

# Sustainable land in sub-Saharan Africa: Improving livelihoods through Local Research

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Vice Chancellor, University of Energy and Natural Resources (UENR)

FONA Status Seminar • June 4, 2025 • Alisa Hotel, Accra

# "THE GREATEST THREAT TO OUR PLANET IS THE BELIEF THAT SOMEONE ELSE WILL SAVE IT"

## Local Empowerment

Communities become architects of their future.

## Shift Mindset

From external help to internal strength.

## Hybrid Solutions

Farmer wisdom meets scientific rigor.

## Our Focus

Academia's transformative role today.



# Global Development Concerns



Climate change



Novel biotechnologies



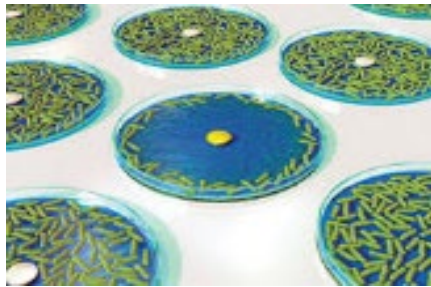
Inequality



Land degradation



Biodiversity loss



Antibiotic resistance



Rapid urbanisation



Political upheaval



Emerging viruses



Nuclear proliferation



Terrorism



Famine



Cybersecurity



Financial Stability



Environmental disasters



# OUR JOURNEY TOGETHER



## Sustainability Crisis

Global degradation emergency affecting Africa



## FONA Response

Transdisciplinary research and collaboration



## Academia's Leadership

Knowledge co-creation and capacity building



## Future Pathways

Resilient communities and scaling innovations

# PLANETARY BOUNDARIES UNDER PRESSURE

100M

Hectares Lost

Productive land lost annually

1.3B

People Affected

Directly impacted by degradation

2°C+

Climate Crisis

Accelerating ecosystem collapse



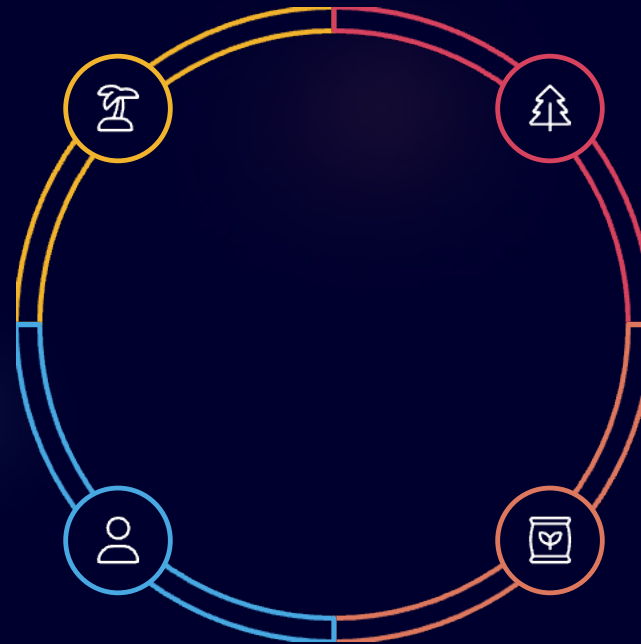
# AFRICA'S LAND DEGRADATION EMERGENCY

65% Land Degraded

Productive land already compromised

Youth Opportunity

Young population + rich knowledge systems



4.4M Hectares

Forest lost annually

65% Soil Compromised

Agricultural soils degraded since 1950s



# The Human Cost of Degradation

70%

Agriculture Dependence  
SSA population relies on farming

60-80%

Food Production by Women  
Yet often lack access to resources

400M

Youth Employment Need

By 2030, across Africa

Land degradation directly impacts livelihoods, accelerates rural-urban migration, and erodes invaluable traditional knowledge systems, creating a complex humanitarian challenge.

# Ghana's Critical Situation

## National Imperative for Action

- 35% land under desertification threat
- \$1.4B annual economic cost (6% GDP)
- Northern regions severely affected
- Mining impacts compounding degradation
- National targets: 882km<sup>2</sup> reforestation by 2030

## Driving Forces of Land Degradation

- Climate change impacts
- Unsustainable agricultural practices
- Deforestation for fuel and timber
- Unregulated mining activities
- Population growth pressure

