Challenges and Issues in Food Security and the Role of Isotopic and Nuclear Techniques

IAEA/RCA Coordination Meeting to Discuss the progress of the field trials

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Purpose of the Coordination meeting

- Review the status of the ongoing field studies on soil and water management practices and plant breeding using marginal land and the roles of nuclear and isotopic techniques

- Address the gaps and needs for best soil and water management practices to optimize marginal land productivity for growing food and bioenergy crops

- Fine tune the ongoing field studies (discuss with Khalid, myself and Fatima)

Outputs:

- Updated and detailed report for ongoing field work
- Future project activities (RTC, Field work and Final Project meeting)
- Meeting report

Joint FAO/IAEA Programme in Food and Agriculture

Corporate Mission

Nuclear techniques for peace, health and prosperity

Sustainable agricultural development, improved nutrition and food security

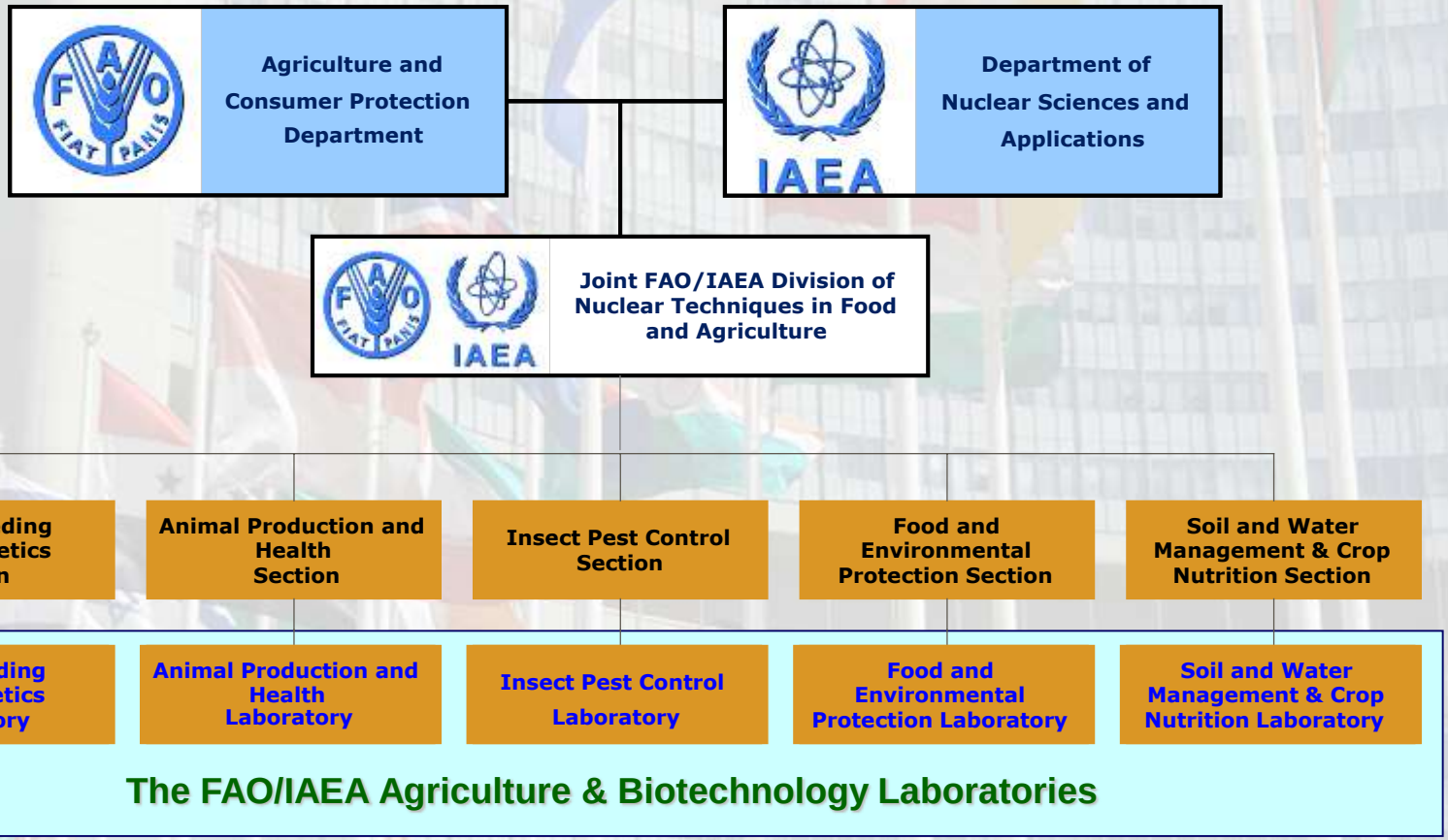
IAEA

Joint FAO/IAEA Programme

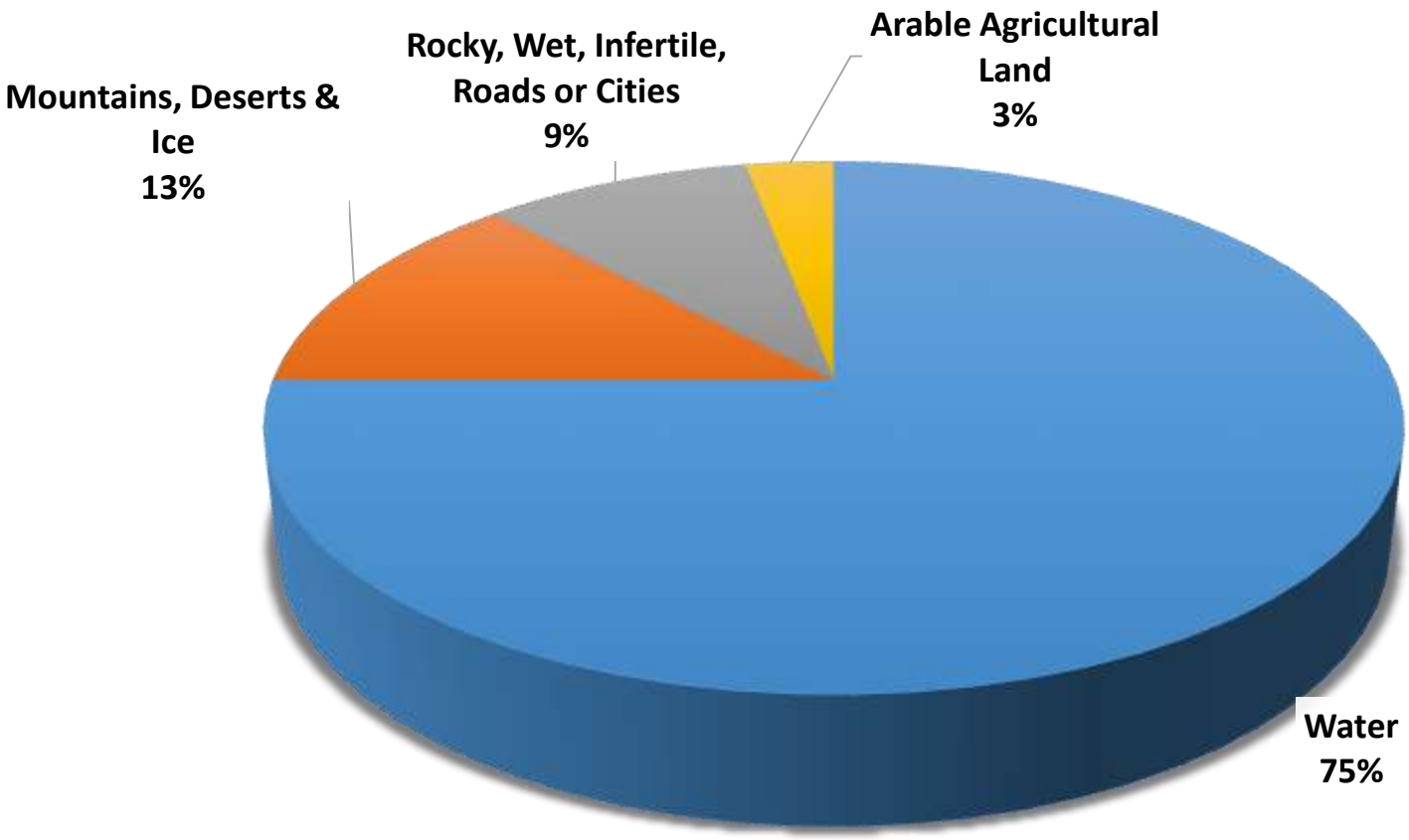
Nuclear Techniques in Food and Agriculture

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

Organizational Chart

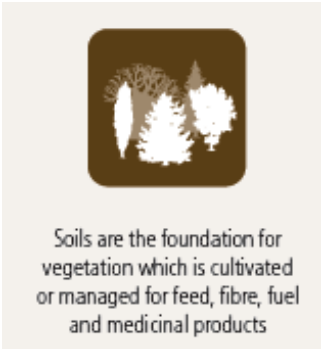


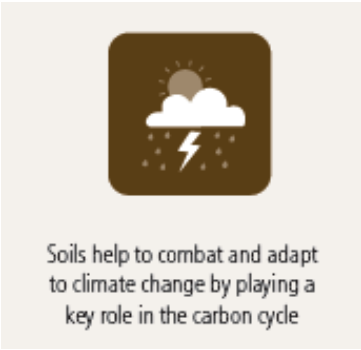
Arable Land: very limited recourse



Soil – the essence of agro/ecosystems

WE ALL DEPEND ON SOILS





4 Fs: Food, Feed, Fibre, Fuel

Water quantity and quality

Biodiversity

Carbon Cycle

Major Issues and Challenges

Food and nutritional insecurity

- Feeding 1.7 billion more people in 2050 will require 70% increase in current food production

