Water Conservation Practices in the Syr Darya Basin of Central Asia: Water productivity impacts and alternatives

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Introduction

Increased shortage and intersectoral competition for water throughout the world places a high pressure on the irrigated agriculture,bringing a need to grow more food with less water.

It is believed that by 2025,70 percent of the world's population will live in areas with physical or economic water scarcity and nowhere is this more evident than in Central Asia, specifically in the Syr Darya River basin. The tremendous irrigation development of the 1960's and 1970's has led to decline of the environmental flows. The disappearance of the Aral Sea and the degradation of the surrounding natural ecosystems and irrigated lands can be listed as the direct results of unbalanced water resource management in the past. The 'more-crop-per-drop'approach which is meant to increase water productivity are seen as way out of the current water crisis in the region.Many farmers within the region have been adapting and developing practices to increase on-farm productivity of water. The purpose of this paper is to document these cases and understand whether they are sustainable.

The most successful strategies have emerged essentially through the endogenous incentives generated by the system itself rather than as a result of rewards.

Objectives and Scope

The research hypothesis of this paper is that water saving practices in the Syr Darya river basin are initiated mostly at the local level and driven essentially by users as a natural response to changing water conditions.

The major objective of this paper is to

(a) Identify and document the "best" practices,
(b) Evaluate their effects on yields,water supply and water productivity.
(c) Assess their sustainability,
(d) Suggest means of institutionalizing the best water management practices.

For this analysis,the paper adopts a methodology that involves a systematic comparison of the impact and sustainability of various successful approaches to the issue between two periods:

Study Area

The Syr Darya basin is one of the two major rivers of the Central Asia. It covers an area of 444,000 km, inhabited by about 18 million people. The Syr-Darya rises in the Tien Shan Mountains,running through the upstream Kyrgyzstan, flowing through Uzbekistan, Tajikistan and Kazakhstan and finally discharges into the Aral Sea.

Four ex-Soviet states have their shares in the territory of the Syr Darya basin: Kyrgyz Republic (35%), Uzbekistan (19%), Tajikistan (3%) and Kazakhstan (43%).

The dominant type of the land use in the basin is pasture, with 55% of the land used for this purpose, with land cultivation being next to it in importance, 8%of the land in the basin is used for this purpose.

Due to its arid climate, almost 90% of the cropland is irrigated.

Agriculture, consuming approximately 90% of the water, is the principal user in the basin, with Uzbekistan and Kazakhstan in the middle and low reaches of the basin, having largest shares in irrigated land, 54% and 26% correspondingly.

Irrigated agriculture and increasing its current productivity are the major challenges of water resources management in the Syr Darya river basin today.

Evaluation Approach and Methodology

The methodology adopted in this paper involves a systematic comparison of the impact and sustainability of various water conservation practices between two periods:

(i) The first period is marked by a prize system introduced by the World Bank to reward the adoption of best practices

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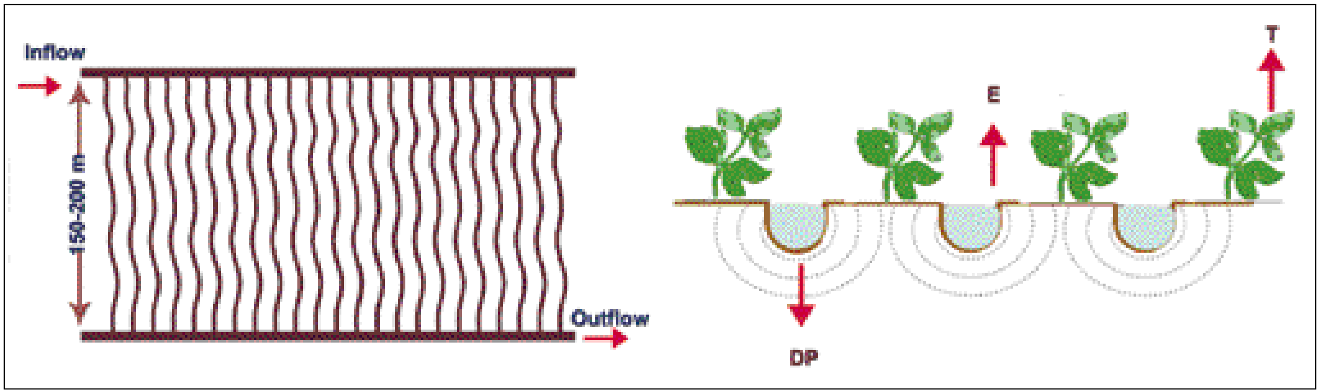

Figure One. Very long furrows (250-400 m) result in high deep percolation rates, non-uniform application, standing water and high evaporation at upper ends

(ii) The second period is marked by the absence of the prize system.

