Sustainable Irrigation Management in Southeastern Anatolia Region of Turkey

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ABSTRACT

In successful irrigation management, firstly the water resource should be developed accordingly, and secondly, the irrigation water should be delivered from the source to irrigation fields. In addition, strategies should be developed to guide producers in irrigation areas, to adopt proper irrigation practices, to optimize the cropping pattern according to the water potential, and to make the production plans that guarantee the income of farmers. The main objective of this study is to investigate issues of the sustainable irrigation management in Southeastern Anatolia Region (SAR) of Turkey. Therefore, some problems and causes/constraints have been investigated and related solution suggestions have been given.

Keywords: Sustainable irrigation, Southeastern Anatolia Region, Turkey.

1. INTRODUCTION

About three-quarters of the world's population lives in developing countries. It has been estimated that this population will reach 8 billion in 2025 and approximately 10 billion in 2050 and that 90% of this population growth will take place in developing countries.

Water resources and the various services they provide support poverty reduction, economic growth, and environmental sustainability in a country. From food and energy security to human and environmental health, water contributes to the livelihoods of billions of people by improving social welfare and inclusive growth. Development and economic growth can be tangible pressure on natural resources and make water security an important issue for people and nature. There have been great uncertainties on water requirements to meet the demand for food, energy, and other human consumption and to protect ecosystems. These uncertainties increase with the effect of climate change.

By the year 2050, agricultural activities are obliged to produce 60% more food globally and 100% more in developing countries. Since the increase in global agricultural water demands has been unsustainable, it is expected that water losses in irrigation schemes will be reduced and agricultural yield per unit area will be increased by increasing water use efficiency. Irrigation induced pollution due to increasingly intensive agricultural practices can be reduced through a combination of tools, including strict regulations, good agricultural practices, and well-targeted incentives.

2. SUSTAINABLE WATER MANAGEMENT

Insufficient agricultural development and low productivity in irrigated agriculture are fundamental economic problems in SAR areas. It makes no difference if the farmers are by the man-made water reservoirs or far from them. As mentioned before, the agricultural progress of the region has been behind the agriculture of Turkey, which already has a limited level of development. The Southeastern Anatolia Region, which lays 12% of Turkey's total agricultural lands and 18% of the active population dealing with agriculture, can only contribute to 8.7% of Turkey's total agricultural production value.

In addition, irrigation has important functions such as the application of new agricultural techniques, the cultivation of more than one crop in the same year in regions where the climate is suitable, the creation of new employment, and national security. With the construction of Atatürk Dam and other irrigation projects in the SAP Region, new areas have been opened for irrigation recently. The start of growing high value-added plants such as cotton, the increase in irrigation opportunities in wheat, which is one of the basic agricultural products in the SAP area, the start of growing vegetables and fruits that did not use to be grown in the region in the past, and the rapid increase in yield and production provided an increase in the income of the farmers living in the region. A total of 1.8 million hectares of land in the SAP region will be opened for irrigation in the coming years. This is a good indication of how important irrigation and irrigation investments are. It has been estimated that the revenue growth achieved so far, thanks to
energy and irrigation in the SAP region, has contributed over $5 billion to the national economy.

Given that the need for irrigation water requirements will increase with the impact of global warming due to climate change, as such the effective use of water will be extremely important in the SAP area in the future. Hence, it should be considered that the lands that have not been under irrigation yet will be irrigated in the future and a possible drought might be observed over the country. Given these likely circumstances, it becomes clear that the existing water resources in the SAP area should be utilized efficiently and effectively.

Surface irrigation methods are still used intensively in Turkey, including the Southeastern Anatolia Project (SAP) region. In practice, observation showed clearly that excessive surface runoff and deep infiltration have been dominant in irrigated agriculture due to excessive use of irrigation water as well as poor irrigation management without taking required precautions by the irrigation methods adopted. In addition, in some surface irrigation networks, main irrigation channels have been filled with fertile topsoil of the lands as a result of excessive and incorrect irrigation practices. Channels filled with erosion have been cleaned over and over again with great effort. Therefore, besides the excess water usage in irrigation networks, the soil loss by irrigation and its side effects are of great importance, and this causes immense economic losses on the financial resources of related institutions.

