Towards sustainable land management for enhancing food security while mitigating climate change impacts:

The Role of Nuclear and Isotopic Techniques

Long Nguyen

Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture

IAEA

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Nuclear Techniques in Food and Agriculture

Corporate Mission

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Atomic energy for peace, health and prosperity

Sustainable agricultural development, improved nutrition and food security

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To contribute to sustainable food security and safety by use of nuclear techniques and biotechnology

1964: 48 Years of Successful Partnership

Applications in Food and Agriculture

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Nuclear Techniques

Food & Environmental Safety

by Food Irradiation and Radio-analytical Techniques

Plant Breeding & Genetics

by Mutation Techniques

Soil & Water Management & Crop Nutrition

by Isotopic and Nuclear Techniques

Insect Pest Control

by Sterile Insect and Related Biological Techniques

Animal Production & Health

by Serological and Molecular Techniques

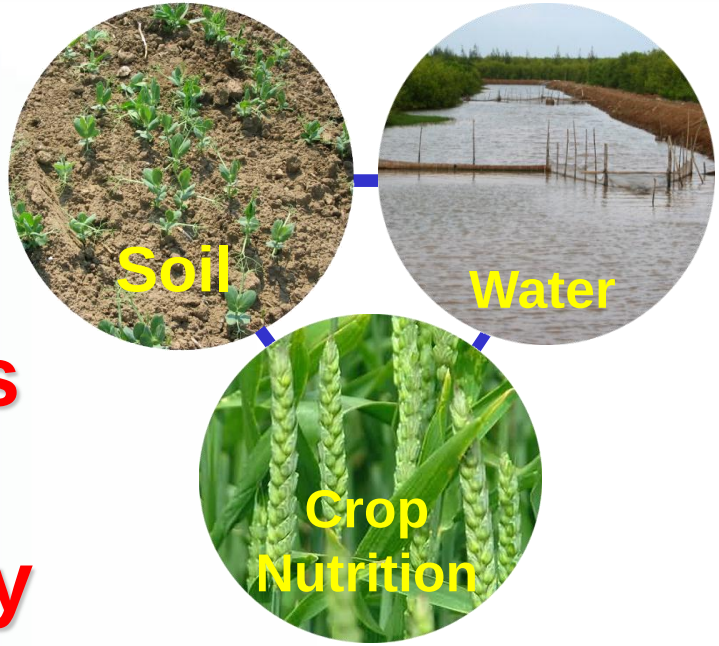
Our Goals:

- **Food Security**
- **Sustainable Agriculture**
- **Resource conservation**

Key Issues

- An increase in global population from 7 billion to 9 billion by 2050
- 70% increase in food production and 50% increase in water demand for agriculture needed by 2050.
- 1.9 billion ha of land degraded with an annual rate of 5-7 million ha.
- Agriculture emits 14-30% of global greenhouse gas (GHG) emissions:

OVERVIEW



An overview on approaches and relevant nuclear and isotopic techniques used by the SMNCN

