IRRIGATION MANAGEMENT IN CENTRAL ASIAN REPUBLICS

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Abstract:
The demise of the former Soviet Union (FSU) led to disintegration of watersheds resulting in water disputes particularly between water-surplus and water-deficit sub-regions, followed by arbitrations, treaties and some water-sharing agreements. Higher water mismanagement mainly by semi-desert steppy lower riparians, their fast growing water needs for dense population and huge thirsty irrigable land and the 'locational benefits', they claim for hydrocarbon resources, on one side, and the mountainous republics becoming conscious about the water resources – all is heading towards a complicated situation. Moreover, the three water-deficit republics have recorded the lowest irrigation efficiencies, much below the world average. Such unhealthy trends are mostly responsible for creating an environmental catastrophe in Greater Central Asia in which Aral Sea presents the worst scene. This dynamics has made irrigation management crucial and detrimental for the sustained crop production. In order to minimize the water loss from source to field, a critical issue in irrigation management, the respective governments, some international organizations, and NGOs have started to improve irrigation efficiency through the application of irrigation technology and the related measures. These initiatives have been successfully rewarded. However, the states being highly interdependent and single planning unit, their sustenance and development jointly lies in managing the resources, significantly water, which requires high degree of regional cooperation.

Keywords:
Irrigation Efficiency, Irrigation and Drainage, Operation and Maintenance, Irrigation Management Transfer, Irrigation Subsystems, Riparian Rights, Locational Benefit, Participatory Irrigation Management, Water Sharing Agreements, Upstream-downstream Dynamics, Anaeorobiosis, Regional Cooperation, Threshold Limit, Food Security.

Introduction:

Irrigation plays a crucial role in agricultural development of Central Asian republics (CARs), where 91% of net cropped area is irrigated which provide almost 97% of the regional crop production. Irrigated agriculture is critical to livelihood of majority of regional population and its absence significantly affects rural population. Irrigated water is, therefore, an asset and its availability or non-availability increases or reduces purchasing power and house-hold capacity to produce income in combination with other assets. Being a guarantee for food security, contributing almost 45% to the regional GDP, every non-farming livelihood activity of rural poor needs water. Prior to FSU break-up, the water sector used to be subsidized in Central Asia but after independence of the republics, water became unaffordable[1] and access to irrigation got

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limited which deteriorated the basic infrastructure resulting in agricultural yield drops, ultimately affecting per capita income of farmers. The degradation of Irrigation and Drainage (I&D) systems in combination with the downturn in various aspects of agriculture, led to worsening irrigation efficiency. As the intensity of farmers responding to degradation of I&D systems increased by de-emphasizing crop production in favour of livestock breeding or seeking non-agricultural employment, the respective governments decided to introduce institutional reforms in the water sector and transfer the responsibility for Operation and Maintenance (O&M) of irrigation systems to water users. A key element of Irrigation Management Transfer (IMT) became the creation of Water Users Association. A periodical evaluation of such initiatives, particularly during the later transitional period suggests that considering water as economic, political and physical capital, the management initiatives should be pro-poor and eco-friendly. Moreover, in order to counter growing threat of environmental catastrophe and its adverse impacts on the regional bio-diversity, some fast-track steps have to be taken in all the five states, albeit, with varying nature and intensity.

Irrigation Systems:

For improving irrigation efficiency, a panacea for regional development, all the sub-systems of irrigation should function properly and in a balanced manner. These sub-systems include water delivery, on-farm distribution and drainage.[2] The spatio-temporal analysis of these sub-systems reveals that the wrong agro-based policies during FSU regime followed by break-down of irrigation infrastructure after independence of CARs have disturbed the coordination of the sub-systems. However, due to some effective management initiatives through the integrated and Participatory Irrigation Management (PIM) efforts, the positive signs have been marked especially during the later phase of transition.

Water Delivery Sub-System:

This sub-system encompasses the source, conveyance, allocation and distribution of irrigation water as far as the users' turnout (farmgate). Most of the regional water, about 73%, originates from Pamir-Tienshan mountain complex, in Tajikistan and Kyrgyzstan respectively in the form of two major rivers i.e. Amu Darya (Oxus) and Syr Darya (Jaxarats)

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1 N. Nizamedinkhodjayeva Nargiza, *Rurual Livelihood and Irrigation Management Transfer: Case Study of Three Countries in the Fergana Valley of Central Asia*, International Water Management Institute, SIWI, Tashkent, Uzbekistan, 2005, p.1.