# SUSTAINABLE DEVELOPMENT IMPERATIVE





United Nations

Convention to Combat  
Desertification

# LAND DEGRADATION NEUTRALITY

## Avoid

Prevent new degradation through  
planning

## Reduce

Minimize impacts through sustainable  
practices

## Reverse

Restore degraded lands through  
intervention



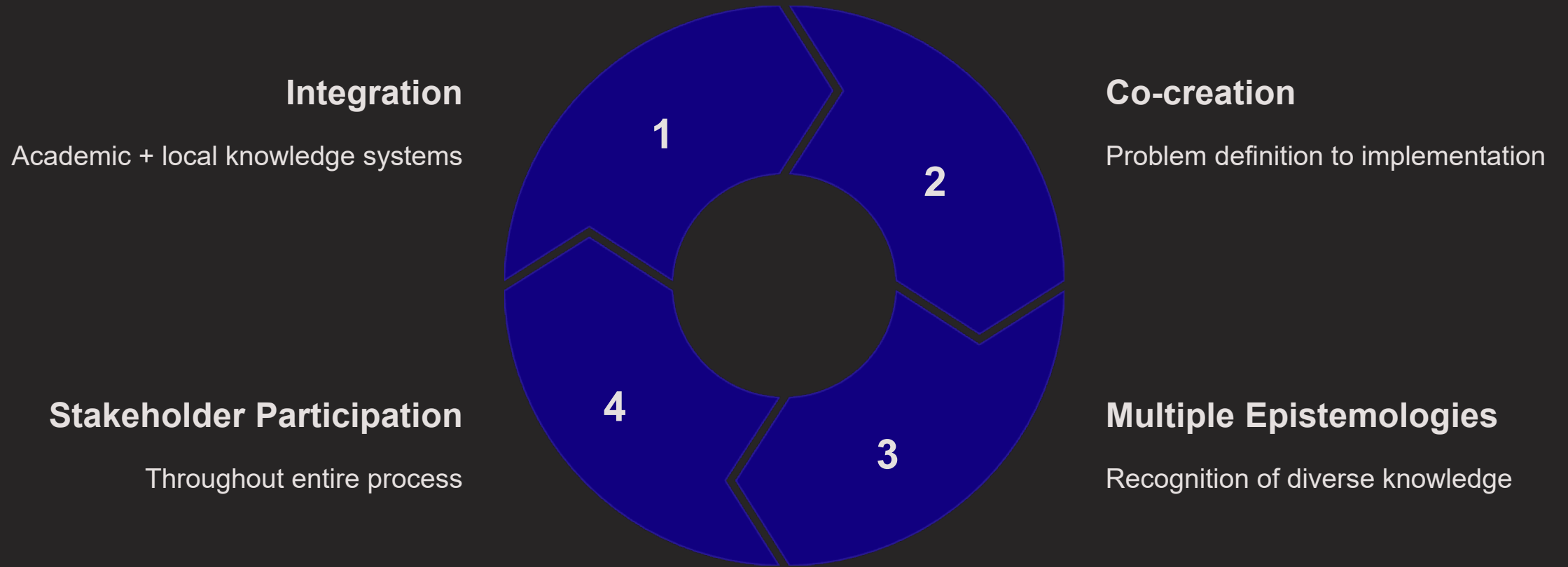
# Research for Sustainability Transformation

FONA Programme: German Federal Ministry funding across seven African countries

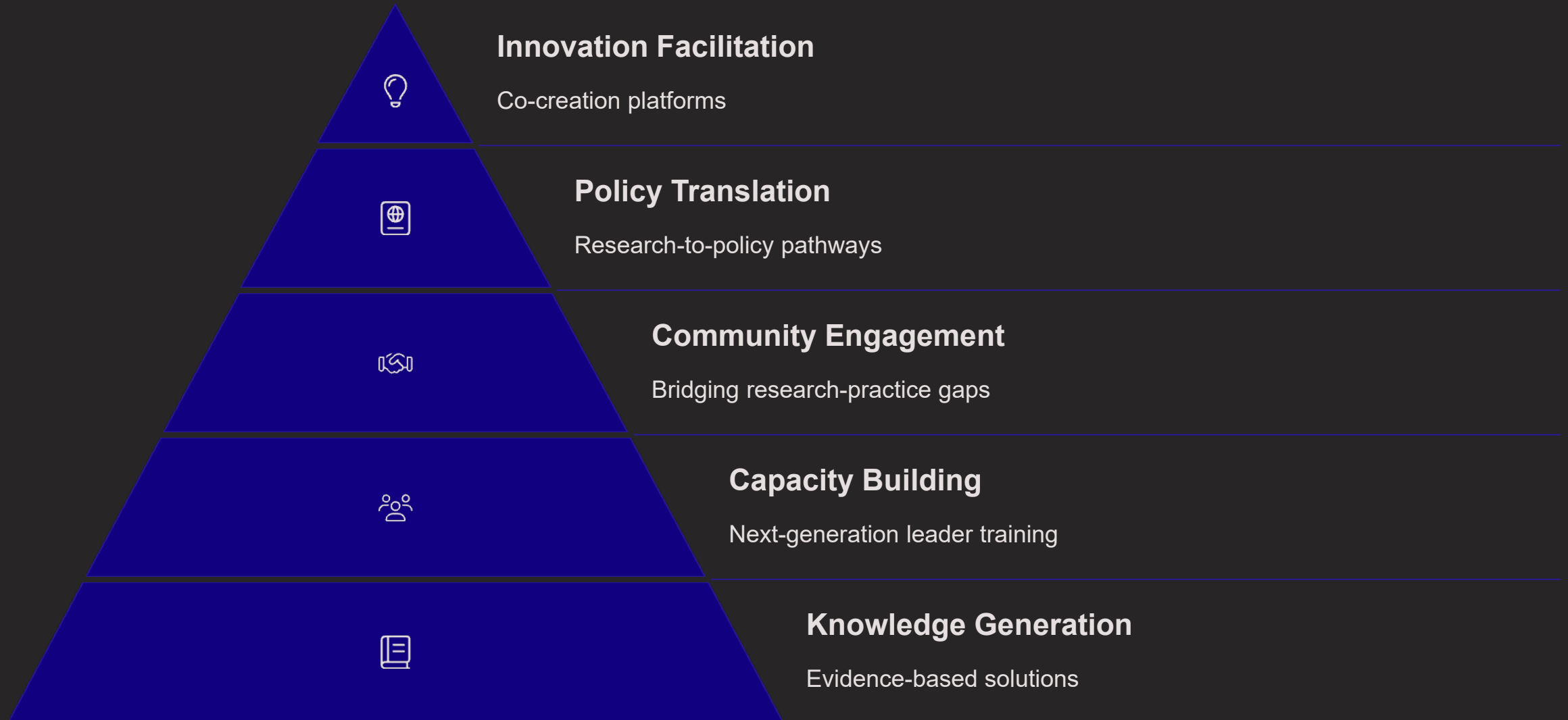
- Transdisciplinary approach to sustainable land management
- Community-centered innovation with INTERFACES coordination



