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Conservation agriculture as a sustainable option for addressing land and water problems in Central Asia

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The regional challenges

Land degradation (soil salinity, waterlogging, soil erosion)

soil salinity

In all cases soil fertility decreasing

overstocking

Water erosion

Windy erosion

Arable land per capita is decreasing followed by increasing demand for food and feed

Land resources and population and agricultural indicators of Central Asia

Country	Total territory (M ha)	Land area (M ha)	Croplan d (M ha)	% Agri. GDP	Populatio n (million)	Per capita cropland (ha)
Kazakhstan	272.49	269.7	21.5	5.3	16.5	1.3
Kyrgyzstan	19.99	19.18	1.17	25.8	5.5	0.21
Tajikistan	14.25	13.99	0.85	19.8	7.8	0.11
Turkmenistan	48.81	46.99	1.8	22.1	5.2	0.34
Uzbekistan	44.74	42.54	4.9	19.4	30.5	0.16
Total	400.3	392.7	30.2	9.9	62.5	0.48
World average						0.20

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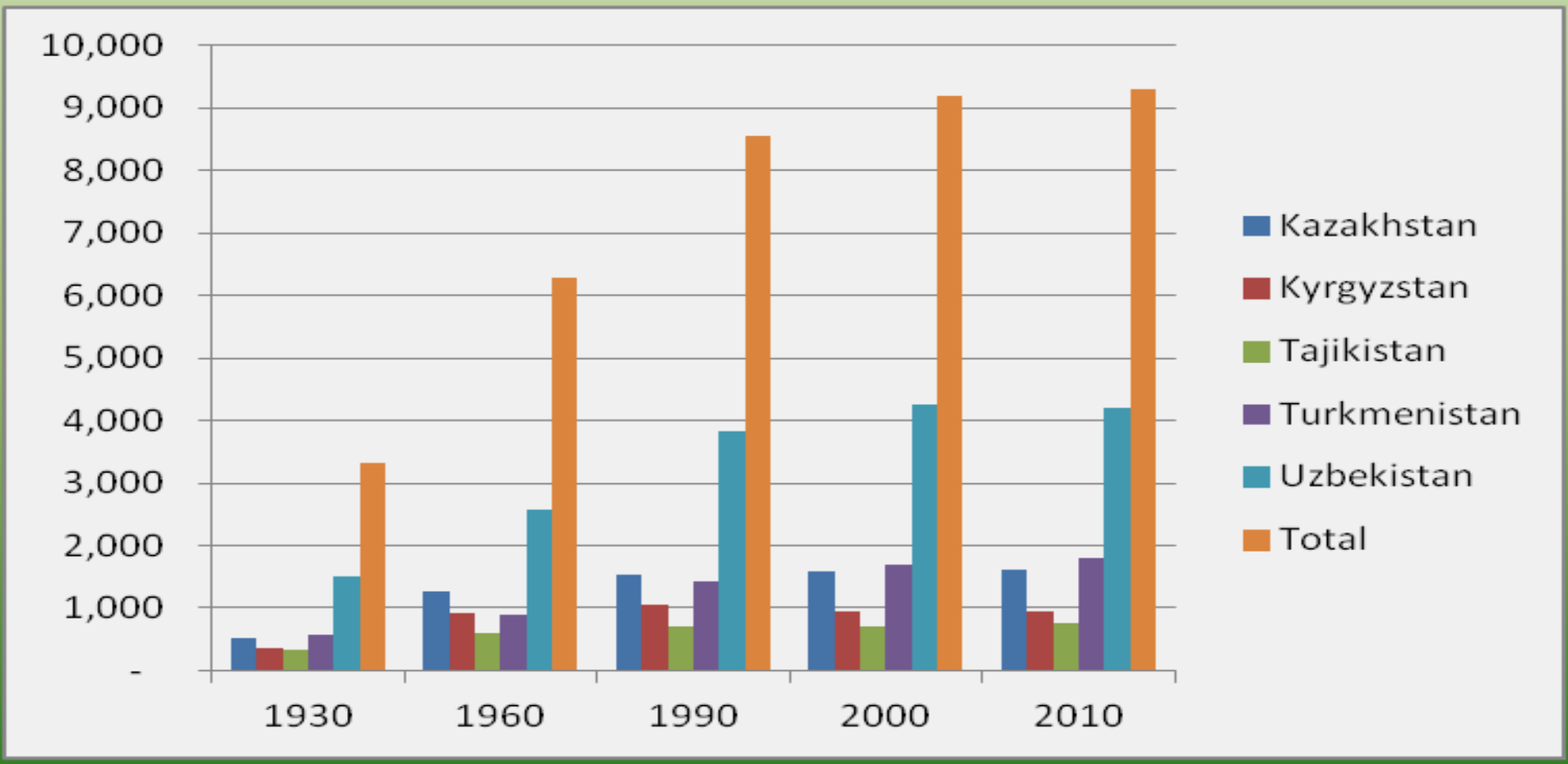
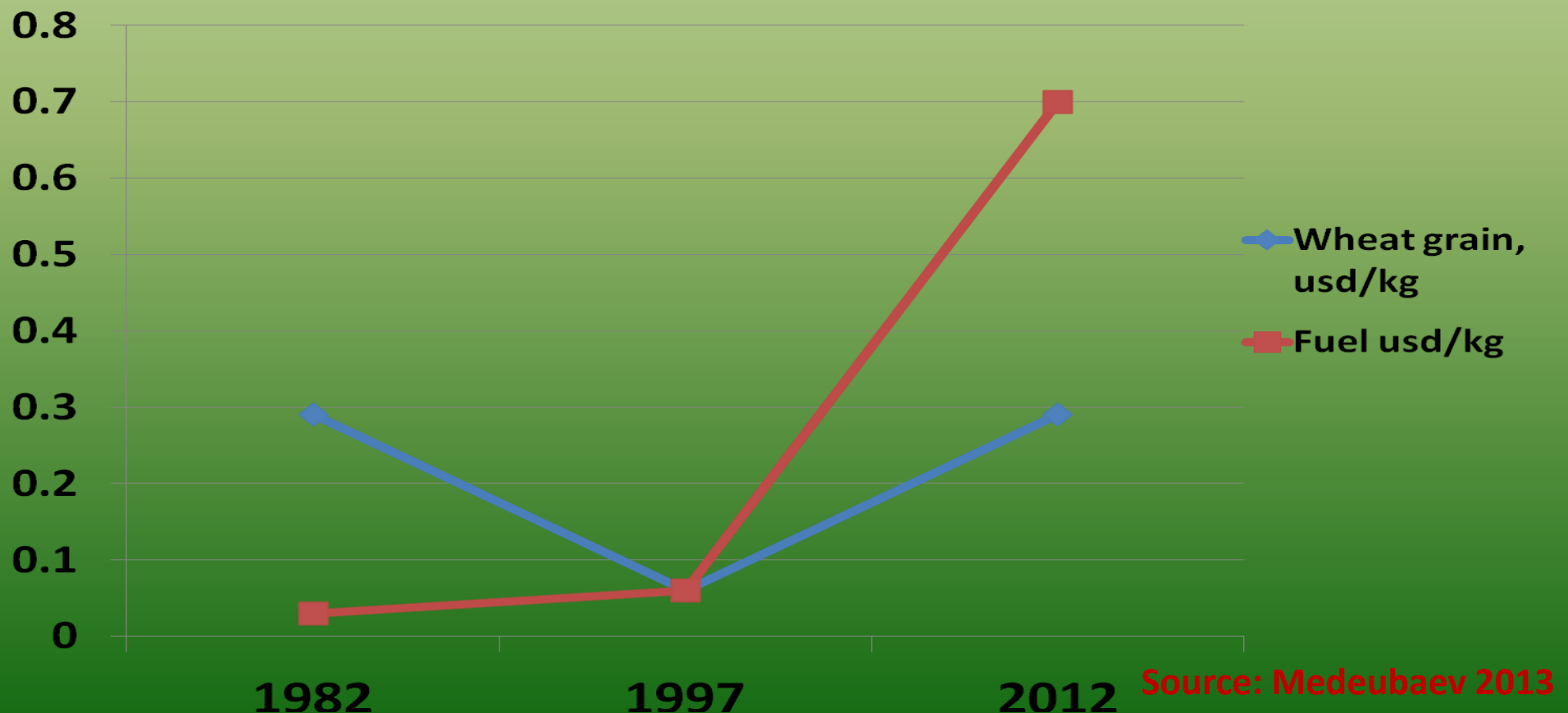
Area under irrigation has been increasing, but no more possible…



