Catena 171 (2018) 416–425

Contents lists available at ScienceDirect

Catena

journal homepage: www.elsevier.com/locate/catena

Spatiotemporal changes of land use/cover from 1995 to 2015 in an oasis in the middle reaches of the Keriya River, southern Tarim Basin, Northwest China

Zubaida Muyibul[a], Xia Jianxin[a,*], Polat Muhtar[a,b], Shi Qingdong[c], Zhang Run[d]

[a] College of Life and Environmental Science, Minzu University of China, Beijing 100081, China
[b] College of Tourism, Xinjiang University, Urumqi 830049, China
[c] Institute of Arid Land Ecology and Environment, Xinjiang University, Urumqi 830046, China
[d] Key Laboratory of Tibetan Environment Changes and Land Surface Processes, Institute of Tibetan Plateau Research, Chinese Academy of Science, Beijing 100101, China

ARTICLE INFO

Keywords:
Land use/land cover
Spatiotemporal change
Landscape pattern
Buffer analysis

ABSTRACT

Land use and land cover (LULC) changes in oases have been a topic of great interest due to the impacts of oases on ecosystem services in arid regions. The oasis that is along the Keriya River in southern Tarim Basin, northwest China, is in an ecologically fragile region and is thus very sensitive to human interference. In this study, the spatial and temporal changes in LULC in the middle reaches of the river were quantified and assessed by using GIS technology based on remote sensing images from 1995, 2005 and 2015. The results indicated that cropland expansion and grassland degradation were the dominant LULC changes, especially in the last decade. Throughout the study period, cropland areas increased by 6.51%, while grassland areas decreased by 30.98%. A buffer analysis along the main river channel was conducted to analyze the spatial LULC characteristics. The results showed that water areas, croplands and forests were predominantly distributed along the river (in the 0–10 km buffer). The majority of mid-density grasslands and low-density grasslands were distributed in the 10–20 km buffer, and high-density grasslands were mainly distributed in the 20–30 km buffer. The conversion rates in different buffers indicated that cropland expansion primarily occurred along the river, and grassland degradation was noted in the 10–30 km buffer. Landscape pattern changes were also analyzed to account for the structural LULC characteristics. The results that were deduced from the landscape pattern change analysis showed that the patch structures of forestland and cropland increased, and increasing fragmentation tendencies were found in the other LULC types. Moreover, a model was introduced to quantify the directions of LULC changes, and the results showed that the direction of LULC change in the oasis was declining, which represents an undesirable change in LULC. Socio-economic changes were also analyzed to explain the LULC changes. The results of this study contribute to the future management of the LULC in the oasis and the protection of the Keriya River ecosystem.

1. Introduction

Land use and land cover (LULC) plays a significant role in maintaining the structure and productivity of an ecological system (Cabral and Costa, 2017), and many LULC types provide numerous ecosystem services (Hao et al., 2017). In the meantime, changes to the LULC have great impacts on landscape patterns and ecosystem services (Hao et al., 2017; Mamat et al., 2014). Extensive changes to LULC may result in the homogenization of landscape patterns or fragmentation of natural habitats (Bommarco et al., 2013).The changes may also enhance or disrupt ecosystem integrity (O'Neill et al., 1999) by influencing the climate system, hydrology, biochemistry and biodiversity (Braimoh and Osaki, 2010). Hence, analyzing and understanding the processes of LULC change are important in environmental research.

Oases in northwest China have changed extensively throughout the past several decades, and human activities have been considered the

Abbreviations: LULC, land use/land cover; LCCI, land cover change index; WA, water area; FL, forest land; SL, shrub land; HDG, high-density grassland; MDG, mid-density grassland; LDG, low-density grassland; CL, cropland; UL, unused land; NP, number of patches; PD, patch density; PLAND, percentage of landscape; LPI, largest patch index; SPLIT, splitting index; XJUAR, Xinjiang Uyghur Autonomous Region

* Corresponding author.
E-mail address: jxxia_muc@sina.com (X. Jianxin).

https://doi.org/10.1016/j.catena.2018.07.038
Received 30 January 2018; Received in revised form 17 July 2018; Accepted 24 July 2018

