Research Prospectus: A Vision for Sustainable Land Management in Central Asia

ICARDA

ICARDA: Raj Gupta, Alisher Mirzabaev, Christopher Martius, Eddy de Pauw,
Theib Oweis, Kamel Shideed, Richard Thomas

NARS : Abdulla Saparov (Kazakhstan)
Malik Bekenov (Kyrgyzstan)
Sanginboy Sanginov (Tajikistan)
Muhammet Nepesov (Turkmenistan)
Rakhimjon Ikramov (Uzbekistan)

ICARDA- CAC-PFU, Tashkent

Dryland Degradation and Restoration

- Drylands occupy 41% of earth's land area
- Hold 1/3 of the world population
- Nearly 1.9% of the total 3392 Mha of degraded lands worldwide
- Crop loses due to salinity (31M); land abandonment 12M USD) (Uzbekistan, 2005)
- Annual production losses are estimated close to USD$ 2 billion
- Not all degradation processes have negative effect(Winslow et al. (2004). Initially degradation is 'creeps' slowly (Reynolds etal. 2007)

Areas with Major Constraints

Country	Area	Salinity	Sodicity	Shallowness	Erosion
Kazakhstan	2715 (22)	215 (8)	1071(40)	386(14)	78 (03)
Kyrgyzstan	198 (23)	1 (1)	(0)	107(54)	56 (28)
Tajikistan	143 (26)	7 (5)	(0)	68(48)	37(26)
Turkmenistan	487 (7)	73(15)	17(4)	35(7)	7(1)
Uzbekistan	446 (16)	63(14)	46(10)	39(9)	13(3)

Area= 000,km² ; Percentage= (%)

Parentheses (??) refers to soils without major constraints

Tajikistan and Kyrgyzstan : >25% lands with slopes >30%

Source: Bot ,AJ. et.al . 2000. Land resource potential and constraints, FAO, Rome

Desertification Definitions

• A ***condition of human-induced land degradation that … leads to a persistent decline in economic productivity (> 15% of the potential) of useful biota related to a land use or a production system***”

Katyal & Vlek (2000)

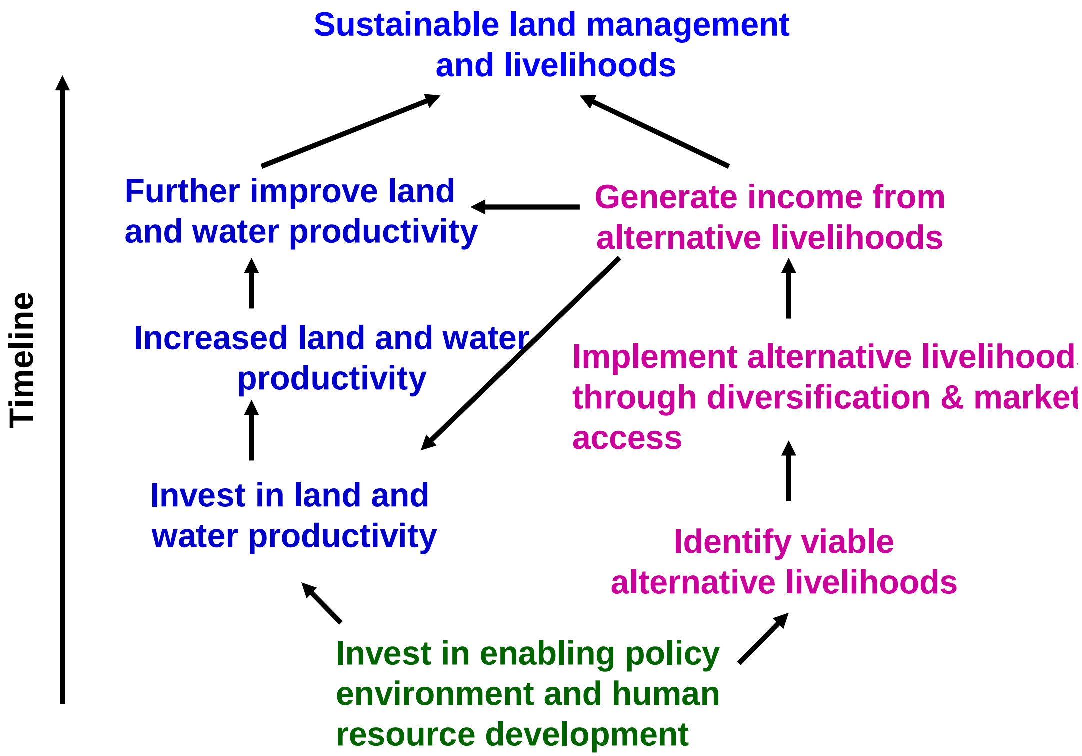
• **Persistent decline in the ability of a dryland ecosystem to provide goods and services associated with primary production”**

Safriel & Adeed (2005)

• **Management that combines <u>technologies</u>, <u>policies</u> and activities aimed at integrating <u>socio-economic principles</u> with <u>environmental</u> concerns**

(Thomas, 2008)

Biophysical-SEP Linkages of land degradation vis-à-vis SLM



Desertification process is a degenerating spiral - driven by interlinked biophysical and socio-economic factors- feeding each into other.

Safriel & Adeed (2005)

Dryland Development Paradigm (DDP)

-Reynold et al. 2007

- **Reviewed the lessons about the functioning of dryland ecosystems and the livelihood systems of their human residents. Introduced a new framework- <u>Dryland Development Paradigm</u>**

- ***Desertification is the emergent outcome of a suite of social and biophysical causal factors, with pathways of change that are specific in time and place.***

Dryland Syndromes and HES

DDP consists of 5 principles linked to typical 'Dryland Syndrome' which should be considered when dealing with 'Human-Environmental System'

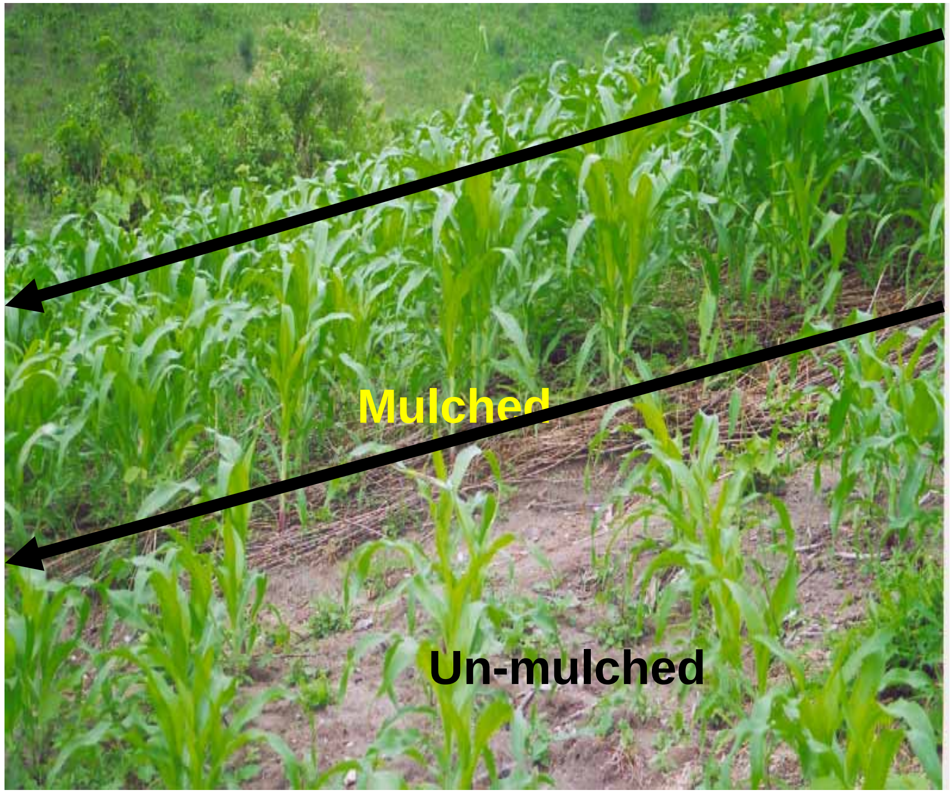
- **Slow, often "creeping" nature of degradation**
- **Variability in thresholds of land degradation**
- **Multiple-scale nature of D-HES**
- **Local environmental knowledge (LEK).**
- **HES - Coupled, dynamic and co-adapting**

- **It is safe to say that fight land degradation along these principles**

Reynolds et al, 2007

Sustainable Land Management- Definition

SLM is an economically viable and socially acceptable 'production - protection' agriculture that reduces the production risks and protects the multi-functional roles of drylands to provide for goods and services (FAO, 1993) and *livelihoods* (WB,2006) for the people who depend on natural resource base.