Development of irrigated areas in five countries of Central Asia during 1930-2010 (Updated FAO Stat 2012 and from Nurbekov et., 2013)

Agricultural input prices increasing (fuel, fertilizer, seed, pesticides, etc.)

Comparison wheat and fuel prices in Kazakhstan (1982-2012)



Source: Medeubaev 2013

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Conservation agriculture can address these challenges

What is Conservation agriculture?

Empirical and scientific evidence internationally shows ....

- **No or minimum mechanical soil disturbance by** – seeding or planting directly into untilled soil
- **Enhance and maintain organic matter cover on the soil surface** – using crop residues and cover crops to protect & feed soil life
- **Diversification of species** -- both annuals and perennials - in associations, sequences and rotations

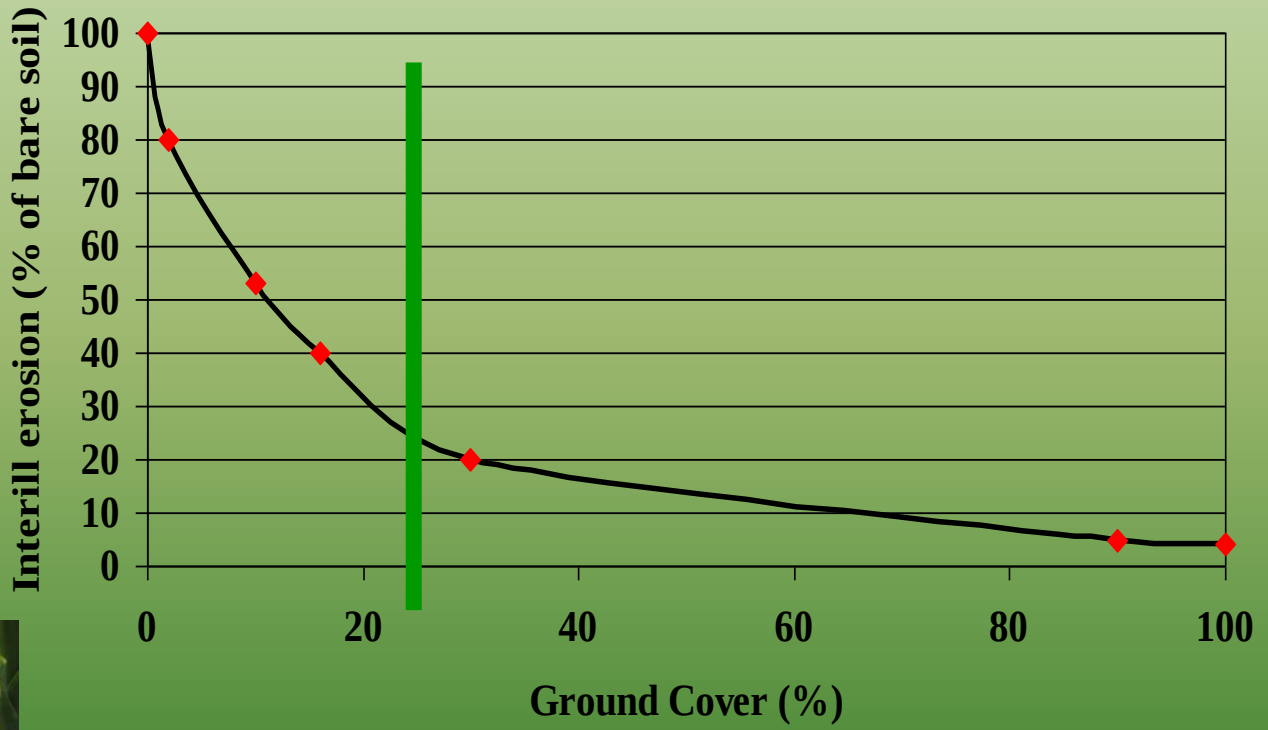
Source: Amir Kassam 2013

CA impact on soil fertility and environment

Type of degradation	Conservation Agriculture impact
Soil salinity	❑ Reduced soil salinity was reported by Devkota (2011) ❑ The differences in soil salinity at the end between conventional practices (0.52%) and NT (0.39%) were significant. After 4 years, NT system had the lowest soil salinity level (Nurbekov 2008 and Pulatov et al., 2012).
Soil organic matter	❑ Numerous results from the irrigated areas showed that crop residue retention improves SOM and soil N content (e.g. Egamberdiev, 2007; Nurbekov et al., 2012; Pulatov et al., 2012) ❑ In comparison, a wealth of information on CA practices worldwide shows an increase in SOM (e.g. West and Post, 2002; Sanchez et al., 2004; Govaerts et al., 2006; Corsi et al., 2012) and these results were also confirmed by selected studies in the irrigated areas in Central Asia
Soil Biodiversity & Biological activities	❑ CA positive effect on earthworm populations, with earthworm biomasses up to 80% higher
Soil Physico-chemical properties	❑ CA positive effect on soil aggregation + 60% (F. Tivet, Laos 2008) ❑ Under CA total exchange capacity + 50% (P. Lienhard, Laos 2013)

Soil Cover and Erosion

80% reduction with 30% cover!!



From Brady and Weil, 2002

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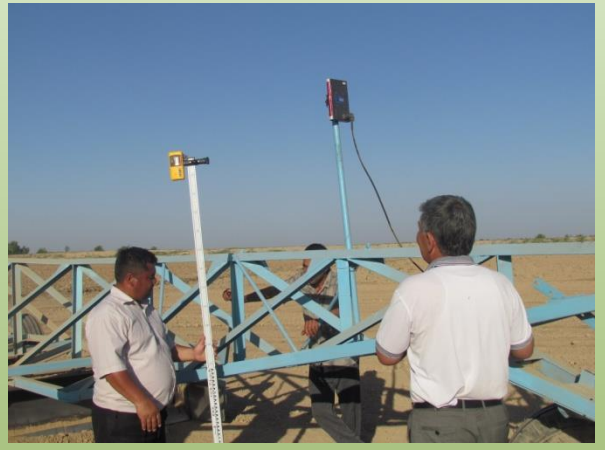
Laser levelling

