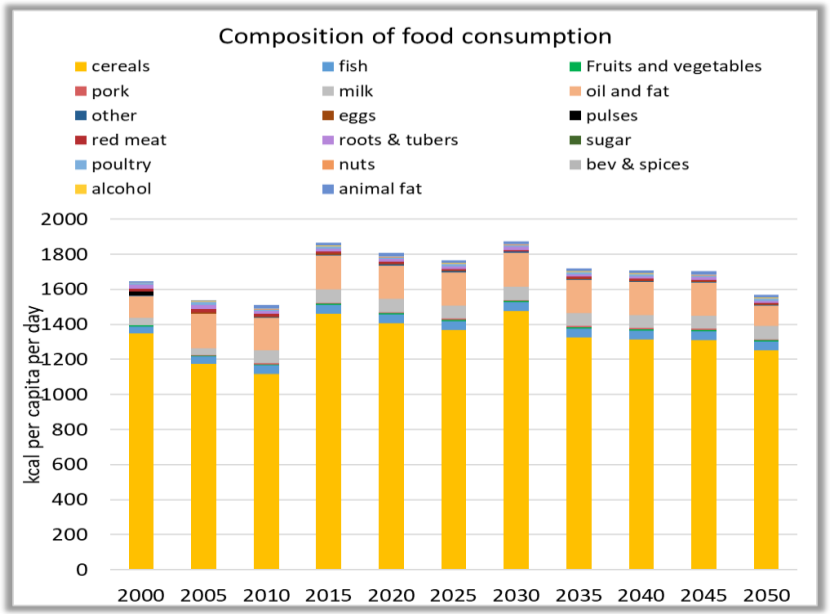


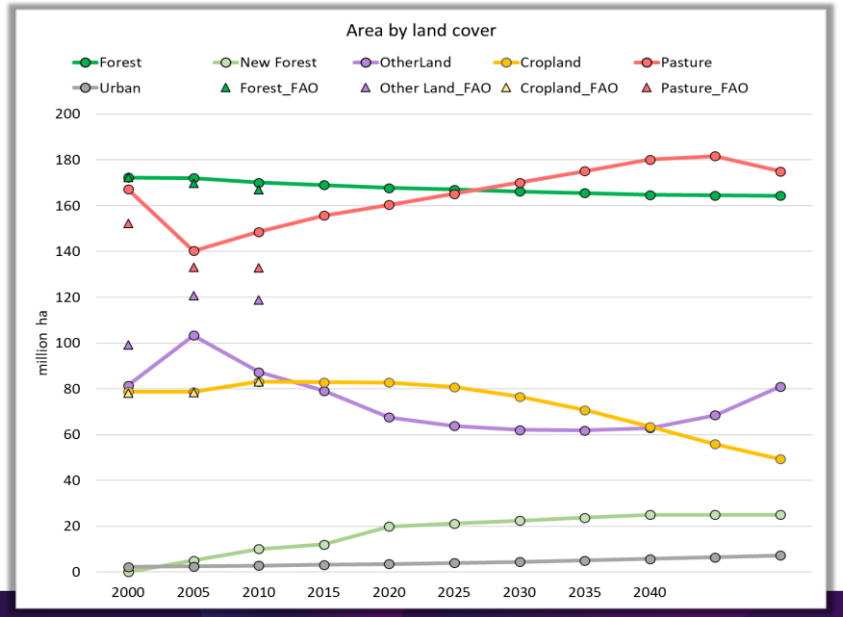
INTERNATIONAL TRADE

- Net trade balance in agriculture