# Transdisciplinary Research Paradigm



# Academia's Transformative Roles





# UENR's Leadership Model



## Education

Ghana's transition zone location



## Research

Renewable energy + agriculture



## Innovation

Community partnerships



## Collaboration

International networks

# Social Inclusion Imperative

## Youth Engagement

400M African youth need jobs

## Indigenous Knowledge

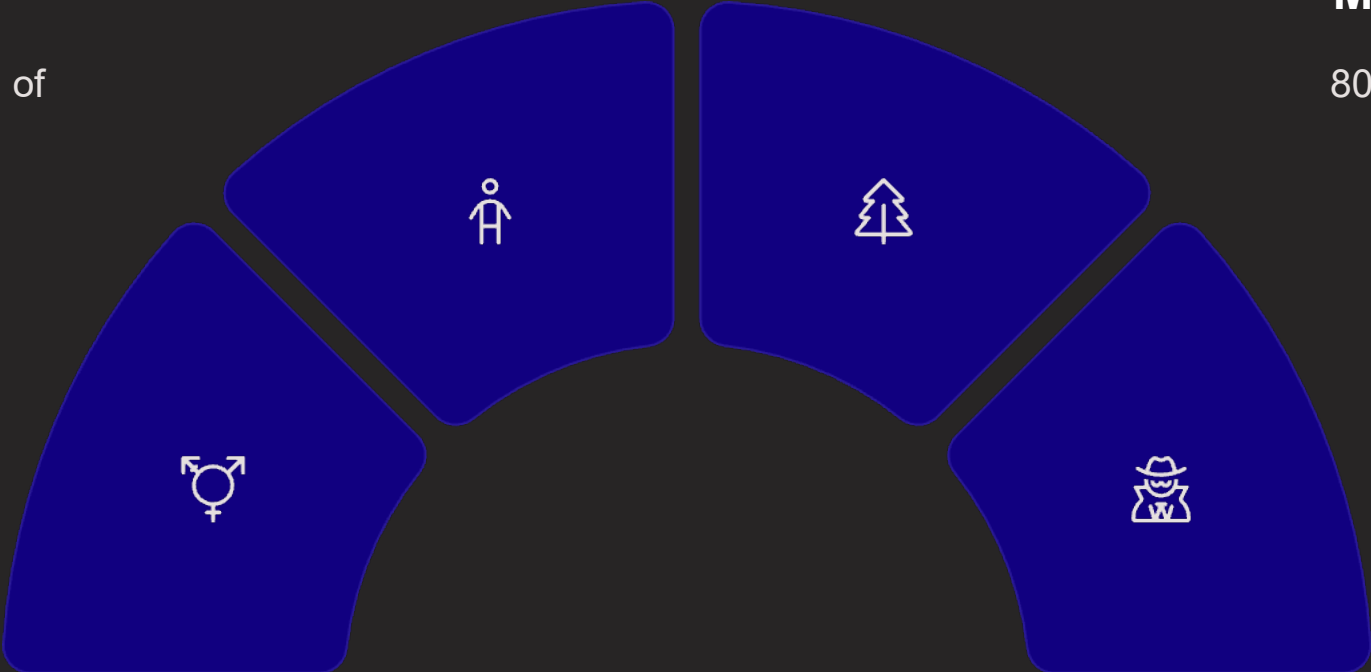
Traditional wisdom integration

## Gender Equity

Women produce 60-80% of food

## Marginalized Voices

80% of world's poor in rural areas



# Gender Dimensions in SLM

## Challenges

- Land access restrictions
- Credit limitations
- Decision exclusion

## Solutions

- Women-focused extension
- Leadership development
- Financial inclusion

## Potential Impact

- 20-30% yield increase
- 100-150M escape hunger
- Gender-sensitive technology



# Youth as Change Agents

**60%**

**Young Population**

Africa's population under 25

**1st**

**Technology Adoption**

Early adopters of digital tools

**2x**

**Innovation Rate**

Entrepreneurial energy



# Knowledge Decolonization

## Value Recognition

African knowledge systems are valuable, not inferior

## Multiple Epistemologies

Diverse knowledge systems contribute unique insights

## Local Solutions First

Starting points for innovation

## Reverse Innovation

From local to global application

# Participatory Research Methods



## Build Trust

Engage traditional authorities

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## Define Priorities

Community-led research goals

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## Design Joint Methodology

Collaborative approach

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## Share Analysis

Interpret findings together

**True partnerships involve joint data collection training and ensure community-owned solution development.**



# Co-Developed Innovations

## Soil Fertility Management

Optimize with organic and inorganic inputs.

## Fertilizer Microdosing

Precision application for smallholders.

## Sustainable Rice

Water-saving, yield-improving methods.

## Community Info Systems

Local weather and market data.

