Application of Indicators to Assess Salinization Threat to Sustainability of Irrigated Agriculture in Luohui Irrigation Scheme, China

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1. Introduction

The study area (32,000 ha), the Eastern Block of Luohui Irrigation Scheme, has been suffering of salinization problems since the introduction of irrigation in 1950s. In this area apple, peach and pear (salt sensitive fruit trees), wheat (moderately tolerant crop) and cotton (tolerant crop) have been cultivated. The main objective of this research was to apply indicators and assess salinization threats as part of the efforts of combating further land degradation.

2. Materials and methods

The study area is located between N 34^0 45′ 23″ to 34^0 56′ 05″ and E 109^0 45′ 22″ to 110^0 10′ 23″ in the Shaanxi province of China.

The altitude of the area ranges from 335 to 400 m.a.s.l.

Field measurements have been carried on, which consisted of Electrical conductivity of groundwater (EC_w), groundwater depth, the geographical coordinate of each well as well as other related parameters. The values of Sodium adsorption ratio of groundwater (SAR_w) were computed by analyzing the collected water samples since 2002.

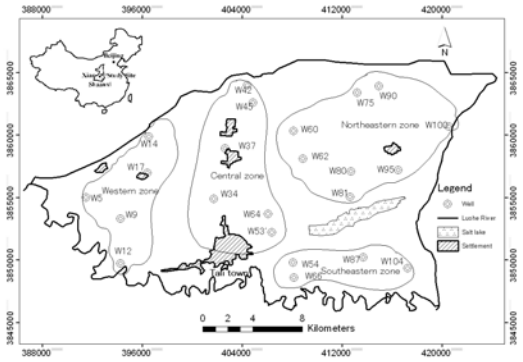

Fig.1. Map of the study area

Weighted overlay of groundwater depth and groundwater salinity was also done using ArcMap 9.2 software to discriminate areas having higher potential risk of soil salinization caused by capillary water rise (Fig.2).

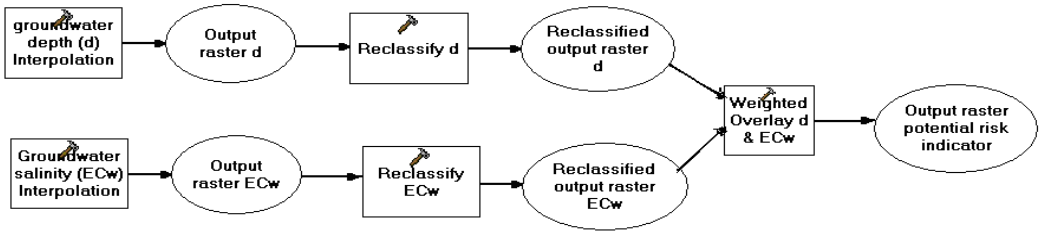

Fig. 2. Weighted overlay procedure

3. Results and discussions

The indicators of future soil salinization threats to the sustainability of irrigated agriculture in the scheme were:

1) Frequently obtained higher values of EC_w and temporally increasing SAR_w (Figs. 3 and 4). The wells located in central zone have higher values of both EC_w (mostly >3 dSm^{-1}) and SAR_w values (rising to about 25) posing soil saline-sodicity while the northeastern zone has smaller EC_w (<2.9 dSm^{-1}) and higher SAR_w values (20 - 40) posing soil sodicity.

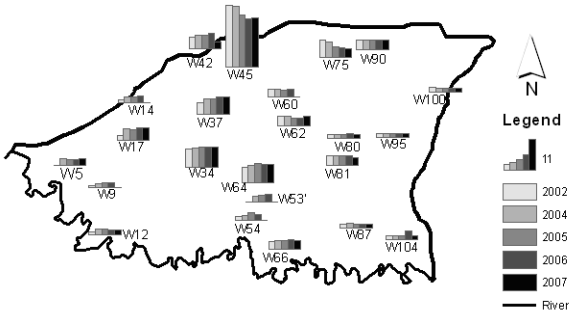

Fig. 3. Groundwater EC_w

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2) Temporally rising groundwater level (Fig. 5). From 2002 to 2007, a maximum rise of 1.69 m in central zone and 1.77 m in northeastern zone are obtained. Besides, it is clearly observed on Fig.5 that most of the wells in central zone and some wells in western zone have relatively approached to the surface to the extent of 0.5 m while the wells in southeastern and northeastern are relatively deeper from the surface with the shallowest depth of 3.09 m.

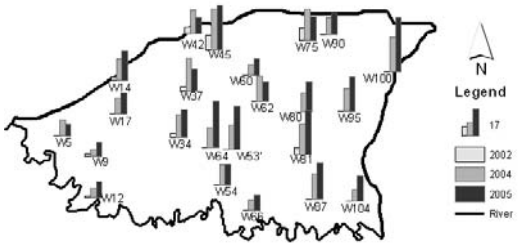

Fig. 4. Groundwater SAR_w

3) High potential for salinization due to capillary water rise (Fig. 6). The areas having high potential for salinization caused by capillary water rise are characterized by groundwater depth ranging from 0 to 3 m and groundwater salinity of more than 3 dSm^{-1}. Accordingly, some areas mainly in the central area are identified as risky to salinization caused by capillary water rise. And the other areas are also expected to develop similar threat as long as surface (flood) irrigation method, excessive evapotranspiration, and poor drainage system exist in the area.

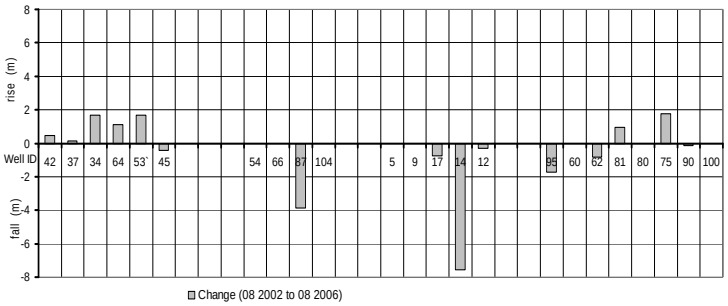

Fig. 5. Groundwater depth

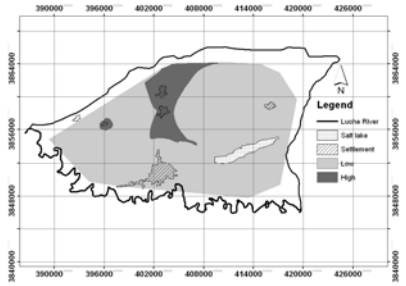

Fig. 6. Potential risk of salinization

In spite of the above indicated salinization threats, the farmers in the study area have been increasing the coverage of fruit trees (apple, pear and peach) to almost double from about 8,000 ha in 2002 to 16,000 ha in 2006. These fruit trees are, however, salt sensitive and they can tolerate EC_e of only below 1 dSm^{-1} to give 100% relative yield (FAO, 1985).

4. Conclusion and recommendations

The wells in central part of the scheme had relatively approached to the surface with higher EC_w (>3 dSm^{-1}) and SAR_w values (rising to about SAR_w of 25) that can pose saline-sodic problem to the soil. The same area is discriminated as high potential risky area for salinization caused by capillary water rise.

The sustainability of cultivating salt-sensitive plants such as apple, peach and pear fruit trees, as main part of the irrigated agriculture in the Luohui irrigation scheme, may be difficult in the future due to salinization threats.

Control of groundwater level rise and monitoring the drainage structures to prevent further rise to the surface as well as practicing efficient irrigation methods are recommended to avert future salinization threats.

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