



CHANGES IN LANDUSE/LANDCOVER AND RANGELAND DEGRADATION IN ETHIOPIA

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Major contents

- **Rangeland and Pastoralism in Ethiopia**
- **Land use/land cover changes**
- **Rangeland degradation**
- **Methodology**
- **Major findings**
- **Recommendations, research and development interventions**

Rangeland and pastoralism in Ethiopia

- Location of Ethiopia
- Ethiopian population size
- Lowlands and highlands
- Area coverage of each
- Economic importance
- Major land use system

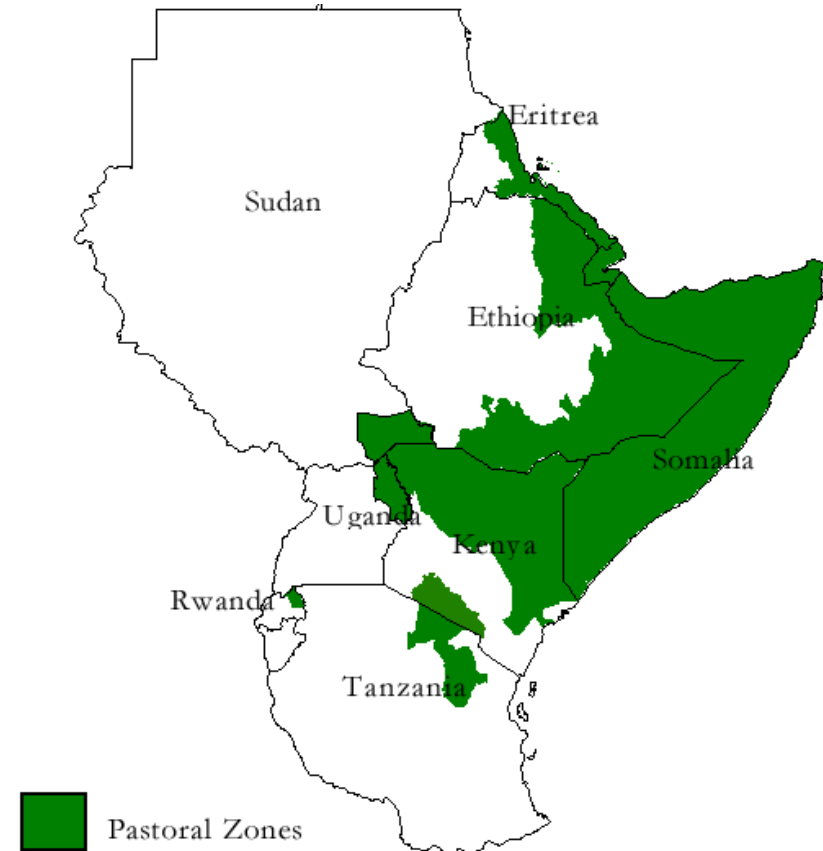
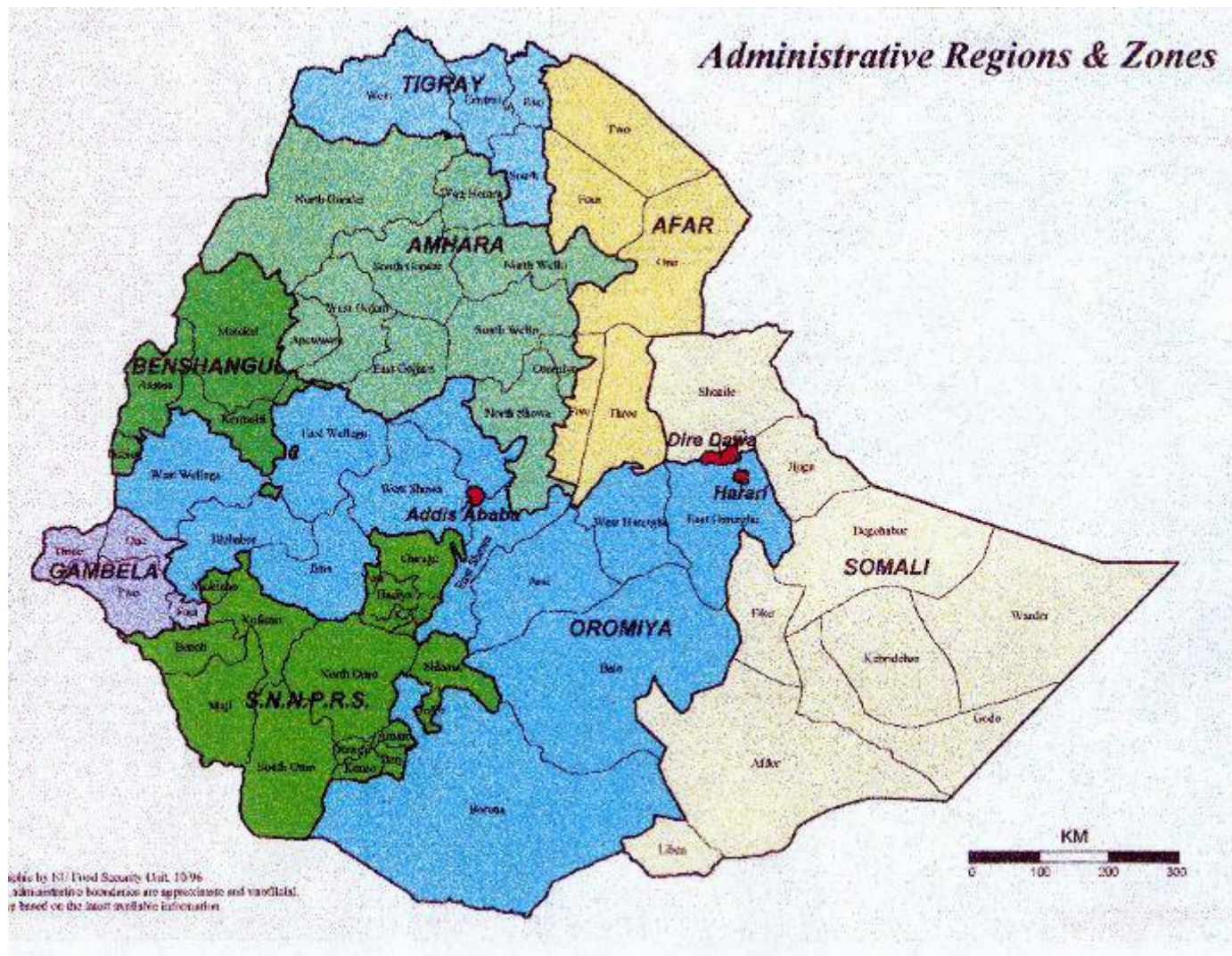


