SYSTEM OF USING DRAINAGE WATER FOR AGRICULTURE IN KASHAN

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Abstract:

Growing world population is leading human to excessive use of natural resources in the arid zones. Major problem is preparation fresh water and productive land for agriculture to supply food of this ever-increasing population. This point is caused that poor-quality water is used for irrigation and lands where have not productive soil is used for agriculture. Iran where is in the desert zones of the world, contact with this problem seriously in Kashan around of Salina. This subject has been solved by especial method. Salina of Kashan is very low and it is a natural drain of region and it is one of the salt sources in Iran. But, around of this Salina you can see irrigated fields of wheat and alfalfa. Agriculture is current for more than 50 years. In this region, poor-quality water is used to irrigation with help of semi deep wells. People, who live there, use natural specification of soil for preparation water that plants need it. Beside of these fields, the pools are planed. They are as a drain and water surplus to plants requirement is entered in pools. In addition to these, pools have other roles. Cumulative water in pools feed on the wells of region. It is used for leaching in order to defend salt from rhizosphere by pumping and this trend continues sequentially with attention to land degradation and water pollution. Use of salty water for agriculture is necessary and we need to develop the same schemes in future.

Keywords: Salina, drainage water, Rigboland, agriculture

Introduction:

At the Junction of the 20^{th} and 21^{st} centuries relation between people and nature has become more complicated. Reached an enormous scale and turned into a real threat to the intactness of the whole ecological system.

Today environmental issues are involved in various forms and to different degree in all most critical aspects of present-day reality.

A complicated and multifaceted plan for the optimization of the natural environment is essential for desert territories as they do more than 30% of the land area on the Earth. The natural environment of the desert is highly vulnerable and fragile and that is why any unwise action by the human species in resources development leads to a disturbance of equilibrium in nature and accelerates desertification.

It is known that desert territories possess rich natural and labor resources, so their rational, stage-by-stage development should be considered a major strategic reserve for the development of the society. But instead in arid area mass suffering due to starvation end disease can be observed along with clashes of the most critical kind in economic, social and ecological matters. In these conditions, any scientific, practical and pecuniary aid to people who find themselves in an intensive, desertification area is the human duty of the world community.

In the arid zones the major problem is preparation fresh water and productive land for agriculture to supply food of this ever-increasing population. It is caused that salty water is used to irrigation, but if salts become excessive losses in yield will result. To prevent yield loss, salts in the soil must be controlled at a concentration below that which might affect yield. The concentration of salts in the soil varied with leaching fraction and depth in the root zone and resulted in an increase in concentration as the leaching fraction decrease or with increasing depth in the root zone. As the soil dries, the plant is also exposed to a continually changing water availability in each portion of the rooting depth since the soil water and soil water salinity both changing as the plant uses water between irrigations. The plant absorbs water but most of the salt is excluded and left behind in the root zone in a shrinking volume of soil-water. Therefore it is necessary to design schemes that salty waters can be used in lands that it does not have sufficient productivity and in desert margin.

Arid Zone Conditions:

A wide swathe of arid and semiarid countries is holding one-fourth of the world’s population. In this reason, scientists are developing new breed of crops and animals that grow faster and stronger need less water, and are genetically, selected for high levels of nutrition.

An estimated 1.6 billion currently live in developing countries and regions affected by insufficient rainfall. Population growth in the arid and semiarid regions continues to be high with national annual increasing ranging from 3.6 percent in the southern Mediterranean region to 3 percent in sub-Saharan Africa, 2.1 percent in the central Asian Republics and over 2 percent in the Indian subcontinent. With growing populations and increasing food deficits, efforts to intensify agriculture have in many places depleted and degraded the natural-resources base of agriculture an alarming extent.

Salinity Effects on Crops:

The primary objective of irrigation is to provide a crop with adequate and timely amounts of water, thus avoiding yield loss caused by extended periods of water stress during stages of crop growth that are sensitive to water shortages. However, during repeated irrigations, the salts in the irrigation water can accumulate in the soil, reducing water available to the crop and hastening the onset of a water shortage. Understanding how this occurs will help suggest ways to counter the effect and reduce the probability of a loss in yield. Salinity effects are closely analogous to those of drought as both result in water stress and reduced growth.

