Effects of land use/land cover changes on soil erosion-a case study of a catchment in the Southwestern China

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The integration of macroscopic study based on LUCC and microscopic study based on extracting soil erosion information from reservoir sediment is the main train of this dissertation. The author carried out studies on LUCC and their effects on soil erosion in Shibanqiao catchment of Guanling County, located in the southwest of Guizhou Province. The macroscopic study was developed with the support of RS and GIS technique. Such results were obtained:(1) Land use/land cover series and changes were achieved based on two aerial photographs taken in 1960 and 1978 and two land use maps in 1989 and 2001. (2) Three negative and one positive succession of land cover was summarized. The negative ones mainly took place before 1978 and the positive one took place after 1989.The part of microscopic study was carried out in Shibanqiao Reservoir. Seven sediment cores were retrieved and analyses of 137Cs, grain size, TOC, C/N and mineral magnetism of sediment samples were undertaken. The corresponding results are:(1) The average deposit rate in each period was gained by 137Cs. Annual sediment amount and annual soil erosion amount were further obtained combined with the hydrology information.(2) The sediment indices show three different phases of erosion and deposit environment: The first phase was from 1962 to 1978. Selective process of natural erosion could be deduced. The second was from 1978 to 1989. Severe surface soil erosion was observed. The third was from 1989 to 2002. The soil erosion amount was the highest. Integrating the two part of study, the author interpret the effects of LUCC on soil erosion:(1) The percentage of soil erosion area in different land cover types showed such pattern: grassland>woodland>cropland>land difficult to use>built up land> paddy field. There was a critical vegetation cover rate on the control of soil erosion, 20-60%. (3) The

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effects of LUCC on soil erosion were presented in three phases: From 1960 to 1978, positive feedback accelerating soil erosion resulted from human damage was dominant. It was the initial stages of accelerated rocky desertification. From 1978 to 1989, both positive and negative feedback developed. Surface soil was the main erosion resource. Soil erosion experienced a threshold in amount. It was the peak phase of rocky desertification expansion. From 1989 to 2002,human activities brought new erosion resources. Such achievements were reached in this paper: ① Developing an approach to extract soil erosion from sediment on relative short temporal scale. ② In land use/land cover classification, vegetation cover rate was selected as an index in the second level, which was suitable for the Karst region. ③ The author went a further step into studies on LUCC by integrating macroscopic study and microscopic study. ④ The accelerated soil erosion resulted from the implementation of ecological engineering was detected, in view of which related suggestions was put forward.

References

1 Arnold J.G., Allen P.M. Estimating hydrologic bud-gets for three Illinois watersheds [J], Journal of hydrology, 1996, 176 (1-4): 57-77.

2 Bouman B.A.M., Jansen H.G.P., Schipper R.A. et al., 1999. A framework for integrated biophysical and economic land use analysis at different scales[J]. Agriculture Ecosystems & Environment, 75, 55-73.

3 Eles C.W.O., Blackie J.R. Land-use changes in the Balquhidder catchments simulated by a daily stream flow model [J]. Journal of hydrology, 1993, 145(3-4): 315-336.

4 Erskine W.D.& Saynor, M.J. Success of soil conservation works in reducing soil erosion rates and sediment yields in central eastern Australia [J]. Int. Assoc. Hydrol. Sci. Publ. 1996, 236:523-530.

5 Glasod. Global assessment of soil degradation[Z].World maps. Wageningen (Netherlands): ISRIC and PUNE, 1990.

6 GLP, 2005. Science Plan and Implementation Strategy. IGBP Report No. 53/IHDP Report No. 19. IGBP Secretariat, Stockholm.

7 Gray L.C. Is land being degraded? A multi-scale investigation of landscape change in southwestern Burkina faso [J], Land degradation & development, 1999, 10: 329-343.

8 Ionita I., Margineanu R.M. & Hurjui C. Assessment of the reservoir sedimentation rates from ^{137}Cs measurements in the Moldavian Plateau [J], Acta Geologica Hispanica, 2000,35(3-4): 357-367.

9 Jockbson H.K, Price M.D. A framework for research on the human dimension of global environmental change. HDP Report, 1990, 1

10 KosinskiL A,ed. Issues in global change research: problems, data and programmes. HDP Report,1996,6

11 Lal R. Soil quality and sustainability [A]. In: Lal R., Blum W.H., Valentine C.*et*

al. Methods for assessment of soil degradation [C].USA: CRC Press LLC, 1998:17-30.
12 Loughran R.J.The measurement of soil erosion [J], Progress in Physical Geography, 1990, 13: 216-233.
13 Meyer L.D. Evaluation of the universal soil loss equation [J], Journal of Soil and Water Conservation, 1984, 39: 99-104.
14 Neil D.T.& Galloway R.W. Estimation of sediment yields from catchments farm dam [J], Australian Journal of Soil Water Conservation, 1989, 2(1): 46-51.
15 Owens L.B., Malone R.W., Hothem D.L. *et al*. Sediment carbon concentration and transport from small watersheds under various conservation tillage practices [J], Soil & Tillage Research, 2002, 67: 65-73.
16 Queralt I., Zapata F.and Garia E. *et al*. Assessment of soil erosion and sedimentation through the use of the ^{137}Cs and related techniques [J], Acta Geologica Hispanica, 2000, 35(3-4): 195-196.
17 Rend K.G., Foster G.R., Weesies G.A., et al. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE) [M]. National Technical Information Service, United States Department of Agriculture, 1997.
18 Ritchie J.C. & McHenry J.R. Application of radioactive fallout ^{137}Cs for measuring soil erosion and sediment accumulation rates and patterns: A review [J], Environ. Qual. 1990, 19: 215-233.
19 Ritchie J.C. & McHenry J.R. Application of radioactive fallout ^{137}Cs for measuring soil erosion and sediment accumulation rates and patterns: A review [J], Environ. Qual. 1990, 19: 215-233.
20 Rogowski A. S., Tamura T. Movement of cesium-137 by run off, erosion and infiltration on the alluvial Captina silt loam [J], Health Physics, 1965, 11: 1333-1340.
21 Sanchez P. A. Tropical soil fertility research: towards the second paradigm Proc.15th Intl. Congr [J]. Soil Science, Acapulco, Mexica, 1994, (1): 65-88.
22 Verburg P.H., Veldkamp T.A., Bouma J. Land use change under conditions of high population pressure: the case of Java[J]. Global Environmental Change. 1999, 9: 303-312.
23 Wayne D.E., Mahmoudzadeh A. Myers C. *et al*. Land use effects on sediment yields and soil loss rates in small basins of Triassic sandstone near Sydney, NSW, Australia [J]. Catena, 2002, 49: 271-287.
24 Wischmeier W.H., Smith D.D. Predicting Rainfall Erosion Losses from Cropland East of the Rocky Mountains [M]. Agric. Handbook No.282. Washington D.C, USDA, 1965: 282.
25 Yan P., Shi P.J., Gao S.Y. *et al*. ^{137}Cs dating of lacustrine sediments and human impacts on Dalian Lake, Qinghai Province, China [J], Catena, 2002, 47: 91-99.
26 Zhang C, Yuan DX. New development of IGCP 448 World correlation of karst ecosystem(2000-2004), episodes,2001,24(4): 279-280
27 Wu XQ, Cai YL, Meng JJ. The relationship between land erosion and landuse in Karst area, take Guanling County of Guizhou Province as a case[J], Research of water and soil protection, 2005, 12(4):46-48
28 Wu XQ. The soil erosion effects of land use change in Karst area of Southwestern China.. Paper for PH.D，2004