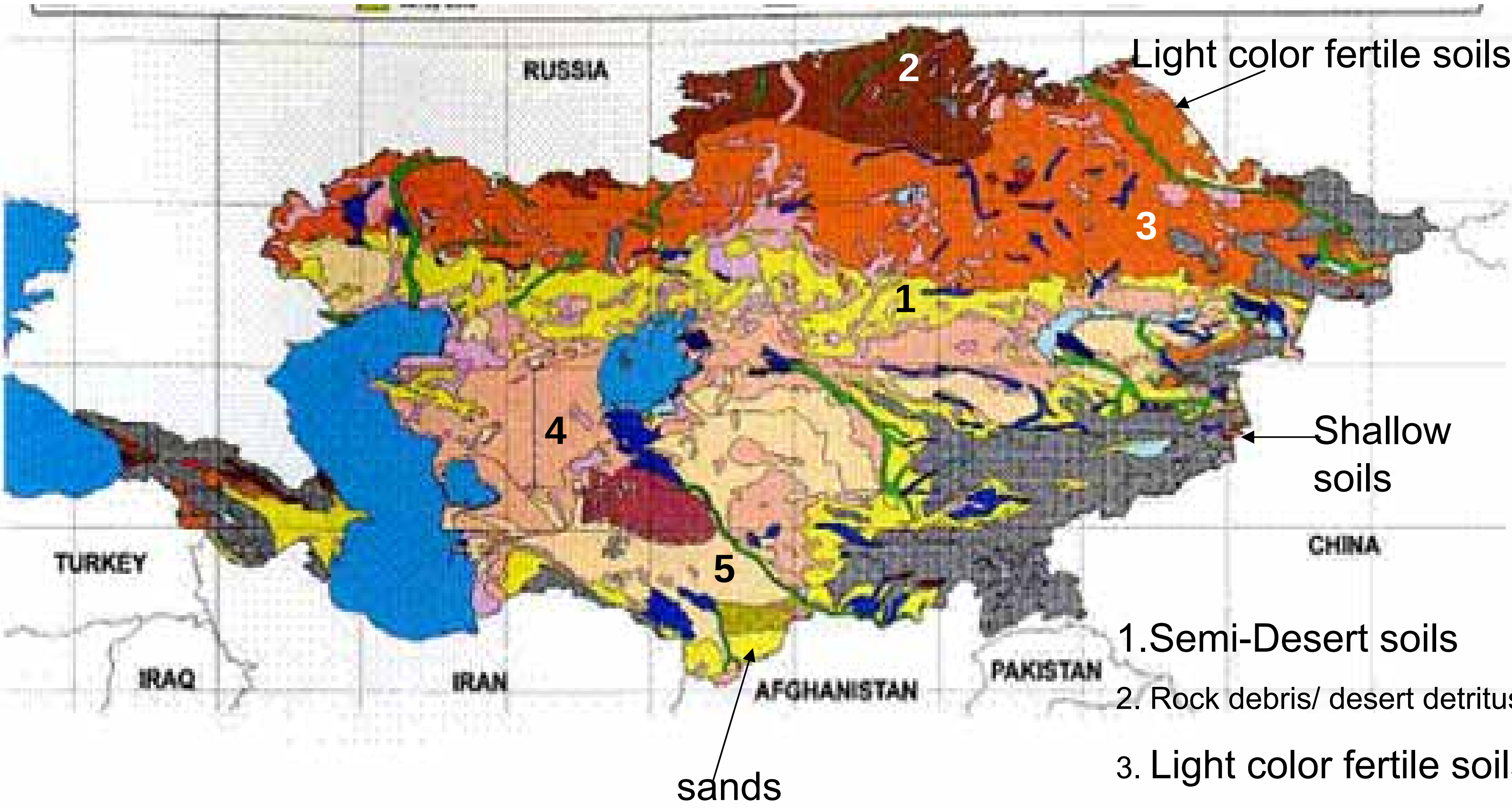
Up-Down Cultivation- Mechanization
- Controlled traffic with Residues

2. Land Use and Agro-ecologies

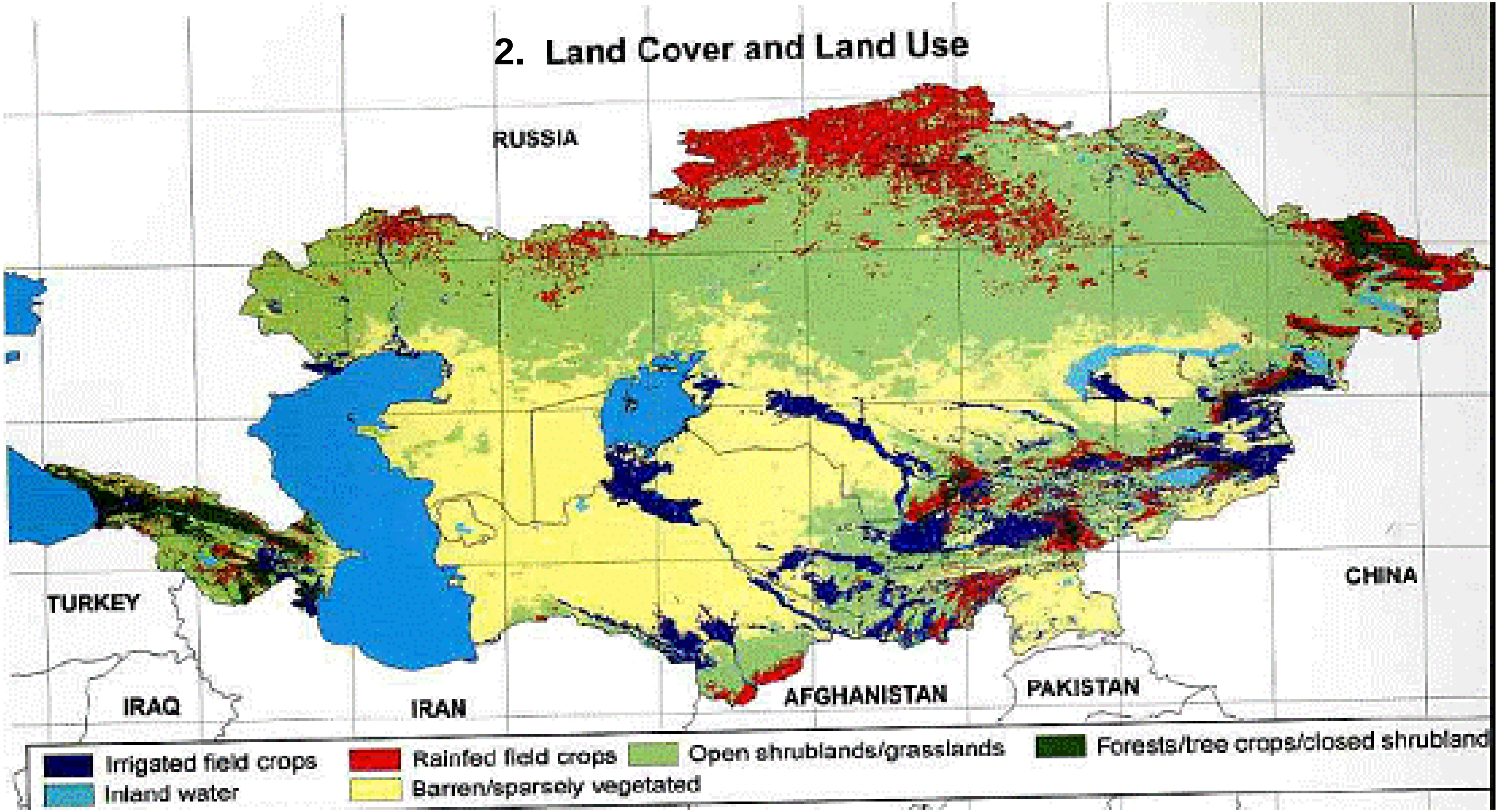
Country	Total Land (Mha)	Rainfed	Irrigated	Permanent Pasture
Kazakhstan	269,970	18,994 (7.0)	3,556 (1.3)	185,098 (68.6)
Kyrgyzstan	19,180	238 (1.2)	1,072 (5.6)	9,365 (48.8)
Tajikistan	13,996	208 (1.5)	722 (5.2)	3,198 (22.8)
Turkmenistan	46,993	400 (0.9)	1,800 (3.8)	30,700 (65.3)
Uzbekistan	42,540	419 (1.0)	4,281 (10.1)	22,219 (52.2)
Total	392,679	20,259 (5.2)	11,431 (2.9)	250,580 (63.8)