# Climate-Smart Agricultural Innovations

Adopting climate-smart practices is essential for resilience and food security. These innovations mitigate climate risks and boost productivity.



## Efficient Water Use

Drip irrigation systems



## Drought-Resistant Crops

Developing resilient varieties



## Renewable Energy

Solar-powered irrigation pumps



## Agroforestry Integration

Trees for soil health





# Digital Agriculture Revolution



## Mobile Services

Local language extension



## Weather Forecasts

Hyperlocal, real-time data



## Market Prices

Instant information access



## Precision Tools

Adapted for smallholders

Digital platforms have reached over 1 million farmers, empowering them with critical information and tools.

# FONA Success Stories

## Senegal

50% millet yield increase via  
microdosing

## Ghana

Community-led soil  
restoration

## Kenya

Pastoralist early warning  
systems

## Namibia

Post-mining ecosystem  
rehab

Key learning: Community participation, local adaptation, and institutional support drive transformative impact.



# AU CAADP Strategy Alignment

## Enhanced Productivity

Boost agricultural output

## Strengthened Markets

Improve access and trade

## Livelihood Resilience

Increase farmer stability

## Shared Prosperity

Promote inclusive growth

**Vision 2030 aims for inclusive agricultural transformation with targets of 10% budget allocation and 6% annual growth.**

# Science-Policy-Practice Interface

Bridging the implementation gap requires strong connections between science, policy, and practice.





# Universities as Change Engines

## Curriculum Integration

Embed sustainability across all disciplines.

## Faculty Development

Enhance community engagement skills.

## Community Partnerships

Foster long-term, impactful collaborations.

## Research Infrastructure

Build collaborative research platforms.

**UENR exemplifies this through interdisciplinary programs, community-based learning, and research-extension integration.**



# Emerging Technologies for Sustainability



## AI Applications

Crop disease diagnosis, yield prediction.



## IoT Systems

Soil sensors, weather stations, livestock tracking.



## Blockchain

Supply chain traceability, smart contracts.



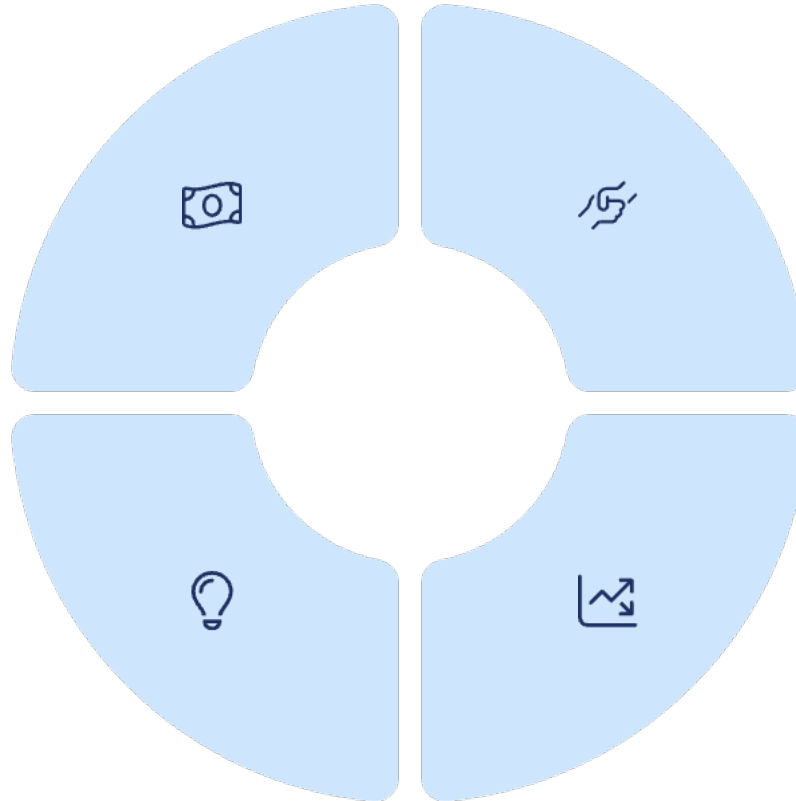
## Gene Editing

Climate-resilient varieties, enhanced nutrition.

The guiding principle is responsible innovation serving human wellbeing.

# Building Resilient Funding

**Diversified Sources**  
Expand beyond traditional funding channels.



**Local Mobilization**  
Engage local communities and resources.

**Impact Investment**  
Attract mission-aligned investors.

**Revenue Generation**  
Create income from services offered.

**Success hinges on government commitment, international partnerships, and private sector engagement.**



# Measuring Transformative Impact

-  — **Livelihood Indicators**  
Track improvements in community well-being.
-  — **Participatory Evaluation**  
Engage stakeholders in assessment.
-  — **Continuous Learning**  
Implement adaptive management systems.
-  — **Sustainability Tracking**  
Monitor long-term environmental and social gains.

**The goal is learning for improvement, not just accountability.**

# UENR's Strategic Commitment



UENR's Department of Land Management draws students from Kenya, Nigeria, and Ethiopia, and **partners** with GIZ, GEO LDN and WOCAT.

