Changes of Soil Fertility affected by Different Land Uses and Altitude in the Three Gorges Reservoir

Li Ma[1,2], Yuncong Li[1] , Xiaohui Fan[1], Lizhong Xia[2]

[1]Soil and Water Science Department at Tropical Research and Education Center, IFAS, University of Florida, Homestead, FL 33031, USA

[2]Institute of Soil Science, Chinese Academy of Sciences, Nanjing 210008, China

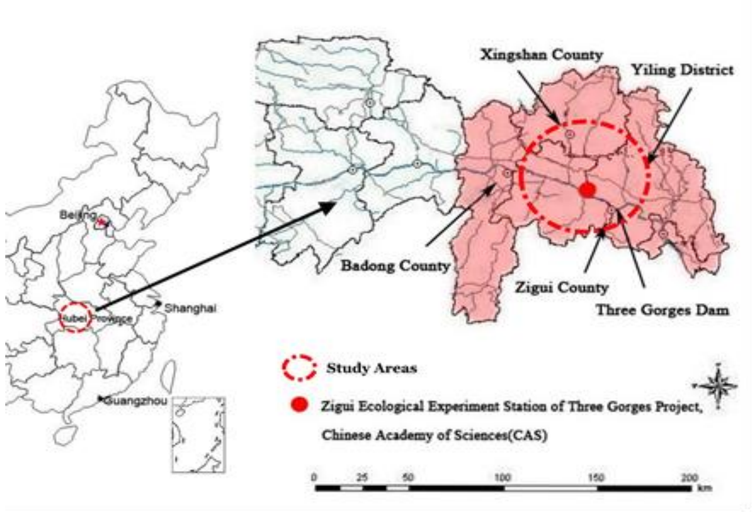
INTRODUCTION

✓ The Three Gorges Reservoir (TGR)，an ecologically fragile zone, is at risk of environmental upheaval due to human development.

✓The rise of groundwater levels following the construction of the Three Gorges Dam (TGD) has greatly impacted the area of usable land, soil quality, and local agriculture in the TGR area.

✓The objective of this study was to understand the relationship between human development and changes in soil fertility, and provide optimization measures in the management of agriculture development in the mountain region. To achieve these goals, a long-term research study through soil fertility monitoring was carried out.

MATERIALS & METHODS

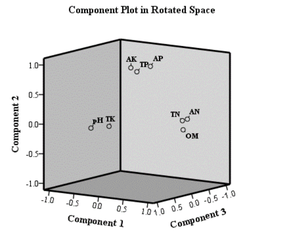


✓The study was conducted between 2005-2014 in three counties (Zigui, Xingshan, and Badong) in the Hubei Province, primarily in the upstream area of the TGR. Land uses in the area include cereal/vegetable crops, citrus, and tea crops at various altitudes.

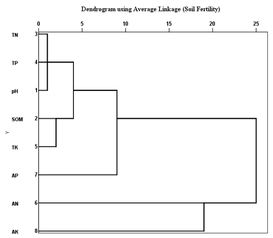
✓A total of 86 monitoring plots were set up to monitor changes in soil bulk density, porosity, pH, SOM, TN, TP, TK, and available NPK, etc. More than 500 soil samples were collected since 2005.

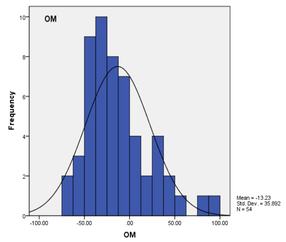
RESULTS

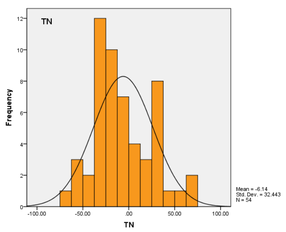
PCA of soil fertility factors

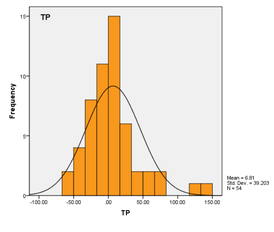


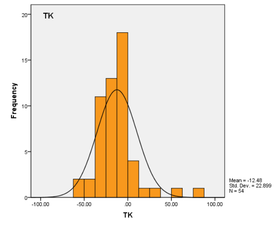
Cluster analysis of soil fertility factors

