

Global Symposium on Salt-Affected Soils (GSAS-21) October 20-22



Integrated crop and soil solutions in rehabilitation and sustainable management of salt-affected soils

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Tottori University
International Platform for
Dryland Research and Education



SATREPS



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Иновациялар революцияси вазирлиги

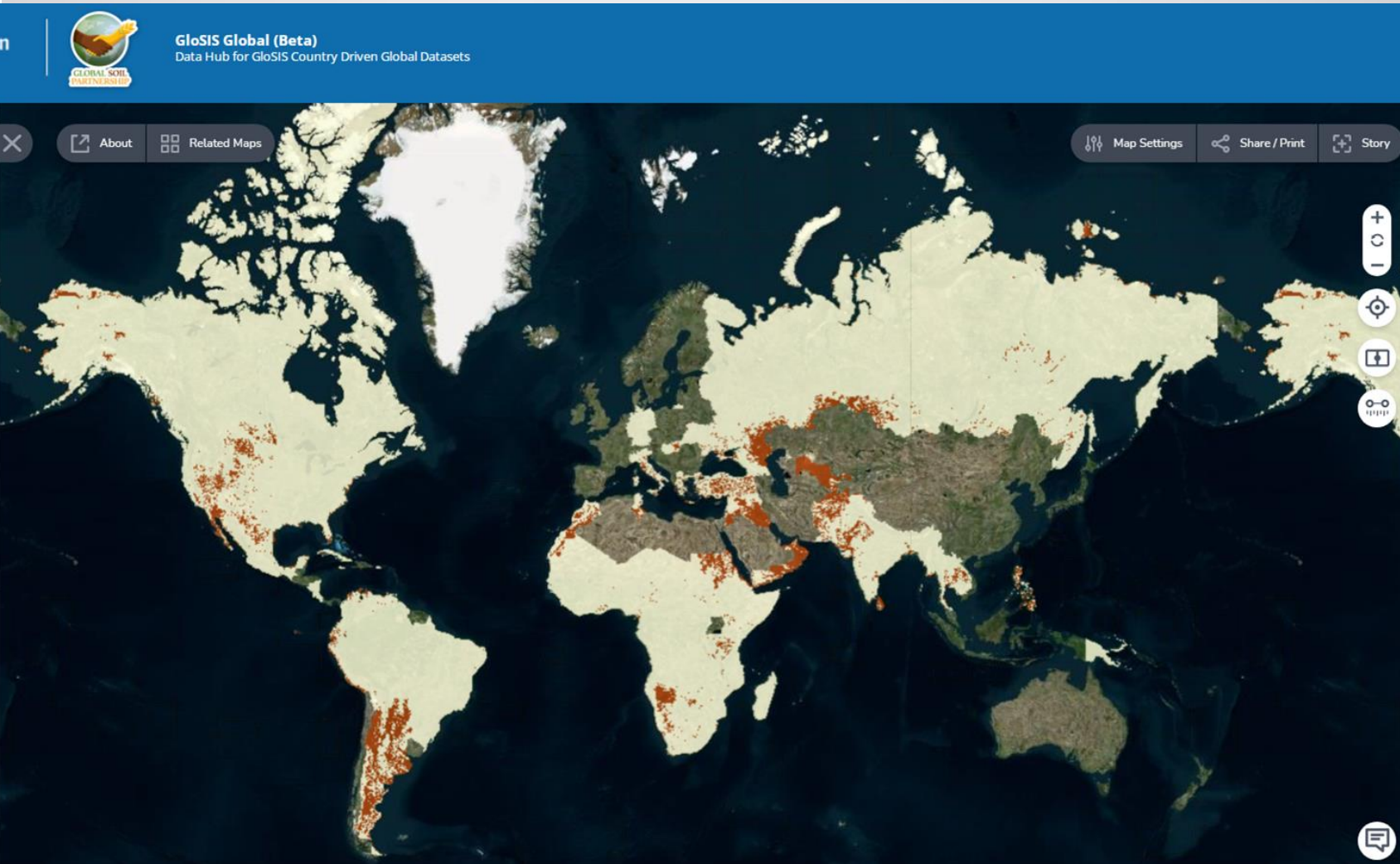


INNOVATION FOR DEVELOPMENT



نزرع للغد
ICBA
AGRICULTURE FOR TOMORROW

Type and severity levels of **salt-affected soils**



Key Hypotheses:

No 1

- Progressing Soil Salinisation is one of the major **drivers** of Land degradation