- Evolution of import and exports over time

LAND USE

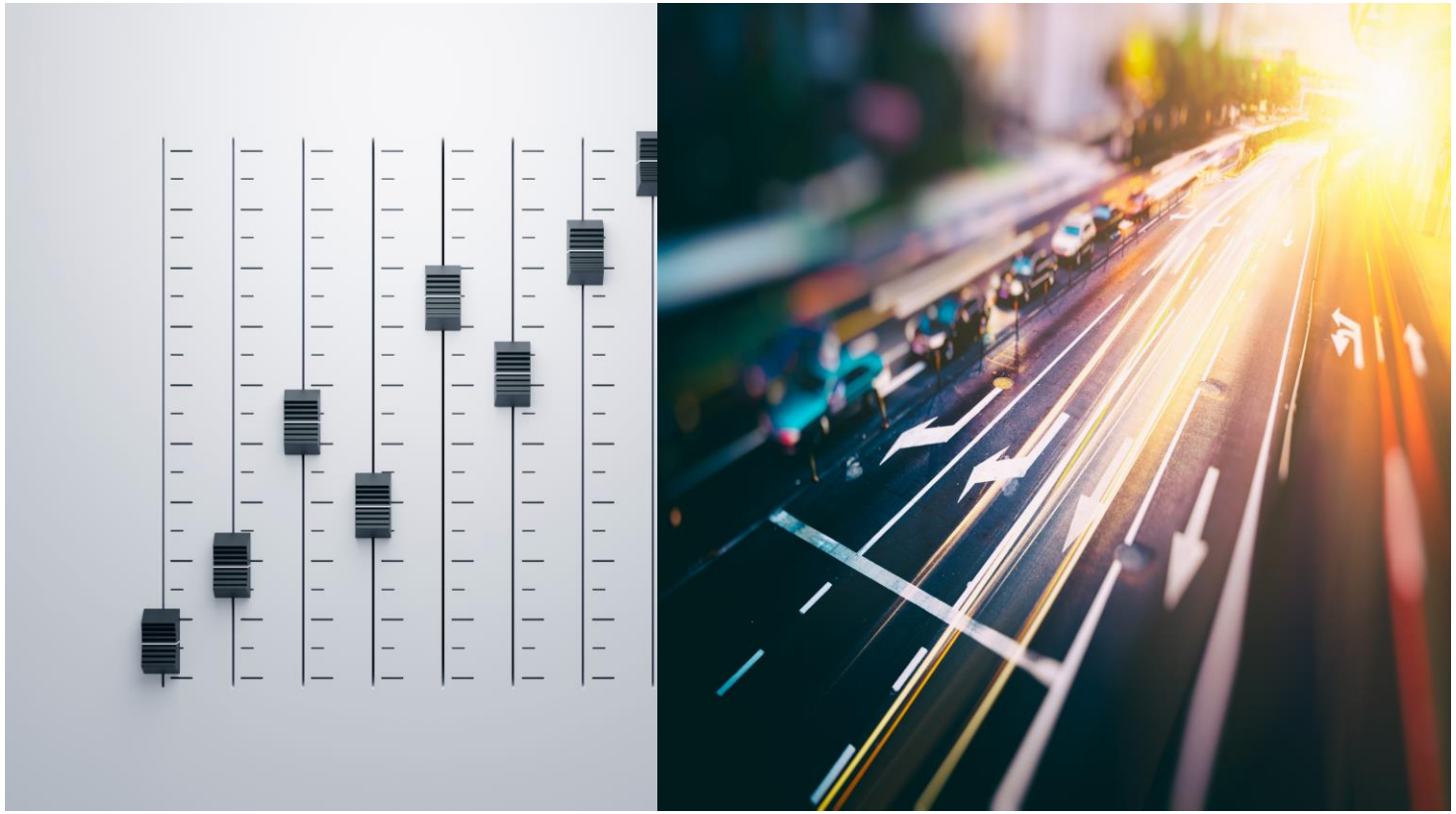
- Evolution of the area of each land cover type
- BINOK