The plant extracts water from the soil by exerting an absorptive force greater than that which holds the water to the soil. If the plant cannot make sufficient internal adjustment and exert enough force it is not able to extract sufficient water and will suffer water stress. This happens when the soil becomes too dry. Salt in the soil-water increases the force the plant must exert to extract water and this additional force is referred to as the osmotic effect on osmotic potential. Salts have an affinity for water. If the water contains salt, more energy per unit of water must be expended by the plant to absorb relatively salt-free water from a relatively salty soil-water solution.

Using Drainage Water (Using Salty Water):

Of the total amount of discharge water, a major of drainage water can be used for Irrigation of forage and other crops. Mediterranean countries, USA, India, Pakistan and Australia have accumulated rich experience in the use of marine, saline groundwater and drainage water for irrigation of different crops. The possibilities of using drainage water for irrigation depend on many factors and conditions: soil texture, soil salinity, salinity of drainage water, and a salt composition in them, salt resistance of agricultural crops and feasibility indices of irrigation systems. Drainage water can be best used for irrigation of sands and coarse-textured soils featuring high filtration properties and a low absorbing capacity.

Using drainage water for leaching, regular or periodic, is dependent on a provision of drainage systems on a territory for regular irrigation. Soil sites with good drainage characteristics of soil series are chosen. If the content of chlorine ion in drainage water is up to 0.3 g/L, then the requirement in drainage increase by 10-40% in composition to plots irrigated with fresh water. For creation of an optimal salt regime in a root zone, the soils in areas of regular and periodic irrigation with drainage water should be either non-saline or slightly saline. It is not recommended to irrigate medium and heavily saline lands with drainage water.

Water Salinity and Environmental Dangers:

No less important are drainage water salinity and salt composition. These indices determine the irrigation properties of water. In order to avoid negative implications for soils and diminishment of fertility under irrigation with drainage water, their quality is assessed by different criteria taking into consideration a risk of total and chlorine salinization, alkalization and magnesium salinization, etc. Calcium sulfate, magnesium and calcium carbonates refer to salts that are not harmful for plants. Harmful toxic salts include all chlorides, sulfates of sodium and magnesium as well as soda. The amount of these salts and their ratio determine; applying different coefficients; irrigation properties of drainage water. Stunting, leaf damage and necrosis are obvious injury to the plant and only noticeable after prolonged exposure to relatively high salinity.

Drainage water is harmful for the natural environment and lead to deterioration of the ecological situation in all irrigated regions. After disposal of drainage water into water bodies, rivers and irrigation sources the water quality in them sharply deteriorates. Diversion of drainage water along waterways to natural depressions or directly into a desert causes groundwater rise and salinization of lands and pastures.

Apart from mineral salts, drainage water also contains chemical fertilizers, agricultural chemicals, petroleum products and other harmful substances that contribute to pollution of water soil and food stuffs. If drainage water cannot be directly used for irrigation, then in order to improve an ecological situation the other more polluted part of them should be subject to decontamination, treatment or desalinization. There are three possible technical decisions of water protection measures:

- Remove to streaming pond.

- Simple freshener.
- Complex demineralization.

Avoiding Hazards of Saline or Sodic Water in Agriculture:

If poor-quality water is used for irrigation, one or more of the following practices may be necessary to avoid soil problems that will limit crop yields:

1. Provide adequate internal drainage, water with either a moderate Sodium Absorption Ratio SAR > 6 or Electrical Conductance EC > 1.5 should not be used unless drainage can be provided.
2. Meet the necessary leaching requirement (over-irrigation) depending on crop and EC_w of water.
3. Maintain higher available water in the soil.
4. Monitor salt and sodium with saline-alkali soil tests every 1 to 2 years.
5. Add soluble calcium such as gypsum to decrease the ASR to a safe value. Table 1 explains the range changes of EC_w and SAR.