**UENR** University of Energy and Natural Resources  
School of Mines and Built Environment

**GEO** LAND DEGRADATION NEUTRALITY

Partial & Fully Funded  
**SCHOLARSHIPS**

In Support of  
**Land Degradation Neutrality (LDN) International**  
Postgraduate Programmes

Prospective Foreign Applicants are to apply before  
**Friday, June 30, 2023.**  
Visit:  
[www.uenr.edu.gh](http://www.uenr.edu.gh)  
Contact:  
**+233 (0) 543311515**

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# WOCAT

&amp;



# UENR

UNIVERSITY OF ENERGY  
& NATURAL RESOURCES

World Overview of Conservation Approaches and Technologies

- WOCAT established 1992 to promote land conservation documentation
- **WOCAT has approved UENR as partnership institution (MoU signing ceremony June 2025)**
- Formalizes collaboration for Sustainable Land Management initiatives
- Strategic Opportunities
  - Regional Hub - UENR serves as West African SLM center
  - Research Collaboration - Joint documentation of land practices
  - Capacity Building - Training programs and expertise sharing
  - Knowledge Exchange - Access to global SLM database and methods
  - Policy Integration - Influence national/regional land management decisions

## Fire Map for West-Africa

Select different days using the date picker, country and fire source to view fires

Click for Map Options

## Available Fire Hotspots

Quick View

Archives

24 Hours



Aqua



Terra



VIIRS



Data Source: [EORIC](#)



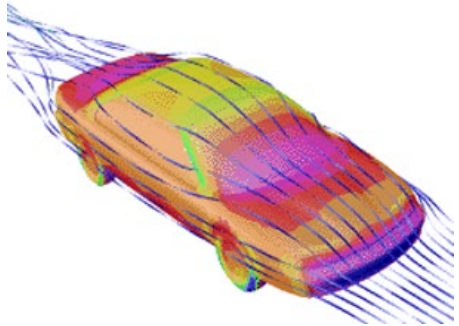
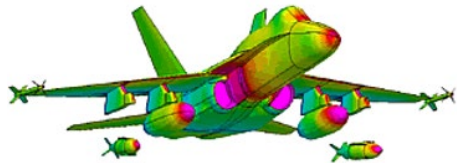
Streets

Reset

Dark

## HIGH PERFORMANCE COMPUTING (HPC)

The HPC Lab offers consultancy, research and training in High Performance Computing, Computational Fluid Dynamics (CFD) and Artificial Intelligence (AI) as well as develop new tools and software packages to address specific challenges.



### PARTNERS



## APPLICATIONS

- Computational Fluid Dynamics
- GPU Computing
- Environmental Modelling
- Weather & Flood Forecasting
- Artificial Intelligence
- ... and many more

## COLOCATION SERVICES-D'ORBIT PROJECT

EORIC-UENR, in partnership with Astralintu, Ecuador, has been enrolled as a member of the LatZero Link Network.

The LatZero Network is leveraging the existing ground station owned by UENR and being managed by EORIC-UENR

### PARTNERS



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## CARBON MONITORING TOWER

The project is a cooperation between the University of Energy and Natural Resources in Sunyani, Ghana and the Global Change Research Institute, Czech Academy of Sciences, The Czech Republic. The project site will be a national asset to support climate change research and national efforts in addressing and reporting on SDG Goal 13 – Climate Action

### PARTNERS



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# COMMISSIONING OF PROJECT <sup>2023</sup>

The Carbon Tower Project was commissioned on the 8<sup>th</sup> of March, 2023, at UENR, Ghana



## UNMANNED AERIAL SYSTEMS

Unmanned Aerial Systems for remote sensing, precision agriculture. We also provide consultancy and a range of courses for those individuals looking to use drones for a variety of purposes.

### MODULES

#### BASIC MODULE

- Drone Technology Background
- Full Day Training with Flight Time
- Drone Simulation Training
- Learn to Fly Before
- Be Ready to Turn Your Hobby into a Profession
- Learn the Rules for Safe and Legal Professional Flights

#### PROFESSIONAL

- Contact us for more information:
- [eoric@uenr.edu.gh](mailto:eoric@uenr.edu.gh)
- <https://eoric.uenr.edu.gh/>

#### SPECIALIZED

- Drone Mapping & Surveying
- 3D modelling
- Precision Agriculture
- Drone Assembly and Repairs



## TRAINING, INTERNSHIP, ATTACHMENT PROGRAMMES

UENR offers hands-on workshops and training in a wide range of areas to solve real-world problems. Our training targets students, interns and professionals. Watch out for our next training happening soon.

Interns and Attaches are welcomed to work and learn hands-on with us.

### TRAININGS PROGRAMMES & WORKSHOPS

- FUNDAMENTALS OF ACCELERATED COMPUTING WITH CUDA C/C++
- INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS WITH OPENFOAM
- SATCOM PROFESSIONAL CERTIFICATE SHORT COURSE
- GEOSPATIAL ANALYSIS WITH R
- UNDERSTANDING DVBS2, DVBT2 & DVB-H IN SATELLITE TECHNOLOGY
- APPLIED REMOTE SENSING FOR VEGETATION MAPPING
- APPLIED SATELLITE TECHNOLOGY FOR INTEGRATED RESOURCE MANAGEMENT
- INTRODUCTION TO DATA ANALYSIS WITH PYTHON
- INTRODUCTION TO DRONE FLIGHT AND DATA PROCESSING
- INTRODUCTION TO LATEX

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# UENR Sustainable Land-use Management Projects