FABLE Calculator - DRIVERS

Food System Adaptations in Changing Environments AFRICA



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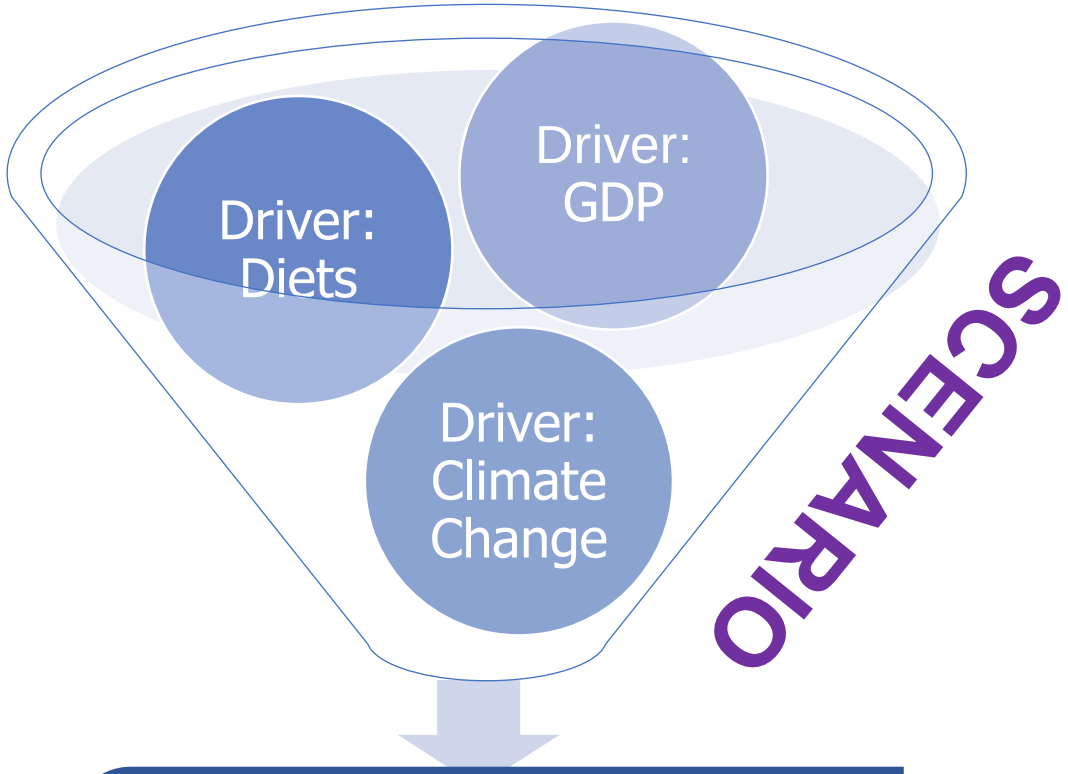
SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

The Food and Land Use Coalition

Session 2: Focusing on Drivers – Scenarios

Present the different drivers, definition, data sources etc.



INDICATORS

Food intake (kcals/capita/day)

Production

Trade balance

Land use dynamics

Exploring the calculator

Scenario options

Scenario definition

Socio-Economic Drivers

Population growth dynamics

- Fundamental to compute the evolution of the targeted human demand together with the diet assumption.
- The scenario options are based on the 5 SSPs (Shared Socioeconomic Pathways) and 9 UN DESA projections on population dynamics

Population activity

- This affects its minimum dietary energy requirement
- (MDER)
- Daily calorie needs increase with higher activity
- Activity-level scenario options are defined in accordance with USDA (Institute of Medicine, 2002): low, middle, and high.

Diets

- 6 scenario options are defined.
- SSP1, SSP2 and SSP3 refer to sustainable, middle of the road and fragmented).
- No change (same as 2010)
- EATLancet recommended Healthy Diets
- Fat Diet (more sugar,fat and meat)

GDP

- 3 Scenario options are defined
- SSP 1 – 9.4% growth
- SSP2 – 7%
- SSP3 – 4%

Production and Trade Drivers

Crop and livestock productivity

- The starting point is always historical productivity growth from 2000-2010
- 4 productivity options are defined
- High productivity
- Low productivity
- No change – same as 2010
- Business as usual (BAU) – same productivity rate observed between 2000-2010

Imports

- Share of total consumption that is imported
- 3 scenario options are defined
- I1 - no change
- I2 - reduced
- I3 - increased trade
- assumptions.