2 C. Barrow, *Water Resources and Agricultural Development in Tropics*, Longman Development Studies, UK, 1987, p.204.

which are considered the life lines of the region as it is also shared by the three down-stream states; Uzbekistan, Kazakhstan and Turkmenistan. [3] This water endowment which was considered a common resource of all republics during FSU became an international issue as a result of disintegration of watersheds. This led to recurring water-sharing disputes among the competitors particularly between the water-surplus and water-deficit areas. The 'locational benefit' doctrine further aggravated the crisis and the situation worsened in the area by growing disputes over sharing of transborder rivers. Arbitrations, water diplomacy, legal actions, and other water security issues forced these states to ink some water-sharing agreements, enabling the water-poor but energy-rich states to get required water deliveries in exchange of subsidized hydro-carbon resources through other payment modes. Non-compliance of some agreements, affected the credibility of the said agreements, leading to an unstable future for sustained irrigation particularly in water-deficit steppes.[4] In addition some unhealthy water resource predictions owing mainly to climatic change, induced experts to argue that water although being a physiological requirement of life, can no longer be an inexhaustible natural resource. Since for a sustained irrigation the sub-system 'sources of water' has to be assured and sustainable at any cost, the uncertain and seasonal source will lead to agricultural crises and regional disaster. The only way out to overcome this problem is to strengthen regional cooperation among these states, treat CARs as single planning unit, and manage water resources on the basis of watershed/river basin, which is an ideal planning unit for preserving, conserving and properly managing the water courses of the region.

So for the conveyance of water from source to turnout (farmgate) is concerned, it takes place by main canals, pipelines or aqueduct followed by distributaries (secondary channels, laterals, tertiary channels or pipes) to the turnout. Substantial irrigation water from source to fields is also drawn by underground water channels called *karez (quantas)*, *kuhla* and *nallah.* Water supplies suffer losses through seepage, spillage, overflow, evapo-transpiration, theft, etc. It has been estimated that the overall picture of CARs with respect to conveyance losses is alarming as more than 48% of the water withdrawals are lost during conveyance stage. Only 25-30% of the regional water diverted for irrigation takes the

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[3] G.M. Mir, *Resource Management, Regional Cooperation and Sustainable Development in Central Asian States*, Prince Art Printers, New Delhi, 2003, pp. 23-24.

[4] The growing need of water, competing for water courses on the analogy of locational benefit, highly un-even regional resource endowment, and a host of other factors, are great threat to the validity of these water-sharing pacts.

form of return flow as ground water.[5] However, the return flows are reported to be somewhat higher in Farghana valley. The remaining water lost through seepage and percolation returns to the irrigation system or feeds low lying irrigated fields. This picture of return flow continues even today causing water logging, anaerobiosis, salinity and other unwarranted environmental degrading forces which have spoiled the regional bio-diversity. The water spoilage is a double-edged sword, on one side, it reduces the water quantity diverted for farm and non-farm utilities, while on the other it spoils the soil, contaminate underground water and has played significant role in Aral Sea environmental catastrophe – a great threat to bio-diversity and future progress of the region.

The most obvious way of reducing conveyance losses from canal supply system, the dominant water carrier in the region, is to route canals to take advantage of topography and line any leak by plastic films. For water conveyance to far flung areas, plastic pipes can be used which are cheap and do not allow evapo-transpiration. Moreover, the system of underground water channels and horizontal wells *(karez)* and other sub-ground techniques which draw substantial water to the fields without any loss through evapo-transpiration, etc should have a denser network. The desiltation process and a continuous vigil and maintenance of all water carriers need to be on the top of management agenda. This is a stage of irrigation management shared both by the conveyance sub-stage and on-form water utility. The distribution stage has remained almost every time the basis of water disputes and soil pollution. In the related incidents recorded so far, CARs have taken a lead with a receding trend as result of some fruitful water-sharing agreements signed during the last decade.

The Farm Subsystem:

This sub-system consists of a network of tertiary channels, or more often, unlined ditches which distribute water from the turnout or where the farmers have access to water, to the point where it is actually applied to the crops. On-farm water losses are also high in CARs. However, the data pertaining to farm conduit efficiency[6] of the republics is neither complete nor with any standardized reliability. However, losses have been higher during this stage as against the world average. A spatio-temporal analysis of magnitude of wastage reduction during this stage in

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5 V.L. Shul'ts and Reki Sredney Azi, *Geografgiz*, Moskova, 1949, pp. 21-22.

6 Farm Conduit Efficiency is the ratio of the amount of water applied to the crop to the amount of water delivered at the turnout.

CARs reveals that the field irrigation efficiency[7] is higher in upper riparian countries as compared to the lower by virtue of climatic, topographic and edaphic variation. Similar factors are responsible for lower field application efficiency[8] in case of three downstream states. In recent years there has been considerable interest in deficit irrigation[9] in the region. This involves decreasing the amount of water or increases the interval between applications – in effect subjecting the crop to planned moisture stress in the hope that it will save water without reducing yields too much. Some crops like cotton may actually improve in quality if subjected to such treatment. The technique has been tested even on flooded rice and some varieties have responded well particularly in comparatively cool and moist belts. The on-farm water management which is crucial to sustained productivity and favourable environmental quality involves both irrigation as well as drainage.