Figure. Geographical location of the countries in the Horn of Africa with their respective pastoral production system zones.



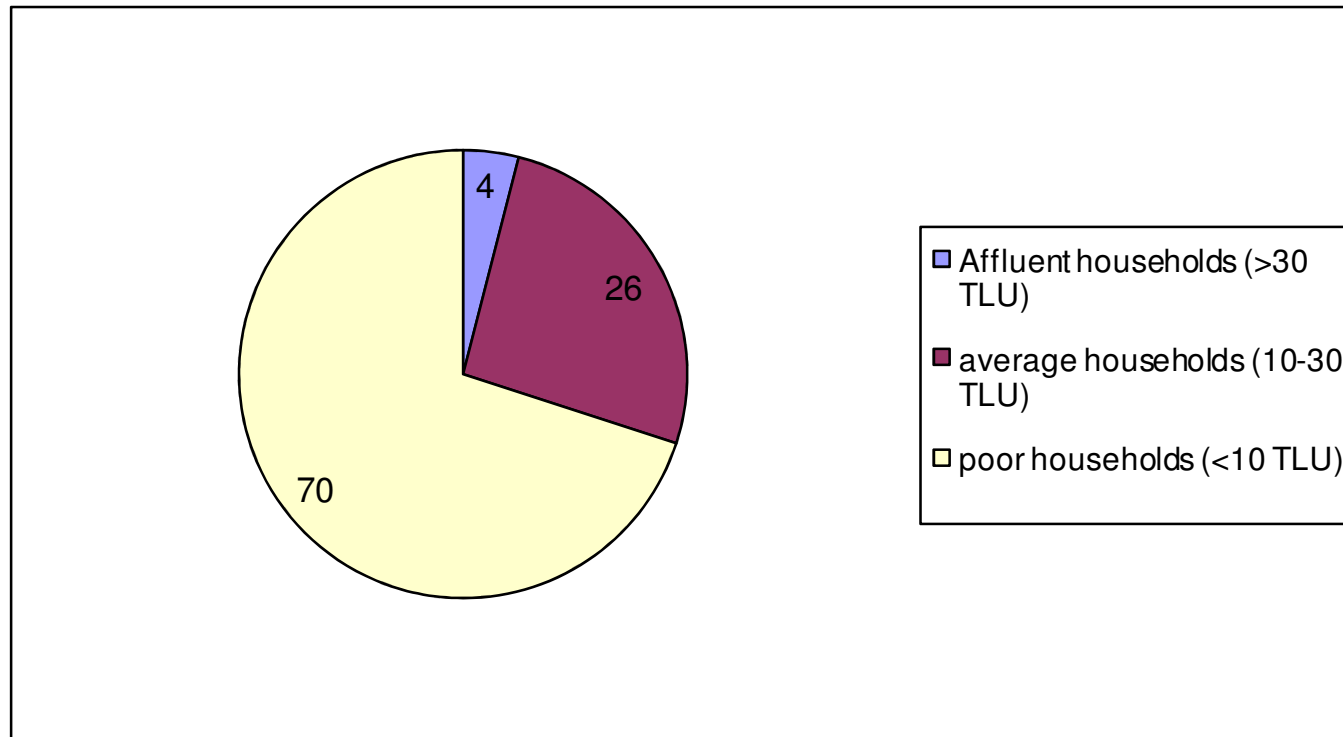
Rangeland and pastoralism in Ethiopia

- In Ethiopia, rangelands support **9.8** million (pastoral and agro-pastoral communities) (PADS, 2004)
- 29 ethnic groups in 7 regions, 21 zones and 124 districts
- 60-65% of the total land area
- Of the 9.8 million, **5.5** million are pastorals, **3.1** million agro-pastorals, and **1.2** million urban dwellers (PADS, 2004).

Rangeland and pastoralism in Ethiopia

- Of the 5.5 million pastoral people,
 - Marginal livelihood condition (Majority)
 - Rely on aid for survival
 - only 1.5 million earn good revenue livestock (PADS, 2004)
