THE ASSESSMENT OF THE ECONOMIC IMPLICATIONS OF THE INTRODUCED SALT-TOLERANT AND DROUGHT RESISTANT CROPS

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Introduction

Agriculture remains an important sector of the economy in Uzbekistan. There is considerable potential for improving the productivity of agriculture to meet the national food demands and to generate rural employment and incomes. However, production is constrained by variable and uncertain rainfall, cold winters, hot dry summers and salinity. One of the major reasons for low agricultural productivity is the inefficient use of water. The lack of proper management of irrigation systems and drainage and the dismantling of former state-operated large-scale irrigation systems have led to resource degradation and inefficiencies in water use and distribution. Appropriate water management and field irrigation practices for maximizing water use efficiency using different sources of water (rainfall, run-off, and alternative irrigation water sources) on small farm holdings, together with better management of inputs such as nutrients and appropriate soil conservation practices will result in improved productivity.

CA is one of the most promising agricultural land use options that have been developed in our times. CA practices will include introduction of practices in maintaining soil cover, direct planting/seeding with minimal soil disturbance, appropriate crop rotations, soil mechanization techniques and on farm water management through improved land levelling, drainage and water saving technologies as well as water control and crop irrigation scheduling using deficit irrigation practices and saline soil leaching, with the primary objective of utilizing the scarce water resources in an efficient and sustainable manner. CA is more an approach sustainable agro-ecosystem management than a production technology because it offers a way to produce more with less while at the same time preserves and enhances many of the ecological functions a natural soil has to offer in a natural ecosystem and also offers economic benefits to farmers who apply it.

The water demand from current farming practices cannot be sustained, and the consequences of non action will be increasing desertification around the Aral Sea, which will progressively engulf greater areas of KK, with disastrous social consequences.

For these reasons, there is an urgent need to pilot changes in irrigation and agricultural practices in the region in order to address the issue of declining water availability - this is a high priority for the Governments of Uzbekistan including Autonomous Republic of Karakalpakistan. Farmers have limited experience in water conservation practices and utilizing salt and more drought tolerant crops.

Technologies which are sustainable and effective using less/optimal inputs could help in saving seed, water, fertilizers, etc. in addition to land such as adoption of cotton-wheat rotation by planting winter wheat in standing cotton using minimum tillage equipment could spare land for growing other crops especially legumes such as chickpea, lentil, field pea for food or alfalfa for fodder.

The demand for food and fodder production will continue to grow not only in Uzbekistan but all Central Asia countries. Wheat, cotton, rice and livestock are the most important agricultural commodities in the region, and with a trend to diversification, forage crops such as sorghum, corn, sunflower, pearl millet, millet, sesame, sudan grass, sweet clover, alfalfa and winter field pea, can become important fodder in the region.

Economic returns

Although the findings, from the research on conservation agriculture (CA) for the irrigated areas, in Central Asia are encouraging, there are few reports on the economic aspects of the CA. This is particularly important since the economic profitability of CA practices varies over time and like any production system, can be site-specific, which necessitates site-specific analyses (Knowler *et al*., 2001). Furthermore, CA practices regularly require long-term investments (e.g., in direct seeders and planters), but it is unrealistic to expect that capital investments for increasing the efficiency of natural resources use will alone be sufficient for convincing farmers to switch from tillage-based agriculture to CA (Knowler *et al*., 2001).