- Total arable lands 31.5 Mha,
- Pasture lands important for livestock production, on-farm capital formation
- ( ) indicate to Percentage, %

2. Dominant Soils in Central Asia

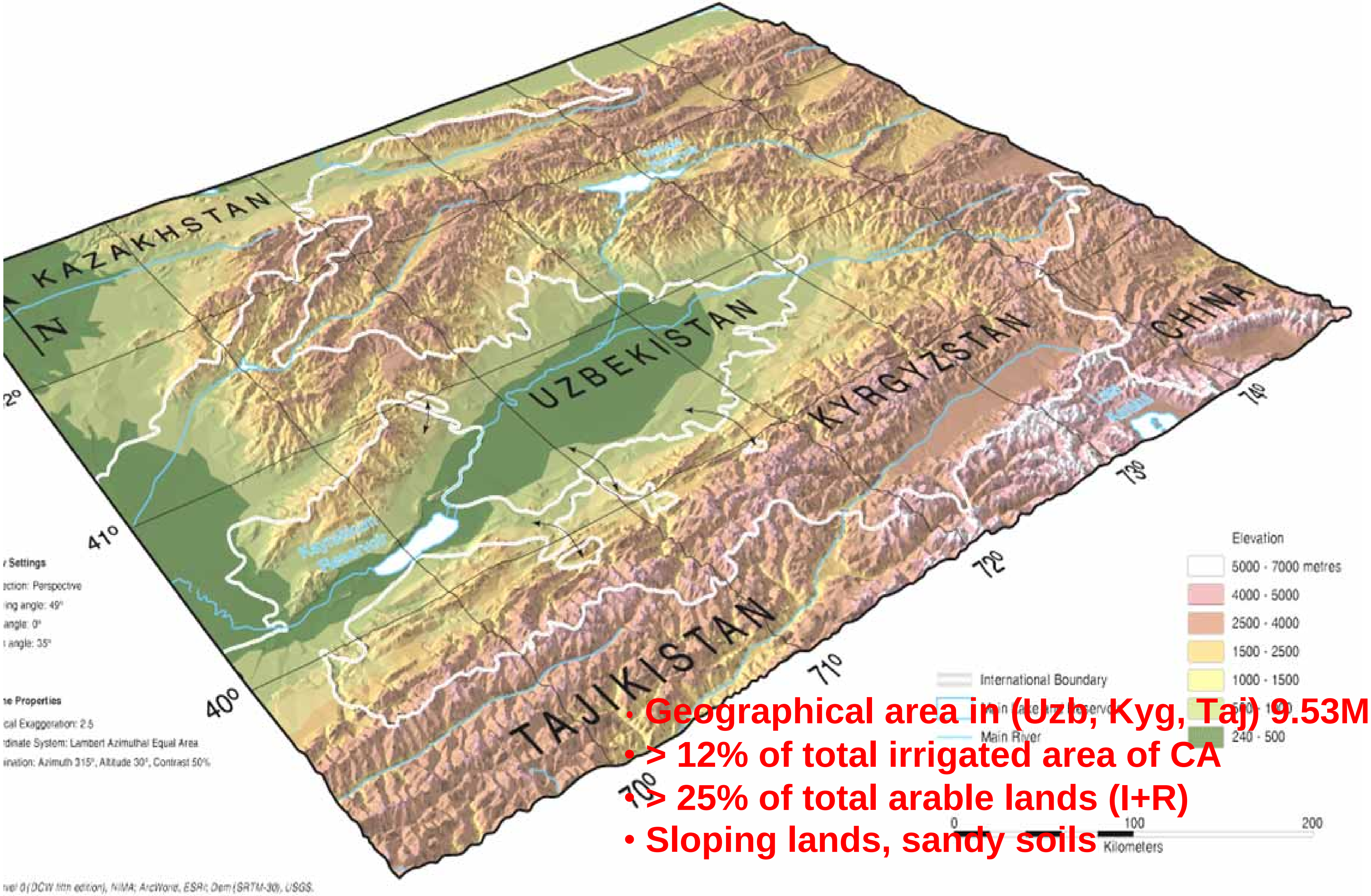


1. Semi-Desert soils
2. Rock debris/ desert detritus
3. Light color fertile soils
4. Sodic/ semi deserts
5. Poorly developed DS



- **Most of the arable lands in CA receive between 100 mm to 300 mm of precipitation, which is 5-15 times less than the observed evapo-transpiration.**
- **Water shortages and it plays key role in agriculture production**
- **Extensive livestock rearing is gaining in importance, - a lifeline for many in rural population (Gintzburger, 2004).**

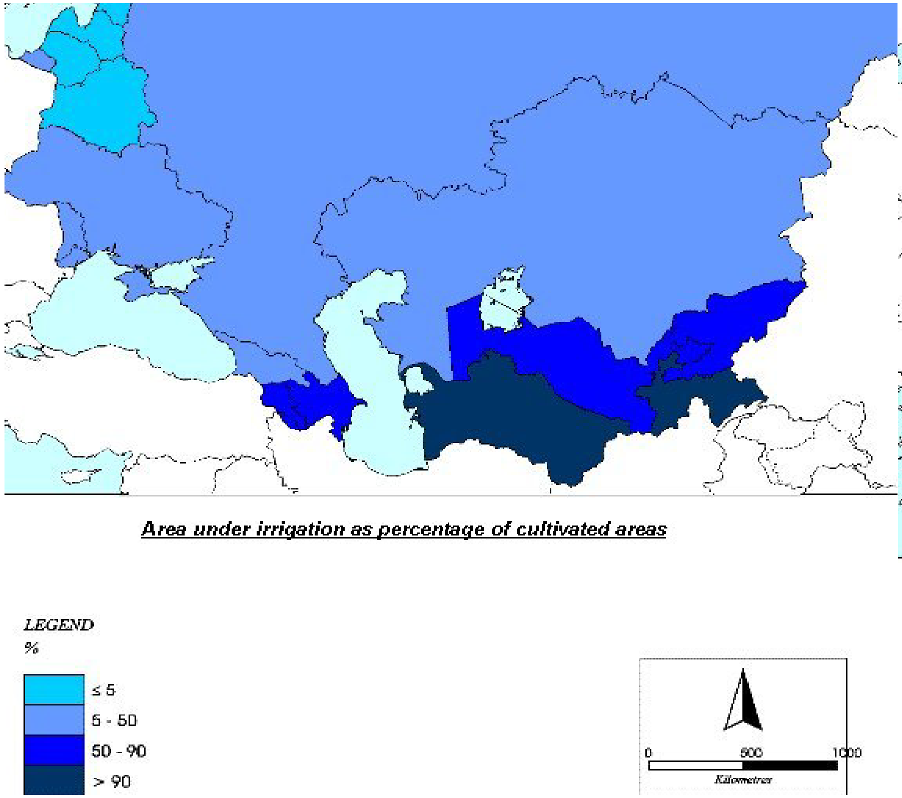
Three Dimensional View of the Fergana Valley Region
(Irrigated Agriculture)