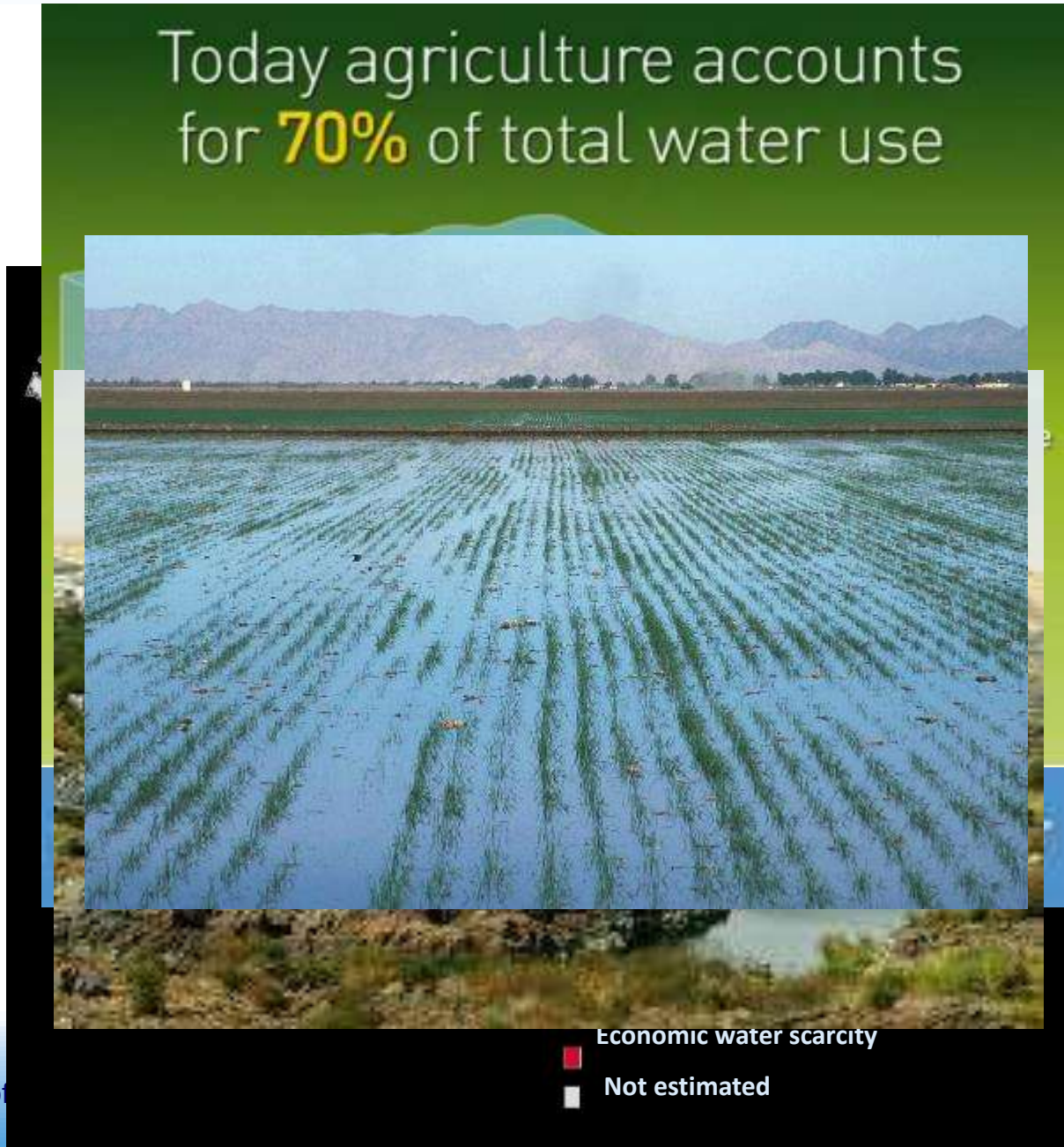
- Depleting soil fertility and quality due to nutrient mining, subsistence farming and poor farm practices (mono-cropping, over grazing and intensive cultivation) contributing to low productivity

- Water scarcity, low water use efficiency (<40%), and increasing pressure on fresh water (70% by agriculture)

Major Issues and Challenges continue

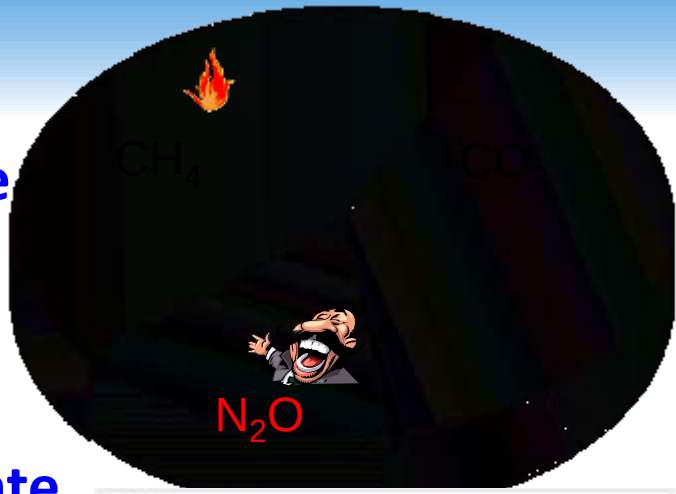
Water Scarcity:

- ✓ Demand for freshwater is now exceeding supply in several areas of the world.
- ✓ Agriculture consumes 70% of freshwaters; and is under increasing pressure.
- ✓ Water use efficiency in agriculture is less than 40%. Clear need of better management
- ✓ Several major rivers, such as the Nile, the Yellow River, and the Colorado, only reach the sea in some seasons of the year, or not at all.