Ecosystem Restoration

Rehabilitating degraded lands



Agroforestry Systems

Integrating trees with crops



Watershed Management

Protecting water resources





# AI-Powered Pest Detection for Sustainable Agriculture



## Early Detection

Identify pests/diseases in cassava, maize, tomatoes, cashew



## Eco-Friendly Management

Targeted interventions minimize chemical use



## Economic Benefits

Higher yields, lower costs, better market access



## Environmental Protection

Reduced water pollution, preserved biodiversity

**Project funded by ATPS and International Development Research Centre (Canada) under AI for Food and Agricultural Systems theme.**



## Maize Disease App

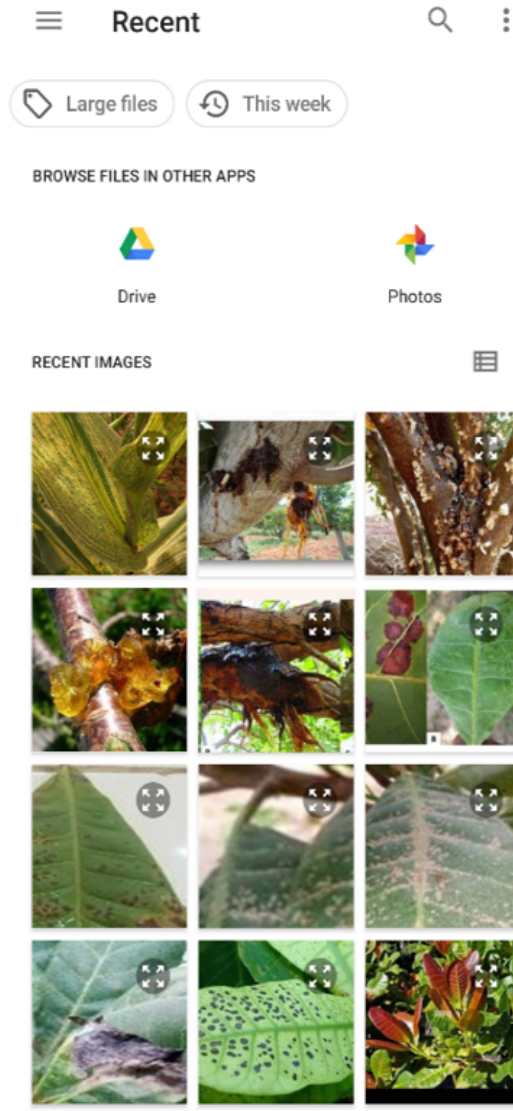


Kamra

Foto



(a)



(b)

## Maize Disease App



100.0%: streak virus

Whatsapp

Control

Kamra

Foto



(c)

Figure: The app interfaces showing (a) maize disease/pest detection page, (b) using the phone camera “Kamra button” to take a picture, and (c) picking a picture from the phone’s gallery using the “Foto” button.



PRESENT

# NBS

Nature-Based Solutions

## International Conference 2022

**THEME:**  
Nature-Based Solutions for Food (NBS4F);  
Getting prepared for a climatic-resilient future.

**UENR Auditorium**  
Sunyani Campus

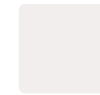
17<sup>TH</sup>  
To  
18<sup>TH</sup>  
AUGUST  
2022



# Nature-Based Solution Project: Wageningen & UENR Partnership

## Project Focus

Rainwater harvesting and forest landscape restoration in Bono Region



## Timeline

2020-2022 field studies, conference in August 2022

## Collaboration

Engaged experts from Forestry Commission, Tropenbos, IUCN, and others

# Green People's Energy - Solar Powered Irrigation Systems



## Sustainable Energy

Harnesses solar power for irrigation



## Efficient Water Use

Optimizes agricultural water distribution



## Community Empowerment

Supports local farmers with clean technology



by Amos Kabo-Bah





**MINISTRY OF ENERGY**  
Republic of Ghana



german cooperation  
DEUTSCHE ZUSAMMENARBEIT

Implemented by:

**giz** Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



**UENR** University of Energy and Natural Resources

**giz** Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

**RCEES** Resource Centre for Energy and Environmental Studies

**SPIS Financial Training**

# Agroforestry Systems at Akufo Pa

## Cocoa Integration

Cassava and plantains with 6-year-old cocoa

## Cashew Integration

Cassava/plantains with cashew; goats with 8-year cashew

## Intercropping Systems

Row system vs mixed cropping with pineapple, cassava, plantain, maize, okro



# Sustainable Land-use Management Practices

Sole planting of pineapple with black plastic mulch without poultry manure.



Sole planting of pineapple with poultry manure and black plastic mulch



Sole planting of pineapple with poultry manure without black plastic mulch



Sole planting of pineapple with black plastic mulch with NPK and selective weedicide.

