Agriculture and Pollutat Sources in the Hula Valley

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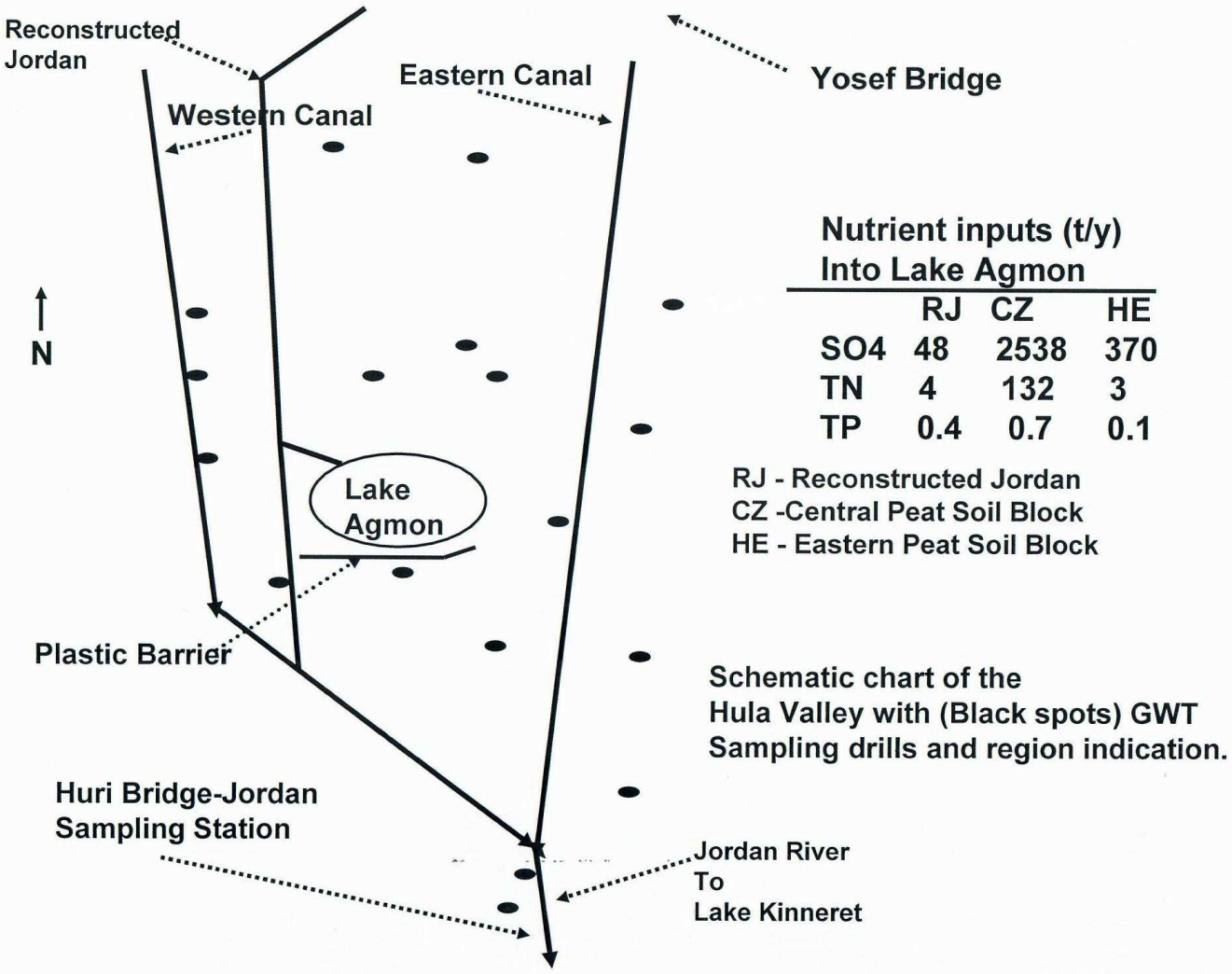
Key Words:
Hula, Kinneret, Pollutants, Agriculture, Reclamation Project

