Assessing the drivers of gully formation and development in the Suswa Catchment, Narok County Kenya, using a participatory geographic information system (PGIS)

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1. Introduction-The Problem

The adoption of participatory action by involving community members, for assessing the resource base conditions has become an attractive methodology for many conservation and development studies (Pathak *et al.*, 2006). PGIS helps to improve communication between the scientific and indigenous communities for sustainable development. The current study was carried out in an area where gully erosion is already affecting the community and livestock. Understanding the drivers of gully erosion is therefore important for reclamation and rehabilitation, hence the need for this study. The research question was: What are the drivers of gully formation and development from the communities' perspective?

Plate 1

2. Study area

This study investigated drivers of gully formation and development using participatory geographic information systems (PGIS) with the local communities of Suswa Catchment Narok County, Kenya.

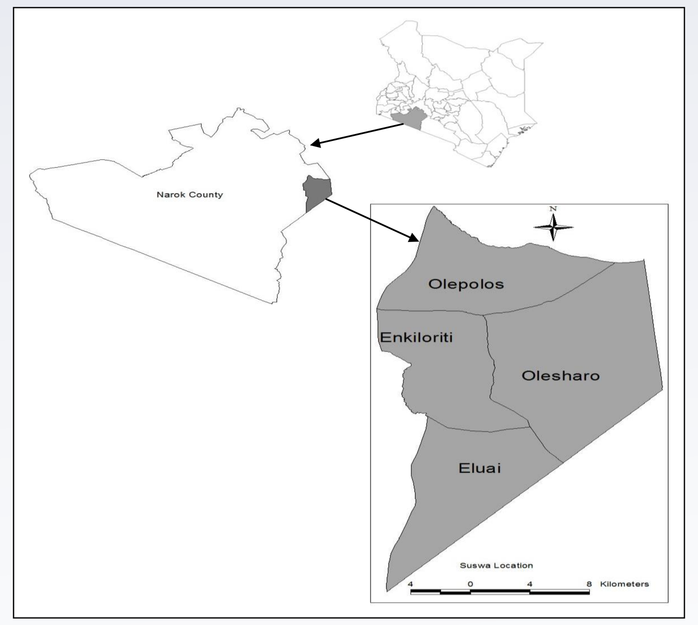


Fig 1:Map of the Study Area

3. Methods

Community members from the 4 villages near the gully, i.e. Eluai, Olepolos, Olesharo and Enkiloriti, were identified.

Purposive sampling was used to identify 30 participants in each village (Ruxton, 2006) who included 15 individuals between 18-35 years, and 15 individuals above 50 years.

Participants drew land use and land cover change maps in Manila papers for the periods 1989, 2000 and 2011 to detect how land use and land cover has changed over time.

The land use and land cover types were classified according to Andersen (1998) guidelines (forest, vegetation, transportation infrastructure including road network).

The PGIS maps were then exported to Arcview-GIS software to calculate areas under different land cover and land uses (forest, agricultural land, grassland, water bodies and settlement).

Percentage changes were determined for the period between 1989-200 and 2000-2011. Chi-square test was used to determine if there were significant changes in land use and land cover change.

Direct benefits and undesirable effects of the changes of the major land resources were discussed in community forums.

4. Results and discussions

The results showed that there were significant changes in shrubland (similar to Udayakumara *et al*., 2010) which decreased in Eluai village ($p < 0.002$) and no significant changes in built up areas, bareland, agricultural land, waterbodies, grassland and shrubland in the 3 villages (Enkiloriti, Olepolos and Olesharo).

Land use change benefits (Table 2) noted in the 4 villages of the study area (Eluai, Olepolos, Olesharo and Enkiloriti) included increased access to grazing areas and firewood. Undesirable land use change effects (Table 3) noted were a decrease in shrubland (similar to Kathumo *et al.,* 2013; Mbila *et al.*, 2003), food production, grazing area and rainfall, and an increase in wind erosion (similar to Syombua, 2013), gully formation and flooding.