Exports

- 3 scenario options
- are defined for the exports
- E1 - no change
- E2 - reduced
- E3 - increased trade assumptions
- The final exports can be reduced if there is not enough land

Trade Adjustment

- This makes it possible to fix trade to certain values
- Overwrite the previous imports and exports scenarios
- 2 options are defined
- “No”, trade is not adjusted.
- “Yes”, trade is fixed to adjusted value.

Environmental Drivers

Climate change

- Climate change impacts on crop yields and input use (fertilizer and water)
- 4 different representative concentration pathways (RCPs; 2.6, 4.5, 6.0, and 8.5),
- 5 global climate models
- 64 climate change scenario options.

Climate Adaptation

- Based on a review work and an expert survey, we identified climate smart agricultural strategies.
- With this we developed the climate adaptation scenario

Land expansion

- This makes it possible to restrict agricultural expansion even when there is still some land available.
- 3 scenarios options:
- No expansion – no expansion of agricultural land beyond 2010
- NoDefor2030 - no agricultural expansion on forest land after 2030
- Free expansion - agricultural expansion of natural land up to the limit of the natural land area which is under protection

Afforestation

- This fixes the total targeted afforested area by 2050 planned on each land cover type (i.e. cropland, pasture, and other natural land)
- There are 2 two alternative scenario options
- No afforestation
- BonnChallenge - the target corresponds to the commitments made under the Bonn Challenge.

Protected areas

- This defined amounts of protected forest and other natural land, which cannot be changed to another land type in the calculation process.
- 2 scenarios are defined: no change - protected area share constant at 2010 levels
- PA expansion - targets a protected share of at least 17% for each ecoregion by 2050.

Sustainability Drivers

Food waste

- Food losses at the consumption level –both distribution and household level
- This affects targeted demand as more food needs to produced to account for the losses.
- 3 scenario options:
  - a constant share of food waste over time
  - increased food waste over time
  - reduced food waste over time

Post-harvest loss

- Post-harvest losses mostly include losses during storage and transportation.
- 2 scenario options are
- defined:
- no change
- Reduced.

Biofuels

- Crops and vegetable oils can also be used for biofuel production creating an additional demand for biofuel production which affects the calculated cropland and associated sustainability indicators.
- Biofuels replacing petrol-based fuels have a positive effect on GHG emissions.
- 2 scenarios options defined:
- stable biofuel demand on 2010 levels
- OECD-FAO projections until 2028

Policy relevance – Narratives

Issues

1. Are our assumptions about the drivers that influence the Gambian food and land-use system valid?
2. Can we improve our model to reflect current and future policy developments? (e.g., NaNa, climate policy, agricultural productivity policies etc.)

Climate Change

- Compare different climate change scenarios based on the RCPs and various climate model?
- Could Gambia's NDC be reflected in the modelling