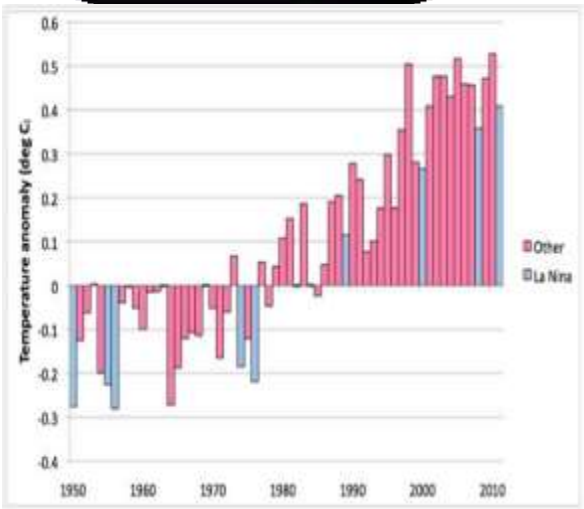
Food and Agriculture Organization of

Major Issues and Challenges continue



- Climate Change is real and happening due to increased GHGs as a result of human activity.

- Agriculture considered as a victim of climate change! but 22% of GHGs come from Agriculture



✓ Rising global temperature 0.05 °C/decade

✓ Extreme weather events including:

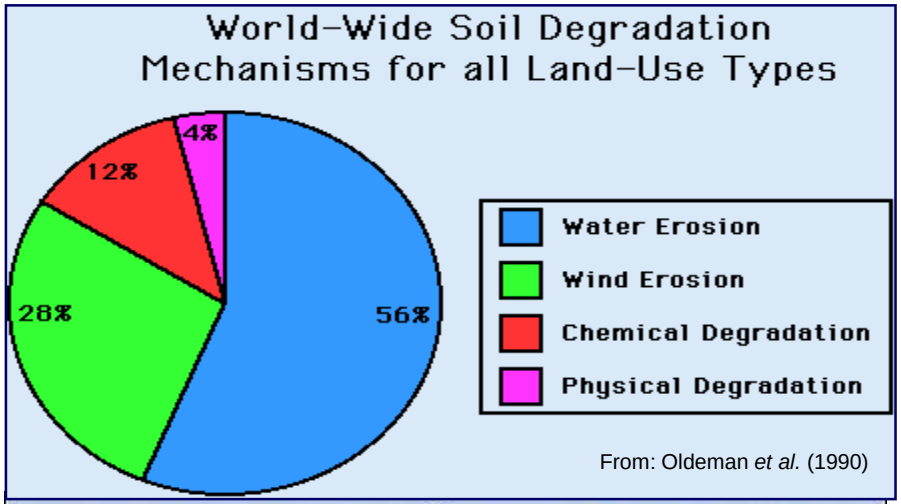
- Drought
- Flooding

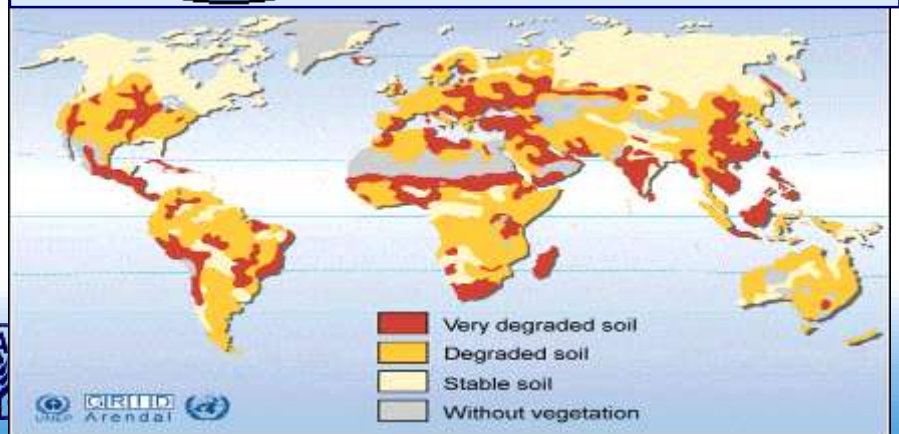
Extent of soil salinization

- Globally about 250,000 to 500,000 ha of arable land is lost to production every year due to salinization
- In Central Asia, up to 50% of the irrigated land is affected by salinity.
- In the Arabian Peninsula, the entire arable land is affected by some degree of salinity.
- In North Africa, South Asia, Southeast Asia arable land is affected by salinity
- Salinization can cause yield decreases of 10 to 25 percent for many crops and may prevent cropping altogether when it is severe
- Addressing soil salinization and salt-affected soils through improved soil, water and crop management practices is important for achieving food security and to avoid desertification.

