What is agrobiodiversity?

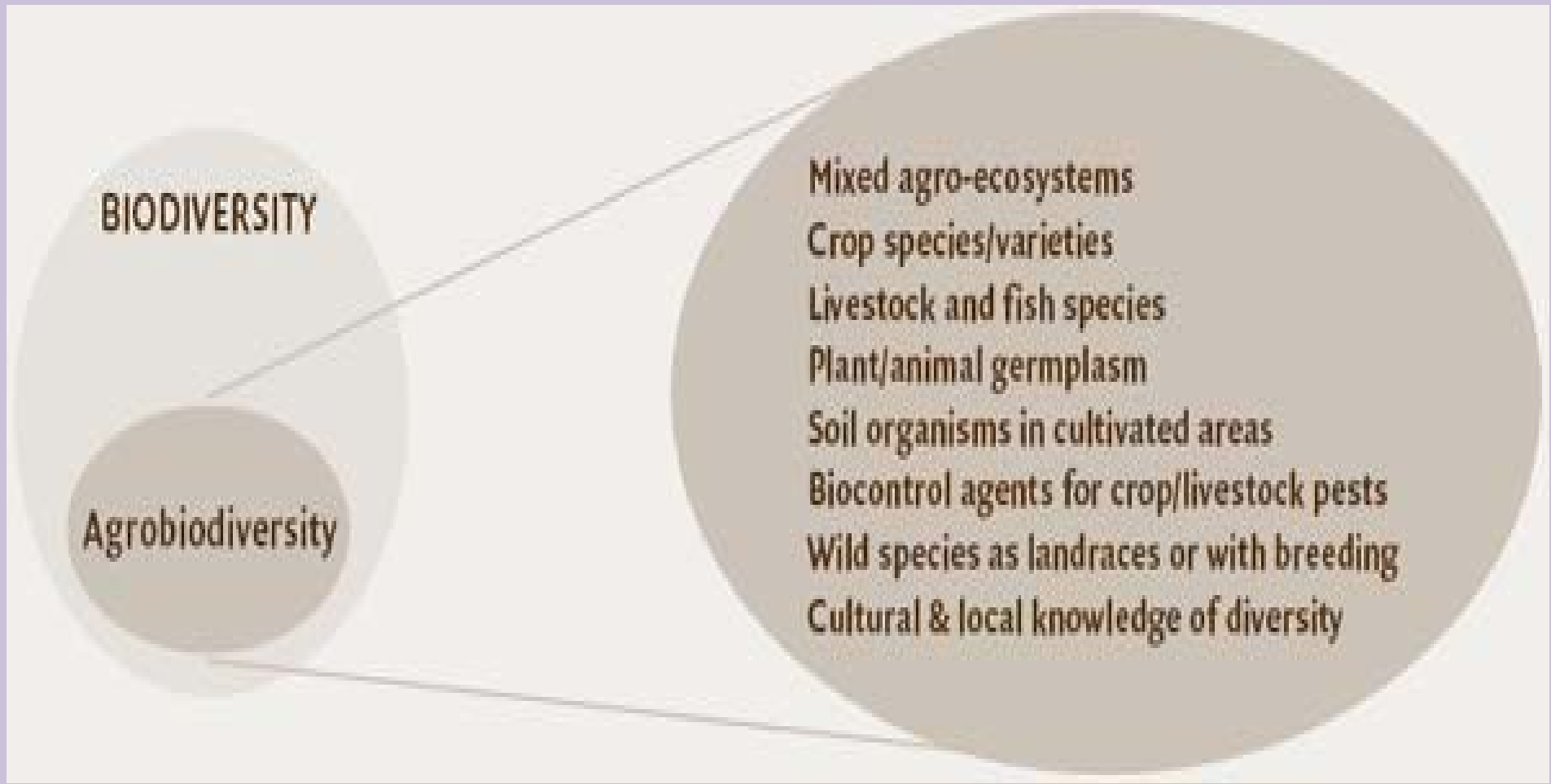
The variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries.

It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fibre, fuel and pharmaceuticals.