# Sustainable Land-use Management Practices

Carrot and onion production with poultry manure



Greenhouse organic tomato production



# Fertilizer Trials

Project Title	Funding Organisation	Partners
<p><b>Fertilizer response trials on Maize, Rice and Soyabeans</b></p> <p>Under this project, UENR conducted fertilizer response trials on maize, rice and soyabeans Bono Region of Ghana, under the Fertilizer Research and Responsible Implementation (FERARI) programme of the IFDC.</p>	<p>International Fertilizer Development Centre (IFDC)</p>	<p>IFDC</p>



# Fertilizer Trials

Project Title	Funding Organisation	Partners
<p><b>Fertilizer testing on Maize, Rice, Tomato, Pepper and Onions</b></p> <p><b>Under this project, UENR performed fertilizer testing on Maize, Rice, Tomato, Pepper and Onions in the Bono and Ahafo Regions of Ghana</b></p>	<p>OCP Ghana Limited</p>	<p>OCP Ghana Limited</p>





# Bundling Small-Scale Irrigation & Drought Insurance

## Project Objective

Evaluate impacts of bundling supplemental irrigation with drought index insurance

## Implementation

Covered costs for rice farmers in Northern and Upper East Regions (2023-2024)

## Partners

USAID, UENR, UC Davis, ICED, GAIP, Allianz, 5 irrigation schemes

# Lake Bosumtwi Institutional visits – March 2021



**Water Resources Commission**



**Environmental Protection Agency**



**Fisheries Commission**



**Bosomtwe District Assembly**

# Traditional Authorities - April 2024





UNITED NATIONS | GHANA | PSIPW

# 5<sup>TH</sup> INTERNATIONAL CONFERENCE ON THE USE OF SPA FOR WATER RESOU



# 4<sup>th</sup> Annual TRANSFORMATIONAL DIALOGUE

ON SMALL-SCALE MINING

## THEME:

### Eliminating Illegal Mining in Ghana - The Will and The Bill

Date:

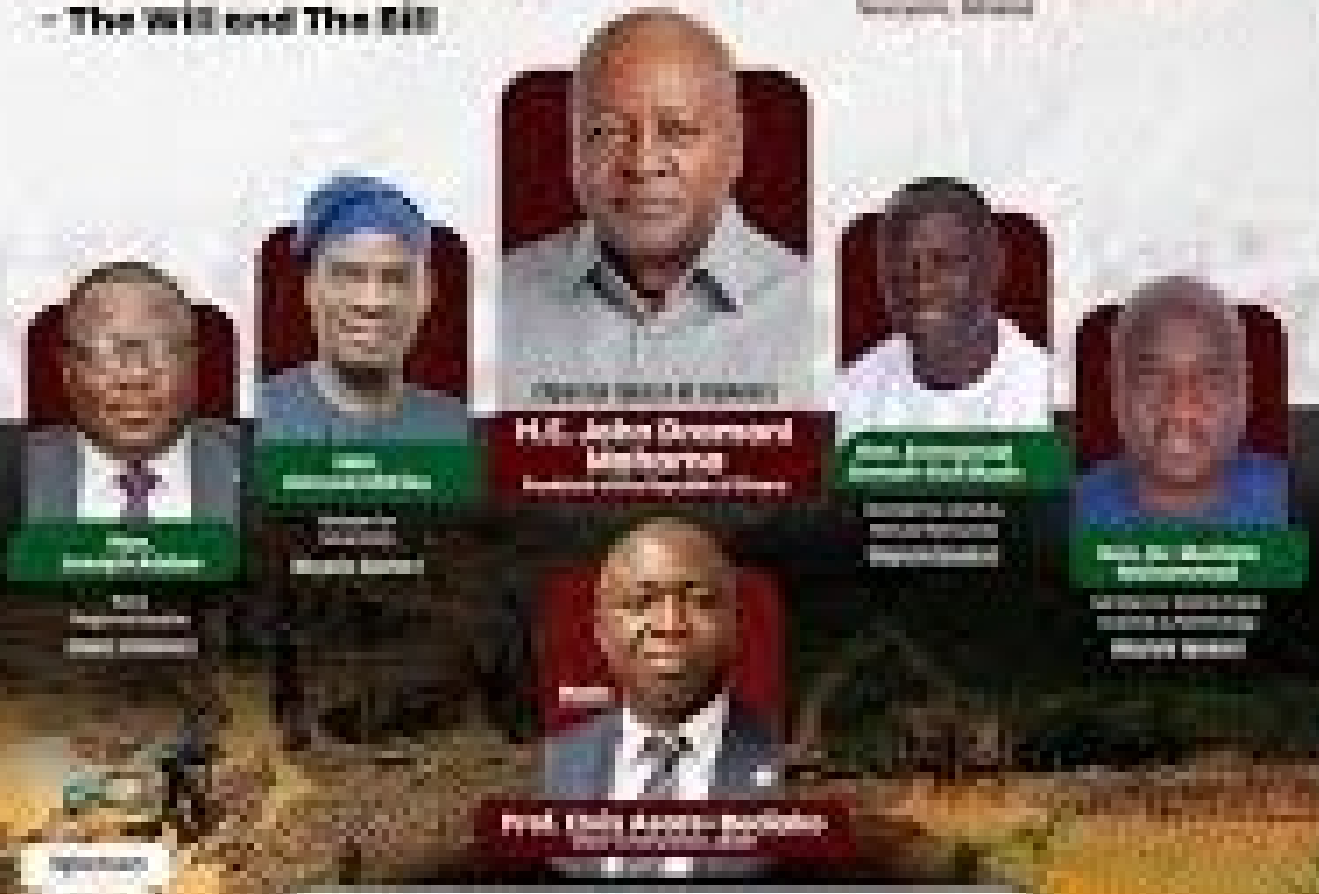
7<sup>th</sup> - 8<sup>th</sup> May, 2025

Time:

09:00 - 16:30 GMT

Venue:

Shelton's Executive Hotel  
Accra, Ghana



H.E. John Osei-Gyamfi  
Minister

Prof. John Agyepong

Prof. Dr. Kwame Agyemang



# Global Recognition Achievements

1586

Research Documents

Extensive publication record.