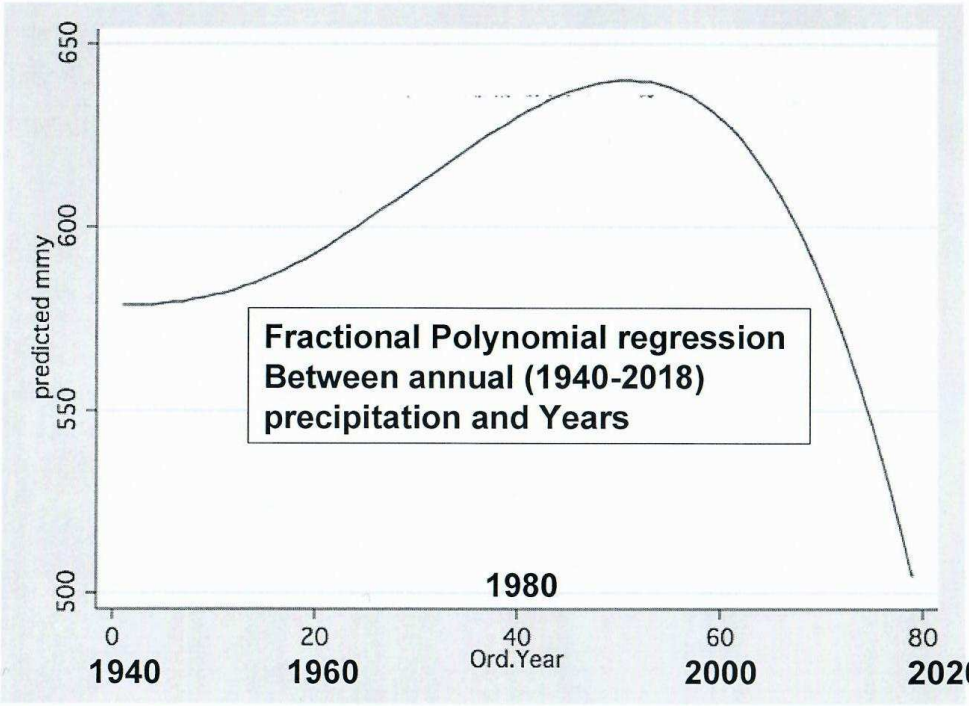
Abstract

Significant positive correlations that was found between TN, TP, NO3, TDP, NH4 and Dissolved Kjeldhal and Jordan River Water Yields (mcm/y) is an obvious hint that precipitation regime is a principle impact factor on pollutants flux from the Hula Valley into Lake Kinneret. Long Term (started mid 1980`s) decline of precipitation included 8 years of droughts with recent 5 years in a row. A reclamation project in the Hula Peat soil, the Lake Agmon System (LAS), was implemented during 1993 – 1997 included, elevation of under ground water table, the use of irrigation portable lines , adaptation cropping cycles to year around green cover, renewal 90 km of canals for irrigation water supply and drainage improvements. Recent monitored data evaluation indicates minor quantitative impact of the LAS on nutrient removal: TP-1.1t/y, TN-34.7 of which 16.0 t/y are due to Nitrates, and Ammonium- 5.4 t/y. Nitrogen drained from the Peat soil is fluxed into Lake Agmon mainly in winter whilst Phosphorus mostly during summer. The principle transporter of Nitrate are the winter precipitation. Most of the Phosphorus migration is in summer by irrigation waters.

The Organic Nitrogen loads from the Basin were significantly reduced mostly due to fishponds restrictions and sewage removal. Total Dissolved Phosphorus from these sources was also reduced but to a lesser extent. The Hula Reclamation Project (LAS) significantly improved agricultural management: Prevention of dust storm. slow down the rate of soil surface subsidence, reduce rodent outbreak and underground fires. Conclusively, nutrient export from the Hula Valley to Lake Kinneret was significantly affected by climate change (precipitation decline), sewage removal and fishponds restriction.

Future Perspectives: The Lake Kinneret ecosystem require a slow gradual increment of Epilimnetic Nitrogen which is presently a factor of limitation. Potential sources of available Nitrogen are the Peat –Organic soil in the Hula Valley. Water mediation is the best "transport service" for Nitrogen supply. Ground Water Table elevation combined with soil moisture increase by irrigation is optimal for the agricultural maintenance. If precipitation decline continue, import of water from other sources (such as desalinization), to improve Hula Valley`s soil condition, are recommended. Recommended future Hydrological management is an integration between the two ecosystems , Lake Kinneret and the Hula Valley. The present increase of salinity and lack of Epilimnetic Nitrogen in Lake Kinneret are the most acute environmental difficulties. Hula Valley soil condition deterioration under dryness is a major concern for agricultural development. A combined proposition is suggested: Import desalinated waters to Lake Kinneret and export (pumping) partly saline lake water to the Hula Valley and enrichment of Kinneret Epilimnetic Nitrogen stock by Hula Valley sources.