It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agroecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agro-ecosystems.

What does agrobiodiversity include?

- **Harvested crop varieties**
- **Non-harvested species in production ecosystems**
- **Non-harvested species in the wider environment**



A short scenario of agro-biodiversity loss

- In the past few decades, the replacement of indigenous varieties of crops, fruits, vegetables by high-yield crop varieties has depleted agro-biodiversity.
- Indigenous varieties and livestock species have lost their significance due to intensification of farming and separation of local communities.
- The well adapted old cultivars have been replaced by few genetically modified varieties and breeds.
- New species are ranked second in threatening the agrobiodiversity.

Loss of agrobiodiversity

Causes & Factors

- Environmental pollution
- **Deforestation**
- Overgrazing
- Global warming
- Climatic change
- Overharvest (forest, fisheries)
- Desertification
- Ozone depletion
- **Nature disaster**

Impacts

- Population decreasing
- Soil nutrient deteriorate
- Damage to DNA
- Influencing animal & plant growth
- Morphology
- Biomass accumulation
- Effect on reproduction (reduce reproductive succcess)
- Disruption of food web

Agro-diversity and cc mitigation & adaptation

- *Climate change responsible for several challenges in agriculture and food security*
- *most relevant climate change: -*
  - rise in temperature*,*
  - changes in precipitation patterns (*and reduced water supply)*
  - increased UV radiation
  - increased incidence of extreme weather events
  - increase of greenhouse gases in the atmosphere

cont. Agro-diversity and cc

- *Loss in diversity of genes, species and significant changes to agro- ecosystems*
- genetic resources $\Rightarrow$ both a victim and a crucial strategy to coping with cc

White sorghum

Pearl millet

Maize landraces: Variation in colour and ear prolificacy

Curcubits

Taro landraces

Amaranthus

Sweet potato

Cowpea –*Vigna unguiculata*

Bambara nut
Vigna subterranea

- **Key pillars:**
  - **sufficient diversity within agro-ecologies to maintain adaptability;**
  - ***in situ* maintenance of traditional adapted materials ⇒ *allows these materials to evolve and adapt to changing conditions***
  - **introducing new materials in many situations**
  - **IKS + new scientific developments**

What could agrobiodiversity do?

Could it

- Increase farm resilience in a changing climate?
- Conserve soil and increase natural soil fertility and health?
- Contribute to sustainable intensification?
- Diversify products and income opportunities?
- Help maximize effective use of resources and the environment?
- Improve human nutrition and provide sources of medicines, vitamins?
- Conserve ecosystem structure and stability of species diversity?
- Increase productivity, food AND nutrition security, and economic returns?
- Reduce the pressure of agriculture on fragile areas, forests and endangered species?
- Make farming systems more stable, robust, and sustainable?

Rationale of our Project

- *From a global perspective there has been a sharp decline in agro-biodiversity, especially as observed over the last century*
- *Food security is threatened because the move away from agro-biodiversity to modern, genetically uniform plant varieties is exacerbating the risks arising from climatic variability and change*.

  a) the modern plant varieties are often more vulnerable to the increasing climate extremes than local traditional varieties, and may have less nutritive value;

  b) many farmers rely on only one or two modern varieties rather than diversity of crops better suited to variable seasons, drought, temperature extremes, nutrient-poor soils and increased pest and disease incidence, and

  c) the knowledge, skills and cultural heritage around diverse food production systems are being lost

“increasing agro-biodiversity will lessen vulnerability to climatic risks and therefore increase sustainable food and nutritional security (along with a range of health, financial and other quality-of-life benefits)”

Agro-biodiversity has been proposed as an adaptation to climate change. This proposition rests largely on principles borrowed from natural ecological systems which have been extended to agricultural systems at a global/regional scale. It has not been tested and evaluated extensively, especially at farm scale in a holistic context of integrated food value chains and using multiple environmental, cultural and socio-economic criteria for evaluation.

