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Spatial Heterogeneity and Fragmentation Status of Ecosystem Services in Tara Gedam Watershed in the Highland of Northwest Ethiopia

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Abstract

Degradation of land and increase of population in northwest Ethiopian highlands result in fragmented and scattered patterns of land ownership. Because of the small size of plots, it is increasingly difficult to apply proper technology and conservation measures. This consequently leads to shrinkage of effectively cultivable area and to a reduction of the production of ecosystem services (ES). Hence, knowing the parcel size distribution is required to choose and to implement best possible solutions. This requires quantitative information on heterogeneity and fragmentation status of land cover/use types (LCUTs) and ES. The objectives of this study were to spatially characterise LCUTs, to quantify ES at fine scale and to understand heterogeneity and fragmentation status of the highland ecosystem. Field survey was done to collect LCUTs data. Field data collection was supported by high resolution images, Google Earth and topographic maps. Vector data were created for parcels as a land mapping unit (LMU) based on LCUTs and ownership. Spatial metrics (number, density, dominance, variations and others) were used to analyse heterogeneity and fragmentation. Spatial and statistical analyses were done using ArcGIS and SPSS, respectively. LCUTs were summarised as cropland, forestland, grassland, shrubland, agroforestry land and for others. The ES were categorised into subsistence, cultural-spiritual and environmental services. The result showed that 36.3 %, 24.9 %, 21.6 %, 3.2 %, 0.2 % and 13.7 % of the study area were cropland, forestland, grassland, shrubland, agroforestry land and others, respectively. Subsistence services accounted for 57.5 %, cultural-spiritual services covered 12.4 %, environmental services comprised 7.6 % and other uses were estimated to cover 22.5 %. 1763 out of the 1868 LMUs delimited in the watershed are allotted for food production. Highest (199/100 ha) and lowest (1/100 ha) density of LMUs were found for food and for cultural service (church forests), respectively. Small sized LMUs are allocated for food and large sized LMUs are used for conservation/protection. Higher number, higher density, smaller size and higher variability are observed on food providing ES, which is an indication of fragmentation. In conclusion, metrics and indices indicate fragmentation status of LCUTs, ES and ecosystem. Specific socioeconomic and biophysical causes for land parcellation need to be identified to design mitigation measures.

Keywords: Ecosystem services, heterogeneity, land mapping units, spatial metrics

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