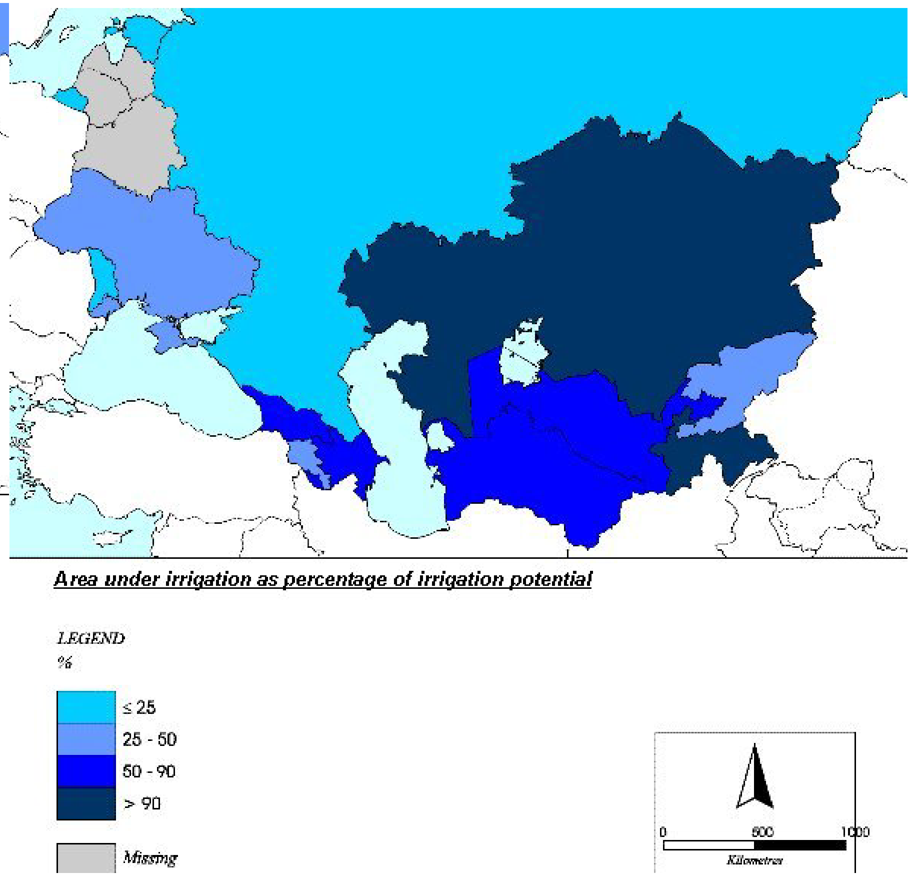


- **Geographical area in (Uzb, Kyg, Taj) 9.53Mha**
- **> 12% of total irrigated area of CA**
- **> 25% of total arable lands (I+R)**
- **Sloping lands, sandy soils**

Created at UNEP/DEWA/GRID-Geneva; June 2004

Irrigation Water in Central Asia (FAO,2006)

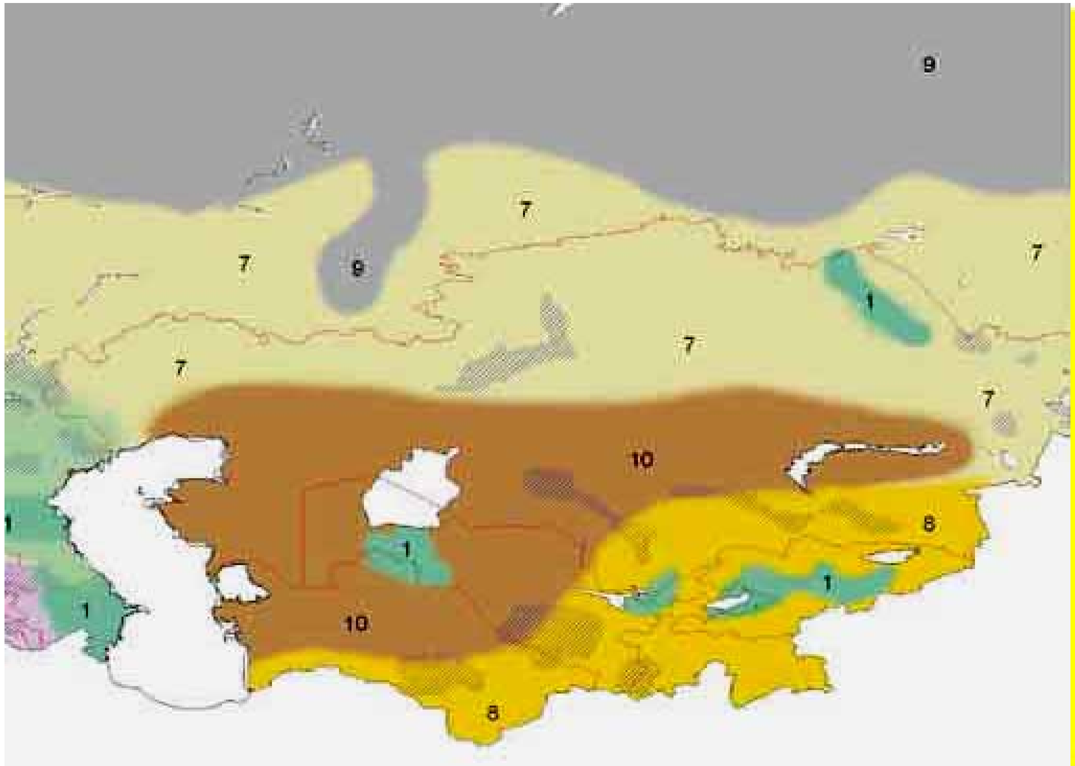


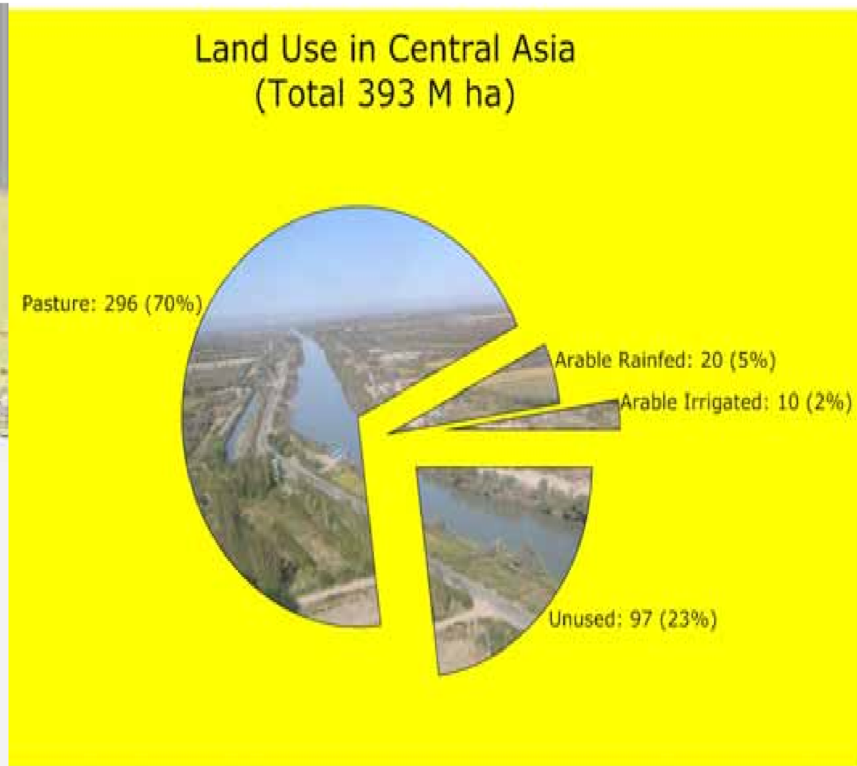


% Irrigation cover

Irrigated Potential utilized (%)