Assessing the relative benefits of agro-biodiversity in the context of climate variability and change

A collaborative project:

Lead Institutions: University of Cape Town (UCT), South Africa. Co-Lead: Curtin University, Perth, Australia

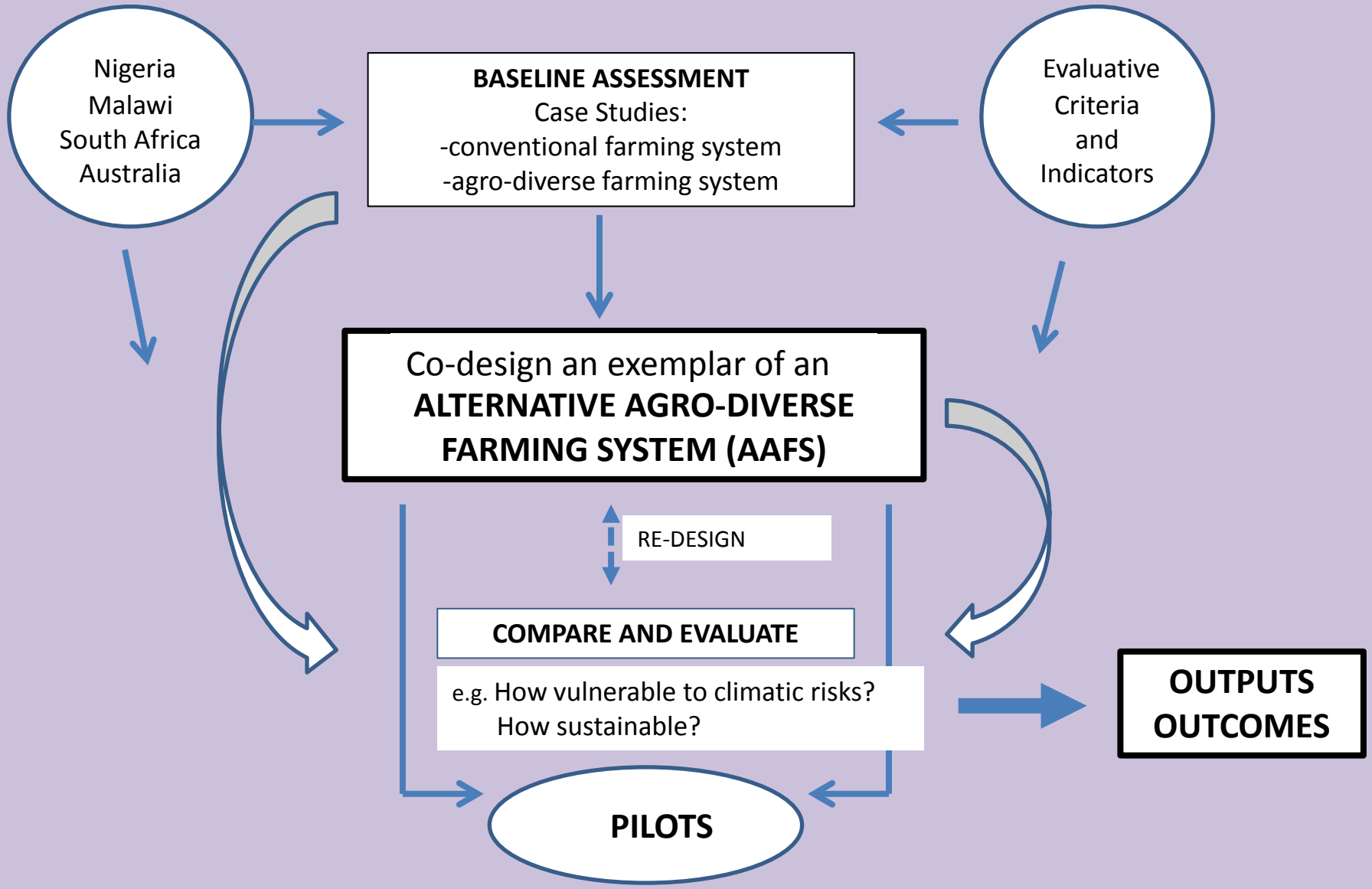
Collaborating institutions: Lilongwe University of Agriculture and Natural Resources (LUANAR), Malawi; University of Ibadan, Ibadan Oyo State, Nigeria; University of Pretoria, South Africa; University of Western Australia, Australia; University of Witwatersrand, South Africa; Univ. of Stellenbosch, South Africa, University of Nairobi, Kenya.