Table 1. Sodium hazard of irrigation water based on Sodium Absorption Ratio (SAR) and Electrical Conductance (EC)

Salinity Hazard, EC_w

	0.75	0.75-1.5	1.5-3.00	> 3.00	Expected and permeability management
	Low	Medium	High	Very High	
SAR Ranges					
Low	< 6	< 6	< 4	< 2	No permeability problems.
Medium	6 to 9	6 to 8	4 to 6	2 to 4	Usually no permeability problems except when soils are high in clay and ECw is high or very high.
High	9 to 2	8 to 10	6 to 8	4 to 6	Possible permeability problems can use on sandy soils may need soluble calcium added if silt loam or finer texture monitor by soil test.
Very High	> 12	> 10	> 8	> 6	Serious permeability problems expected. Requires added soluble calcium or use only limited amounts as supplement to rainfall or good quality water. Monitor with soil test at the end of each season.

Iran Conditions:

Iran has been situated in southeast of Asia and its area is 165 million hectares, 3/4 of this area is semiarid and arid. As a result of the geographical and ecological situation of Iran, as well as the blowing of unfavorable winds in the Central Desert, more than 80% of the 165 million hectare area of the country is subject to the condition of arid and semiarid regions and characterized by low precipitation, ranged between 50 to 250 mm per year. At the present of the poor and desertified ranglands which 12 million hectare correspond to the sandy soils 5 million of the some shifting sand dunes. It is estimated that the trends of desertification in the country is about 1% annually. In Kashan (Isfahan State) there is 10,600,000 hectares desert and sandy land areas.

About Kashan and Salina:

Kashan is one of the central cities of Iran that is located in Isfahan State, 260 km to Tehran toward south. The rainfall is 136.6 mm and the temperature is between −14.5 and 49°C, but the average is 18.8°C. According to demarton aridity coefficient it has a dry climate. In this area, evaporation is 2850 mm at year. At the northeast of Kashan, there is salina about 80 km further, (Fig. 1).

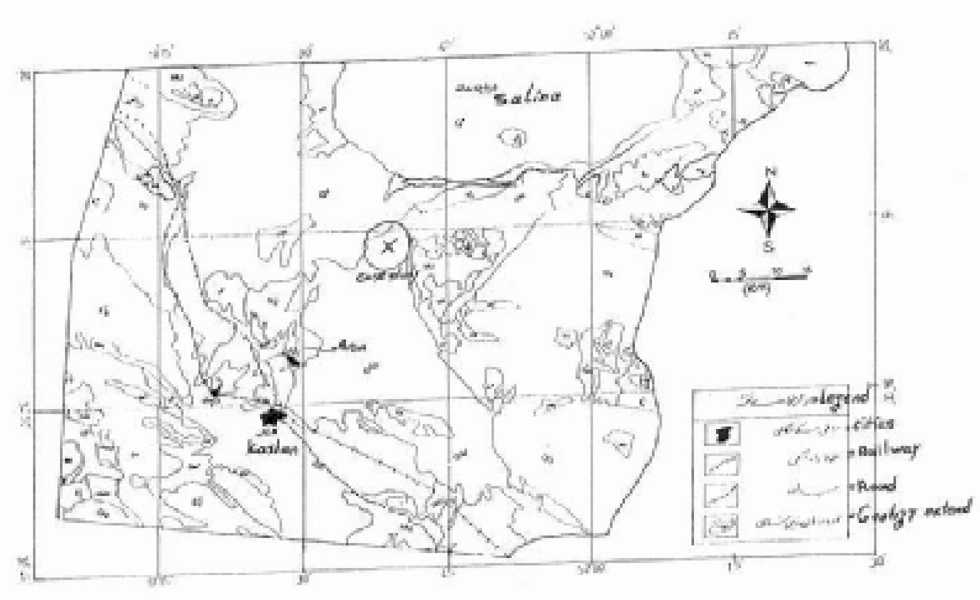

Fig. 1 Case study and position of it between Kashan and Salina and Rigboland

Rivers such as Shorrud, Rud-e-karaj, Jajrud, Hablehrud, and Gharahsoo are led to it. These rivers will be salt because of passing marsh in this region. Kashan Salina is the place for exploitation of salty compositions such as Na2So4 and Nacl. Accumulation of this material has made this place one of the salt sources of Iran, (Fig. 2).