Major Issues and Challenges continue

- **Growing human population, intensification of agriculture, climate change and variability, poor land and water and irrigation management practices are leading to increased risk of land degradation.**





- ✓ 65% of the global soil resources is degraded (1.9 billion ha)
- ✓ Since 1960, 30% of arable land have been lost
- ✓ 80% of degraded land is located in developing countries
- ✓ On-farm + off-farm costs of soil erosion =

  US $400 billion per year

Poor Agricultural practices lead to desertification of farm land

- ✓ Food Insecurity & Hunger
- ✓ Poverty due income loss
- ✓ Mass migrations out of rural areas into urban areas
- ✓ Unemployment
- ✓ Environmental problems impacting air and water quality

Good News:

Soil and Water Management and Crop Nutrition (SWMCN)

Subprogramme focusses on development of packages of Climate Smart Agricultural Practices using Nuclear techniques to help MS to improve Food Security and to adapt/minimize the impact of Climate Change.

Climate Smart Agriculture refers to:

Enhancing food security via

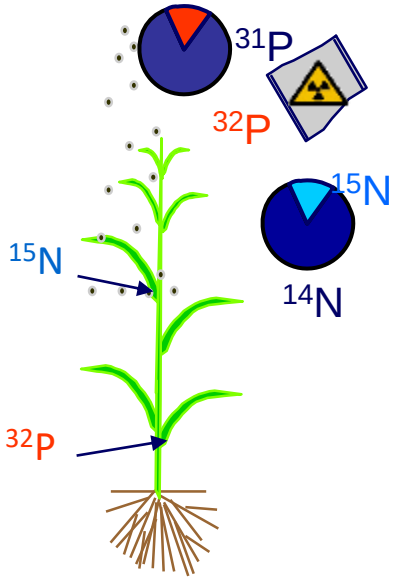
- Increased crop productivity
- increased resilience of soil (adaptation)
- reduces GHGs
- preserve ecosystems benefits

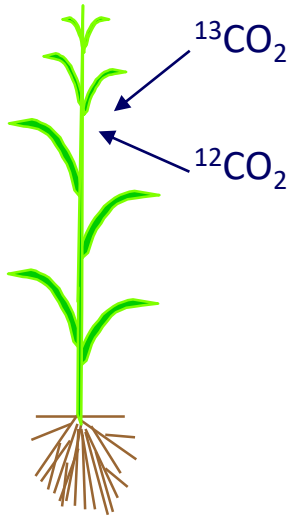
in a sustainable manner

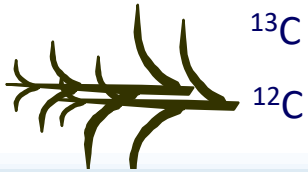
Better Soil, Water and Nutrient Management Lead to Better Soil Health and Improved Crop Productivity

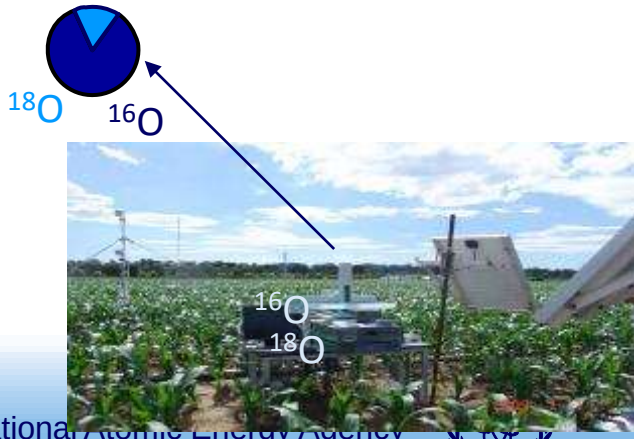
Nuclear Techniques Used in SWMCN

^{15}N	^{15}N	^{13}C	^{18}O ^{2}H
To quantify biological nitrogen fixation to save N fertilizers	To quantify the flow and fate of N fertilizers to improve fertilizer use by crops	To assess adaptation of crop tolerance to drought and salinity	To estimate sources and fluxes of water to improve WUE



