



Original research article

The impact of land use and spatial changes on desertification risk in degraded areas in Thailand



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ABSTRACT

Land use, which relates to land cover, is one of the influential factors associated with desertification risk. A study was conducted on the impact of land use and spatial changes on desertification risk in Huay Sai Royal Development Study Centre in southern Thailand. The study used spatial analysis and the MEDALUS model to investigate the extent of land degradation, land use changes and desertification risk in the study area from 1990 to 2010. The Study examined three groups of factors: soils, climate and human activity to classify the severity of desertification risk. The study findings indicate that most areas (74.4%) in the Huay Sai area were at high risk of desertification, and the risk remained high (77.2%) in 2010. However, the areas classified as at severe risk of desertification decreased at 4.2% per annum. The study finds that land use changes influenced desertification risk.

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1. Introduction

The process of desertification is complex, involving interaction among many factors, both environmental and anthropogenic [1]. The phenomenon affects very large areas of the world and can result in irreversible loss of land productivity. The United Nations Convention to Combat Desertification has taken steps to address these issues through many national and regional action programmes [2]. The progress of desertification maybe evaluated by several means, for example, by direct observation and measurement, mathematical models and parametric equations, estimates, remote sensing (RS) and other indicators [3,4]. Typically, the evaluation of desertification risks combines both the physical characteristics of the location and land use patterns in the area [4].

Direct and indirect impacts of land use change on the environment and their implications in global changes and sustainability have long been the subject of study [5]. An attempt to raise awareness of the linkages between land and soil to climate change would not only enrich the substantive and conceptual debates on

effective means for carbon sequestration. It would also provide a new and a highly interesting platform for developing countries to enter into their adaptation and mitigation agendas, considering that soil is the single most important natural resource [2]. Many studies have indicated that land use changes have an effect on soil erosion [6–10], soil degradation [11,12] and soil quality [13,14]. Moreover, land use is considered as a major factor affecting desertification [15,16].

The areas of the Huay Sai Royal Development Study Centre, located in the southern region of Thailand, have faced soil degradation problems for the past 40 yr due to deforestation, expansion of agricultural land, improper land use and over-cultivation without any soil conservation measures [17,18]. In short, the Huay Sai area has been severely exploited. Monocropping and extreme weather conditions, particularly drought, have impacted soil quality [9,15,18]. Moreover, most parts of the Huay Sai area (80.8%) were at a high desertification risk. Previous studies of areas at a high to severe risk of desertification indicate that soil texture and soil fertility are critical factors that lead to desertification [15].

This study aimed to investigate the land use changes and assess the risk of desertification affecting different types of land in the study area. The MEDALUS model was applied to investigate the desertification risk assessment. The RS technique and geographic information system (GIS) software were employed to evaluate changes in land use.

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2. Materials and methods

2.1. Study area description

The study was conducted on the premises of the Huay Sai Royal Development Study Centre, in Cha-am District, Petchaburi Province, Thailand (Fig. 1). The site was completely forested, and was once a habitat for much wildlife, particularly hog deer which is an indigenous species up until 1983, covering approximately 18,414,600 m². The area was subsequently subjected to deforestation and expansion of monoculture farming which caused this area facing the depleted soil and top soil loss problems. Moreover, the area became drought and rain shadow. The consequences of land degradation triggered desertification processes in the area and its vicinity. His Majesty King Bhumibol Adulyadej paid a royal visit to the site in 1983 and remarked on the need for restoration of this area as part of the Huay Sai Royal Development Study Centre project. Subsequent restoration work was based on three approaches: natural resource restoration, water resource development and quality of life improvement for local residents. The latter included the improving of knowledge and awareness for natural resources conservation, and the understanding of the importance of ensuring a sustainable balance between humans and nature [17].

The Huay Sai area has suffered from continuous deforestation, monocropping and the heavy use of agrochemicals which resulted

in direct effects on soil fertility such as drought, low soil fertility levels, soil surface destruction and turning fertile soil shale. The inappropriate use of the soil has brought long-term impacts on the area's fertility [9,15].

