Natural resource use in soil-eroded area under semi-arid climate, central Kenya

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We aim at clarifying landform changes and people's natural resource use under physical environmental condition, driving such short/long term landform changes in the semi-arid pastoral area, Laikipia North sub-county. The investigated area, the Il Polei sub-location (N 0°21'56", E 37°04'32"), has an altitude of 1,750 to 1,850 m. According to previous literatures, a mean annual rainfall at the Mukogodo Station, close to the study area, is 362 and/or 371 mm; tree coverage is extremely low, which comprises sparse woods and shrub consisting mainly of Acacia genus. The area is underlain by Proterozoic gneiss, migmatite, quartzite, and schist, belonging to the Mozambique Belt, and geomorphologically, inselberg-pediment systems are regionally identifiable with widespread distribution of pediplain.
Below piedmont angle of the system, near the central settlement, 1.5- to 2-km long gullies exist on the pediment. On the upper part of the pediment, specific sections of gully are present, where the ratio of depth to topmost width of the gully is relatively high (maximum depth: 10 m, topmost width: 1.5 m), although the ratio is much lower than 1.0 in the many of remaining sections, which correspond to general tendency of gully morphology. It is inferred that active gully erosion continues to dominate especially in and around the high ratio sections, because in those sections several knick points are apparently observable on the gully floor and the channels and deposits indicating rill wash occurring are frequently discernible close to the gully head. Bedrocks on the pediment slope are overlain by about 5-m thick sheetwash deposits which intercalate several buried humic layers. The conventional radiocarbon ages of the humic soils in the lowermost part of the deposits are 1,440±20 BP (602-641 cal AD, IAAA-143886) and 1,690±20 BP (338-393 cal AD, IAAA-143887). In order to make clear the erosional rate of gullies, we started to conduct topographic measurements of gully wall; however, significant amounts of gully wall retreat during 6 months (March-September 2015) could not be observed.
It was reported that 2,850 people and 275 households inhabited the Il Polei sub-location in 2005, where most inhabitants were pastoral Maasai peoples, except a minority of Kikuyu who engaged in store management in the central settlement. On the basis of hearing survey, people recognized eroding landscape including gullies in the whole area as a threat to livestock's survival when heavy rain occurring. This is also considered to be due to heavy downpour happening in 2005, when human lives lost by intense flush from the gully. It is said that the entire area had no gullies when residents began to settle in the mid-1980s and that the gullies rapidly became more widespread in early 1990s and have extended since then.
Domestic water in the settlement is distributed with pipes from a borehole of 1.5 km east, and the cost of Kshs 10 per 20 liters is significantly higher. The water supply system was completed in 1994 and currently has relative vulnerability from the viewpoints of system trouble frequency, seasonality of pump discharge, and occurrence of drought. Recently sand harvesting for construction material gradually becomes active in the regional area including the sub-location, in order that people earn cash income more easily. Harvesting targets are mainly obtained by excavation of the river bed, gully floor, and sheetwash deposits. At present, it can be considered that sand harvest still does not promote gully erosion remarkably in the study area. In 2007, however, Kenyan government enforced "National Sand Harvesting Guidelines", since the harvesting became

environmental problem in the whole semi-arid and arid areas. Also in the study area, we need to pay further attention to whether sand harvest will be connected with land degradation in future, under the condition which securing water is severe environmentally and economically.

Keywords: semi-arid area, soil erosion, gully, sheetwash, sand harvest, Kenya