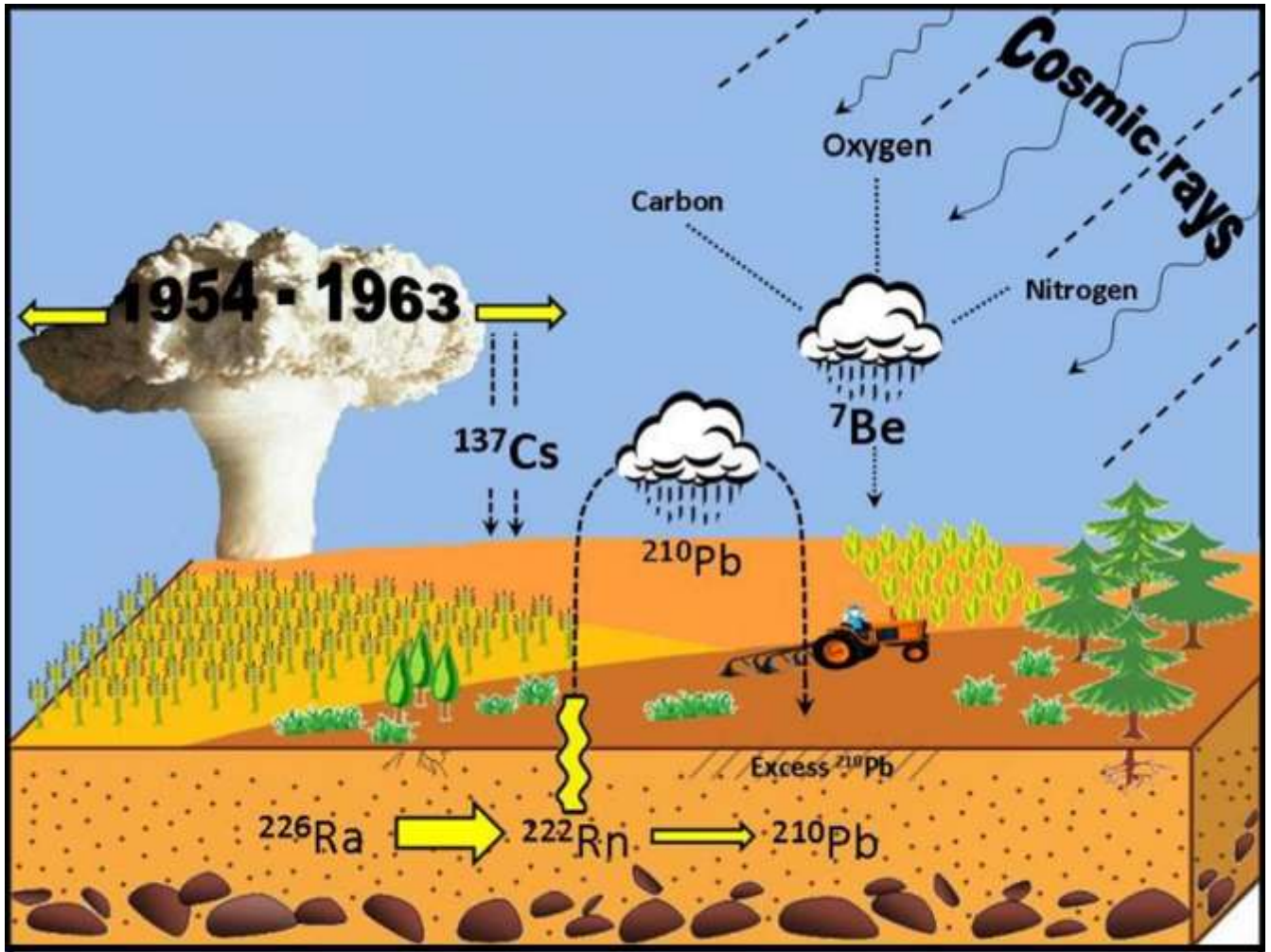






To assess soil organic carbon storage “Sequestration”

Fallout Radionuclides (FRNs) for erosion studies

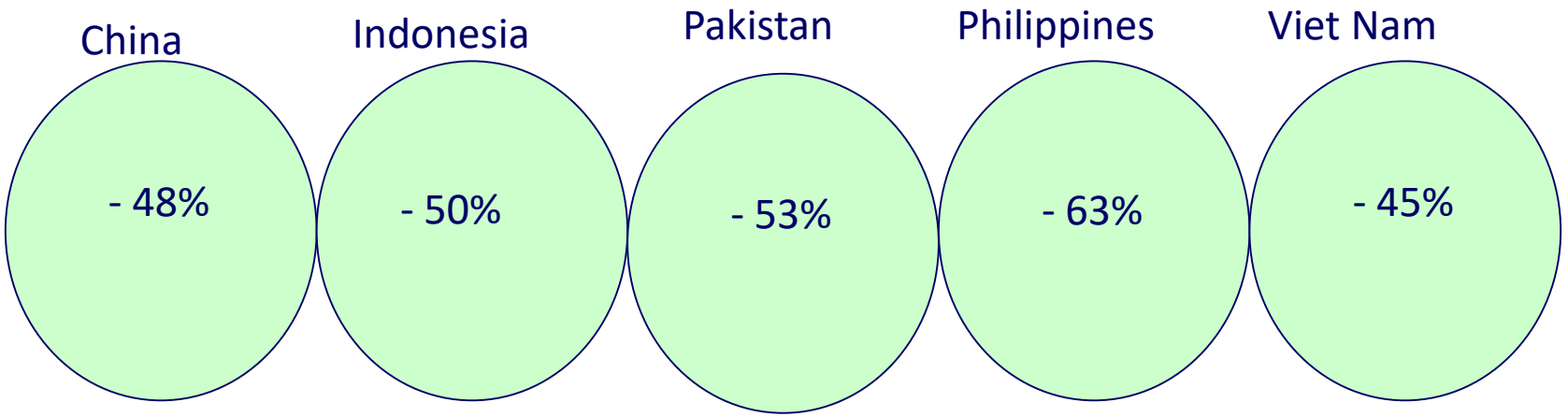


Adapted from : Zupanc, V., Mabit, L. (2010). Nuclear techniques support to assess erosion and sedimentation processes: preliminary results of the use of ^{137}Cs as soil tracer in Slovenia. *Dela*, 33, 21-36.