!!!!!! Soil Salinization Early Warning/Alarm System

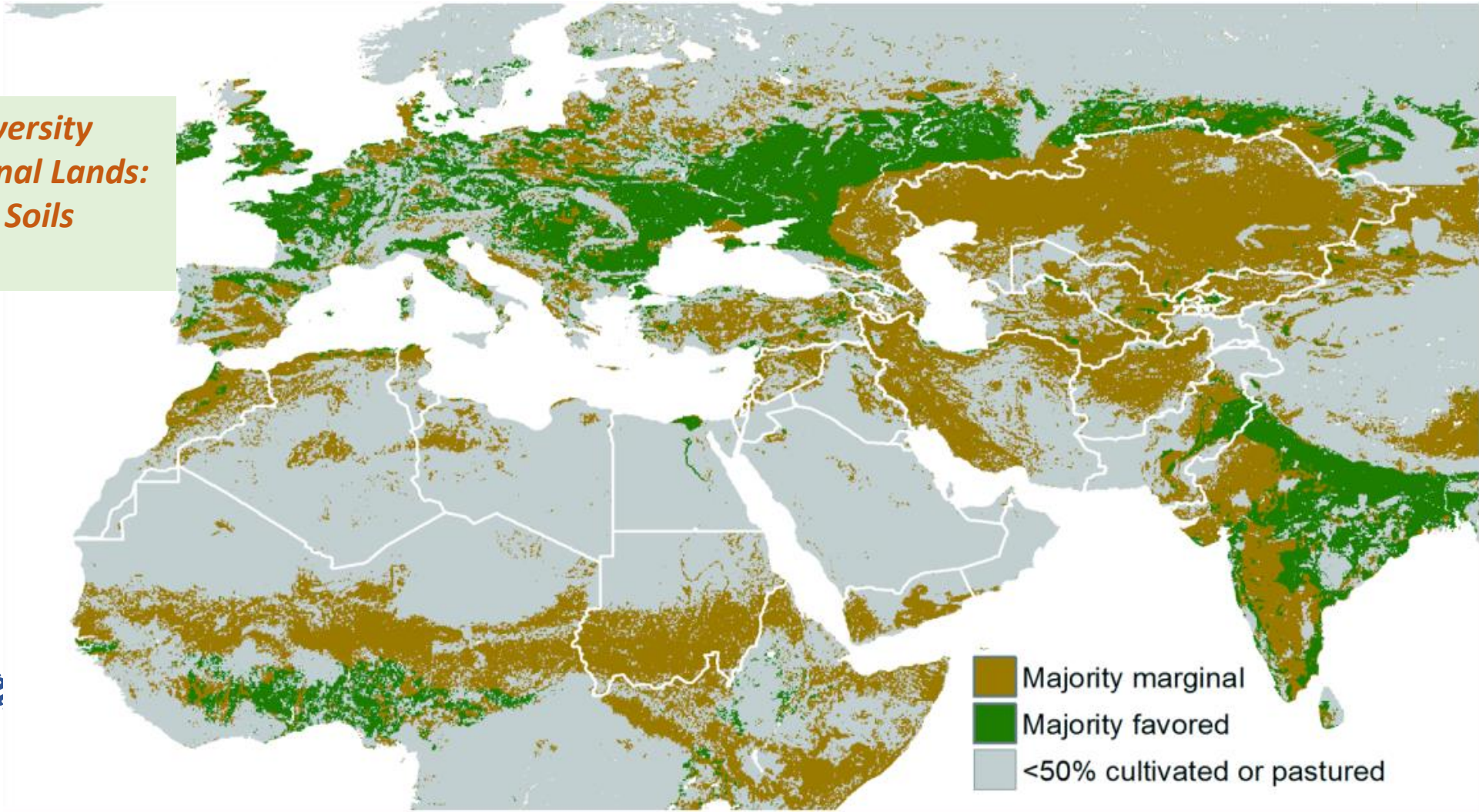
- Saline soils: 397 million ha
 - Sodic soils: 434 million ha
 - **Salt-affected soils**
 - 45 million ha (19.5 %) of 230 million ha of total irrigated land
 - 32 million (2.1 %) of 1 500 million ha of dryland agriculture
- (>40% of the earth surface is arid: inclined to salinization)*

Reference: www.fao.org/land-water/overview/wasag

Hypothesis No2. Since the Climate is changing (CC) then Agriculture and Food System Must Too

Hypothesis No3. *Agrobiodiversity Mainstreaming from Marginal Lands: more Food from Saline Soils*

Why Marginal Environments are Important?



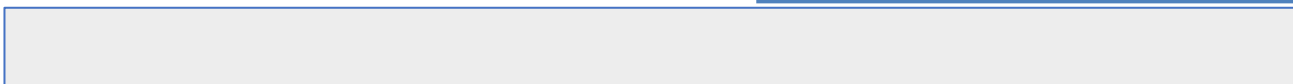
More than 55% of drylands ecosystems are degraded; 1/3 of people directly depend on these degraded lands

Lands sensitive to agriculture, but suitable for livestock grazing; landscaping, fisheries; bio-energy, technical crops & other alternative land use

More thoughts / Hypothesis No 4

We must Learn How to live with Salinity

	MANAGING SALINITY \$\$\$	LIVING WITH SALINITY \$
REGIONAL and WATERSHED or GROUNDWATER BASIN SCALE	Regional Irrigation and Drainage Management	Marginalized Basin Focus on non-agricultural sectors
IRRIGATION DISTRICT	Reclamation Drainage Salt extraction Salinity prevention	Shifting ag systems * Grazing * Biosaline agriculture * Agro-forestry
FIELD SCALE		

