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# 学位論文内容の要旨

博士 (環境科学)

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## 学位論文題名

### Studies on changes of vegetation cover of pasturelands in the eastern Alai Valley, Kyrgyzstan

(キルギスタン, アライ谷東部における放牧地の植生被覆変化に関する研究)

Kyrgyzstan became an independent country after the collapse of Soviet Union in 1991. This resulted in great social-economic changes occurred in this country. The Alai Valley, located in the southern margin of Kyrgyzstan, is characterized by a long history of pastoral practice. However, no detailed research about the social-political influences on the grazing activities and vegetation cover of pastureland was conducted in the Alai valley. Moreover, understanding the relationship between climate variables and vegetation cover is important to predict ecosystem response to climate change in the future. This study examined the influence of social-political and climate factors on vegetation cover of the pasturelands in the eastern Alai Valley after the independence of Kyrgyzstan in 1991. First, seasonal pasture use (seasonality) of the pasturelands in the eastern Alai were surveyed by interviews. As a result, three types of the pasture-use seasonality were identified: (1) spring and autumn pastures (SA-type pastures), (2) summer pastures (S-type pastures), and (3) all-season pastures (A-type pastures). NDVI (Normalized Difference Vegetation Index) values of Landsat imageries (acquired on 2<sup>nd</sup> June 1990 and 25<sup>th</sup> June 2013) were calculated and were represented as the situation of vegetation cover of pastureland at the end of Soviet era and two decades after independence. According to the threshold method of NDVI values, the land cover were classified into three types: (1) bare and sparsely vegetated area ( $NDVI \leq 0.2$ ) (2) moderately vegetated area ( $0.5 \geq NDVI > 0.2$ ) (3) densely vegetated area ( $NDVI > 0.5$ ). The result on the changes of the pasture resource from 1990 to 2013 shows that intensely vegetated area increased 20.8%, while bare and sparsely vegetated area and moderately vegetated area decreased 5.0% and 15.8%, respectively. It is indicated that vegetation cover has generally recovered since 1991 in the eastern Alai valley due to the great decrease in the livestock number. MODIS EVI (Moderate Resolution Imaging Spectroradiometer Enhanced Vegetation Index) time series data were used to identify the dynamics of vegetation cover of pastureland from 2000 to 2013. A seasonal-trend decomposition procedure (STL) was applied to decompose the time series data of precipitation, air temperature and EVI into seasonal component, trend component and remainder component. A relationship between the trend component of climate variables and

the trend component of EVI indicates that variation of vegetation cover was more related to precipitation than to air temperature. The 7- or 8-month lagged effect of the trend component of precipitation on the trend component of EVI suggests that snowfall in winter had an influence on the vegetation cover in summer. The lag effect of precipitation also indicates that the growth of vegetation does not respond to the precipitation instantly but to the history of soil moisture. The MODIS EVI time series analysis shows that the general trend of vegetation cover increased from 2000 to 2013. However, in details, the trend of vegetation cover decreased from 2005 to 2008 due to the decrease in the trend of precipitation. The grazing model (Howard and Higgins 1987) were used to assess the grazing intensity during the slope measurement. Summer pastures own the highest grazing intensity due to the highest percentage of overgrazed slopes (53.8%) and the lowest percentage of slopes without grazing steps (34.6%). A-type pastures had the lowest grazing intensity, and were characterized by the lowest percentage of overgrazed slopes (29.5%) and the highest percentage of slopes without grazing steps (60.0%). Vegetation cover mainly decreased on S-type pastures (2.1%) and near the main river across the entire area. This result may be due to higher grazing intensity in these areas. The analysis of the changes of vegetation cover and grazing intensity indicates that summer grazing (S-type pasture) exerts a more negative influence on the sustainability of vegetation cover of south-facing slopes. Although the vegetation cover of the pastureland has recovered after the country's independence, some species were identified as unpalatable. Moreover, the species which were regarded as the indicator of overgrazing exist in the study area (*Artemisia sp.*; *Trisetum sp.* And *Polygonum viviparum*). These species influence the pasture quality and are expected to be removed in the future. The result of the prediction of future scenario based on Markov Chain analysis and CA-Markov analysis indicate that decrease in precipitation in the future may lead to the degradation of vegetation cover. Local people are suggested to graze their livestock on the flat, unused area south to the study area to release the grazing pressure of summer grazing activities on the south-facing slopes.