2.2. Evaluation of spatial land use changes

According to Lillesand and Kiefer [19] and Ramadan and Kontny [20], Landsat satellite imagery represents the most comprehensive archive of earth observation satellite imagery to date. These data also provide an excellent baseline resource in moderate resolution to provide a basis for land use change detection research.

Landsat 5TM satellite data were used to classify the various types of land use in ENVI image processing software. Several image manipulation techniques were employed, including image enhancement, band ratio and spectral classification, in order to optimize the results for multispectral land classification and visual interpretation [8,9,16,19,20]. Land use changes were investigated by conducting field surveys and applied RS technique and GIS software to interpret the Landsat imagery [8,9]. The two different images taken in 1990 and 2010 were used to classify the various land use types in ENVI using supervised and unsupervised classification techniques. The classified map consisted of five classes of land use: agricultural areas, bare lands, forests, community areas and water bodies.

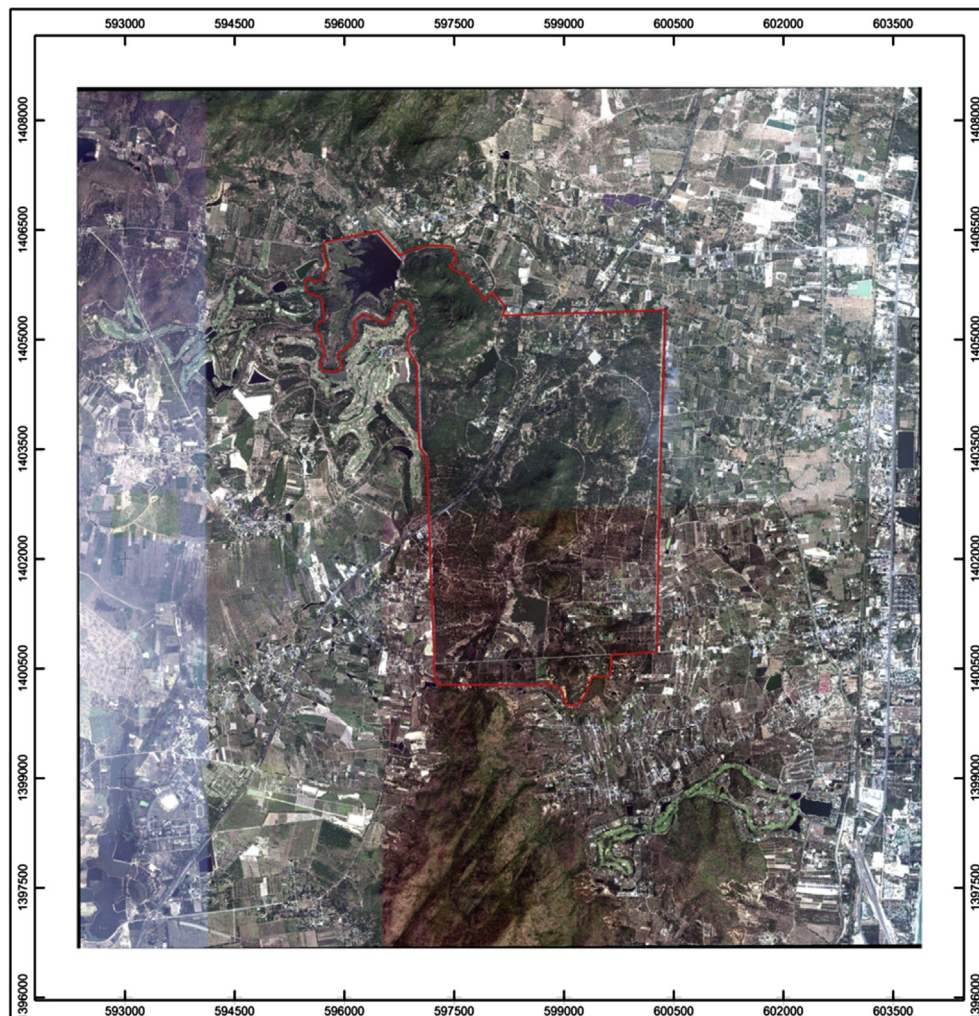


Fig. 1. Huay Sai Royal Development Study centre.

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