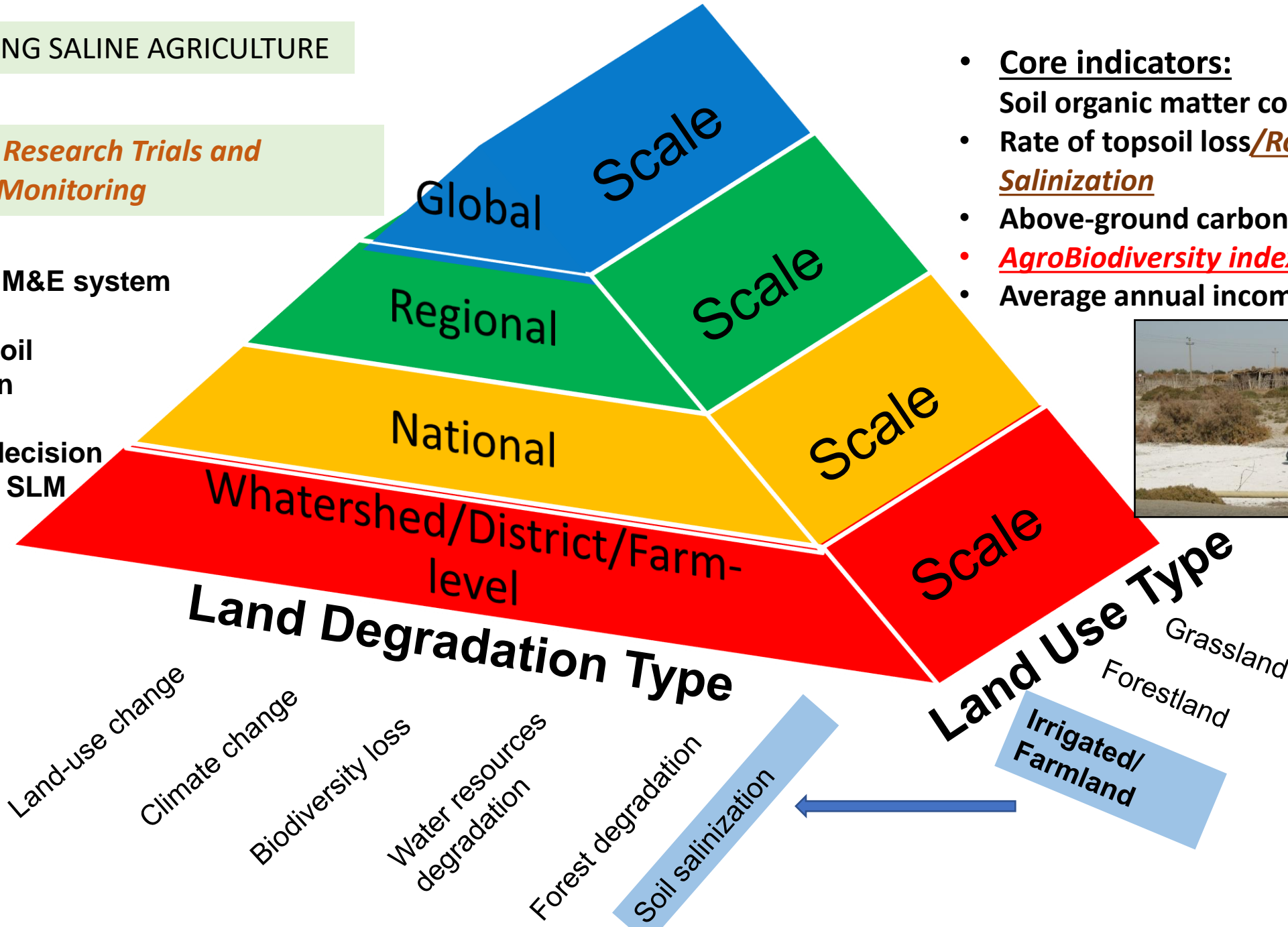


DIGITALIZING SALINE AGRICULTURE

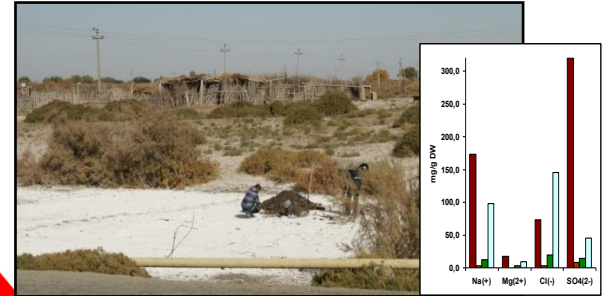
Joint Pilot Research Trials and Digitalize Monitoring

