Irrigation water quality and its effects upon soil

Edlira SHAHINASI and Vasil KASHUTA

Tirana Agricultural University, Tirana, Albania
E-mail: eshahinasi@yahoo.com

Abstract

The geographic position of Albania is suitable for agriculture. The moderate temperature and weather conditions provide an ideal climate for its development. As a matter of fact agriculture is one of the most important sectors in our country.
According to the above-mentioned sector, irrigation water quality is an essential component of sustainable agriculture.
Irrigation water concerns have often been neglected because of available good quality water supplies but recently in many areas, this situation is changing, as a result of human activities. The aim of this study is to help Albanian farmers providing and choosing suitable alternatives related to potential water quality problems that might reduce production under conditions of use.

Keywords: *agriculture, irrigation, water quality, Albania*

Introduction

Irrigated agriculture consumes 60 – 80 percent of the total water usages, and contributes nearly in 38 percent of the global food production. It has played a major role in generating employment opportunities in the rural areas and providing food for cheap prices for all those low income families and middle class ones in the urban area. Wordwild during eighties and late nineties irrigated agriculture lands have considerably increased. According to FAO data, it is projected / foreseen to further increase in the next 34 years (based in 1995/96, FAO 2000). This indicates that irrigation sector uses a large share of the entier global water, whereas also the demand for irrigation water is going to rise in the coming years (CSD 1997).

Albania is a rich country full of water, where the annual average per capita is 3,080 m^3 being the highest in Central and Eastern Europe. Total run-off equals on average 25.7 billion m^3 per year, of which 2 percent or 588 million m^3 can be stored in irrigation reservoirs.
Irrigated agriculture is one of the most important sectors in Albania, which in the prevailing situation takes into consideration more than 50 percent of GDP and employment. Due to the importance of this sector and the need for irrigation, the irrigation water quality plays an important role in this sector.

Irrigation water quality is a key environmental issue faced by the agricultural sector as well as it is very important for every agricultural use, passing through such activities as irrigation to livestock watering, from safe household family drinkable water on farms, etc. Agricultural water sources may be of poor quality because of natural causes, contamination or both, and often require improvement before it is acceptable for a given use. (Ayers. R.S at al. 1998).

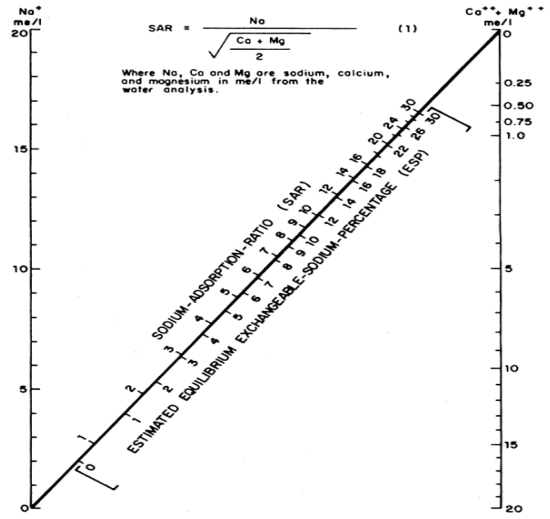
Water quality problems

Salinity

Soils with high levels of salinity are called ***saline soils.*** High concentration of salt in the soil can result in a “physiological” drought condition. It is, even thought that field appears to have plenty of moisture, the plants wilt because the roots are unable to absorb the water. Water salinity is usually measured as TDS (Total Dissolved Solid) or EC (Electrical Conductivity).

The infiltration problem

The infiltration problem is expressed in terms of SAR (***Sodium Absorption Ratio***). SAR is calculated from the ratio of sodium to calcium and magnesium.
SAR can be calculated by formula or by nomgram



$$\text{SAR} = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

Fig. 1 ***Nomogram for determinating the SAR values of irrigation water (Richard 1954)***

Toxicity problems

Many trace elements, in addition to sodium, chloride, boron and organic compounds are toxic at very low concentration. Generally, irrigation supplies contain very low concentration of these trace elements and are not problematic.

Chloride

If the chloride contamination in the leaves exceeds the tolerance of the crop, injury symptoms develop such as leaf burn or during leaf tissue. These symptoms occur when leaves accumulate from 0.3 to 1.0 percent chloride.

Sodium

Sodium toxicity is not diagnosed quite easily as chloride toxicity. Typical toxicity symptoms are leaf burn, scorch and dead tissues along the outside edges of leaves in contrast to symptoms of chloride toxicity, which normally occur initially at the extreme leaf tip. For tree crops, sodium in the leaf tissue exceeding 0.25 – 0.50 percent is often associated with sodium toxicity.

Boron

Boron is an essential element for plant growth. Boron is needed in relatively small amounts, however, and if present in amounts appreciably greater than needed, it becomes toxic. Boron problems originating from the water are more frequent than those originating in the soil.
Boron toxicity symptoms normally show first on older leaves as a yellowing, spotting, or drying of leaf tissue at the tips and edges.