Best Practices and Their Impacts

Observed Set of "Best Practices" The term "best" practices is used in this paper to refer to the water management and agronomic methods which led to better agricultural and water use performance in the monitored fields and farms. The former can be classified into three groups based on outcome.

The first group of the practices improved the irrigation and drainage infrastructure.

The second group led to improvements in the use of water at field level and agricultural practices.

The third resulted in an improvement to organizational and fiscal structures.

The "best" practices were documented through monitoring conducted by field staff and direct field visits,surveys of the farm managers.

Description of "Best" Practices

This section provides detail on the best practices. It starts with typical water use practices, and then compares best practices. The text and diagrams depict water flow paths, and show how best practices influence these by comparing to the typical water use practice. Some practices are aimed at increasing uniformity, while others target reduction in deep percolation or surface runoff. These should help in determining where these practices can be applied. An estimate is given on how much land can be covered by the best practice.

Typical water use practices - Many Syr Darya farmers use water in amounts that far exceed crop water requirements resulting in low application efficiency.

The major defect of typical practices are non-uniformity of water distribution in the field; in some parts of the field high evaporation is observed while in other parts crops are under water deficit. As a result of non-uniform water distribution cotton yield reduction may be as high as 25-30% In the typical water use practices farmers are using very long furrows (250-400 meters), resulting in high deep percolation rates, non-uniform application, standing water and high evaporation in the upper ends, and often leads to high ground water levels, soil salinity and waterlogging.

Long furrows were popular in Soviet times because of the large scale mechanization on collective farms (See figure 1).

Shorter furrows - Short furrows are an old, traditional practice that was replaced by the long furrow method in Soviet times.

Furrow irrigation has been practiced regularly in the Syr Darya river basin since the 18 th and 19 th centuries as a major method on cotton irrigation, and is still used for cotton, wheat maize and vegetables.

For different soils there are different recommended lengths of the furrows. The length of the furrow and soil water permeability has an impact on discharge of water in the furrow, with shorter furrows having higher discharges, reducing irrigation time.In practice many farmers select furrow lengths instinctively.

Many experienced farmers prefer to have short furrows (from 50 to 100 meters) to better manage their irrigation system. (See figure 2).

Alternate Dry Furrows - (ADF). This is a furrow irrigation method for cotton, where each second furrow is not irrigated. In Central Asia two schemes of furrowing are practiced-0.60 and 0.90 meters. In ADF irrigated furrows are spaced 1.20 and 1.80 meters respectively. The major crop under ADF is cotton.

Non-irrigated furrows are frequently tilled and kept in a cultivable condition, making for easy air-moisture exchange for root zone. Fertilizers injected into the non-irrigated furrows will stay longer and will be more effectively used by roots, minimizing the leaching of fertilizers into ground water. The cotton in ADF is short with a very well developed root system (root depth may reach 1.5-1.9 meters from the soil surface).

Soil surface leveling - (SSL) - This method,applicable for all types of crops, mainly increases uniformity of water in the field. The undulated surface of the irrigated lands major reason of formation of waterlogged and dry spots in the field. In practice farmers tries to bring water to the dry spots and over irrigates the field.

SSL could be practiced over the entire basin. However, at present, only 10-15% of total irrigated areas of Syr Darya basin are practicing of SSL. The high application cost,

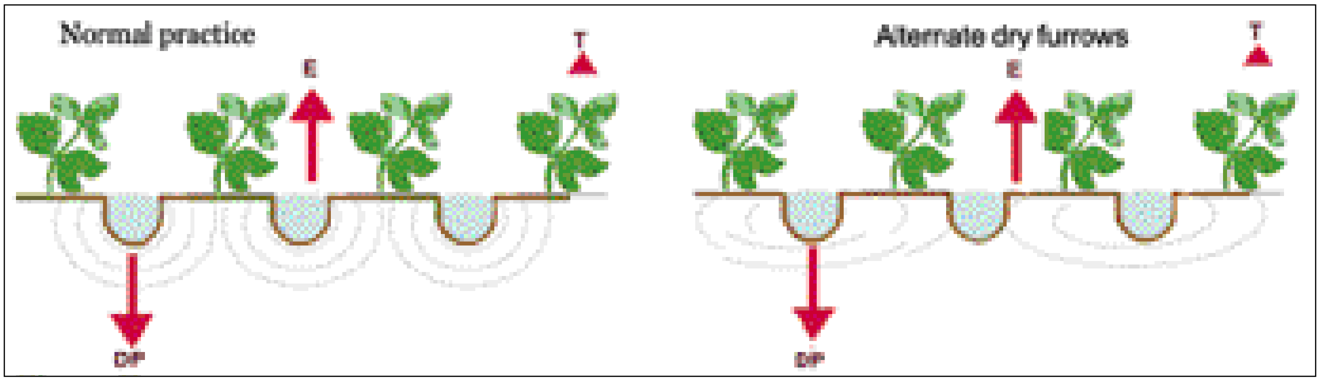

Figure Two. Alternate dry furrows reduce evaporation and overall deep percolation.
Note: T - transpiration; E - evaporation from soil surface; DP - deep percolation.