Multiscale M&E system to:
- impact Soil Salinization

- support decision making on SLM

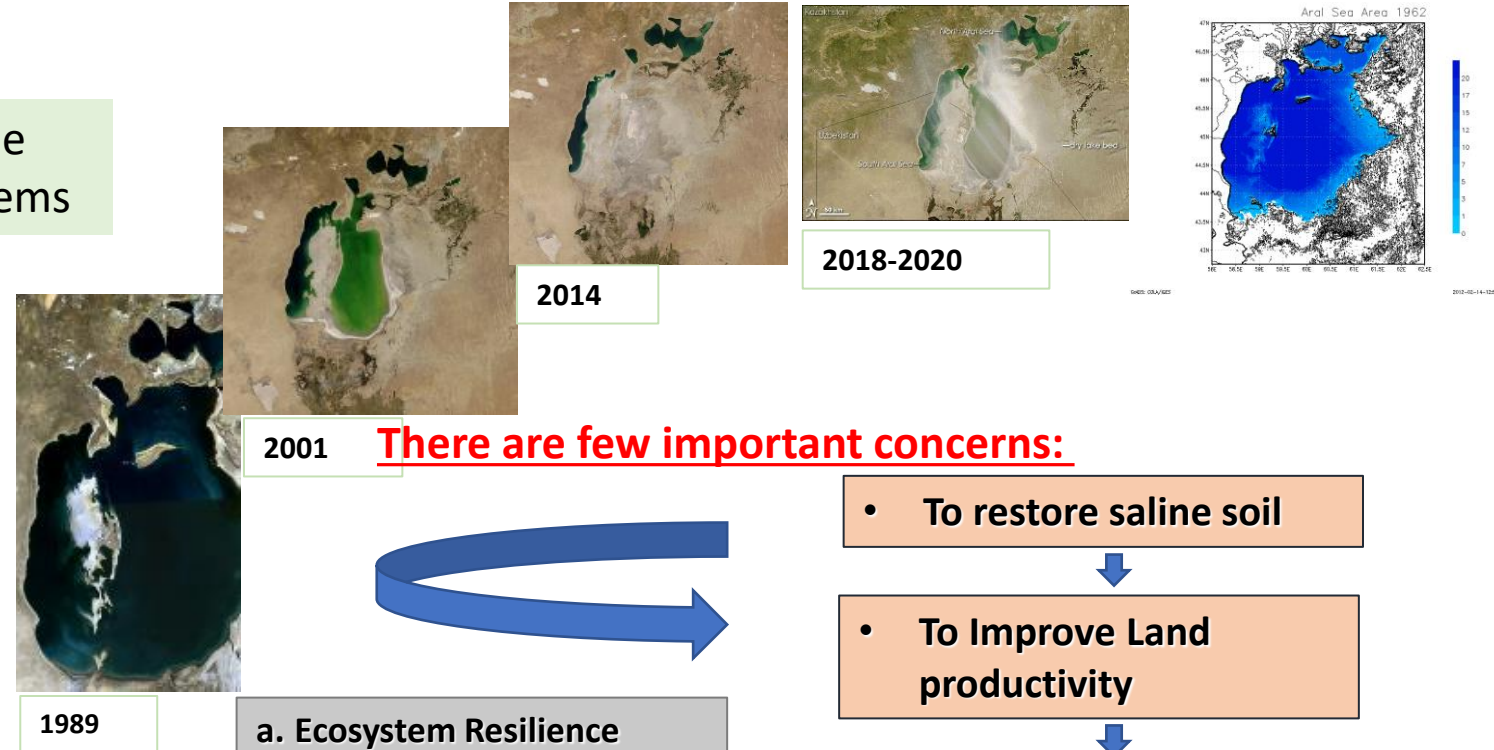


- **Core indicators:**
Soil organic matter content
- Rate of topsoil loss/Root Zone Salinization
- Above-ground carbon stocks
- AgroBiodiversity index (ABI)
- Average annual income per capita



- **Globally:** Land degradation due to salinization is expected to have profound consequences on biodiversity loss and on decline of food and fodder production.
- **Regionally:** The shrinking of the Aral Sea - one of the planet's worst environmental disasters being affected by salinization, water scarcity and drought

The **NEW SALINE ARALKUM DESERT** as a part of the coldest desert belt among the world's agroecosystems



There are few important concerns:

- To restore saline soil
- To Improve Land productivity
- To develop Salinity stress-tolerant agricultural systems

- a. Ecosystem Resilience
- b. Adaptation & Mitigation measures
- c. Biodiversity Preservation

Livelihood & Food Security

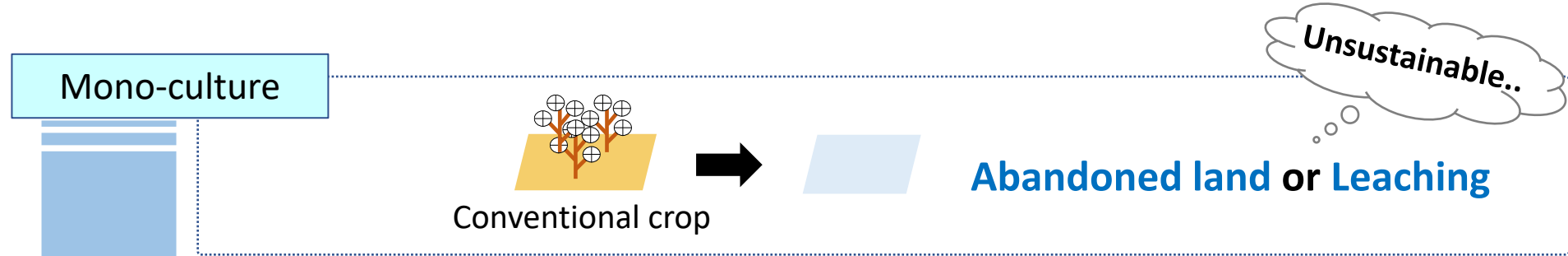
- **Interstate Transfer Agreement on Commercial Germplasm/any Bioresources**
- **Policy framework and interplay of relevant institutions in Aral Sea Basin Countries: regard toAgrobiodiversity Use & Preservation**