2. Land Use and Agro-ecologies in Central Asia





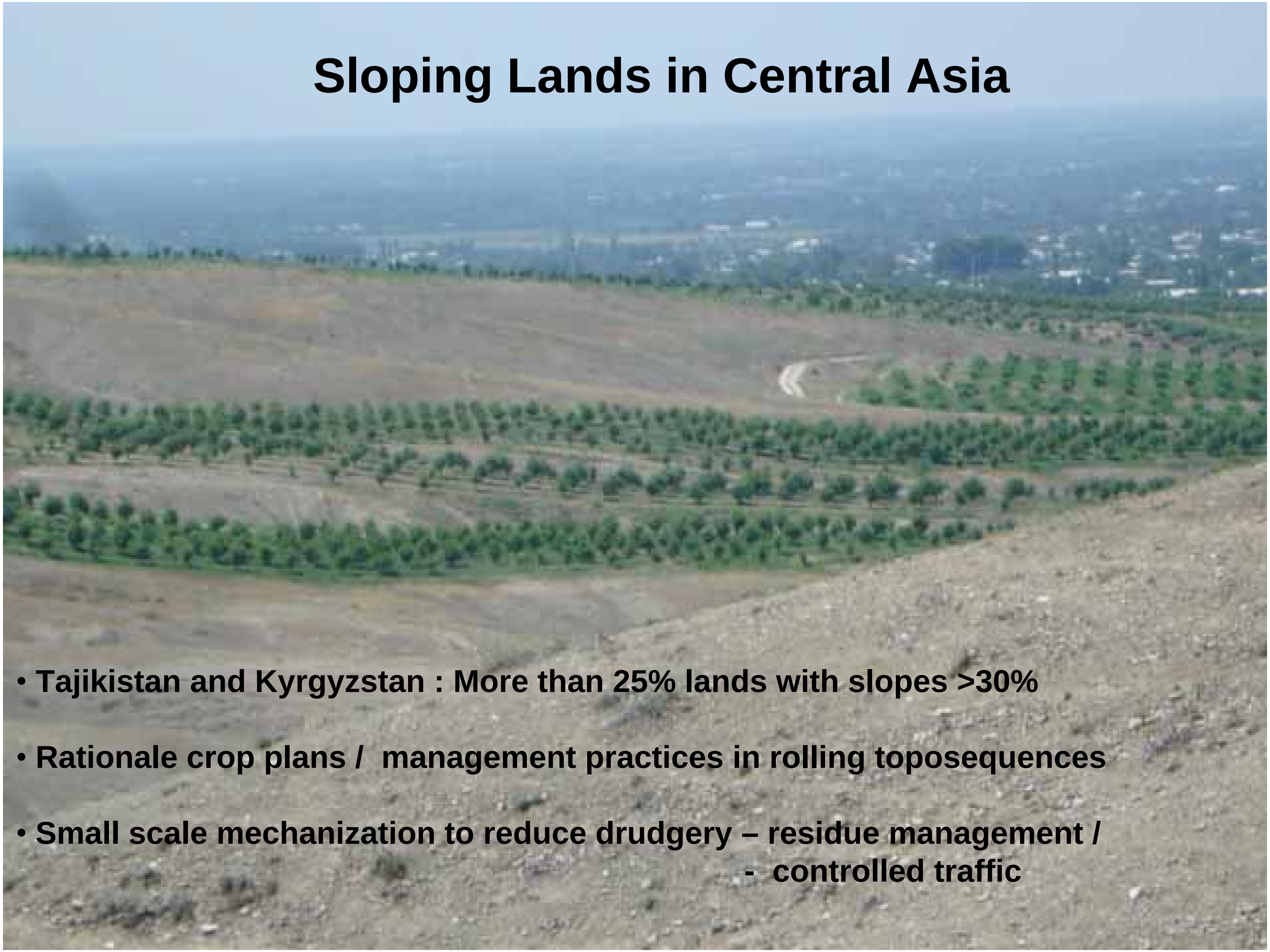
<u>Farming systems</u>

1. **Irrigated**
7. **Extensive cereal- livestock**
8. **Sparse arid cold**
10. **Sparse arid**

- **Pastoral systems – over deserts, steppes and Mountains**
- **Livestock rearing is gaining in importance, - a lifeline for many**

(Gintzburger, 2004).

Sloping Lands in Central Asia



- **Tajikistan and Kyrgyzstan : More than 25% lands with slopes >30%**
- **Rationale crop plans / management practices in rolling toposequences**
- **Small scale mechanization to reduce drudgery – residue management /**
  - controlled traffic

3. Drivers of Landuse Changes

1. Demographic pressures
2. Economic and policy swings
3. Competition for water
4. Soil fertility and land degradation
5. Climate changes
6. Crop production and Fodder Availability
7. Technological changes
8. Land use policy prescriptions

3. Challenges to SLM in Central Asia

- Increasing population
- Changing food habits
- Competition for land and water
- Expansion into fragile areas
- Scarcity of fodders: Production efficiency, crop diversity
- Increasing resource fatigue
- Input supplies and use efficiency
- Water shortages - fallow lands
- Adapt to climate change

- Innovative Networks and HRD
- Lack of enabling policy environment
- Inadequate land use plans

- Weak Public-Private partnerships
- Land-locked and long seclusion

4. Land degradation Problems In Central Asia

Country	Area	Salinity	Sodicity	Shallowness	Erosion
Kazakhstan	2715 (22)	215 (8)	1071(40)	386(14)	78 (03)
Kyrgyzstan	198 (23)	1 (1)	(0)	107(54)	56 (28)
Tajikistan	143 (26)	7 (5)	(0)	68(48)	37(26)
Turkmenistan	487 (7)	73(15)	17(4)	35(7)	7(1)
Uzbekistan	446 (16)	63(14)	46(10)	39(9)	13(3)

- Lands without hazards range from 7-26% in different countries
- Degradation sources also vary between countries

4. Salt-affected Irrigated Lands in Central Asia

Country	Salt-affected lands,(000 ha)	Percent of Total Irrigated Lands
Kyrgyzstan	124	11.5
Tajikistan	115	16.0
Kazakhstan	763	33.0
Turkmenistan	1,672	95.9
Uzbekistan	2,141	50.1
Total	4,805Mha	

- Salinity- a consequence of inefficient water management

Source- FAO, 2003

4. Cause – Effect Relations of Land Degradation

Forms

- Wind erosion
- Water erosion
- Salinization/waterlogging
- Degradation- range/pastures
- Forest land degradation