TABLE 1 Guidelines for interpretation of irrigation water quality.

Water parameters	Symbols	Units	Normal ranking in irrigation water
Electrical Conductivity (or)	EC_w	dS/m	0-3
Total Dissolved solids	TDS	mg/l	0-2000
Calcium	Ca^{2+}	me/l	0-20
Magnesium	Mg^{2+}	me/l	0-5
Sodium	Na^{+}	me/l	0-40
Carbonate	CO_3^{2-}	me/l	0-1
Bicarbonate	HCO_3^{-}	me/l	0-10
Chloride	Cl^{-}	me/l	0-30
Sulphate	SO_4^{2-}	me/l	0-20
Nitrate-Nitrogen	NO_3-N	mg/l	0-10
Ammonium-Nitrogen	NH_4-N	mg/l	0-5
Phosphate-Phosphorus	PO_4-P	mg/l	0-2
Potassium	K^{+}	mg/l	0-2
Boron	B	mg/l	0-2
Acid/Basic	pH	1-14	6.0-8.5
Sodium Absorption Ratio	SAR	me/l	0-9

Material and methodology

Water samples were taken at 11 sampling sites. Tirana area (4 sampling sites); Durrës and Kavaja areas (9 sampling sites). The farmers of these areas use irrigation water from same different sources. The water samples in Lana River, Tirana River and Erzeni River are taken during the summer. In order to provide samples, it is chosen this season as a result of having high temperature compared to other periods of the year and the concentrations of most parameters (e.g. Electrical Conductivity) also increase. In addition, this is the period of time where water is probably used for irrigation.

Fig.2 Lana River

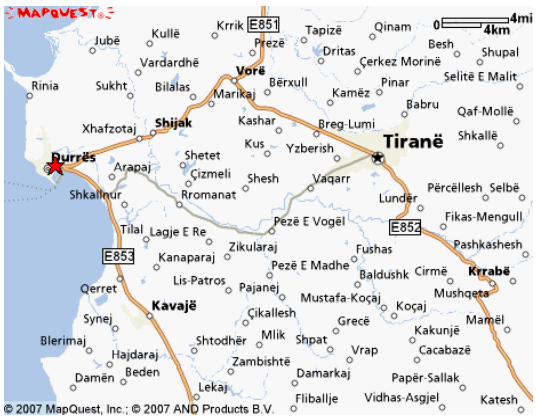


Fig.3 Study area

Numerous parameters are used to define irrigation water quality and to assess salinity hazards. A complete water quality analysis is taken to determine the following:

- The total concentration of soluble salts,
- The relative proportion of sodium compared to the other cations,
- The carbonate concentration as related to the concentration of calcium and magnesium and,
- Concentration of the specific elements and organic compounds.

All water samples are analysed by the Institute of Soil Studies, Tirana, Albania.
Some of the results are presented in the following tables.

TABLE 2: Maximum parameters values registered in irrigation water (Tirana area)

No	Potential Irrigation Problem	Symbols	Units	Çerkezë	Lana River	Tapizë	Tirana River
1	Electrical conductivity	EC_w	dS/m	1.5	0.6	0.36	0.6
2	Sodium Absorption Ratio	SAR	me/l	0.40	0.50	0.30	0.30
3	Alkalinity/Acidity	pH		8.0	7.9	8.2	8.0
4	Ammonium	NH_4-N	ppm	Trace	9.45	Trace	7.84
5	Phosphate	PO_4^{3-}	ppm	0.90	5.45	1.10	6.27

TABLE 3: Maximum parameters values registered in irrigation water (Durres- Kavaja area)

No	Potential Irrigation Problem	Hamallaj	Beden	Pompa Qeret	Stacioni Ballaj	Karpen	Stumë	Hidrovor
1	Electrical conductivity	1.50	0.90	10.30	0.34	1.50	1.05	5.30
2	Sodium Absorption Ratio	1.00	2.00	14.60	1.20	3.40	1.00	12.80
3	Alkalinity/Acidity (pH)	7.2	7.7	7.4	7.2	7.9	7.2	7.8
4	Ammonium	1.40	1.12	3.75	3.15	1.12	1.40	1.12
5	Phosphate	1.00	0.90	23.90	0.40	0.40	1.00	0.50

Discussion

Approximately, the entire water that exists somewhere contains dissolved salts and trace elements, many of which result from the natural weathering of the earth's surface. Water with high salinity is toxic to plants can cause the degradation of soils. It is, even thought that field appears to have plenty of moisture, the plants wilt because the roots are unable to absorb the water.
The data in (Tables 2; 3 and Fig. 4) show that in general the water is suitable for irrigation except the areas that use water from Pompa Qerret and Hidrovor (Kavaja). These water providers are unacceptable for irrigation because have a high value of salinity, respectively 10.30 dS/m and 5.30dS/m compared with the values the are given in Table 1 where the optimal ranges of this parameter are 0-3 dS/m. These water providers are not used because their use causes salinity of soil. Therefore, in some areas water must be under control because its value of electrical conductivity is a little bit high (1.50dS/m).