As is known, irrigation is a complex practice with technical (engineering), economic (financing), and social aspects. Even if the technical and financial situation is provided and implemented in some way, irrigation practices involve different aspects such as irrigation management, education level of farmers, awareness in the use of soil and water resources, the socio-cultural structure of the region. All these conditions directly affect the effective management of the system and the effective and efficient use of water. Additionally, those structural and institutional inadequacies are available, and some sanctions are either insufficient or not adequately applied results in excessive use of irrigation water. This process can lead to the loss of lands in a short time due to erosion, salinity, drainage problems, desertification, etc.

Surface irrigation (wild irrigation) methods are among the most commonly used irrigation methods all over the world and in Turkey, too. Today, this method is used in 95% of irrigated lands over the world. In Turkey, surface irrigation is used in 94% of the areas opened for irrigation, and pressurized irrigation methods are used in only 6%.

Today, the amount of irrigated land in the GAP region is 1.8 million ha. To date, approximately 230,000 ha of land has been opened for irrigation by DSI. Soil salinity has surprisingly developed in approximately half of these areas where drainage has not been established. Even if the Euphrates River water quality is well enough, it is expected to accumulate 1.1 tons of salt on a land of one hectare every year. In Turkey, the amount of salty, sodium, and boron land has reached 1.6 million hectares.

If surface irrigation methods are adopted, then 2 m³ of water should be diverted to the network to meet 1 m³ of water required by the crop. Due to the overuse of water in surface irrigation methods, the applied water leaks much lower than the root depth of the plant and causes the soil to become infertile by removing plant nutrients from the root zone.

Considering the drought impact of global warming and the depletion of our water resources, it is clear that pressurized irrigation methods for saving water should be extended over the country. The irrigation sector in Turkey has to reduce the level of water usage in agriculture to the level of developed countries.

2.1. Effective Use of Water in Agricultural Irrigation

The factors that should be considered to use irrigation water more effectively in agriculture are given below:

➢ In all areas where climate, soil, and topography conditions are suitable, one of the sprinkler and drip irrigation methods should be chosen. However, if there is a salinity originating from the soil’s parent material, the sprinkler method should be preferred. However, if there is salinity in the irrigation water, then the drip irrigation method will be a remedy.

➢ It has become a necessity to expand the limited use of water and to ensure the expansion of irrigation areas. It is necessary to irrigate during the periods when the plant requires more water. Other than that, limited irrigation should be done, irrigation should be stopped completely, and larger areas should be irrigated with the saved water. It is inevitable to experience a decrease in yield in the area where irrigation is limited, but the use of the saved water in arid areas will increase the total production and income more.

➢ In agriculture, methods should be used to conserve soil moisture. The use of continuous commercial fertilizers in agricultural production disrupts the soil structure and reduces the water holding capacity of the soil. Green fertilization and the use of animal manure may help to increase the water-holding capacity of the soil. Since tillage causes moisture loss, the no-tillage technique should be preferred by using a direct sowing machine.

➢ Drought and salinity resistant varieties should be developed. The seed industry in our country generally operates to market imported hybrid seeds domestically. These seeds can be productive if the water is available in the growing medium. Public-led development of our drought-resistant varieties is a must.

➢ The Agricultural Insurance Act should be expanded to include drought, flood, and frost disasters, and the insurance premiums of poor farmers should be covered by the state.

➢ In order to adequately meet the water needs of the increasing population, water basins should not be occupied by residential and industrial facilities; water resources should not be polluted; pastures and forests that serve as clean water sources; and natural dams should be increased rather than reduced.

➢ In order to guarantee sustainable water management in agriculture, on-farm development works such as land leveling, land consolidation, and drainage should be coupled with irrigation systems. It should not be
ignored that the success of irrigation projects depends on the regulation of soil-water-human relations in the physical infrastructure project area.

- In order to overcome excessive irrigation, the approach based on the amount of water, rather than plant-area should be adopted as soon as possible in determining water fees. Necessary measures should be taken to prevent irrigation through drainage channels.
- Priority should be given to the restructuring and training activities of the farmers. This will help the authorities to ensure the economic sustainability of farmers’ organizations and ensure a strong financial structure in order to improve performance in irrigation networks and ensure effective water use.