Future projections

FACE-Africa

Impacts on **food & nutrition security, production, land use** and **trade**

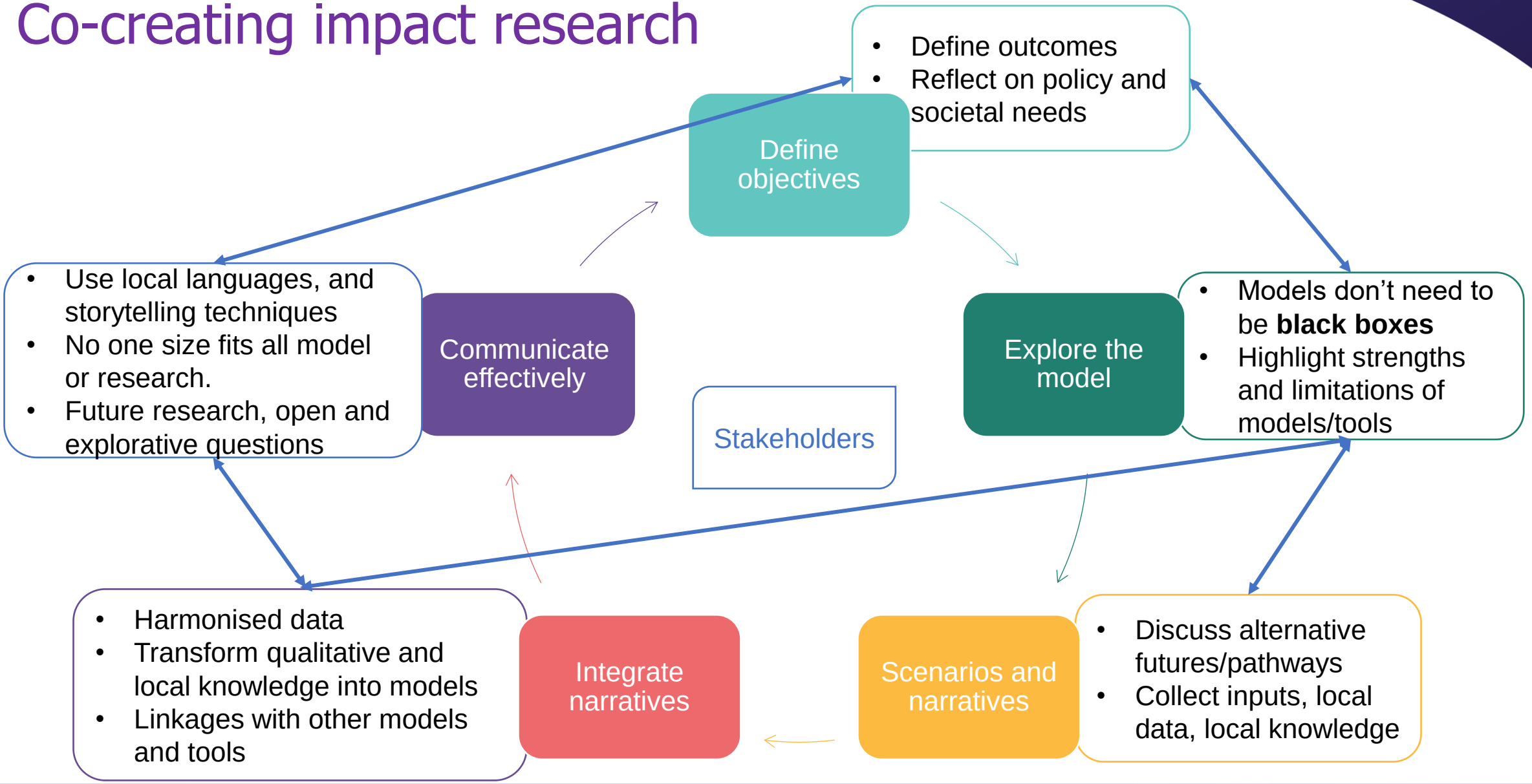
Adaption and mitigation

Coping strategies
Climate smart agriculture
Impacts of crop and livestock productivity
Input use intensity