1. Managing soils for enhancing crop production and ecosystem services

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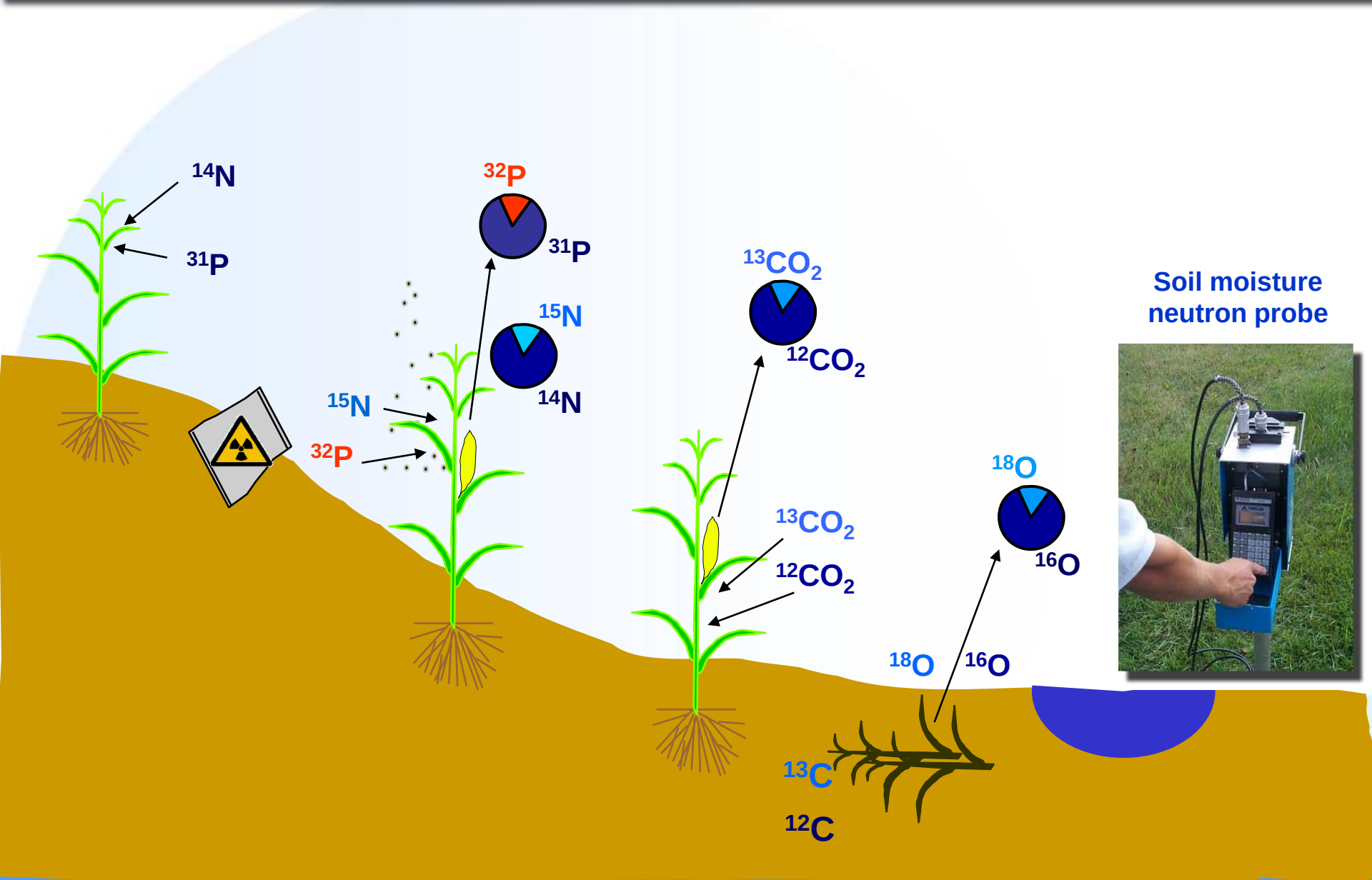