If the irrigation water does not enter the soil rapidly enough, it can cause an infiltration problem, so the waters which have SAR values up to nine (Table 1) are unacceptable for irrigated agriculture.
In general, the arrangement of SAR values registered in different areas taken in this study is similar to that of salinity measures (Table 2; 3 and Fig.5). Meanwhile, the maximum value registered in Pompa Qerret (SAR = 14.60 me/l) shows that this water is not used for irrigation purposes. The same situation is presented at Hidrovor Kavaja. (SAR = 12.80 me/l).
Although Lana River has low values of salinity, its use must be limited for irrigated agriculture because of high values of ammonium and phosphates. (Fig. 5)

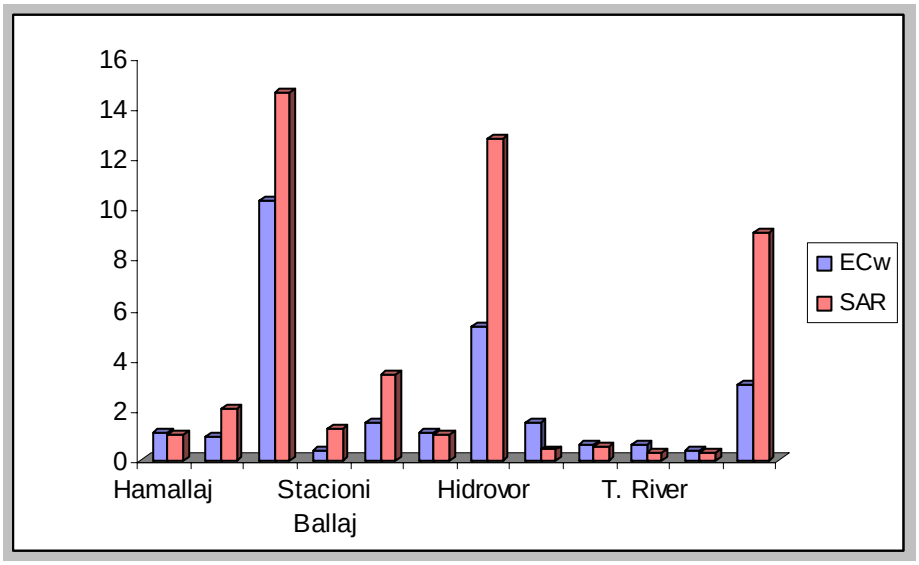


Fig. 4 Measurement values of EC and SAR In irrigation water (Tirana, Durrës, Kavaja area)

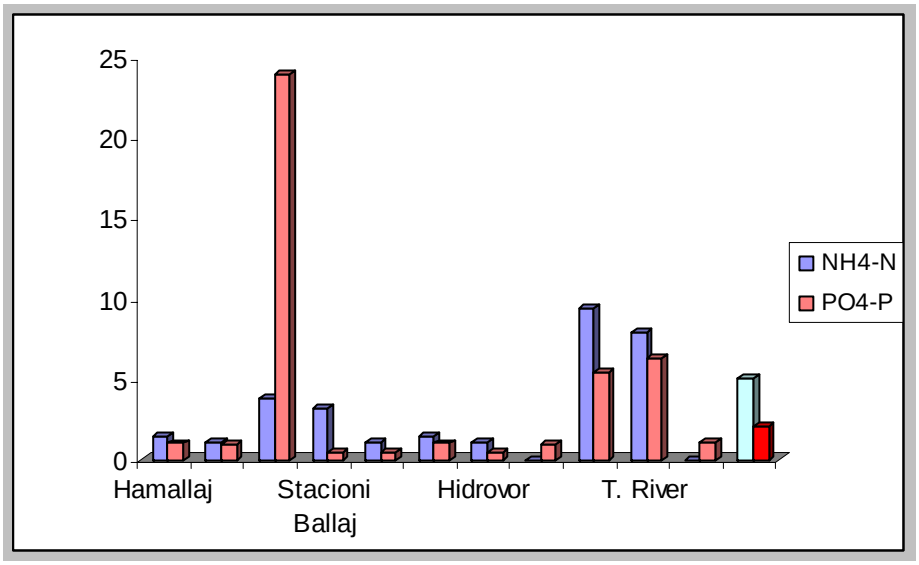


Fig.5 Measurement values of Ammonium and Phosphate In irrigation water (Tirana, Durrës, Kavaja area)

Conclusion

As a conclusion, we should emphasise that the water that we have analysed in this study has a good performance for agriculture sector. But, some of these water sites must not be used for irrigation purposes, because they have a negative impact in the soil as a result of causing salinity and infiltration problems.

It is also very important to stress the role of human activities in the irrigation water quality (e.g. Lana River or Tirana River). High values of ammonium and phosphates have been originating from domestic water and sewages.

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