Causes

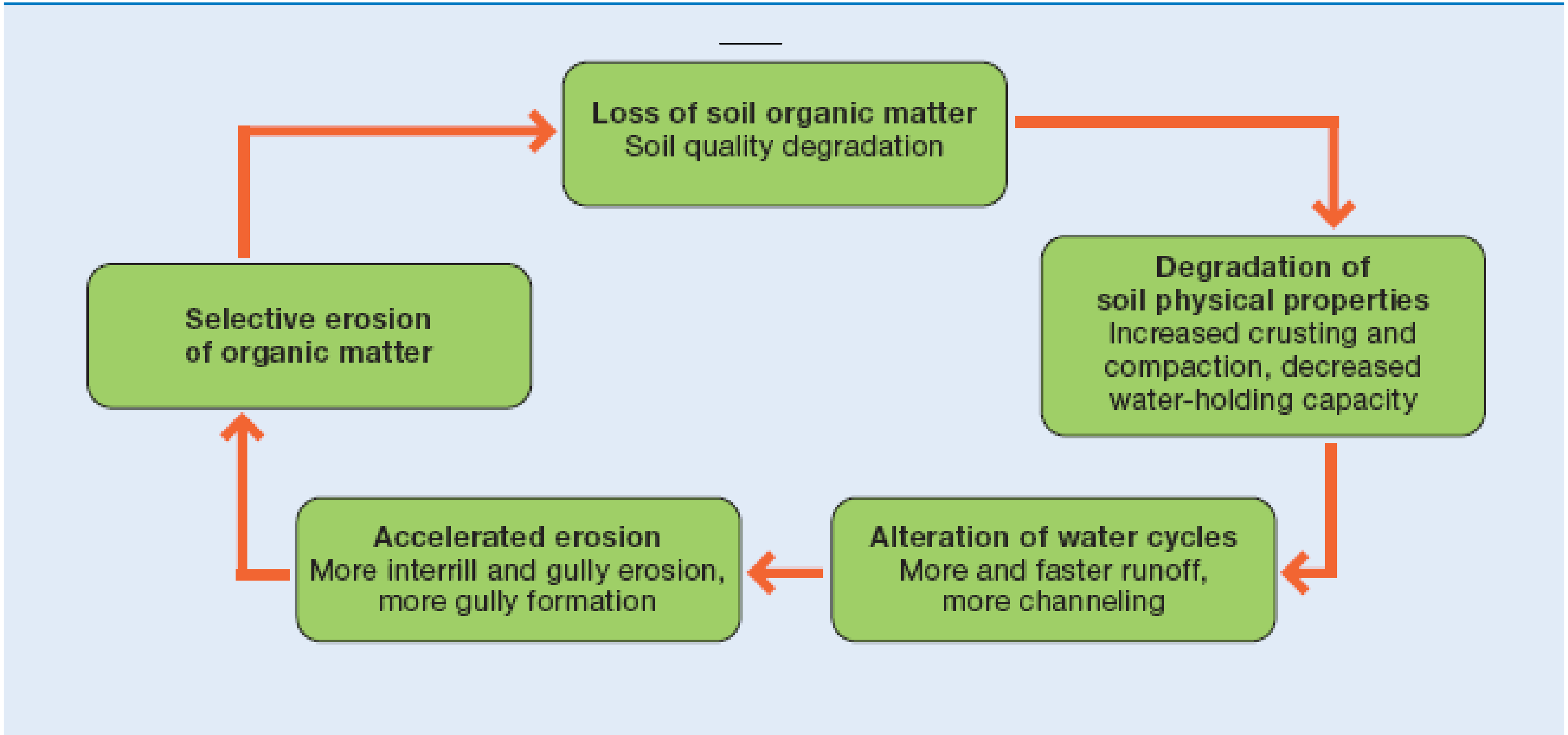
- Carbon-losses
- Excessive Tillage
- Overgrazing
- Deforestation
- Erosion
- Loss of covers
- Practices

Impact

- Declining soil fertility & crop yields
- Reduced biodiversity
- Declining factor productivity
- Declining livestock productivity
- Escalating prod/rehabilitation costs
- Greenhouse Gas emissions
- Low farm incomes- livelihoods
- Loss of labor

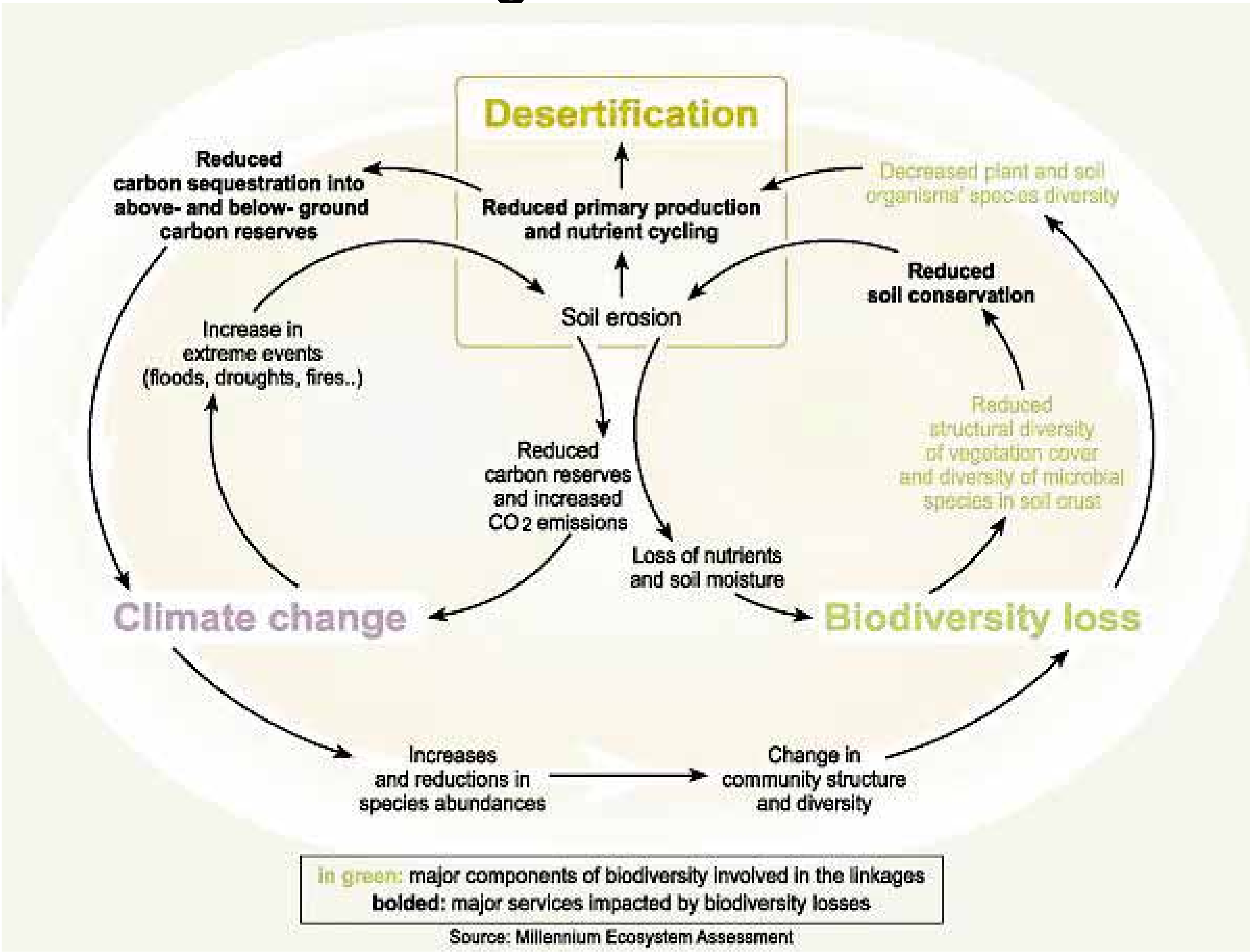
Desertification spiral is driven by interlinked biophysical and socio-economic factors- feeding each other.