Water Removal Subsystem:

Drainage is one of the most critical aspects of irrigation. Sustained cropping often depends almost as much on getting rid of excess water as on getting enough to irrigate with. This subsystem pertains to installation of drainage systems to control ground water level and / or to guide surface run off to where it can be safely disposed off when return flows are badly contaminated with salts and other agro-chemicals. Within irrigation and drainage, the later indicator is even worse in CARs due to lack of maintenance. Most of the horizontal as well as vertical drains are blocked, choked with weeds, silted with no standard quality repairs. Some drains have failed due to institutional as well as technological faults. Some being uncommissioned, others incorrectly built, scores left unfinished and some having no proper outlets.[10] This breakdown of I&D systems, particularly drainage failures, have led to salinization and water logging considered to be the most dangerous elements threatening regional agricultural sector. The alarming situation where the benefits of irrigation were being balanced by the losses rendered by poor drainage system, however, shows some positive signs of improvement in some areas of CARs through the application of some technological devices.

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7 Field Irrigation Efficiency is the ratio of volume of water actually consumed by the crops to the volume of water applied to the field.

8 Field Application Efficiency is the ratio of the average depth of water reaching and remaining in the root zone to the average depth of water applied to the field.

9 Deficit Irrigation is the ratio of irrigation water reduction to the amount of soil/root moisture retention required for crop growth.

10 M. Thurman, "Irrigation and Poverty in Central Asia: A Field Assessment", Report submitted to the World Bank for its publication in *Irrigation in Central Asia: Where to Rehabilitate and Why*, Washington DC, 2001, pp. 14-15.

The region requires two types of drainage sub-system. Draining soils require some sort of artificial drainage to cope with excess irrigation water and intense downpours. Whereas water logged areas need sub-surface field drains. Both types of drains require a constant vigil. The last stage of drainage requires careful attention when pesticides, herbicides, excess fertilizers and other agro-chemicals are drained to streams and other water bodies. This drainage component needs urgent attention on the part of management for its redressal before it adds to the already existing threshold limit in some affected areas of the region.

Irrigation Efficiency:

A positive correlation exists between the results of irrigation management efficiency. Higher irrigation efficiency leads judicious water-use in farming which ultimately affects the crop production, yield level and water productivity.[11] Whereas, water-use intensity and irrigation efficiency are negatively correlated, the magnitude of such relationship within CARs is evident from the table

Irrigation Efficiency, Water-use Intensity and Crop Production in CARs

Country	Indexed Matrix		
	Irrigation Efficiency	Water Use Intensity	Crop Production
Uzbekistan	0.2	0.08	1.49
Turkmenistan	0.3	0.06	1.47
Kazakhstan	0.4	0.05	1.58
Tajikistan	0.6	0.03	1.56
Kyrgyzstan	0.7	0.02	1.62

Source: Computed on the basis of data provided by various international agencies

An insight into the table reveals that the two mountainous states have lower water-use intensity and higher water-use efficiency[12] corresponding to higher water productivity. On the contrary, all the three lower riparian republics have registered lower irrigation efficiencies as a result of higher per unit farm water consumption and have lower indices of water productivity. Apart from this, due to the timely release of the required water quantities to downstream states the upper riparian suffer

[11] Water productivity is the ratio of crop yield to quantity of water used.

[12] Water-use efficiency is the ratio of volume of water used for crop production to the volume of water diverted from or stored at source.

huge losses through floods, deforestation, etc as a result of big dams and canals which often destroy their basic infrastructure. Moreover, they cannot irrigate their irrigable land, divert water and are unable to generate hydroelectricity, for which they have much potentials, owing to some water sharing agreements with co-riparian. This is an eye-opener for all the stakeholders, particularly the three downstream republics who are to shoulder the responsibility of developing, preserving, conserving and rationally managing the regional water resources. It has been predicted that if the existing levels of irrigation efficiencies are improved upto a reasonable level, all the irrigable area of the region will get irrigated, the production will be multiplied and the yield level will also increase substantially. Moreover, the improved irrigation efficiency will go a long way in averting the Aral Sea environmental catastrophe as well as will solve some of the major regional problems. Some of the international agencies[13] are doing commendable job in improving the management in water sector for sustained food, livelihood and nature but the water productivity will not improve without effective people-centered integrated irrigation management approach.

[13] The major ones include World Bank, IMF, UN, IWMI, SIWI, Water International etc.