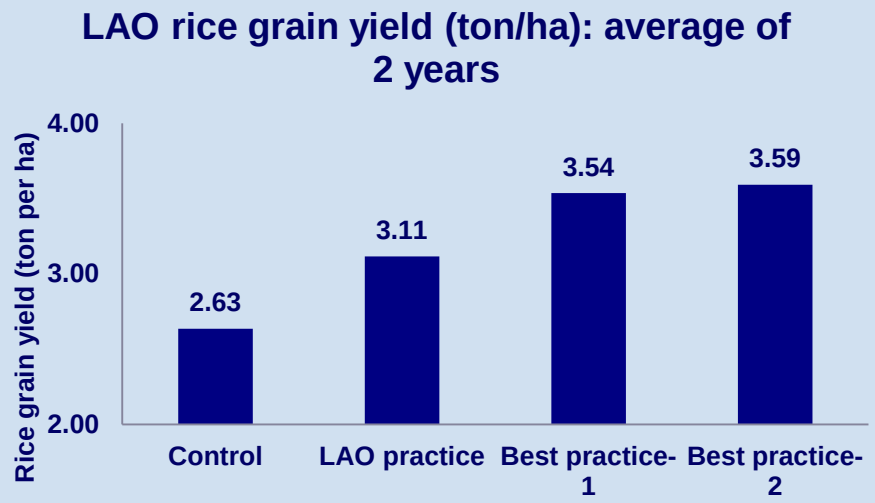
Success Stories of SWMCN

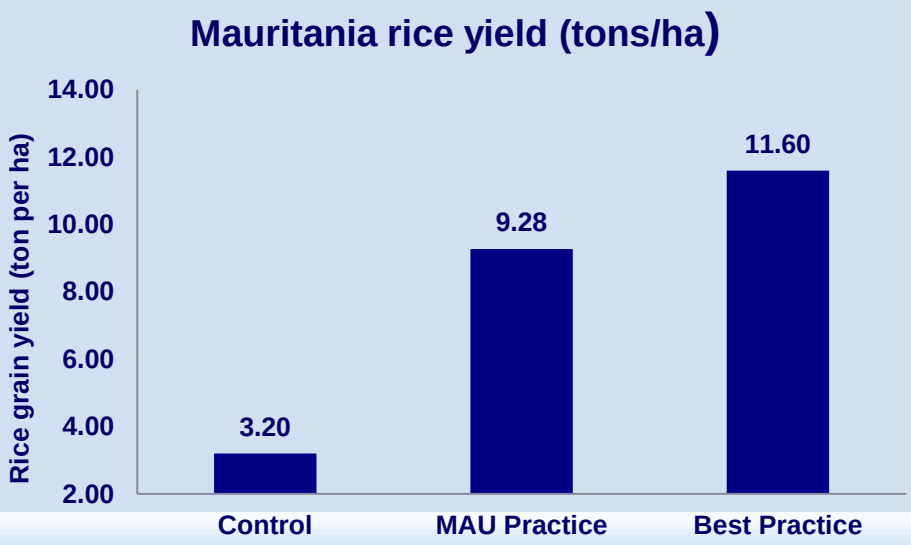
- **Developed database of FRNs in 14 Asian Countries**

- **Reduced land degradation by 50% saving millions $ in retaining plant essential nutrients on farm, enhanced productivity and improvement of water quality**



Best Rice Practices in LAO and Mauritania increased rice production





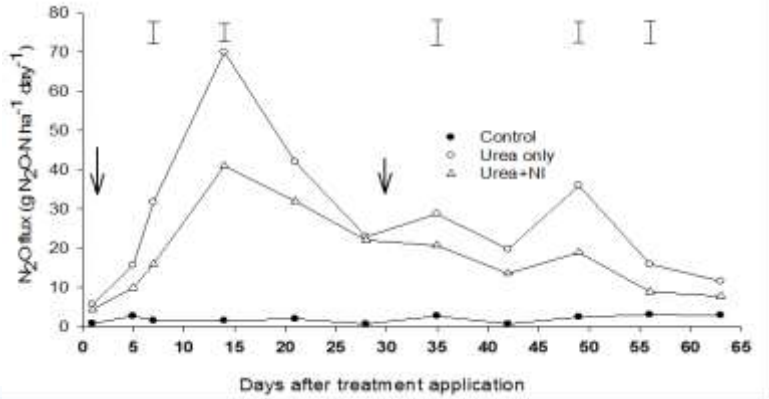
- 1000 brochures of best rice practices in Local LAO was distributed among farmers.
- 100 farmers adopted best rice practices.

