The impact of land use change on quality evolution of soil genetic layers on the coastal plain of south Hangzhou Bay

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Abstract: Land use change plays an important part in the studies of global environmental change and regional sustainable development. The change of soil quality can particularly reflect the impacts of human socio-economic activities on environment. Taking the coastal plain of south Hangzhou Bay as a study case, we analyzed the effects of land use changes on organic matter (OM), total nitrogen (TN), total phosphorus (TP), available phosphorus (AP), available potassium (AK), total salinity (TS), pH value in soil genetic layers, and assessed soil quality change related to different land use types from 1982 to 2003. The results show that: (1) The general change tendency of soil quality in the coastal plain of south Hangzhou Bay declined obviously in A layer and slightly rise in B (or P) layer and C (or W) layer. The contents of TP decreased generally in all soil genetic layers, but the variety difference of other soil quality indices was relatively great. (2) The change of soil quality in the areas where land use changed is far more remarkable than that with land use unchanged. The value of quality variety is A layer >B (or P) layer >C (or W) layer. (3) The changes of soil tillage, cultivation, fertilization, irrigation and drainage activities related to land use may make some soil-forming processes disappeared and bring in other new processes which will affect the soil quality and soil genetic layers directly.

Keywords: land use; soil quality; soil genetic layer; coastal plain; south Hangzhou Bay

1 Introduction

Land use is the comprehensive reflection of production activity carried out by human on land (Turner et al., 1991). As the subject of human activity for production, the health and quality situation of soil is an important factor for the sustainable development of global biosphere, as well as an important evaluation standard for agricultural soil management. Modern pedology thinks that soil is the mutual action result of natural factors such as parent material, climate, creatures, terrain, time, human activities. Physiographic elements fundamental
tally determine the physical-chemical properties and biological features of soil, such as granularity, biochemical reaction, fertility, etc. But land use and land use change (LUCC) usually alters management measures such as farming system, irrigation, fertilization, etc (Halvorson et al., 2000; Ross, 1993; Lei et al., 2005) and many ecological processes relevant to soil (Bushchbacher et al., 1988) which inevitably affects the qualitative feature of soil (Riley et al., 2005; Sharma et al., 2005; Nael, 2004). With the deepening of research on LUCC, the research on soil quality change caused by human activity has become the hot spot of scholars and governors (Doran, 2001; Wang et al., 1998; Sparling et al., 2004; Manaa et al., 2005). Related international research focuses mainly on the impact of land use on quality evolution of surface soil, whose research area mainly covers urban and rural conjugation area (Qin et al., 2000), intensive agricultural area (Kong et al., 2003; Gosling et al., 2005), woodland (Nael, 2004), karst area (Jiang et al., 2005), hilly area (Fu et al., 2001; Gong et al., 2004), while there is rare research on quality evolution of the entire soil genetic layer (Luo et al., 2005). In this paper, the coastal plain of south Hangzhou Bay is taken as the case study to explore the impact of LUCC on the nutrition situation and quality evolution of soil genetic layer, and to provide scientific basis for research of soil ecological process and the formulation of proper soil management measures.

2 General situation of the study area

The coastal plain of south Hangzhou Bay is situated in the northeast of Zhejiang Province, near to Ningbo in the southeast, neighboring Yuyao in the southwest, and facing Shanghai in the north across the sea. It is located in the central region of the economic golden triangle of Shanghai–Hangzhou–Ningbo (Figure 1). The study area has northern subtropical monsoon climate, which is warm in winter and cool in summer, with an annul precipitation of 1272.8 mm and perfect temporal and spatial allocation of light, heat, water within this area. Agricultural development here has a long history. The coastal plain of south Hangzhou Bay is composed of low mountains and hills, lacustrine and marine depositional plain, marine depositional plain and coastal muddy flat. Low mountainous and hilly area has mainly red soil. Lacustrine and marine depositional plain extends from south of Dagutang to the coast line of south Hangzhou Bay with tilt terrain. The parent materials are sediments of old shallow sea and alluvial-lacustrine deposit. Owing to long-term farming, irrigation and fertilization by human, especially after used as paddy fields, the internal structure of soil has changed drastically. Marine depositional plain ranges from Dagutang to the coast line of south Hangzhou Bay with tilt terrain. According to soil-forming history and land use pattern, from coast line to Dagutang, the soil is divided into three categories: saline soil, fluvo-aquic soil and paddy soil. Aggradational muddy flat in the north from the coast line forms an arc-like belt, with the maximum width of 10 km. With continuous northward expansion of land area, desalini- zation of the existing reclamation area, the land use pattern has changed gradually from saline soil and wasteland to dry land and paddy fields. In recent years, adjustment in agricultural structure and development of industrialization have made land use more complex.