Azerbaijan

Kazakhstan



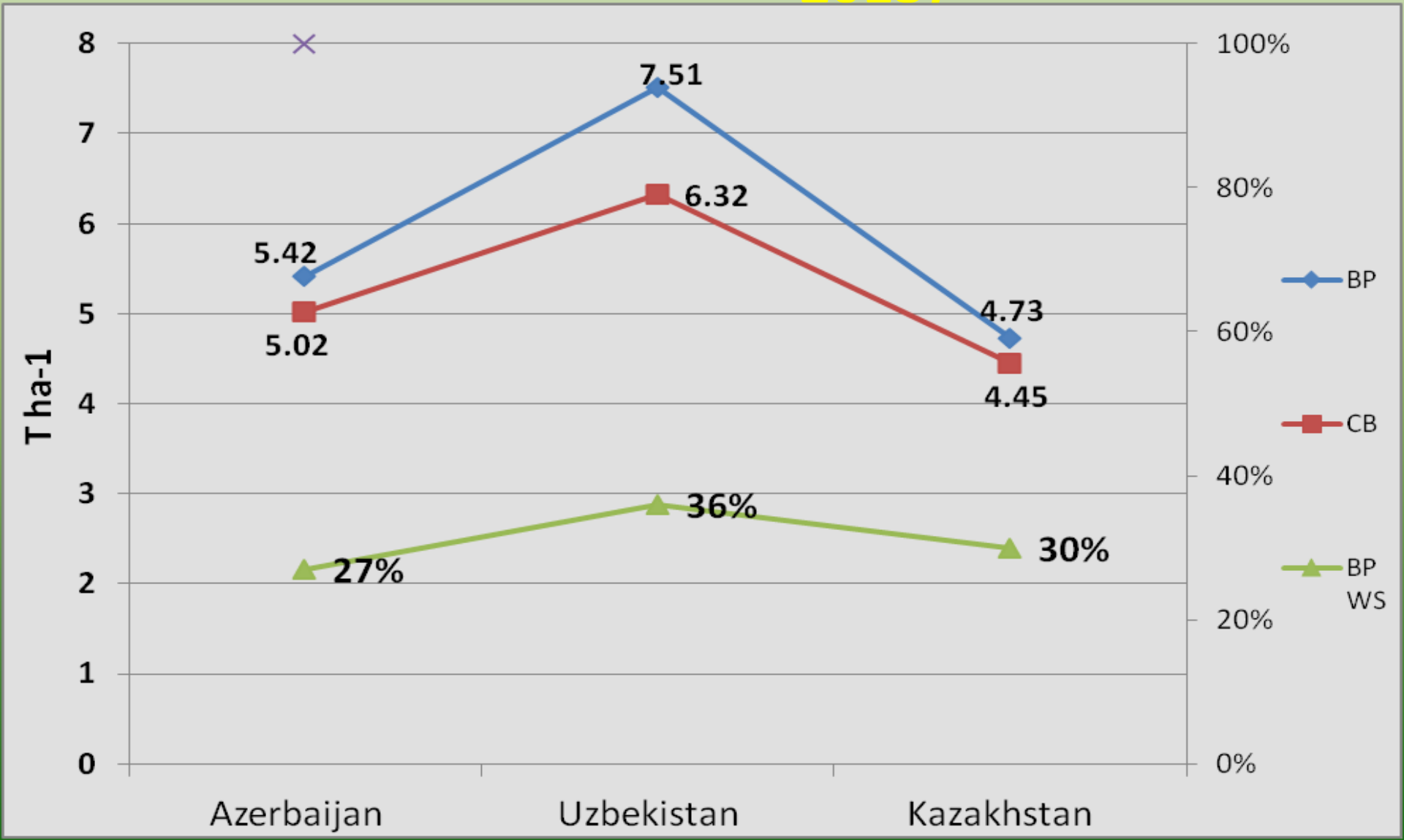
Uzbekistan

Laser land leveling was done on 15 ha in the respective project countries which is the base for improved irrigation practices. Water use for the new crop rotations introduced

2 cm (8m³)	5 cm (20 m³)	-4 cm (16m³)	-4 cm (16m³)	-2 cm (8 m³)
3 cm (12 m³)	6 cm (24 m³)	-3 (12 cm³)	-4 cm (16m³)	-2 cm (8 m³)
1 cm (4 m³)	7 cm (28 m³)	-5 cm (20 cm³)	0 cm	0 cm
5 cm (20 m³)	7 cm (28 m³)	-4 cm (16m³)	-3 cm (12 m³)	-10 cm (40 m³)
6 cm (24 m³)	7 cm (28 m³)	-10 cm (40 m³)	0 cm	0 cm

Fill up to 2 cm
Fill from 3-5 cm
Cut up to 5 см
Fill >6 cm
Cut > 5 cm
± projected

Wheat Yield Response to planting method under laser levelled field (2011-2013)



Double crops will be essential to improve sustainability of farming and land use efficiency

Effect of no till succeeding maize in Azerbaijan (2011-2012)

Crops	Crop yield, t/ha			+-, t ha -1
	Winter wheat	Maize	Winter wheat+maize	
Winter wheat, control	**5.17**	**-**	**5.17**	**-**
Winter wheat + maize	**5.17**	**5.21**	**10.38**	**5.21**