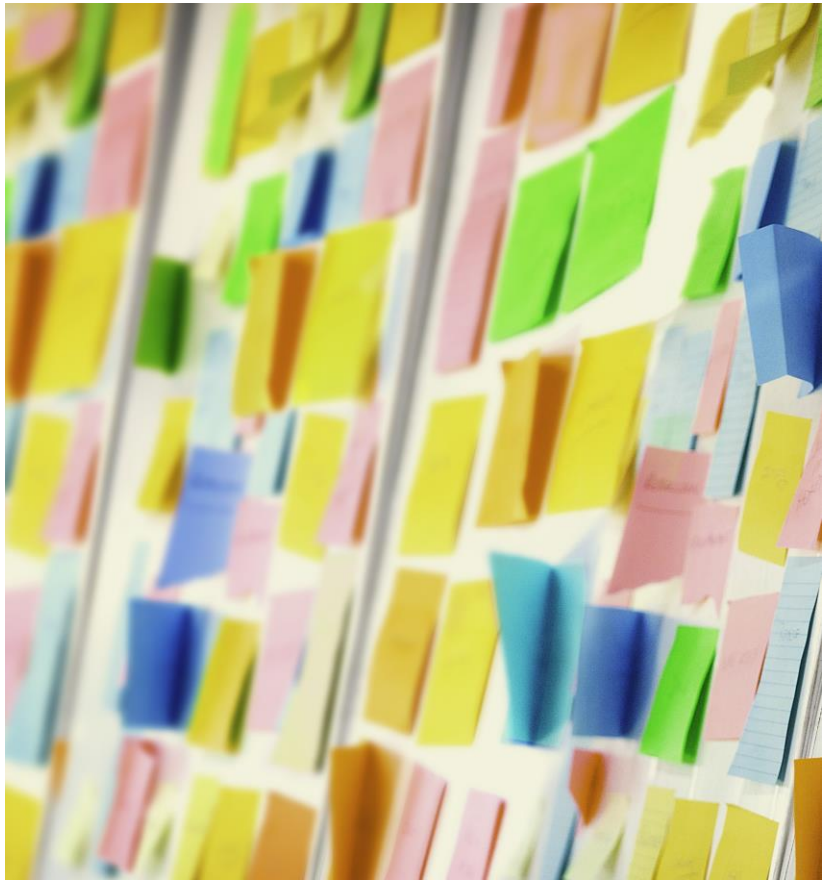
Nutrition and food security

- Composition of food consumption over time
- More fruits and vegs, less cereal/sugar etc.
- Shifts in production
- Less import dependent over time
- Can the WHO/EAT Lancet healthy dietary recommendation be achieved?

Co-creating impact research



Breakout group 1: Reflections on systems approach



Group reflections:

- How do you see your research in the space of systems analysis and thinking. It could be a model providing input or output
- Do you bring quantitative knowledge or qualitative assessments?
- If you do qualitative work, how do you bring ground knowledge into your research? Or if you do quantitative work, how does your research contribute to the systems approach?
- **What are the opportunities and barriers to research co-creation in your field/in the region?**

Share your thoughts on sticky notes!

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Co-creating with stakeholders: Lessons learnt

Challenges

Selecting the "right" stakeholders: How to select stakeholders from a distance?

Institutional dimension

Multiple institutions and organizations of relevance for the research (governmental ministries and agencies, NGOs, farmer groups, int. agencies)

Different institutions have different goals, and perceived benefits of the stakeholder engagement. **Bringing it together!!**

Demography of stakeholders

Most institutions had multiple representatives, different ranks, ages, genders, etc.

How to get individualized ideas in a semi-institutional hierarchical setting?

Presenting in research goals clearly
What is the role of stakeholders
Highlight collective product given the differences.

Effectively communicating the research goals and objectives

How do we get stakeholders to put aside institutional/personal agendas to focus on a collective product given the differences.

How to convert qualitative knowledge in quantitative models

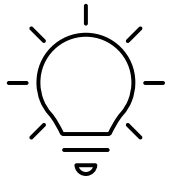
Facilitating and guiding debates and discussion

Understand local and cultural construct

Avoid campaigns to change cultural and social construct.

How to ensure that all ideas are heard, recorded and considered in the discussions and further model development

Exploring opportunities



Selecting "right "stakeholders from a distance?

Work and partner with a local institution with ties and positive relationships with the different institutions.
Create networks: builds trust between stakeholders and project/research partners.

Effectively communicating the research goals and objectives

Showcase and explore your model in an interactive and simple manner
WHY???
Generates interests, helps stakeholders to understand and visualize their contributions/inputs and the potential impacts of their inputs on the quality of the research

Facilitating debates and discussion
Giving everyone a voice

Breaking into smaller groups
Ensure balance in the group **NO natural selection** but pre-selected participants into the groups to ensure proper representation
Project partners facilitated the breakout group discussions to ensure consistent flow and reduced diversions from the goals- differences in facilitators tend to help
Reporting back after the breakout discussion to present an overview of all discussed aspects and allowing for feedback

Lesson learnt: Integration and ownership

Integration

Present to stakeholders a tentative plan how their contributions are applied in the models

“Its not just another exercise” but we co-created and co-designed the scenarios

Literature review and additional modelling effort is required to transform qualitative inputs into quantitative models

Paint the full picture: these *xyz* inputs could be integrated and these not because… (i.e., model infeasibility, time constraints, etc.