Soil Water - Plant Relationships and Land Degradation



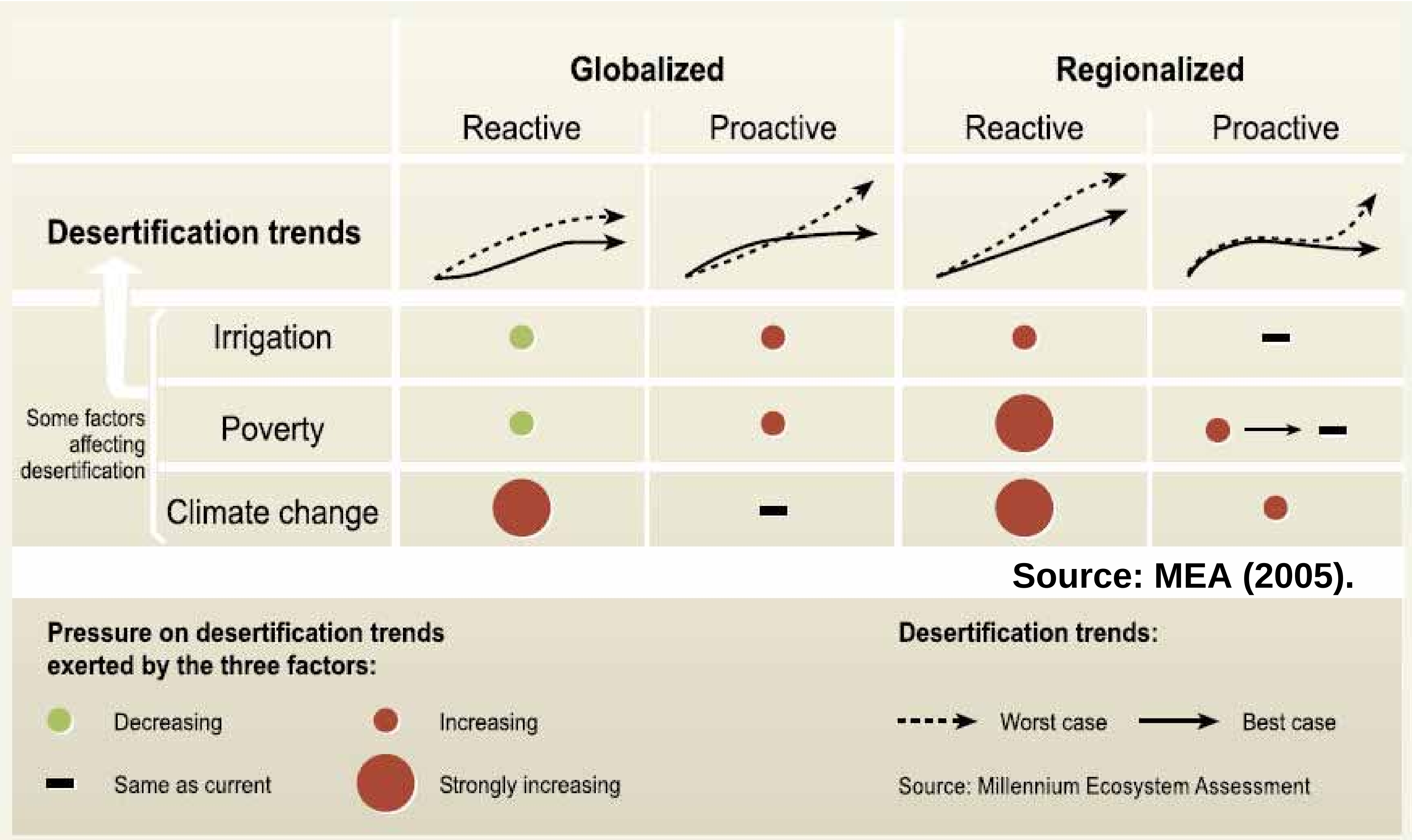
Loss of SOM adversely affects IPNS to result in yield declines

4. Land Degradation, Biodiversity and Climate change Nexus



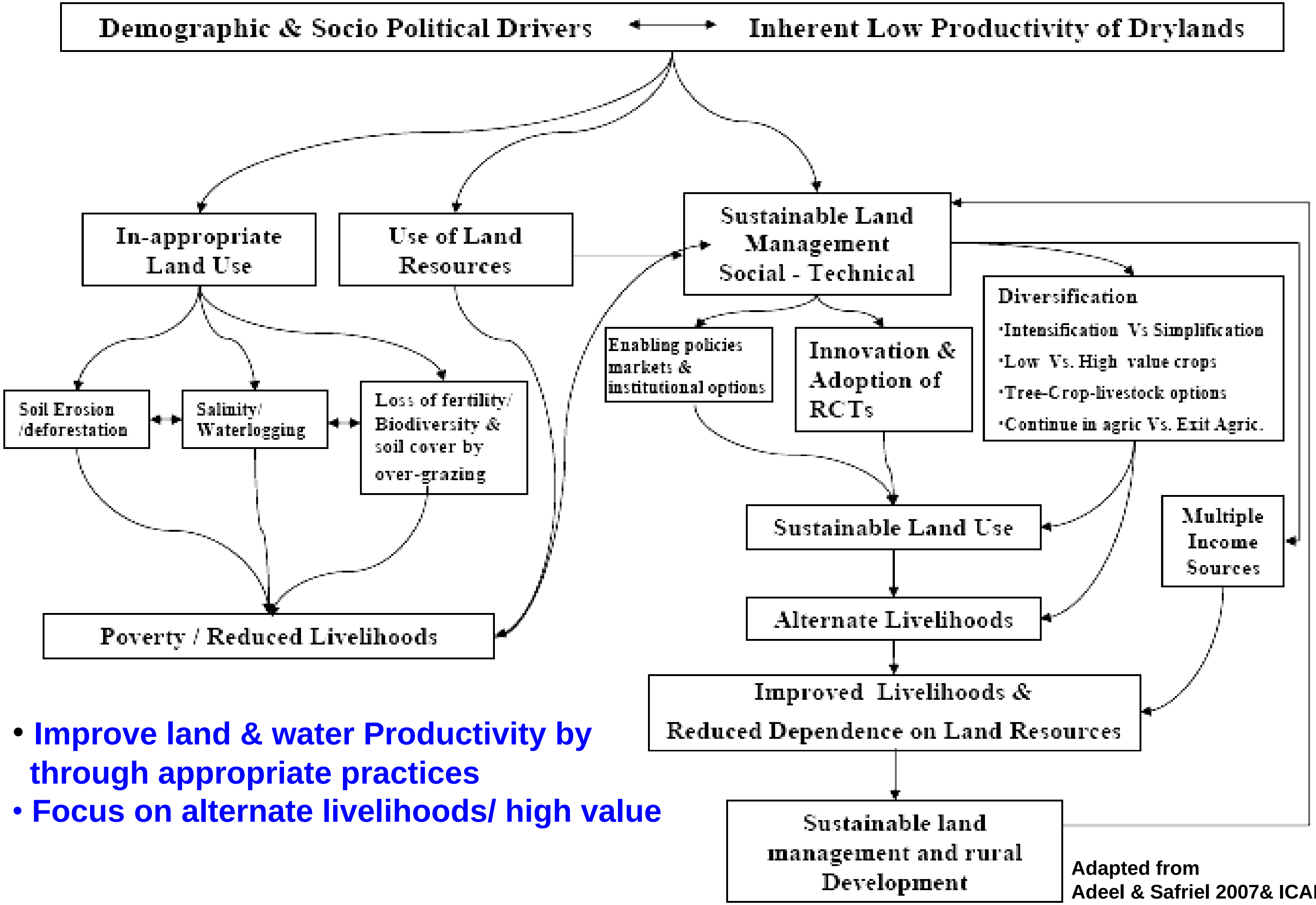
Millennium Ecosystem Assessment (2005)

Development Scenarios for Drylands



Source: MEA (2005).