658

Contributing Authors

Broad collaborative network.

**UENR is recognized globally as West African SLM regional hub via WOCAT and for earth observation capacity with GEO LDN.**

# SYSTEMIC TRANSFORMATION IMPERATIVES

## Curriculum Reform

Integrate sustainability into learning.

## Promotion Criteria

Value community impact for tenure.

## Community Partnerships

Invest in authentic, lasting ties.

## Faculty Development

Support continuous learning.

## Innovation Platforms

Create co-creation spaces.

## Regional Networks

Strengthen collaborations.

# TOGETHER WE SHAPE THE FUTURE

## Four Foundations:

**Research Excellence**  
Rigorous, relevant, participatory approaches.



**Community Empowerment**  
Local ownership, strong capacity.

**Innovation Scaling**  
Impact from local to regional.

**Policy Integration**  
Evidence-based development decisions.

"When education enlightens, research uplifts, and innovation empowers, we don't just manage land—we restore dignity, build resilience, and transform lives."

# Call to Action: Researchers

1

## Embrace Transdisciplinary Collaboration

Work across fields.

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2

## Prioritize Community Engagement

Involve local stakeholders.

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3

## Focus on Real-World Impact

Deliver tangible benefits.

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4

## Build Sustainable Relationships

Foster long-term partnerships.

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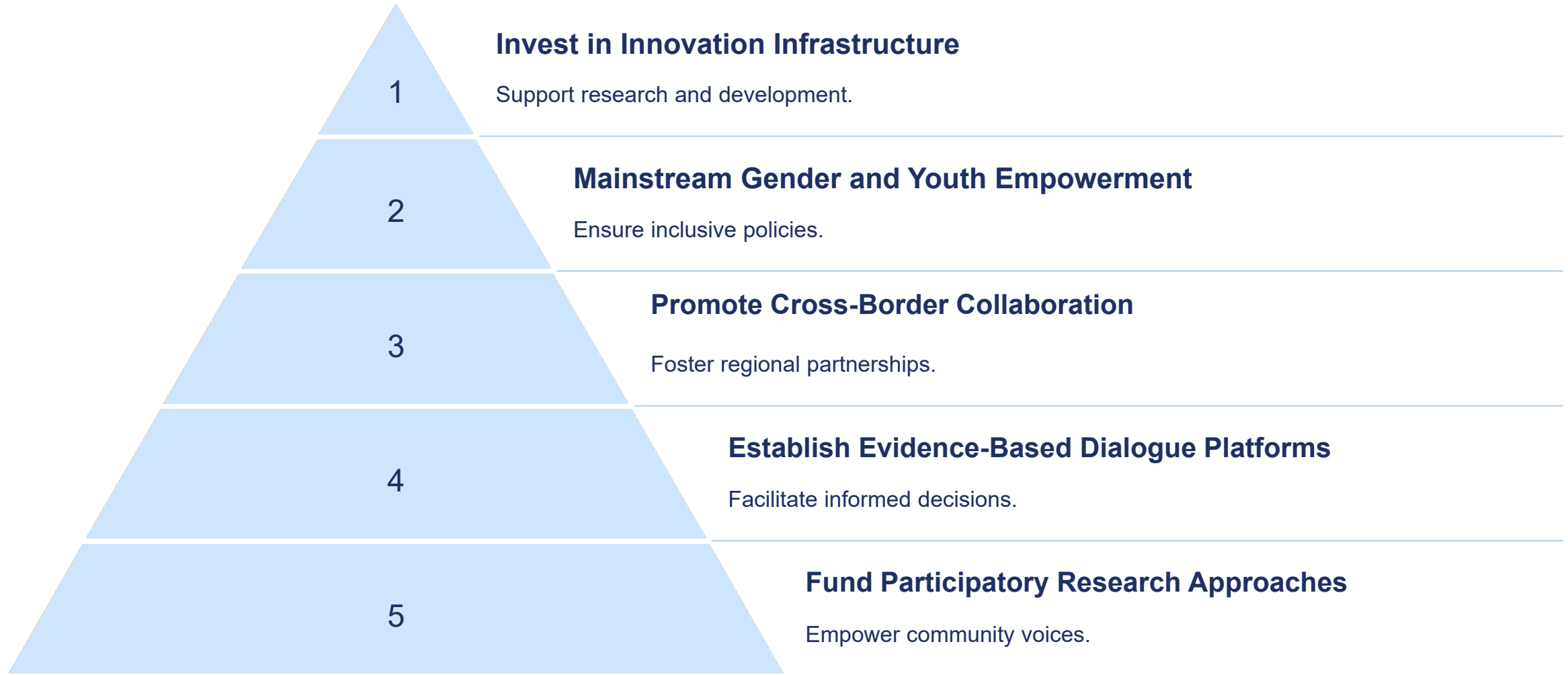
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## Translate Findings for Policy

Influence decision-making.

Mentor next-generation practitioners to sustain progress.

# Call to Action: Policymakers



**Crucially, meet the CAADP 10% research investment target for agricultural development.**

**Prof Elvis Asare-Bediako**

**Vice Chancellor, University of Energy and Natural Resources, Sunyani**

**Contact: [elvis.asare-bediako@uenr.edu.gh](mailto:elvis.asare-bediako@uenr.edu.gh)**

Thank You • Asante • Merci