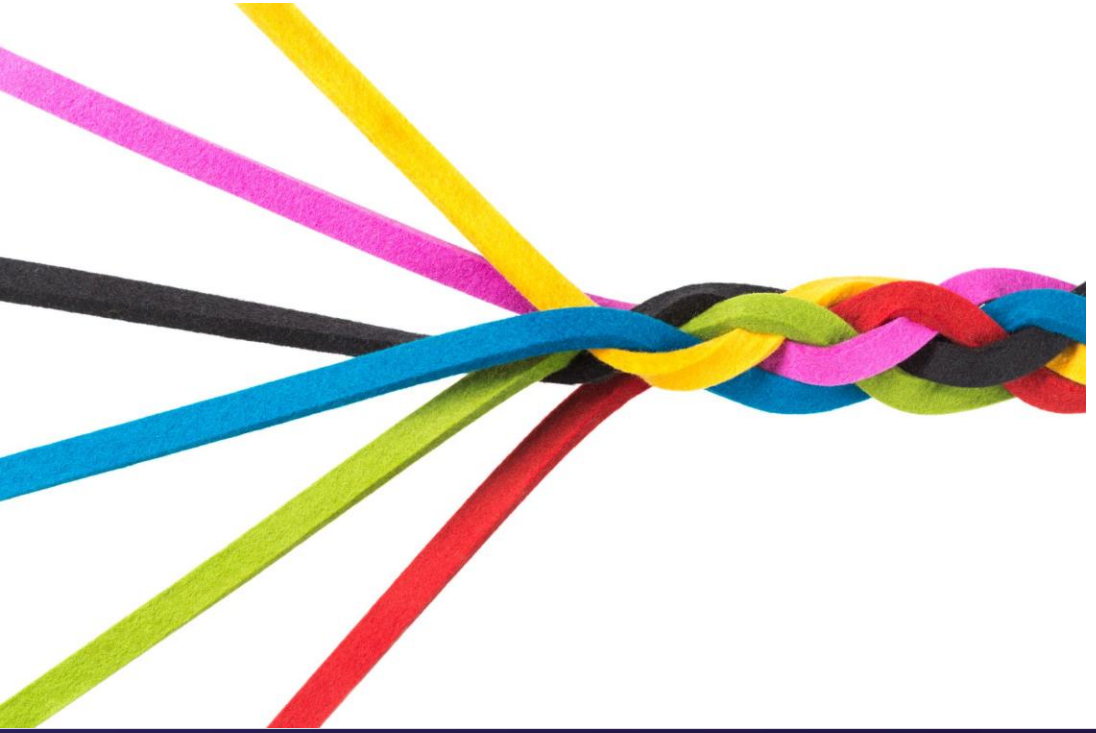
Ownership

Keep stakeholder informed

Reports, policy briefs, symposiums and workshops: this maintains interests in the research

Make tools and models available to stakeholders (particularly if these can be scaled up or down and used by the participating institutions in further research

Breakout group 2: Enhancing systems approach in Africa



Group reflection:

- Building on the conversation above, in your group choose a system. With the diverse areas of expertise, how would you practically link with the others in a systems thinking framework? How can you bring the different research inputs into a system and how can each contribute to the system?
- **What do you see as opportunities and challenges of doing this?**

Share your thoughts on sticky notes!

Switch up your groups!

Let's wrap up! Real talk with Chika and Agnes

Stay in touch

Research collaborations with IIASA

- SGCI participants are members of the IIASA Sub-Saharan Africa Regional Member Organization (SSARMO).
- IIASA prioritizes collaborations with member countries and regions.
- IIASA has over 30 ongoing projects in the region and is looking to develop further collaborations.

Stay in touch

IIASA capacity building opportunities

- Young Scientists Summer Program (3 months, for PhD students)
- Post doc opportunities (various opportunities to join IIASA teams)
- Summer schools (2 weeks, for graduate students)
- PhD opportunities with NRF, British Council and IIASA
- Potential future trainings in the region

Stay in touch

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