Sources: Norikazu Yamanaka & Kristina Toderich ,2020



Strategy ①

Sustainable Saline Agriculture based on Circular Halophytic Mixed Farming



Neo-Domestication of Hal. & NCC for an Alternative Saline Agriculture

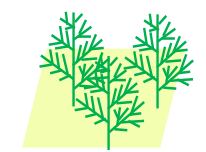
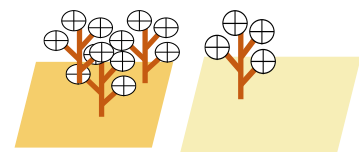
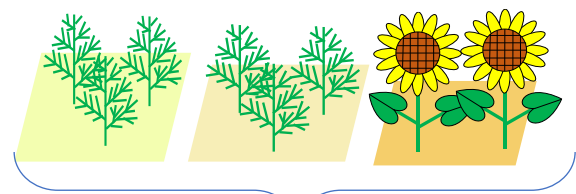
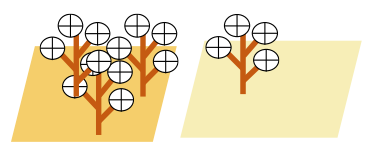
essential to meet future food demand

Circular Halophytic Mixed Farming

Poly-culture



Economic Values



Halophytes/Salt tolerant non-conventional crop (NCC) → existing agricultural system

Halophytes...successions

New biofortified staple crops with increased nutritious content Under Saline Environments

Arid Land Research Center , Tottori University, Japan will strengthen collaboration **with IICAS** on transferring innovative technologies on breeding and seed production of spring wheat.

Promoting spring wheat –based production system on saline lands will:

- reduce topsoil salinization by 20-25%;**
- improve water-use efficiency by 25%, and;**
- increase net income of farmers by 15-18%**

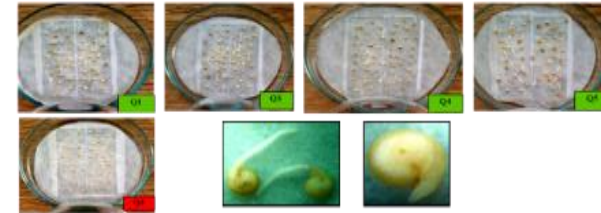
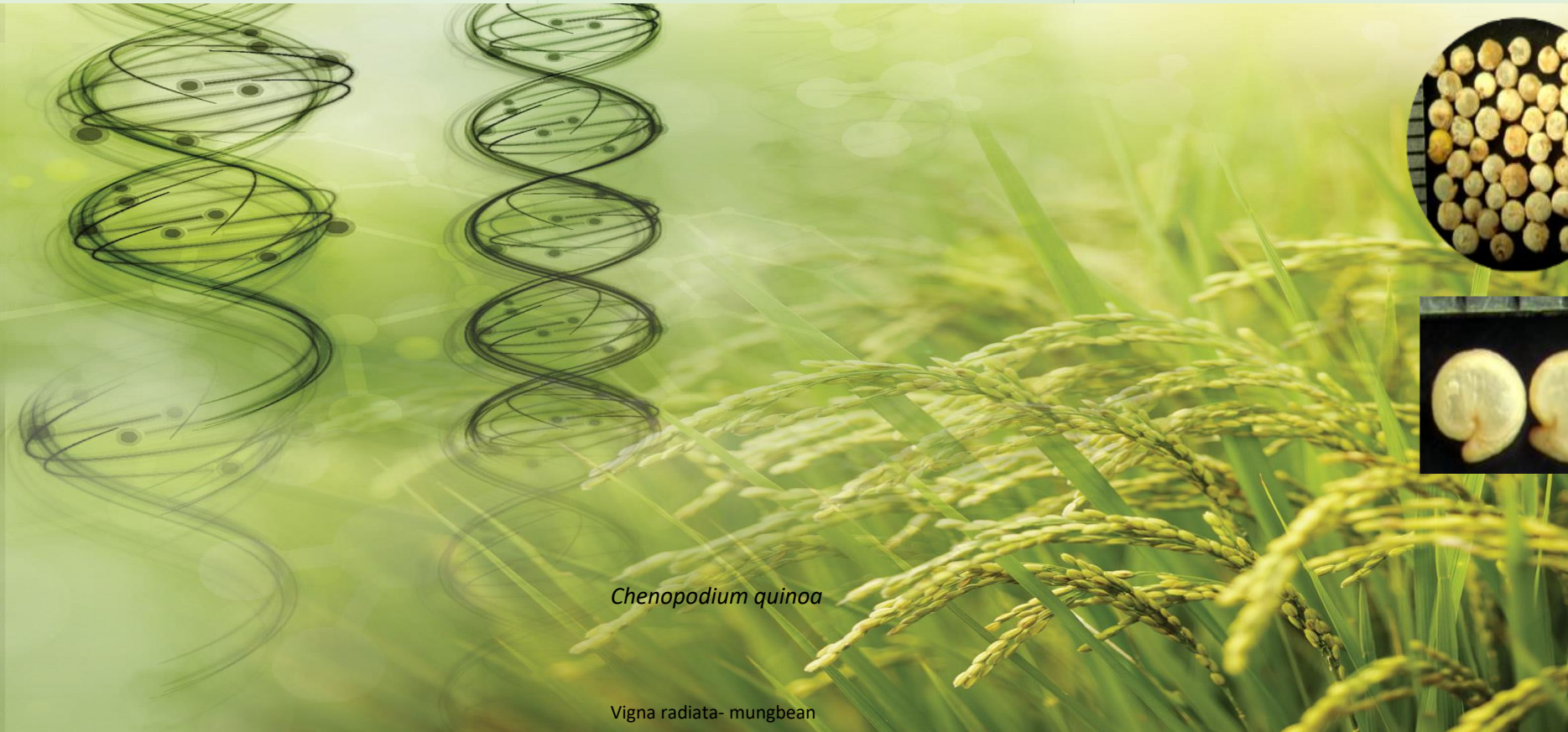