Table 1: Land use and Land cover change from PGIS maps

Village	Land use/cover	1989 (area in km2	2000 (area in km2	2011(area in km2	Change (1989-2000) %	Change (2000-2011) %
Olepolos	Built Up Area	0.05	0.52	1	1200	92.3
	Agricultural	0.1	1.56	3	1460	92.31
	Shrubland	3.62	2.07	1.19	-42.82	-42.52
	Waterbodies	0.04	0.28	0.44	600	57.38
	Bareland	0.48	0.88	1.17	83.33	32.95
	Grassland	7.28	6.16	4.67	-15.38	-24.19
Enkiloriti	Built up Area	0.01	0.02	0.1	100	400
	Agicultural	0.001	0.01	0.3	900	200
	Shrubland	2	1.81	0.74	95	-53.59
	Waterbodies	0.001	0.01	0.02	900	50
	Bareland	0.07	0.16	0.38	100	171.43
	Grassland	1.05	1.14	1.5	8.57	31.58
Eluai	Built up Area	0.1	0.13	1.7	30	1200
	Agriculture	0.01	0.1	5.07	900	5600
	Shrubland	29.71	28	8.06	-5.76	-71.25
	Waterbodies	0.1	0.15	1.05	50	600
	Bareland	0.7	2.05	5.78	192.86	181.46
	Grassland	10.44	14.37	23.08	37.64	60.54
Olesharo	Built up Area	0.15	0.52	1.13	246.67	117.31
	Agricultural	0.1	1.56	3.38	1460	116.67
	Shrubland	5.76	4.24	2.77	-26.39	-34.67
	Waterbodies	0.06	0.12	0.24	100	100
	Bareland	0.64	1.22	1.73	90.63	42.62
	Grassland	9.6	8.55	6.96	81.37	-18.6

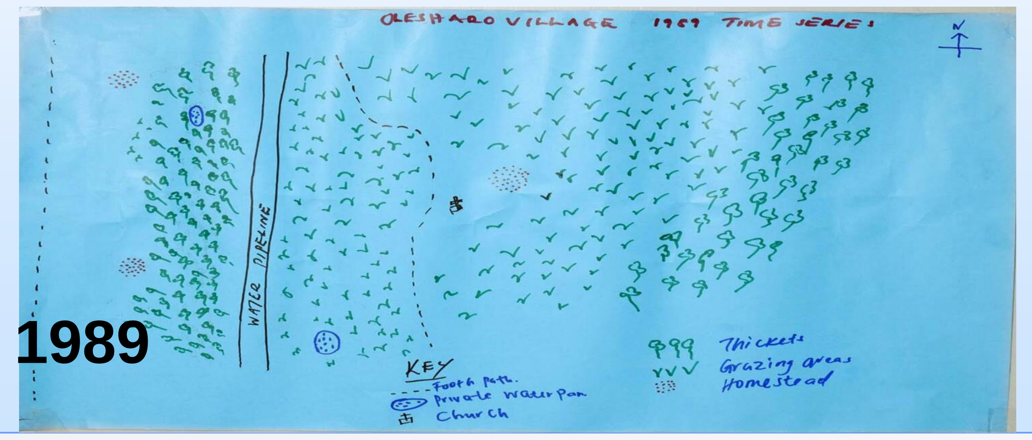
Table 2: Land use change benefits by village

Benefits	Eluai	Enkiloriti	Olesharo	Olepolos
Food production	*	*	*	*
Availability of settlement area	*	*	*	*
Access to nursery/primary schools	*	*	*	*
Access to murram/footpaths	*	*	*	*
Increased pasture land	*	*	*	*
Access to firewood	*	*	*	*
Access to water (water pans)	*	*	*	*
Access to shops	*	*	*	*
Access to churches	*	*	*	*
Access to police post/chief	*	*	*	*

Table 3: Undesirable land use change by village

Benefits	Eluai	Enkiloriti	Olesharo	Olepolos
Reduced rainfall	*	*	*	*
Increased wind erosion	*	*	*	*
Reduced shrubland	*	*	*	*
Floods (water erosion)	*	*	*	*
Reduced pasture	*	*	*	*
Reduced food production	*	*	*	*
Gully formation	*	*	*	*

Maps showing land use and land cover changes in Olesharo village from 1989 to 2011



5. Conclusion and recommendations

The conversion of built up areas, bareland, agricultural land, waterbodies, grassland and shrubland affects the land use system and benefits.

Undesirable land use change are therefore drivers of gully erosion as seen in the study area.

Community recommendations included afforestation, construction of terraces, training on soil conservation, and use of alternative energy other than charcoal.

There is a need for land use zoning and planning in the study area for sustainability.

Also early warning signs of erosion particularly in highly prone areas should be emphasized.