Strategy for Achieving SLM



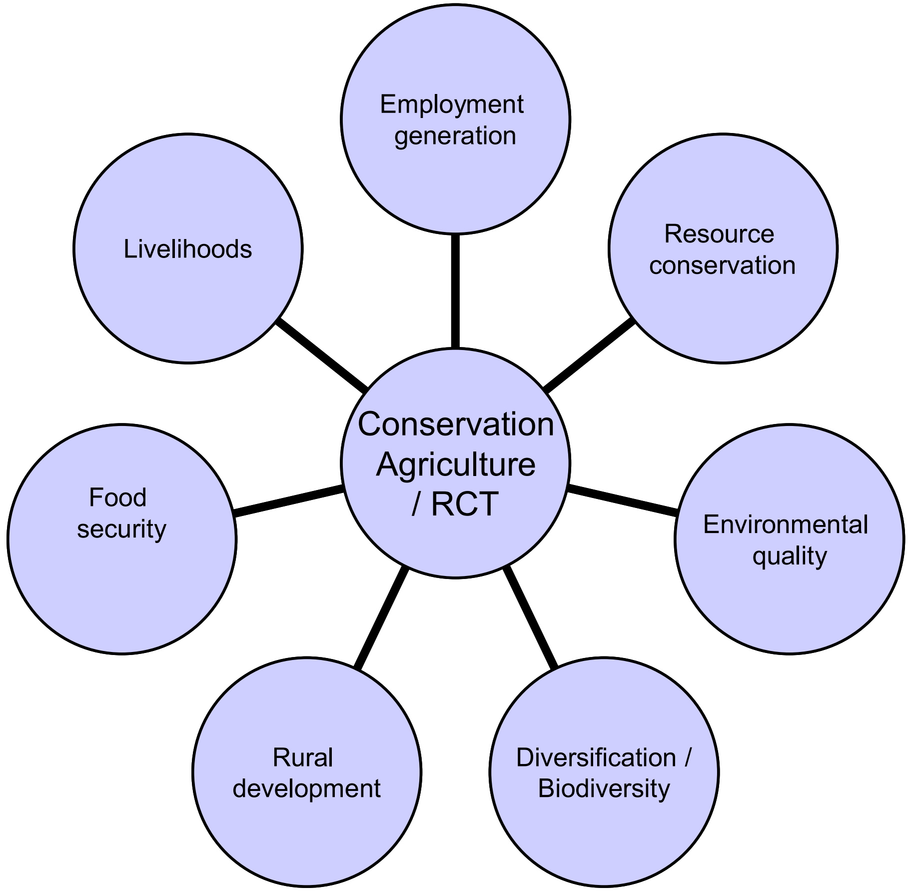
- **Improve land & water Productivity by through appropriate practices**
- **Focus on alternate livelihoods/ high value**

Adapted from
Adeel & Safriel 2007& ICARDA 2007

An Integrated Approach for SLM

Oasis K-streams link research to sustainable development by putting SLM in the center stage and following SLM principles such as to:

- Produce more at less cost,
- Enhance the quality of the environment and natural resources,
- Enhance biodiversity and
- Improve farm incomes, and livelihoods of the farmers in Central Asia
- Generates additional employment through diversification
- Promote food security



Shifts Required ?

New paradigm for agricultural research and development is to improve productivity in marginal and fragile areas and enhance and sustain the productivity of intensively irrigated and cultivated areas

The major shifts for enhanced sustainability of agriculture:

- ■ Intensive tillage ➔ No-till or reduced till agriculture
- ■ Mono-cultures ➔ Diversified cropping systems
- ■ Residue burning ➔ Residue retention and controlled traffic
- ■ Sole crops ➔ Intercrops and relay crops

Research Questions- Activities for Promoting SLM

Objective : Develop empirical understanding of thresholds and factors responsible for resilience of the soils.

Priority	Research Questions	Activity
1.Under-standing land degradation	What attributes of degraded dry lands contribute to predicting thresholds and resilience of soils in different toposequences and agro-ecologies of Central Asia?? How can dryland ecosystem services be valued for trade-off evaluations for decision making?	•Use of remote sensing, GIS tools and techniques for dynamic assessments and monitoring of land degradation •Metadata on benchmark sites for technology targeting •Empirical analysis of the trade-offs for ecoservices for trans-boundary applications

Research Questions- Activities for Promoting SLM

1. Assess salt, nutrient and water balances to enhance positive tree-crop-livestock interactions
2. Develop socio-economic-technical innovations for value-added chains to promote diversification

Priority	Research Questions	Activity
2. Improve soil-water and soil fertility management	1. What are the risk implications of continuous practice of intensive cotton-wheat systems on soil quality ? 2. What would motivate and enable farmers to diversify their farming system?	•Develop tree-crop-livestock management options to ensure soil resilience and adapting to climate change •Develop irrigation water quality guidelines for conjunctive use of multi-quality waters for favorable salt and water balances •Innovate nutrient, water and IPM practices for changes in biotic and abiotic conditions due to surface covers (residues/ canopy). •Rationale leaching and irrigation methods to save on water and reduce drainage volumes •Assessment of Carbon sequestration potential •Legume intercropping in major cropping systems and plantations

Research Questions- Activities for Promoting SLM

1. Build capacity for PMI research to improve the understanding of PMI forces to mitigate land degradation
2. Study policy that undermine investments in RCTs from private and public sectors
3. Assess the impact of policy changes on land degradation

Priority	Research Questions	Activity
3. Improve policy, markets and institutional options	1. What policy, market and institutional (PMI) failures contribute to land degradation in central Asia? 2. What are the risks for policy makers and factors that enthuses them to promote SLM in dry lands of central Asia? 3. Do Central Asian republics have a comparative advantage for livestock and high value fruit / nuts production systems? 4. Do Central Asian republics have a comparative advantage for livestock and high value fruit/ nuts production systems? 5. What are the economic and environmental trade-offs associated with alternative policy options?	-Assess the private and social costs of PMI failures -Identify win-win PMI options for different agro-ecozones for pastoralists and other farming systems. -Strengthen the capacity of the NARS for PMI research - Quantify economic and environmental trade-offs associated with alternative policy options and value environmental benefits/ externalities

Research Questions- Activities for Promoting SLM

Objective :

1. Understanding of the development pathways that improve success of RCTs
2. Evaluate & develop innovative diversification options with Value-added chains

Priority	Research Questions	Activities
4. Development pathways for secured livelihood	Can Resource conserving technologies (RCTs) contribute to improved livelihoods and sustainable development? How would RCTs overcome the risk-aversion behaviors of farmers and decision makers? How would enabling policy an institutional options facilitate the adoption of RCTs?	•Develop yield-enhancing, input-saving, eco technology for no-till systems. •Germplasm enhancement for reduced- and O-till system •Mechanize small farm-holdings •Management of sloping lands • Technology targeting using new techniques •Estimate adoption path with and without enabling policy options. •Identify and quantify social, economic and environmental indicators.

Research Questions- Activities for Promoting SLM

Objective :

1. Understanding of the development pathways that improve success of RCTs
2. Evaluate & develop innovative diversification options with Value-added chains

Priority	Research Questions	Activity
5. Improving co-evolution and 'co-learning' of technologies	How technology generation and dissemi-nation systems can be truly grounded in biophysical and socio-economic contexts of the intended users? What influences the behavior of managers to pursue and implement the SLM practices in dry lands?	•Improve the skills of the farmers to articulate their needs for research- and extension-backstopping •Re-orient technology development process ed in the NARS •Statistical tools for analysis of farmer participatory trials •Organize farmer-service provider-researcher participatory traveling seminars and workshops to jointly analyze the impacts of livelihoods and quality of natural resources

THANKS