Land use efficiency with different crop rotations

	Farm 1																																	
	2011										2012										2013												
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1	Corn (*Zea Mays*)										Winter wheat (*Triticum aestivum*)										Mung bean (*Vigna radiata*)										Field pea (*Pisum sativum*)										Corn (*Zea Mays*)										Winter wheat (*Triticum aestivum*)									
	Farm 2 farmers' practice																																	
	2011										**2012**										**2013**												
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
2		Soy bean (Glycine max.)									**winter wheat (*Triticum aestivum*)**										**Fallow**										**Sorghum (*Sorghum bicolor*)**										**Fallow**									
	Farm 3																																	
	2011										2012										2013												
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
3	Sorghum (*Sorghum bicolor*)										Winter wheat (*Triticum aestivum*)										Kidney bean *(Phaseolus vulgaris L.)*										Winter barley (*Hordeum vulgare L.*)										Soy bean (*Glycine max*)										Field pea (*Pisum sativum*)									

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Challenge - Agricultural input prices increasing

Traditional agriculture – wheat





Conservation agriculture – wheat




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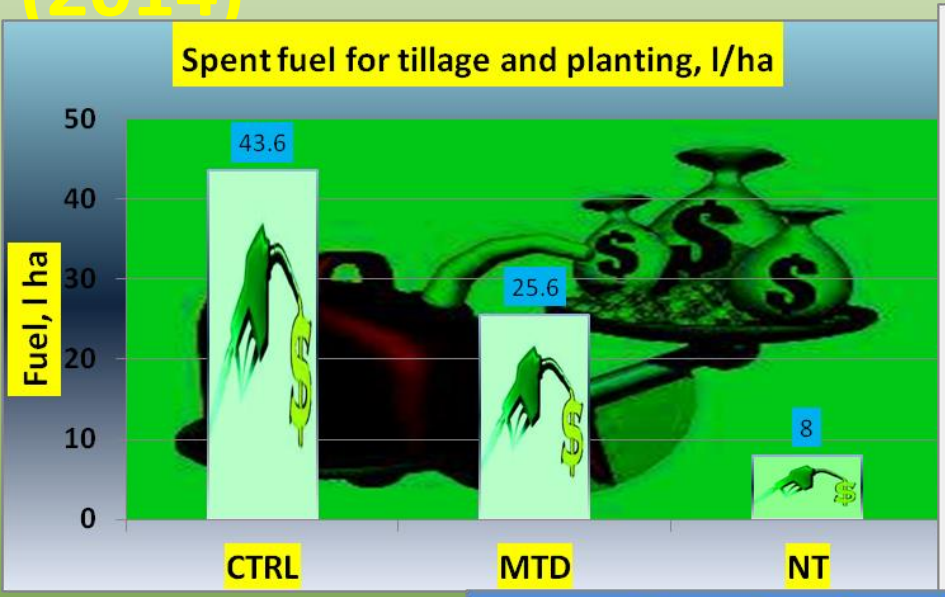
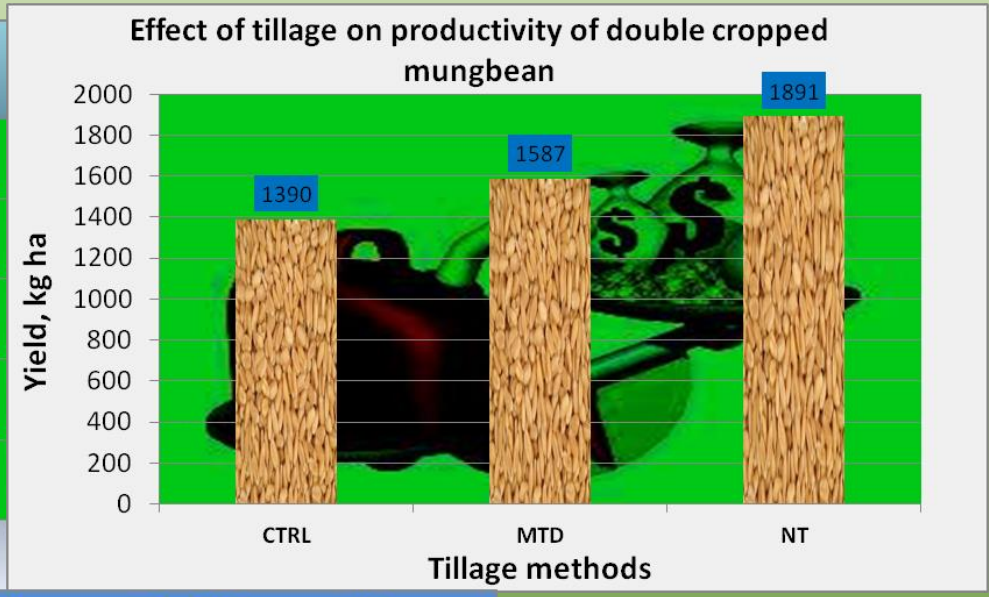
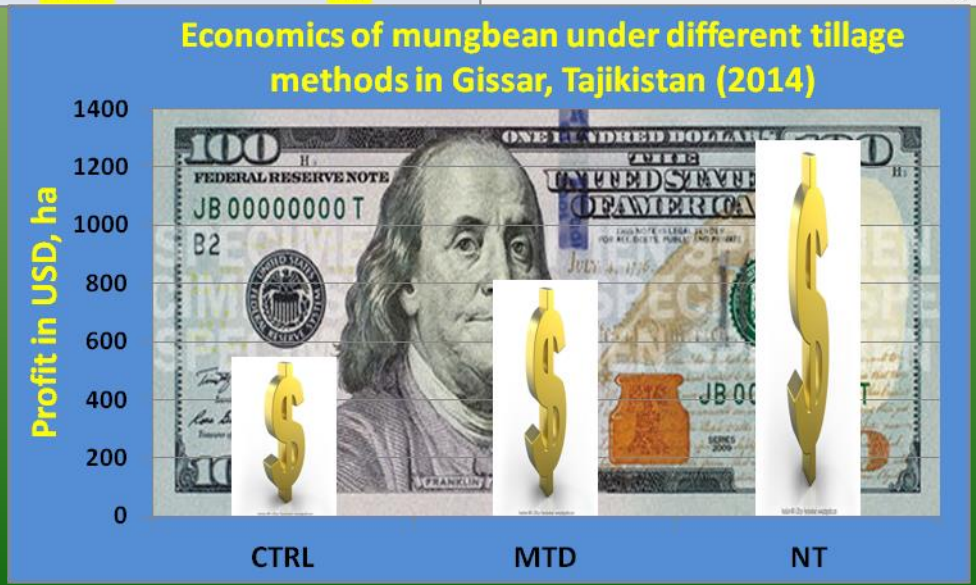
Challenge - Agricultural input prices increasing