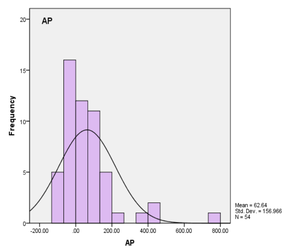


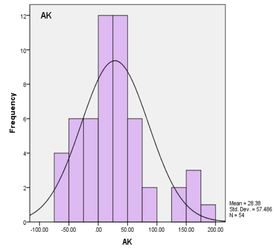


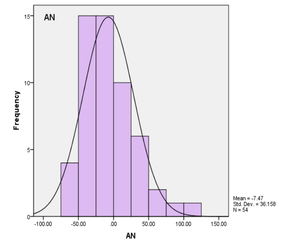












Analysis of variation frequency of soil fertility during 2014 -2005

The X-axis was percentage of different value of 2014 and 2005 (%), the Y-axis is frequency.

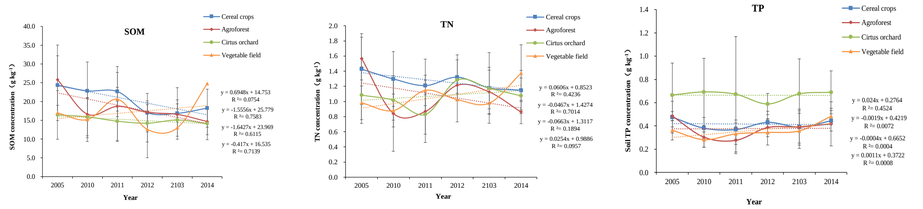
Soil nutrient status in middle and low altitude areas under different land uses

Land use	SOM (g/kg)	TN (g/kg)	TP (g/kg)	TK (g/kg)	AN (mg/kg)	AP (mg/kg)	AK (mg/kg)
Paddy field	29.93±5.74	1.65±0.25	0.41±0.01	15.38±0.94	129.71±19.66	7.48±3.59	46.67±5.20
Slope land	20.40±10.69	1.18±0.46	0.63±0.28	19.44±2.64	96.39±22.29	17.15±19.27	64.17±10.10
Terrace Field	26.08±4.53	1.44±0.52	0.47±0.03	14.48±0.93	159.46±5.45	17.98±5.91	60.00±5.00
Sig.	ns	ns	ns	s	s	ns	s

Soil nutrient status in low altitude areas under different land uses

Land use	SOM (g/kg)	TN (g/kg)	TP (g/kg)	TK (g/kg)	AN (mg/kg)	AP (mg/kg)	AK (mg/kg)
Slope land	13.29±2.00	1.12±0.31	0.77±0.09	22.34±1.26	79.43±10.25	75.79±52.10	213.13±28.16
Terrace field	22.10±6.26	1.44±0.20	0.98±0.29	16.55±1.45	117.74±20.43	117.11±58.04	317.50±125.32
Terrace field intercrop	16.36±7.59	0.88±0.29	0.68±0.25	19.58±4.74	80.33±13.20	36.84±31.03	130.00±49.16
Slope land intercrop	11.15±3.79	0.74±0.18	0.37±0.07	19.68±3.34	55.34±17.12	11.32±7.23	112.50±45.18
Sig.	ns	s	s	ns	s	s	s

Typical soil profile in the area of the TGR



Changes of soil fertility of different land uses from 2005 to 2014

CONCLUSION

1. Terraced fields and protective cultivation (hedgerow, inter planting and straw mulch) are commonly implemented in the study area. Areas at an altitude of 600-700 m was primarily reserved for citrus, while areas at altitudes of 700-900 m were mainly utilized for cereal and vegetable crops.
2. From 2005 to 2014, SOM, TN, TP, and TK concentrations decreased while concentrations of soil available nutrients increased. Soil fertility degradation has become a major constraint for local agriculture.
3. Switching from sloped cultivation to terraced farming led to improvements in soil fertility, including soil nitrogen and phosphorus concentrations, which may have resulted from terracing's reduction of water runoff and soil erosion.
4. Improving soil fertility can be achieved through a number of effective approaches for soil and water conservation for the sustainable development of agriculture in the TGR.

ACKNOWLEDGEMENTS

The program was supported by the monitoring project of the Three Gorges Project ecological environment monitoring system (SX[2015]-016) and the National Natural Science Foundation of China (No. 41301307) .