In 2020 ALRC in collaboration with IICAS were evaluated:

- **Spring Wheat – 300 genetic lines**
- Sorghum - 50
- Pearl millet– 17
- Barley– 59
- Triticale – 7
- Pseudocereals:
(Quinoa and Amaranthus – 8)



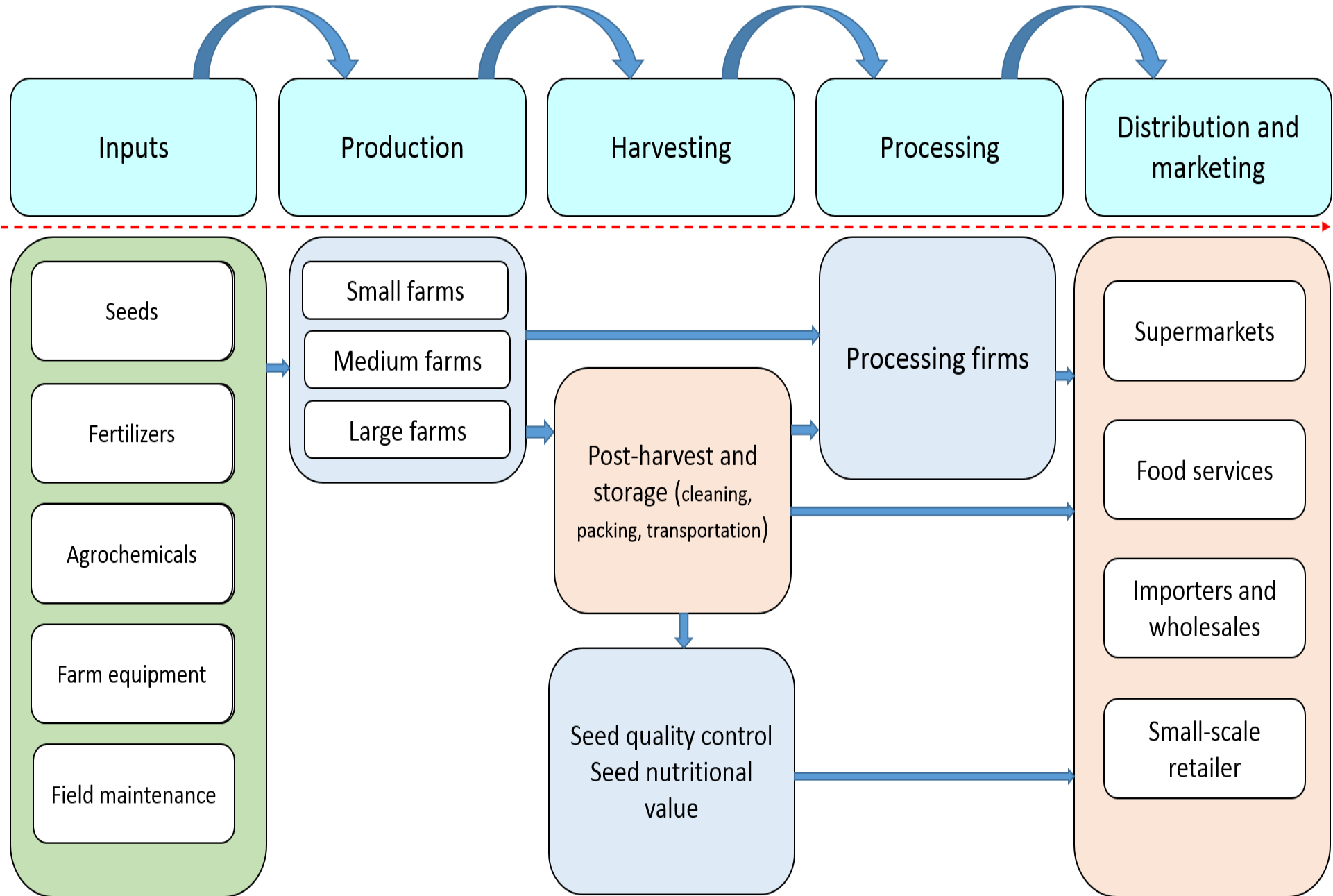
Genomics for Food Security



- large-scale development of molecular markers for linkage mapping, association mapping etc