Dr Peter Johnston, Prof Janet Bornman, Assoc Prof Charles Jumbe, Dr Casper Madakadze, Dr Kinuthia Ngugi, Dr Adeola Olajide, Prof Kadambot Siddique, Prof Coleen Vogel, Prof Richard Warrick, PhD

- **KEY RESEARCH QUESTION:** To what extent can agro-biodiversity improve food security and climate resilience, given both current and future climatic risks?
- **BROAD APPROACH AND METHODS:** In order to address the key question, the project must be highly collaborative, integrative and interdisciplinary, with contribution of methods and expertise from diverse fields such as agronomy, biology, dryland management, climatology, anthropology, food sciences and economics. Consequently, the methods are equally as diverse, ranging from climate impact modelling to on-farm pilot agro-biodiversity plots, including capacity building for application and on-going assessment and trials. The assembled team from the participating universities in Africa and Australia will cover this range of diversity. The broad approach of the team will be to conduct case studies at farm scale in each of the five countries (Australia, South Africa, Malawi, Nigeria and Kenya) using consistent methods that will allow for cross-comparisons.
- **PROJECT AIM: To assess the role of agro-diversification in contributing to food security in the context of increasing climate risk**

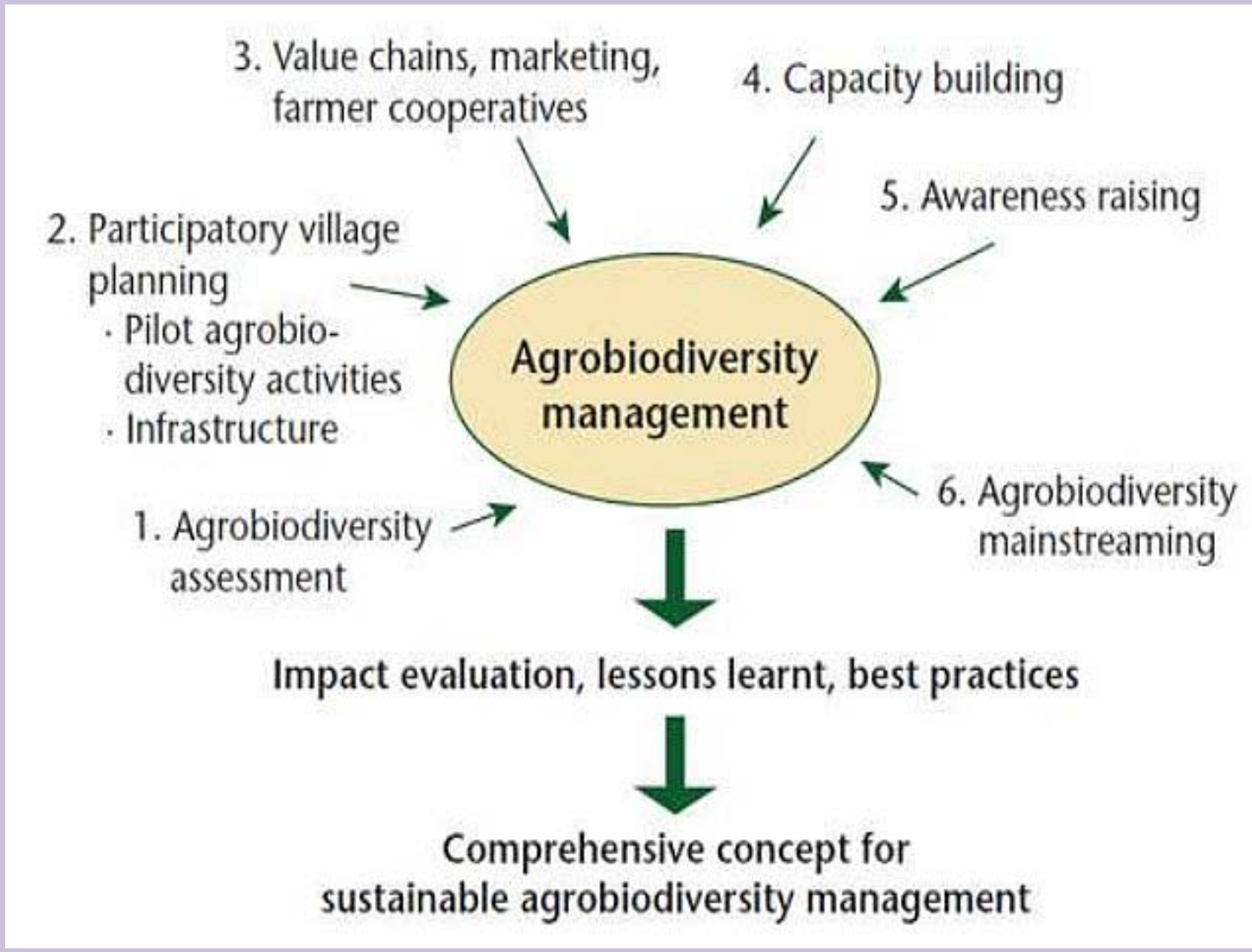
Objectives

1. Develop a set of evaluative criteria and indicators that are appropriate to the cultural and socio-economic circumstances of each case study (but with sufficient commonality for cross-country comparisons), in order to provide measures for selecting case studies and evaluating the viability of different farming systems.
2. Establish the baseline situation for purposes of comparison and evaluation of the farming systems.
3. Develop an exemplar of an alternative agro-biodiverse farming system for each case study in order to compare to the baselines
4. Compare the alternative system of each case study to the baseline, in order to determine the relative advantages and disadvantages of agro-biodiverse farming systems