Although no significant effects of reduced soil disturbance on cotton or wheat yields had been observed for instance in Uzbekistan, the initial yield loss that allegedly occur when introducing CA was also not observed, while savings in operational costs were achieved immediately (Egamberdiev, 2007; Tursunov, 2009). The values were highest under CA with crop residue retention, which amounted to UZS 1,288,000 (ca. USD 1,075) per ha accumulated over three years. While using the results of three consecutive growing seasons, a dominance analyses showed that CA had much higher potential than the conventional practices owing to higher total variable costs and lower gross margins (GM). Cumulative gross margin analysis showed higher GM in all CA practices tested as compared to conventional tillage. Dominance analysis further revealed the advantage of the CA practices over conventional tillage because of the lower total variable cost and higher GM (Tursunov, 2009). Thus, adopting CA practices on the irrigated soils of Central Asia can improve the sustainability in agricultural production, provide benefits to farmers and reduce the threat of food insecurity. The financial analyses from Devkota (2011a) over four seasons of a rice-winter wheat rotation subject to a change from flood-irrigated to water-saving irrigation methods, showed a reduction in overall production, GM and Benefit : Cost ratio, which were highest with conventional tillage combined with continuous flood irrigation and lowest with permanent bed and zero till plantings while retaining all crop residues. Devkota (2011a) concluded that as long as irrigation water cost was not charged to farmers, it is unlikely that a economically-driven change in attitude will occur.

Introduction of CA technologies has been shown to lower production cost, raise profitability of winter wheat production, and accordingly facilitate sustainable development of agriculture in different forms of agricultural entities in the South of Kazakhstan (Sydyk *et al*., 2009). It has been found that in South Kazakhstan direct planting of winter wheat provides cost reduction by 28-44%. According to Fileccia (2009) considering both the cost savings and the yield gains, the economic efficiency of wheat production with no-till technology resulted in an average improved net profit per ha of over 50% in Kazakhstan. Meanwhile, the application of mineral fertilizers at the rate of $P_{30}N_{50}$ and the treatment of crops by herbicides facilitate the growth of conventional net income by 85.2% and reduces the production cost (Sydyk *et al.*, 2009).

In calculating energy efficiency in cultivating wheat in rainfed areas, Sydyk *et al*. (2008) determined the cost of aggregate energy directly associated with fulfilment of field operations described in ‘technology maps’ based on energy equivalents. It was found that about 7-22% energy expense was for soil treatment and planting; 3-4% for application of mineral fertilizers; 4-5% for application of herbicides; 40-45% for harvesting and transportation of crop; and 34-36% for post-harvesting treatment of grain (Sydyk *et al*., 2008).

It was determined, that application of mineral fertilizers and herbicides, in South Kazakhstan province, did not require significant energy expenditure, but gave highest payback of energy resources, where energy efficiency ratios were 1.31 and 1.52 (Sydyk *et al.*, 2008).

It was revealed that under irrigated farming system of Southern Kazakhstan, raised-bed no-till direct planting of winter wheat is a promising technology of CA. Significant reduction in cost for production of grain can increase amount of conventional net income almost 1.4 times (Sydyk and Isabekov, 2009a).

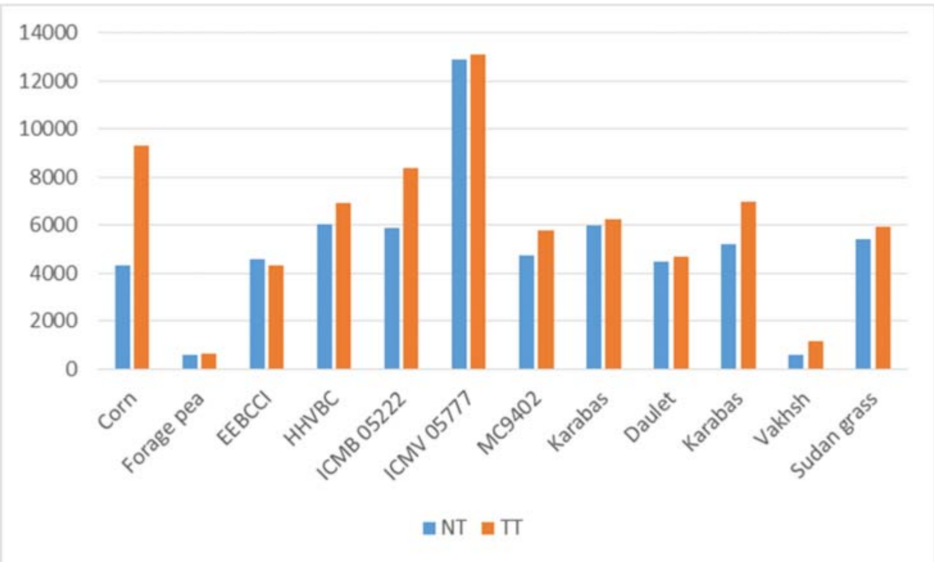
Comparing the Economic Components of Tillage Systems

When evaluating whether a particular tillage system will work for you, the expected costs associated with each set of practices must be considered. How well each system works will depend upon multiple factors and will result in different fixed and variable costs and gross returns.