Global Collection Sites (Hot Spots) -----Global Market-Oriented Halophytes;NCC Crops/ Genetic Materials

METHODOLOGICAL APPROACHES on SEED PRODUCTION of NON-TRADITIONAL CROPS



Agribusiness Model No1

ADVANTAGES for PROMOTION of AGROFORESTRY AGRICULTURAL PRODUCTION SYSTEM from SALINE LANDS

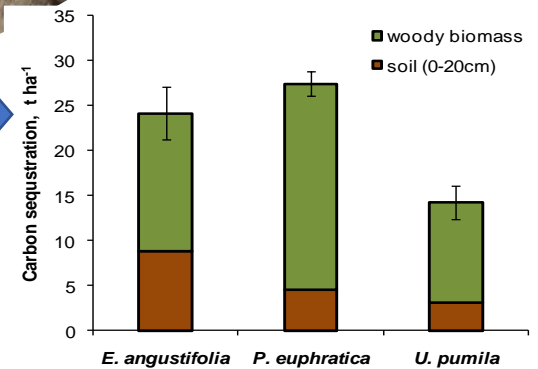
After 5 Years /
2300Trees/ha



Livelihood
Benefits



- Reducing Topsoil Salinity and Increased soil organic carbon (SOC) stocks by 10-35%;
- Sequestration of CO₂ in Woody Biomass – 10-20 t/ha



Agribusiness Model No 2

Forage diversification; animal foodstuffs processing and livestock by-products marketing

- Halophytes desalinize the soil by salt uptake into biomass → Antinutritional Factors
- Forage diversification to ameliorate the effects of climate change
- Bio-processing of grains, tubers, forage, edible roots, oil seeds cakes and by-products as animal feed
- How to remove salt from forage?



Agribusiness Model No 3

Opportunities: for "Zero_Waste Farming"

Integrated Crops-Livestock multi-profile Mini-cooperatives

Saline groundwater



Desalinization unit
< 2,5 g/l



Biomass from halophytes
&NCC production



Livestock feeding/dairy complex



Capacity Building



- Centralized management
- Desalinized water permits production security
- Rural community planning
- Links to markets
- Investment in small and medium businesses



Milk & Meat

Social Impact



Grain production of sorghum and pearl millet nearby Panaev Farm

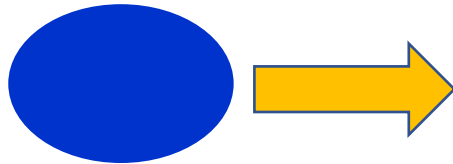
Closed Aquaculture BaliqNukus Farm ”- Agri-Business Model No4

The use of salty, warm groundwater for catfish breeding. The caviar of the Aral brine shrimp (a type of crustacean) collected in the Aral Sea and various lakes is artificially reared and used as feed for catfish fry.

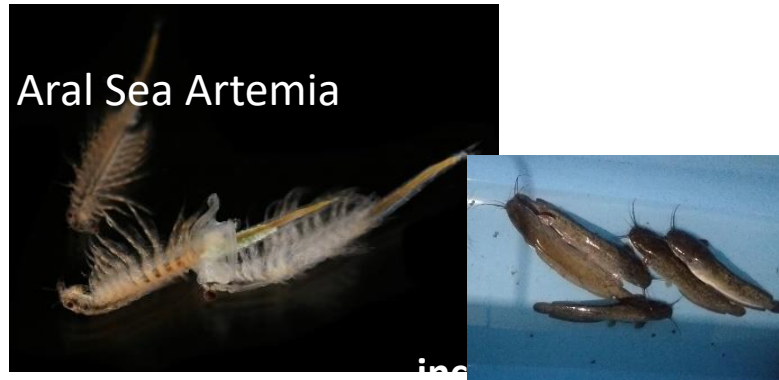
As a way to reuse wastewater, options of home gardening and tree planting, as well as using it as a source of food and income for the local community will be investigating.



Collecting brine shrimp from Aral Sea and other lakes



Aral Sea Artemia



Dry caviar



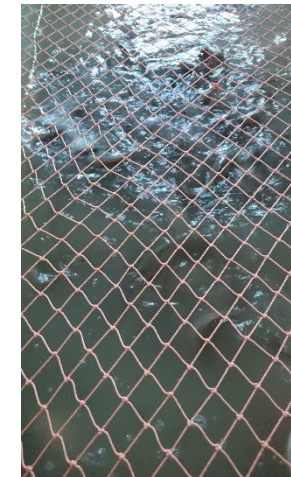
input



Filtering



salinity
~40 .6g/L



Adult species

To the market





Gender Mainstream and Women Benefits from Alternative/Innovative Biosaline Agriculture