5. Assess the comparative sustainability of existing and alternative agro-biodiverse farm systems under scenarios of future climate change and its associated climatic risks, in order to ascertain the extent to which agro-biodiversity can serve as adaptation to climate change.
6. Pilot selected innovative alternative species/systems identified for agro-biodiversity, in order to establish their suitability/viability (across the food value chain).
7. Disseminate the findings of the project widely, in order to publicise the methodology and findings and to facilitate replication of the approach and methods)
8. Develop training initiatives and tools in order to build capacity in assessing and implementing Agro-Biodiverse Farming systems


Nigeria
Malawi
South Africa
Australia
BASELINE ASSESSMENT
Case Studies:
-conventional farming system
-agro-diverse farming system
Evaluative
Criteria
and
Indicators
Co-design an exemplar of an
ALTERNATIVE AGRO-DIVERSE
FARMING SYSTEM (AAFS)
RE-DESIGN
COMPARE AND EVALUATE
e.g. How vulnerable to climatic risks?
How sustainable?
OUTPUTS
OUTCOMES
PILOTS

Outputs/milestones

Set of evaluative criteria/indicators developed and case study sites selected
Baselines conditions of study sites described, evaluated and assessed
Exemplar alternative agro-biodiverse systems developed for each site
Relative merits of agro-biodiverse systems assessed and barriers identified
Agro-biodiversity as adaptation to climate change has been assessed
Suitable agro-biodiverse farm systems validated and assessed from pilot results
Knowledge base for agro-biodiversity research produced
Cohort of researchers and practitioners trained


3. Value chains, marketing, farmer cooperatives
4. Capacity building
5. Awareness raising
2. Participatory village planning
· Pilot agrobio-diversity activities
· Infrastructure
Agrobiodiversity management
1. Agrobiodiversity assessment
6. Agrobiodiversity mainstreaming
Impact evaluation, lessons learnt, best practices
Comprehensive concept for sustainable agrobiodiversity management

First step?

selecting alternative crops based on a set of selection criteria, and then going into detail on the potential of a small number of the crops that emerged from the selection process with comparative rankings

2 or 3 case studies….

Kwaheri