2.2. Solution Suggestions

Since irrigation systems are intended to take water from the source and bring it to the irrigation area and from there to the plant root zone, it is desirable to provide three basic tasks in planning and operation of the system:

1) Providing the highest income to the farmer;
2) Conveyance and application of irrigation water with minimum loss;
3) The long-term productivity of the agricultural area should be maintained by preventing land degradation, soil salinity development and drainage problems in the area.

In case of insufficient irrigation water, irrigation water management is required by taking into account the principle of social justice based on farmers by making limited irrigation if necessary. Thus, undesirable situations, such as some farmers doing full irrigation and some not doing it, are avoided. The ways to do this are to avoid excessive irrigation by using irrigation water sparingly, to reuse the water returned from irrigation, and most importantly, the selection and use of technical and economical irrigation methods that include new technologies that will create an alternative to traditional irrigation in the region will be extremely important. In Turkey, the Ministry of Agriculture and Forestry has been providing grant support to the farmers who adopted pressurized irrigation systems since 2007. This must be continued in a sustainable way.

In addition, necessary measures should be taken by the state in order to comply with the targeted (planned) cropping pattern in case of lack of irrigation water in the catchment. This goal can be achieved by activating incentives on some specific crops, marketing, and price policy. As a result, more water demand or requirement than planned can be reduced by at least complying with the projected cropping pattern at the project level. Surface irrigation methods are still widely used in Turkey. In this context, the biggest problem is the excessive use of irrigation water. For example, in surface irrigation, irrigation water over 10 000 m³ per unit of hectare can be used during an irrigation period.

Basic solution recommendations regarding irrigation problems mentioned in the previous sections can be summarized under two main headings: a) technical, and b) institutional.

2.3. Technical Solutions

- Irrigation by providing the technical conditions required by the irrigation method: Avoiding surface irrigation on sloped land, not watering down slopes, leveling the land, choosing, and applying the appropriate furrow and border dimensions, etc.
- Irrigation by providing the technical conditions required by the irrigation method: Avoiding surface irrigation on sloping terrain, not watering down slopes, land leveling the land, choosing, and applying suitable furrow and border dimensions, etc.
- Application of modern irrigation techniques: Using drip, sprinkler, and other mobile irrigation systems.
- Deficit irrigation applications: In case of water shortage, which may occur naturally or due to climate change, one of the alternative applications of agricultural irrigation is to either not irrigate at all or to apply less irrigation water in some periods of the plant.
- Sprinkler irrigation, especially in hot areas, should be practiced during cool hours of the day or at night.
- Use of irrigation or drainage water.
- Use of wastewater in irrigation of crops.

2.4. Institutional Solutions

Charging Irrigation Water on a Volume Basis: As it is known, a water fee collection policy has been based on area and crop type in Turkey. Instead, if the irrigation water used in agriculture is charged on the basis of volume or at least the number of irrigations, then excessive and unnecessary water usage will be averted in practice. Ad hoc, the authorized and relevant organizations in the region (such as the Provincial Directorate of Agriculture and Forestry, DSI, and Water User Associations, i.e., WUAs) should take the necessary initiatives to establish the legal and technical infrastructure for this. It still seems difficult to implement this in surface irrigation networks both physically and administratively. However, when other countries are considered, effective water management and water savings are achieved since water is supplied to water users on the basis of volume in surface irrigation networks. It will be difficult to measure it in practice in the farmer’s field in the irrigation network in Turkey. However, the water diverted from the source can be measured at least until the water gauging facilities have been completed at the catchment level. Water user associations may use this type of measurement in advance for pricing water by volume. If pricing is made according to the total flow (hence the amount) of water supplied, irrigation unions will inevitably tighten their inspections and take new measures. For the solution described and proposed above, it is considered applicable by the joint legal decision of the relevant institutions (DSI), decision-makers and political authority. Immediate implementation of this is thought to be effective in preventing excessive irrigation, erosion, and soil salinity, as described in the previous chapters, and seen in the real pictures in the previous chapters.