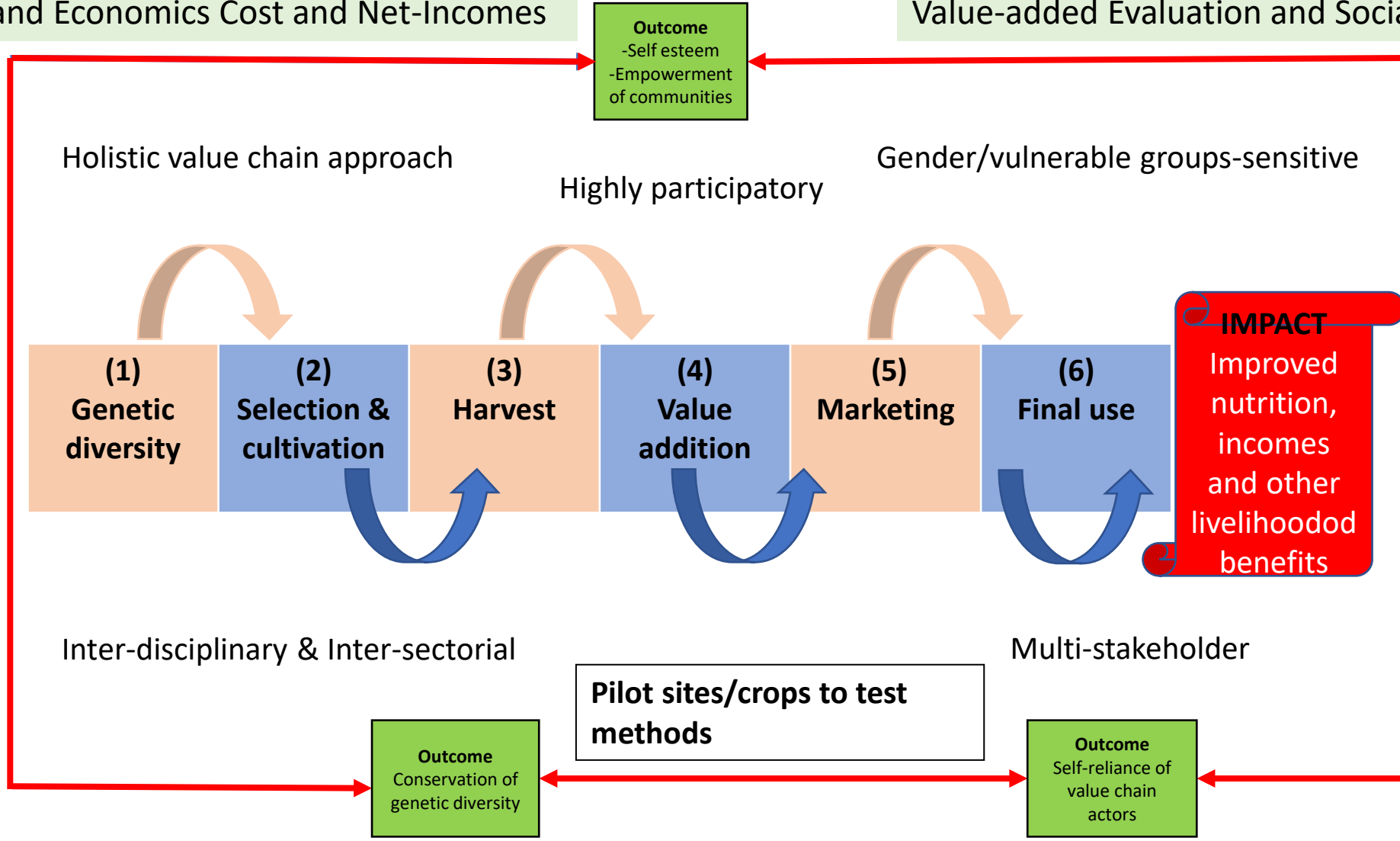
- **Module: Role of marginalized Women Communities in Soil/Water/Crops/Bioersity Conservation/ Management disseminated;**
- **Valorization of Bioresources through Rural Women Learning Alliances (RWLA)**
- **Self-Help Women Group (4 neighbor villages -78 women) involved in seed multiplication of dual-purpose non-traditional crops in Nurata region, Uzbekistan ;Turgen Farm in Kazakhstan**
- **Regional Platform of Young Professionals in Biosaline Agriculture Initiated;**
- **Documentation of Best Practices of Biosaline Agriculture Technologies started recently in collaboration with WOCAT**



INSTEAD of CONCLUSION

Agricultural Land Economics Cost and Net-Incomes

Value-added Evaluation and Social Impact



Holistic value chain approach

Highly participatory

Gender/vulnerable groups-sensitive

(1)
Genetic diversity

(2)
Selection & cultivation

(3)
Harvest

(4)
Value addition

(5)
Marketing

(6)
Final use

IMPACT
Improved nutrition, incomes and other livelihood benefits

Inter-disciplinary & Inter-sectorial

Multi-stakeholder

Pilot sites/crops to test methods

Outcome
Conservation of genetic diversity

Outcome
Self-reliance of value chain actors

Outcome
-Self esteem
-Empowerment of communities