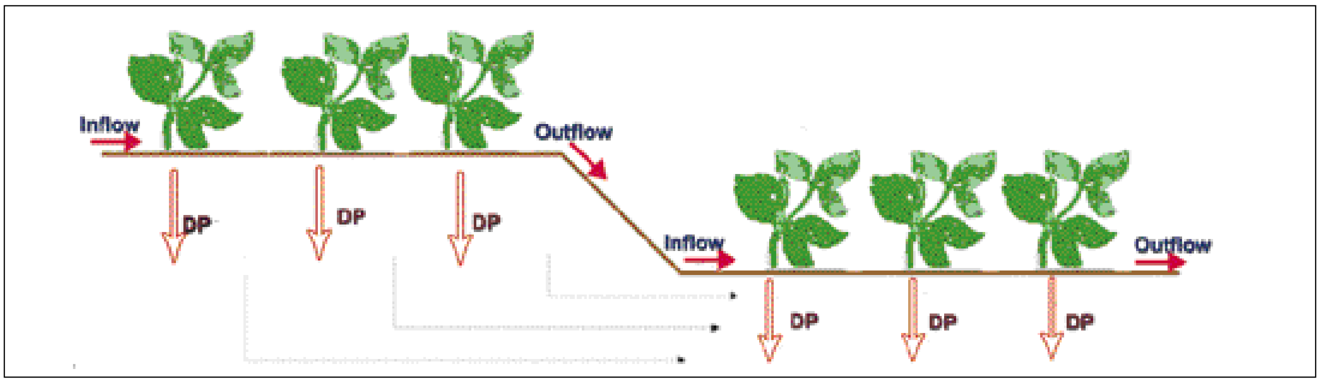

Figure Three. Water re-use in the irrigation system: Part of the deep percolation in the highland retums as groundwater to the lowland and is reused.
Note: T - transpiration; E - evaporation from soil surface; DP - deep percolation.

from $3.1/ha to $10.5/ha, making it a very strong limitation for replication.

Change of crop pattern (cultivation of drought-tolerant and higher cash crops).

For a long time, monoculture cotton was a feature of the Central Asian landscape. In the nineteen-eighties 55%to 70% of the total irrigated area was planted by cotton.

Other major crops were rice, wheat and vegetables that occupied the remaining areas.

After privatization and reforms in irrigated agriculture high water consumption crops such as cotton and rice declined.

Instead wheat, corn and alfalfa are taking their place, requiring considerably less water.

Improvement of water use discipline and assistance to farmers on water use planning

The restricted amounts of water are related with water use plans, developed and submitted by water users.

To composing these water consumption projections,with the majority of farmers in the region lacking the necessary skills to do so. In the areas running the project, farmers receive ongoing training to prevent overuse of water, due inefficient planning. (Figure 3).

Best Practices:Incentives and Economic Analysis

Two surveys were conducted among 120 farmers to determine the incentives fo water conservation during the second phase. The first was held in 2001, prior to project activity, and the second in 2002. The participants were chosen at random from the 1999-2002 subject lists.

The survey was conducted by trained field staff and questionnaires asked respondents to indicate their major incentive for applying water saving methods in their farm and/or field.

Economic Analysis of “Best’Practices

The economic aspects of water conservation methods could be the most important issue on dissemination and intensification in the future. The economic and input indicators of the pilot areas were recorded in order to analyze the profitability of the farming future. The pilot areas were grouped by country, due to different agricultural and economic policies.

The highest seed inputs per hectare were registered in Tajikistan and the lowest, in Kazakhstan. The highest fertilizer inputs were in Uzbekistan with the lowest in Kazakhstan, again.

The heaviest manual workforce was applied in Uzbekistan and Tajikistan, the lowest, in Kyrgyzstan.

Mechanical application was almost equal in all the pilots.

Conclusions

The results clearly demonstrate that farmers in the project areas have developed exemplary practices, which could provide models for water use throughout the basin and in other the arid zones. There were a number of practices found and documented at the pilot areas that resulted in higher values of water productivity.

The research hypothesis may thus be considered validated, because in spite of the declining trend, the average crop yields were physically higher in the non-prize period.

However,the applications of the "best" practices were not led to tremendous economic growth of the pilot farms. Rather farmers with limited inputs have been using "best"practices in order to compensate absence or limited availability of the other non-water inputs. This approach is very important for improving land and water productivity in the developing countries.

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