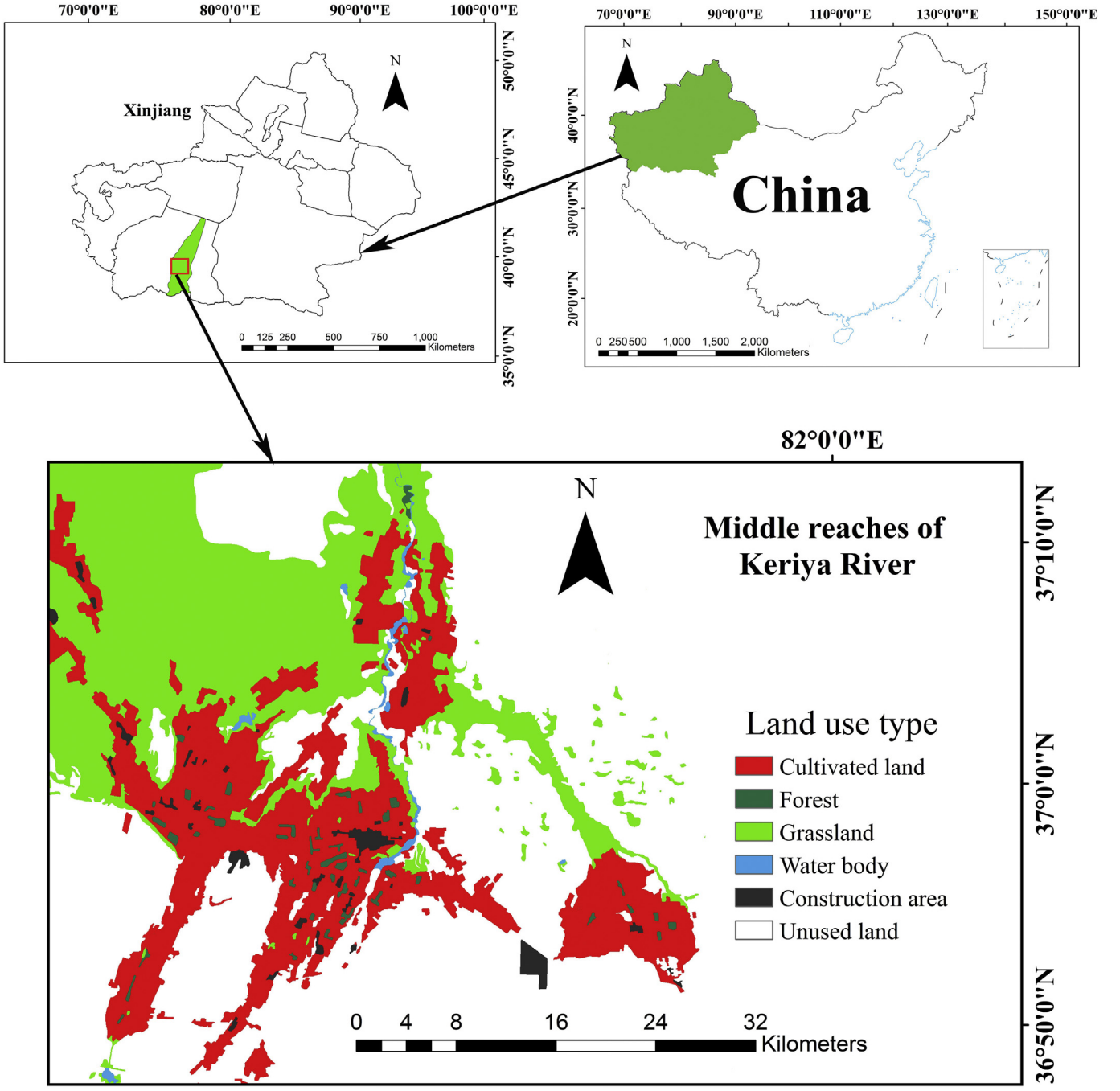

Fig. 1. Map of the study area.

main driving forces of these changes (Xie et al., 2014; Zhou et al., 2017). Cropland expansion has the greatest contribution to the expansion of oases, and the expansion is primarily induced by population growth, economic development and agricultural policies (Lei et al., 2015; Zuo et al., 2014). In northwest China, 61.4% of grassland degradation has been caused by human activities, while 19.94% has been caused by interannual climate change (Zhou et al., 2014).

Large oases occur along the river basins in the Tarim Basin in Xinjiang Uyghur Autonomous Region (XJUAR), and these oases have played significant roles in maintaining human life and biodiversity in these areas (Mamat et al., 2014). Oases provide people with settlement and productivity opportunities because they are a more suitable environment than the surrounding desert (Luo et al., 2008). However, the oases in these regions are ecologically fragile and very sensitive to human interference. With population growth and economic development, oases have changed considerably since the land reform campaign and the market economy changed (Zuo et al., 2014; Luo et al., 2008). Land use/land cover LULC in the Yanqi Basin (along the Tarim River) has changed dramatically, and landscape fragmentation has increased since 1964 (Wang and Wang, 2013). The oases along Hotan River have significantly increased, while the ecotone, an area sandwiched between the oasis and desert, has decreased (Amuti and Luo, 2014). Although the expansion of oases contributes to economic growth and sufficient food production (Zhou et al., 2017), it can cause many environmental problems, such as dust storms, groundwater decline, desertification, salinization, and soil organic carbon decline (Zuo et al., 2014) and disrupt ecosystem integrity, increasing the risk of sustainable development in oases (Fan and Ding, 2016). Hence, analyzing and