No-till Mungbean grown in Gissar Tajikistan (2014)







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Why
CA is it not spreading?

Adoption – Regionally

- Kazakhstan **2.1 M** ha
- Uzbekistan **0.6 M** ha minimum till wheat (only one year), including **2450** ha in rainfed area
- Tajikistan 25,000-50,000 ha minimum till wheat
- Kyrgyzstan 700 ha
- Turkmenistan no data

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Why has there been so little adoption of Conservation Agriculture outside the Kazakhstan?

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Constraints - adoption of conservation agriculture

- Mind set
- Lack of extension services throughout the region
- Training needs larger than perceived
- Lack of local manufacturers
- Limited number of publications CA
- Little or no mainstreaming of CA in National Programs
- Policy makers unaware of CA

Conclusions

- CA practices are suitable for the existing major cropping systems.
- CA also can combat land degradation in the region through application of no-till, crop residue retention and crop diversification;
- CA can provide similar or higher crop yields while saving considerable production resources, including fuel, seeds, water and labour.

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Discussion

- Under the prevailing scenario of increasing fuel prices and land degradation, decreasing per capita crop land, salinization of irrigated lands and low priority given to fodder production and preservation, CA can go a long way to solving these challenges in the years to come.
- Further research in Central Asia across agro-ecological zones is necessary:
  - on weed, nutrient, pest and water management;
  - on sowing depth, dates, density and fertilizer rate;
  - on the impact to livelihoods and environment.
- To make results applicable on a wider scale, state programmes should become more active in conducting research, training and extension on CA.

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Thank you