Soil moisture neutron probe

1. Managing soils for enhancing crop production and ecosystem services (continued)

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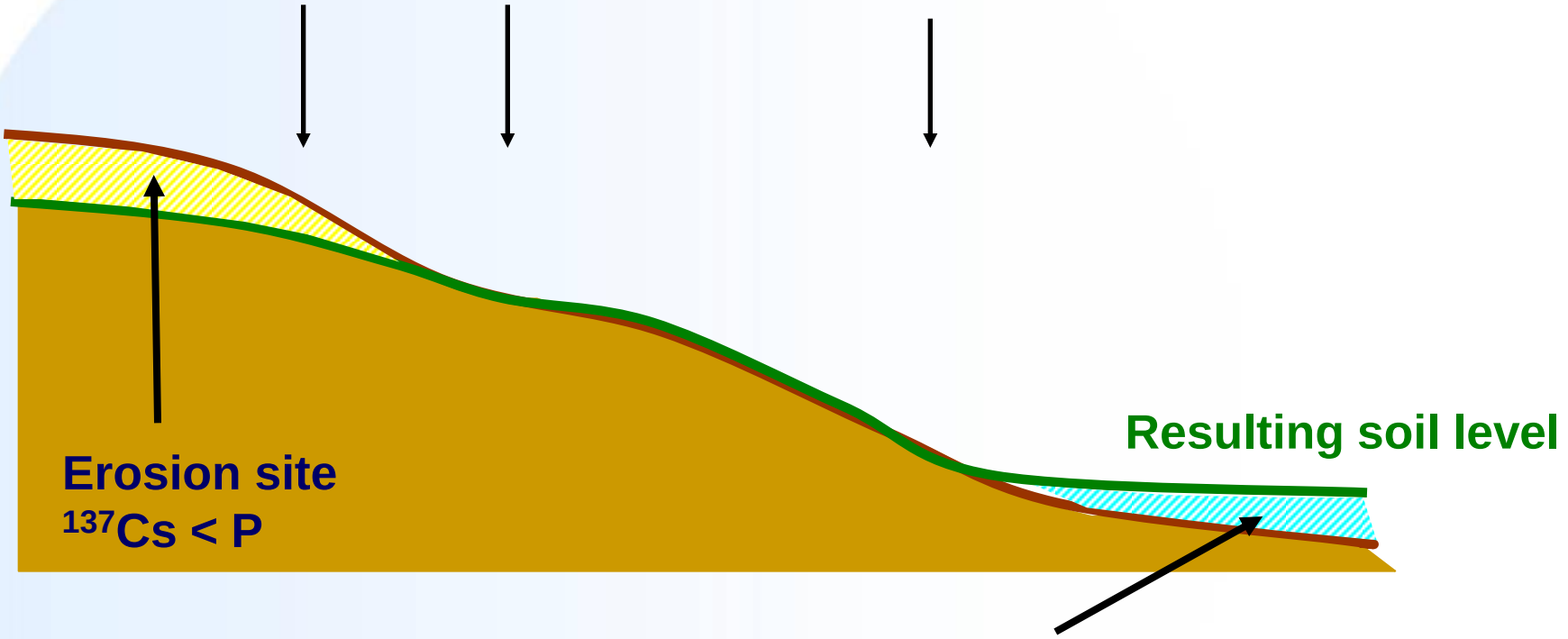
1. Integrated soil-water-nutrient management in:

- **Agroforestry,**
- **Dryland and irrigated agriculture.**
- **Cropping systems in tropical high P fixing soils.**

2. Evaluation of crop genotypes with increased WUE using carbon isotope discrimination technique.

3. Identification of food crop genotypes tolerant to soils of low N and P status.

2. Preserving and protecting soil resources – the use of Fallout Radionuclides (FRN)



2. Soil erosion and salinization (continued)

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1. **Erosion:**
   - **Extent of soil erosion: 7Be , 137Cs and 210Pb for short-term (<30 days), medium-term (~40 years) and long-term (~100 years).**
   - **Sources: Compound specific stable isotope (CSSI).**
2. **Salinization**

3. Managing soils for climate change

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- **Increasing soil quality and productivity**
  - **Soil fertility**
  - **Conservation agriculture**
  - **Mulching**
  - **Bio-fertilisers**

4. Managing soil water storage for climate change

- **Improving water use efficiency in rainfed and irrigated agriculture**
  - **Agroforestry**
  - **Mulching**
  - **Irrigation scheduling**
  - **On-farm water storage**

The Way Forward

Soil Carbon and GHG Management

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- Increasing soil carbon storage (C sequestration in soil and crops)
  - Soil fertility
  - Conservation agriculture
  - Mulching/cover crops
  - Bio-fertilisers

- Reducing GHG
  - N fertilisers
  - Animal manure
  - Irrigation scheduling

Area-wide/catchment WQQ

- **A more holistic system approach:**
  - **Integrated cropping-livestock.**
  - **Non-point source pollution control**
  - **Water recycling through constructed wetlands and riparian zones.**
  - **Alternative land uses**

- **Increasing soil and agricultural resilience against drought and flooding events:**
  Climate smart agriculture

CONCLUSIONS

- Nuclear and isotopic techniques (NIT) offer comparative advantages of high specificity, accuracy and sensitivity.
- Multi-disciplinary approaches.
- Capacity building, networking, coordination and information exchange are important in NIT applications.
- Partnerships and innovative collaboration modalities important.