- Best practice 1: NPK (90:30:30)
- Best practice 2: 5 ton rice straw+ N

In Mauritania, Best Practice led to **31%** more rice production

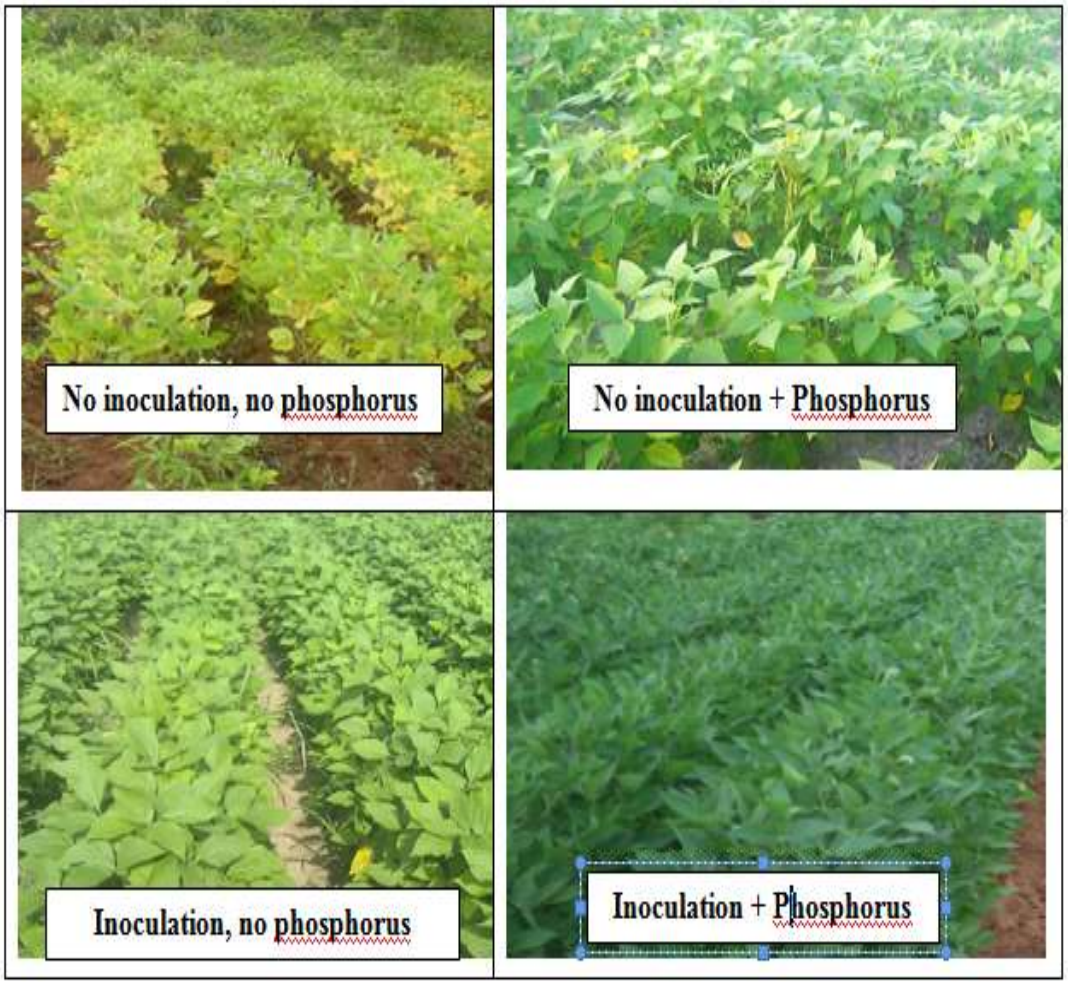
Greenhouse gas reduction from Agriculture

- ✓ Under CRP D1 5016, using better soil, nutrient and water management led to significant reduction in GHGs in Brazil, Chile, Costa Rica, China, Iran, Germany, Spain and Pakistan.



Enhancing soil fertility through BNF in Benin

- ✓ Enhanced biological N fixation to improve soil fertility, and dependence of fertilizer
- ✓ The average revenues for farmers also increased from US $193 per hectare without inoculation and P addition, to US $ 866 per hectare



Farming is a business

To remain in this business, one has to be smart enough to be aware of the Climate Smart Agricultural Practices and proactive

We can feed the growing population

- Climate Smart Agricultural practices
- Commitment and Resources
- Teamwork and better coordination (IAEA and MS) meaning proactive CP, TO and PMO

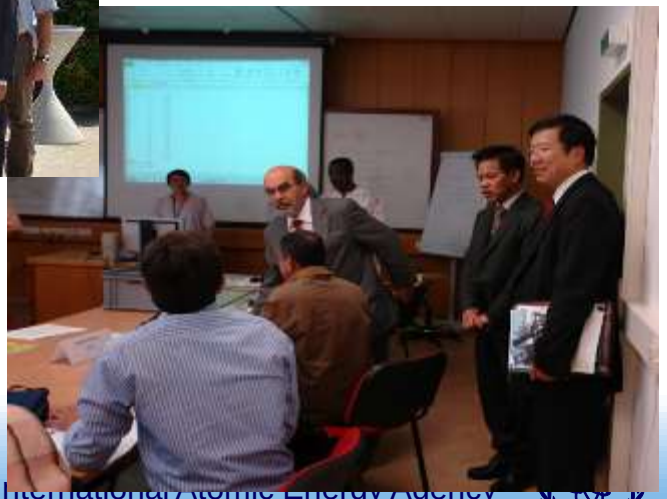


Seibersdorf SWMCN Laboratory

SWMCN Laboratory

- ✓ Developing and testing of new methodologies using NT
- ✓ Supporting CRPs
- ✓ Fellowship training
- ✓ Analytical services & external quality assurance

Group Training Courses in Seibersdorf



Soil and Water Management & Crop Nutrition Newsletter

Soils Newsletter

IAEA

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To Our Readers

http://www-naweb.iaea.org/nafa/swmn/public/SNL-37-2.pdf

Thank you

IAEA

Joint FAO/IAEA Division
of Nuclear Techniques in Food and Agriculture
50 years, 1964–2014