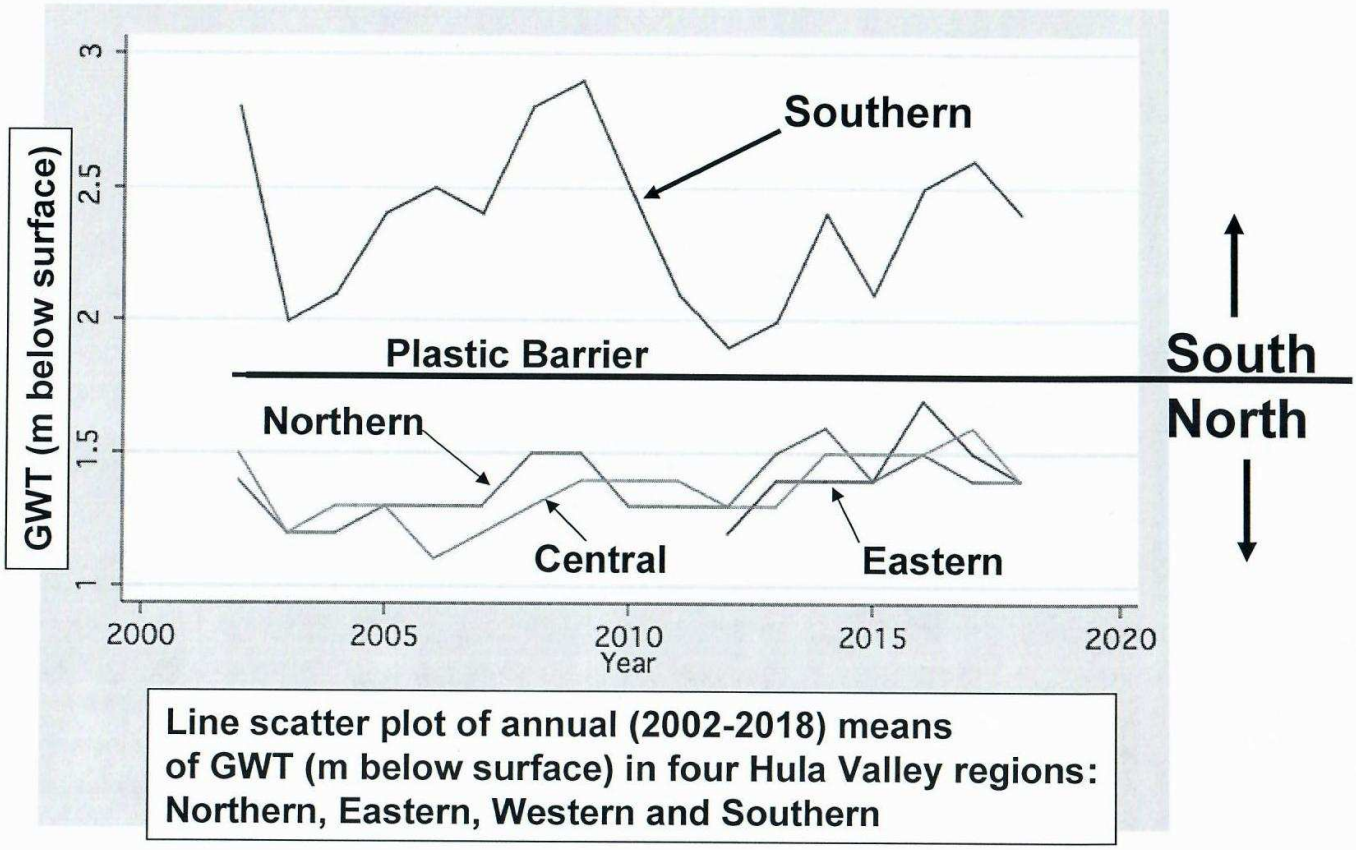

Reconstructed Jordan
Western Canal
Eastern Canal
Yosef Bridge
N
Lake Agmon
Plastic Barrier
Huri Bridge-Jordan Sampling Station
Jordan River To Lake Kinneret
Nutrient inputs (t/y) Into Lake Agmon
RJ CZ HE
SO4 48 2538 370
TN 4 132 3
TP 0.4 0.7 0.1
RJ - Reconstructed Jordan
CZ -Central Peat Soil Block
HE - Eastern Peat Soil Block
Schematic chart of the Hula Valley with (Black spots) GWT Sampling drills and region indication.



Drought Level (A, B, C, D) occurrence (%) results of Standart Precipitation Index (SPI) (Givati Report 2016):A=Close to Normal Conditions; B=Moderate Drought; C=Severe Drought; D= Normal Conditions

	1930-1980	1981-2014
A	34	21
B	26	18
C	2	3
D	38	58

Ground Water Table Hydrological Gradient from North to South



Line scatter plot of annual (2002-2018) means of GWT (m below surface) in four Hula Valley regions: Northern, Eastern, Western and Southern

LR Between Annual means of nutrient concentrations (ppm) and Annual Jordan Discharge (mcm) during 1999-2018

Parameter	R square (r^2)	Probability (p) (S=Significant) (NS=Not Significant)
TN	0.6244	0.0022 (S)
TP	0.4117	0.0245 (S)
NO3	0.7035	0.0007 (S)
TDP	0.4734	0.0134 (S)
NH4	0.3872	0.0307 (S)
Kjeldhal Dissolved	0.3344	0.0489 (S)

Results during Post similar to Pre-Hula Reclamation Project

Taking Home Message

- Regional Precipitations decline.
- The higher the Jordan Discharge is - the higher are nutrient concentrations in it.
- Reclamation Project of the Hula Valley Peat soil renovated drainage canal system and newly constructed lake Agmon. Its contribution to Nutrients removal was found to be minor.
- Significant removal of Nitrogen from Lake Kinneret is due mostly to Sewage treatment and fishponds restriction.
- The Hula reclamation project achieved significant benefit improvement of agricultural management, tourism and reduction of dust storm mediated P input from the Hula Valley into Lake Kinneret.
- The Lake Kinneret Ecosystem was modified from P to N limitation.
- Input of additional P to Lake Kinneret is probably due to bottom sediments flux and dust deposition ex-regional sources.