2.5. Applying Water-Saving Irrigation Methods

Today, the importance of the use of micro-irrigation techniques, especially drip irrigation, which saves water, is increasing day by day. The installation and use of pressurized irrigation systems should be directly or indirectly supported. This practice was put into practice in Turkey at the end of 2007, and farmers who will establish
and operate a pressurized irrigation system are directly supported. In order for this application and the important support given by the state to be used effectively and appropriately, it should be monitored very effectively both during the project phase and whether the implementation is done. In addition, the transformation and/or rehabilitation of at least on-farm irrigation networks of existing large irrigation projects into pressurized irrigation applications should be provided. Now, the state has started to establish pressurized irrigation projects in new irrigation projects. In order for the planned new irrigation projects to develop in this direction, demands should be increased by farmers, farmer associations and Agricultural Organizations.

2.6. Increasing the Efficiency of Water User Associations

After the irrigation water is diverted from the main source, the distribution and use of the water in the field is done by Water User Associations (WUAs) and the irrigators, respectively. Currently, WUAs are managed and supervised by the principle of a participatory approach, i.e., partial elections and democratic rules, within the framework of existing laws and regulations. However, there are significant inconveniences in practice. Since the subject is the use of land and water resources, administrative and supervisory disruptions or inappropriate practices can cause irreversible damage. Effective supervision should be provided by the relevant institutions in both the administrative and supervisory stages of the existing WUAs. For this purpose, Law No. 6172 on WUAs, which is more effective and has economical sanctions on the farmers than before, was enacted in September 2012.

3. Conclusion

If the applied irrigation water cannot be measured, it is not possible to mention the effective use of water in irrigation and irrigation management. In Turkey, irrigation water diverted directly to the farm fields or given to the farmers is not measured in terms of quantity or volume, and the water service fee is determined based on the type of plant grown and the area. Some irrigation unions, i.e., WUAs, still have difficulties in collecting service fees for the operating and maintenance costs of the network. This indicates that farmers often apply the desired amount of irrigation water to their lands. In this regard, technical staff or institutions of DSI, WUAs, and Provincial Directorates of Agriculture and Forestry do not have any enforcement power. The given training to practitioners and farmers also remains only as advice.

Since the use of surface irrigation systems is still widespread in Turkey, although there are water measurement structures in irrigation networks, it cannot be said that they are used effectively. In this regard, the problem is primarily structural (institutional). Because there is no legal sanction for giving irrigation water to farmers on the basis of volume. There may be some problems in applying irrigation water to farmers on a volume basis in the scheme. However, the Water Supply Institution (DSI) may directly deliver irrigation water diverted from the source to the WUAs with an acceptable error margin. This situation may force the farmers and, most importantly, the WUAs to take precautions to utilize the water efficiently and economically in irrigation. In that case, concretely, DSI will set a fee based on the amount of irrigation water diverted from the source, and the farmers and WUAs will take this as a coercive measure on their members (farmers).

In addition, penal sanctions should be imposed on the farmers who do not irrigate properly, cause erosion, apply overirrigation, and irrigate downslope. This type of legal practice will help the technical staff of water authorities to exercise their authority on water management. As a result of the GAP Agricultural Education and Extension Project (GAP TEYAP), which is still implemented in SAR region, it can be a driving force in solving the above-mentioned problems. In this regard, it should be presented to the decision-makers and the political authority as a report with technical details, and accordingly, the legal basis for the measurement of irrigation water and other measures should be established as soon as possible.

Laws, legislations, and regulations related to the development of soil and water resources do not comply with today's conditions. For the effective use of soil resources, legal arrangements should be made to prevent non-agricultural use of agricultural lands, pollution and loss of soil and water resources. Therefore, the "Water Law", which considers water resources as a natural resource and aims to integrate all relevant sectors, should be enacted as soon as possible. In the "Water Law," the limits of authority of state institutions related to water should be determined; the authorities and responsibilities of the relevant institutions should be clarified, and the disorder in the legislation should be eliminated. All legal gaps, such as the allocation and protection of surface waters and the planning of sectoral and intersectoral use, should be filled, and the Groundwater Law No. 167 should be updated to meet today's needs.

References


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