Yield Variability

One of the most frequently asked questions about alternative tillage systems is what impact they have on yield. In areas with adequate and timely precipitation, and water supply, conventional tillage has been shown to have a fairly consistent yield advantage over no-till. In areas with a greater drought potential, no-till systems have been shown to have a yield advantage over conventional systems.

Our research results shows that that no-till had a slight yield decrease over conventional tillage (Figure 1). Although the average difference is small, the crop-to-crop variability appears to be quite different for each system. No-till, for example, showed a pattern of either having the highest or lowest yield in different crops. Conventional tillage showed a little less variability than no-till, but it also did not show as much potential for consistently high yields.



Field operations and input costs

Data from the cost benefit analysis indicates that the biggest differences in cost between tillage systems are those related to machinery operation and input cost. The cost benefit analysis of this research is done to compare economic returns of two tillage systems in different crops. In Table 1, the costs of various field operations are listed on a per hectare basis.

The cost benefit analysis of different forage crops under no-till and conventional tillage estimated in Karakalpakistan, Republic of Uzbekistan. The cost benefit analyses of technologies revealed that no-till practices have considerable advantage than conventional tillage in Karakalpakistan. The table 1 shows that the highest profit was recorded with no-till forage pea (1782 USD) while the negative net revenue was observed with forage pea under conventional tillage (-123 USD).

Table 3. Cost of tillage and planting operations ($/ha).

Cost items	No-till								TT							
	Corn	Forage pea	Mungbean	Pearl Millet(HH VBC)	Sesame	Sorghum K	Sorghum D	Sunflower	Corn	Forage pea	Mungbean	Pearl Millet(HH VBC)	Sesame	Sorghum K	Sorghum D	Sunflower
Yield kg/ha	2786	626	1156	1953	1187	2168	2414	1746	2989	646	1251	2068	1252	1920	2486	1773
Crop price per kg/usd	0.3	1.3	2.1	0.5	1.3	0.5	0.5	1.1	0.3	1	2	0.5	1.3	0.5	0.5	1.1
yield USD	836	814	2428	977	1543	1084	1207	1921	897	646	2502	1034	1628	960	1243	1950
Total variable costs	645.2	645.2	645.2	645.2	645.2	645.2	645.2	645.2	769.3	769.3	769.3	769.3	769.3	769.3	769.3	769.3
Profit	191	169	1782	331	898	439	562	1275	127	-123	1733	265	858	191	474	1181

Conclusions

The economic assessment of technologies was based both in quantitative and qualitative methods of analysis. No-till practices were found to be useful for increasing farmers' income and improving their livelihoods which is very important in drought and salt affected regions of Karakalpakistan. In legume-cereal based systems of Aral Sea region, no-till proved to be more profitable, resource and energy saving.

Forage, cereals, and legume crops have been continued to be the major crops grown by the private and public sectors. There is an opportunity to introduce sweet clover, forage pea, oats to the existing crop production system in the farms under no-till practices. Crop rotation is one of the principle of the conservation agriculture so in this case crop diversification can be introduced in the project sites across Karakalpakistan.

From this example, it is obvious that conventional tillage, according to these assumptions, costs much more than either reduced or no-till and also requires a lot more labor. Labor requirements for no-till are less than half those for the conventional tillage example. This labor advantage has benefits from both a timeliness and labor management standpoint. If limited time is available for field operations because of weather or other demands, no-till may allow for more optimal corn planting. Even when field conditions are favorable for tillage operations, no-till can save a significant amount of time that could be used more profitably.

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