Fig. 2 Salina, the white part of figure is salt and road for carry out salt

In this area, there isn't any plant coverage but around it there are species of salsola, soueda, halocnemum, seidlitzia, tamarix, etc. This Salina is in low attitude therefore the level of ground water is high in this place; in addition to this it has a high salinity. One of the important problems in Kashan is Rigboland, the longest dune in the world (18 km width and 90 km long). It is the source of many sand storms in this city, although some part of this dune has been fixed with mulch and biological fixation. The rainfall in Salina is very little and some years; there is no rainfall. By getting near to Salina, the rainfall decreases and temperature increases.

Case Study and the System of Use Salt and Drainage Water for Agriculture:

At the 30-35 km to Salina, in the edge of Rigboland, in the east of Aran-Salina road, there is the case study that agriculture has been common here about 60 years in traditional system. Some plants are planted here, including wheat, alfalfa, barley and trees such as mulberry, apricot has been planted around the fields in order to protect it from wind storm and act as a breakwind, (Fig. 3).

Fig. 3 The fields and position of them near of sandy dunes

Yield in this area is 2000-2500 kg/ha. Soil in this place is deep and semi-deep. According to the American classification, they are in Entisols and Aridisoils order, and their texture are sandy, sandy loamy, loamy sandy. Electrical conductivity of these soils is about 3-3.5 µmohs/cm and are almost salt.

Some semi-deep wells are used for irrigation of fields. Depth of these wells is 25 m, they have been caved 100 m horizontally in order to accumulate water from around and feed on wells are planed. This water are rather salt, its EC is 3000 µmohs /cm and its SAR is 25, while it isn't good for agriculture, but water of wells is used for it in farrow-trench system. Especial conditions of soil and its high permeability, give to people how lives there an opportunity to use it. Of course, irrigation should be does everyday so that prevent salt from plant root zone and they try to maintain wet the field soil. In order to prepare sufficient water for irrigation, people of this location, have been planed some pools around of fields. These pools have 500 m^2 area and 2-3 m depth, (Fig. 4).

Fig. 4 One of the pools that after set at liberty is used for rainfed crops such as melon

According to their situation for field, they drainage 5-10 ha of fields. Water in these pools has EC and SAR more than the water of wells. But this water is used for irrigate field too and by pumping it enters in the system of irrigation. Of course, in these pools, they can aquaculture warm water fishes. For irrigation of field one day, they use from pool water and another day use from well water. In addition, cumulative water in these pools feed on wells of region. After some time, water of pools is emptied, because of increasing of salty water and it isn't good for agriculture at all, and used for rain fed crops. Although, this method is used in limitation area, but it is current over 60 years and can be used for other regions with same conditions.

Conclusion:

Salinity control, however becomes more difficulty, water quality becomes poorer. As water salinity increases, greater care must be taken to leach salts out of the root zone before their accumulation reaches a concentration, which might affect yields. Alternatively, steps must be taken to plant crops tolerant to the expected root zone salinity. The frequency of leaching depends on water quality and the crop sensitivity to salinity.

Salinity reduces water availability in a similar manner to all types of plants, but not all crops are equally affected at the same soil salinity. Some are more able than others to extract or absorb water from a salty soil and therefore, more tolerant of salinity. In areas where irrigation management can not control salinity within the more tolerance of a preferred crop, a yield loss will result unless an alternate crop more to the expected salinity is planted. The economic advisability of application can be determined by the efficiency of drainage water for regular irrigation which can be determined by the efficiency of capital costs composition of anent income increment with costs of irrigation with drainage water in comparison to fresh water. The economic advisability of application of the drainage water for periodic irrigation is factored by comparison of additional economic benefits obtained by overcoming of an irrigation water deficit.

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