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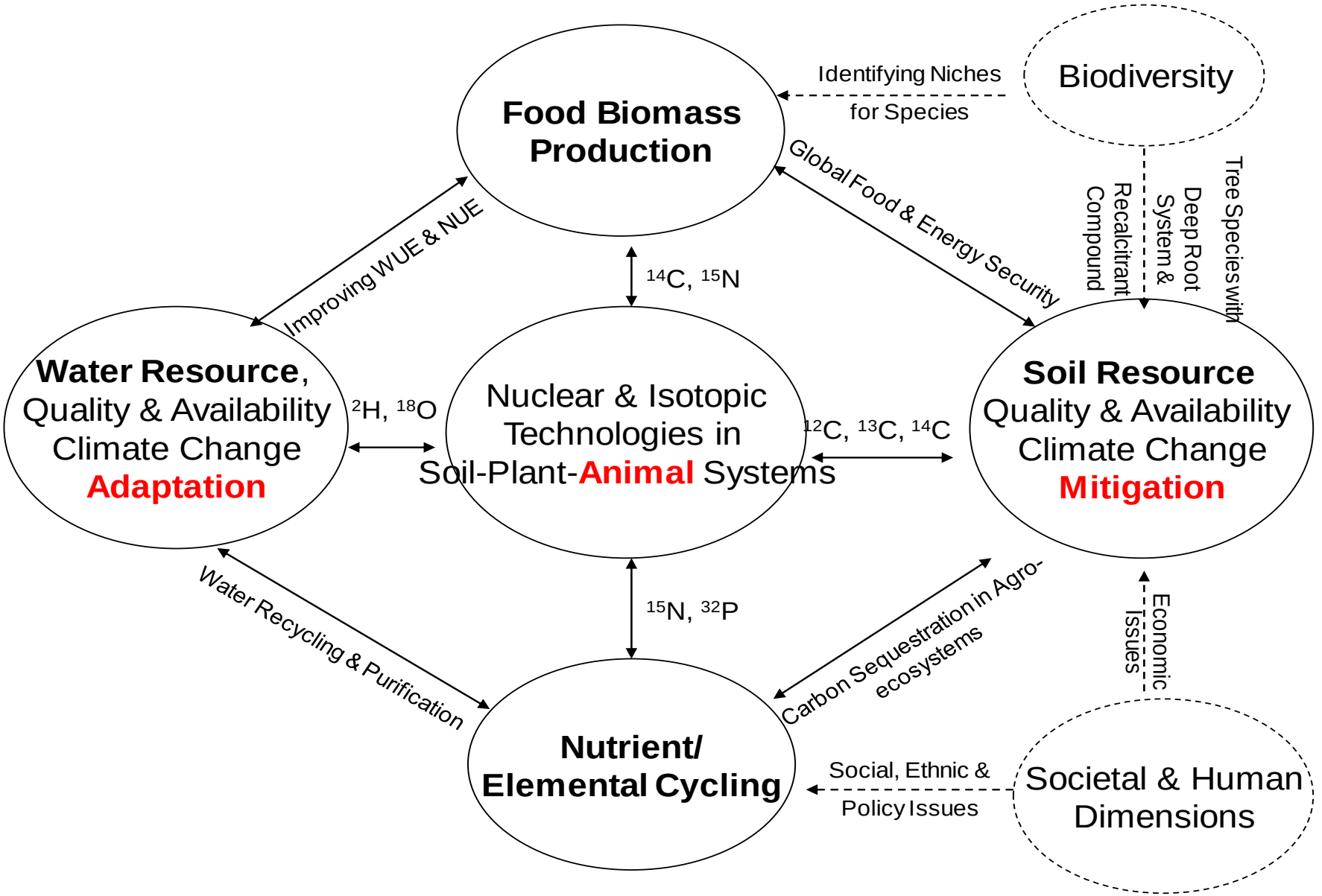
Food Biomass Production
Identifying Niches for Species
Biodiversity
Global Food & Energy Security
Improving WUE & NUE
Recalcitrant Compound
Deep Root System &
Tree Species with
14C, 15N
Water Resource, Quality & Availability Climate Change Adaptation
2H, 18O
Nuclear & Isotopic Technologies in Soil-Plant-Animal Systems
12C, 13C, 14C
Soil Resource Quality & Availability Climate Change Mitigation
Water Recycling & Purification
15N, 32P
Carbon Sequestration in Agro-ecosystems
Economic Issues
Nutrient/ Elemental Cycling
Social, Ethnic & Policy Issues
Societal & Human Dimensions