- The labour force is **97% illiterate**.

Three Wealth strata of pastoral households in Ethiopia (percent)



Rangeland and pastoralism in Ethiopia

- **Nowadays, pastoralists can no longer live from livestock alone.**
- **Need for alternative livelihood**
- **The current livestock population (25% of human food demand).**

Condition of rangelands in Ethiopia

Range condition class	Area (km ²)	Percent
Good	124, 980	20
Medium	149,970	24
Poor	318,690	51
Areas without range resources	24,990	4
Other land cover types	6250	1
Total (122 districts)	624,880	100

Major rangeland constraints

1. Climatic Fluctuations and drought

Periodic drought

Currently, frequency every **2 to 3 years**.

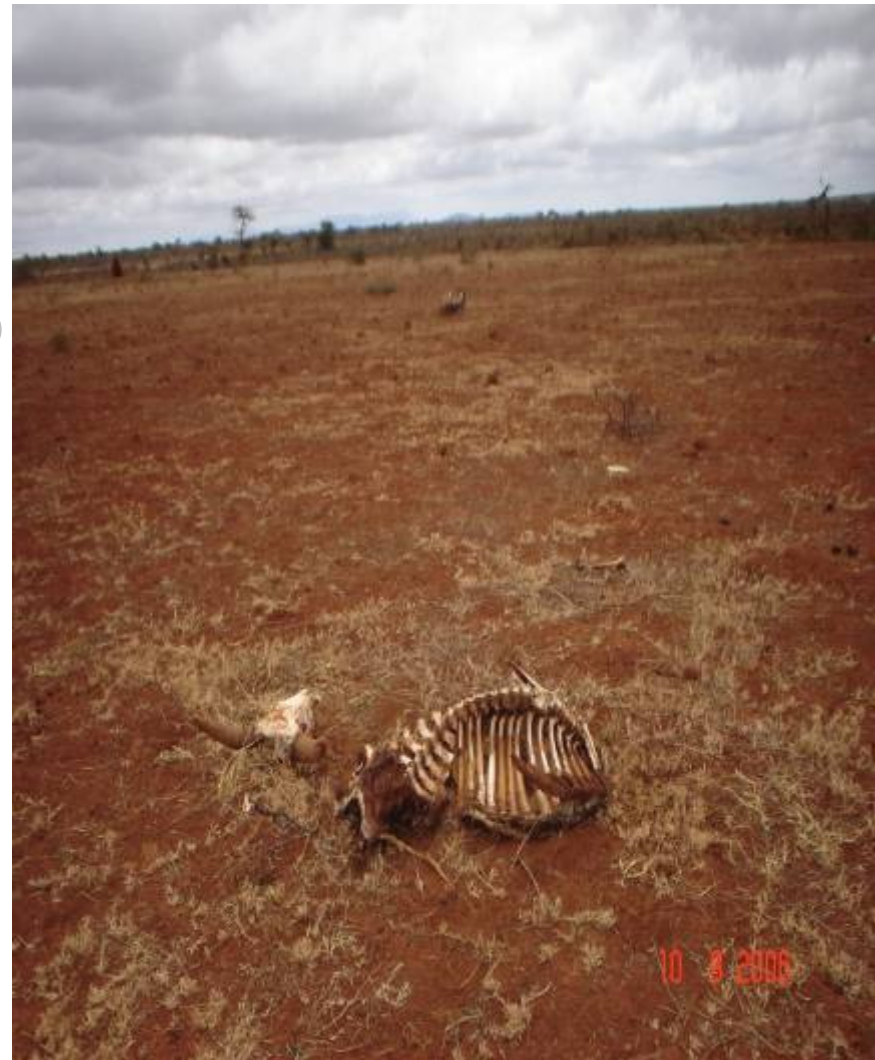
PARIMA

**Herd Dynamics: Synthesis
(Borana)**

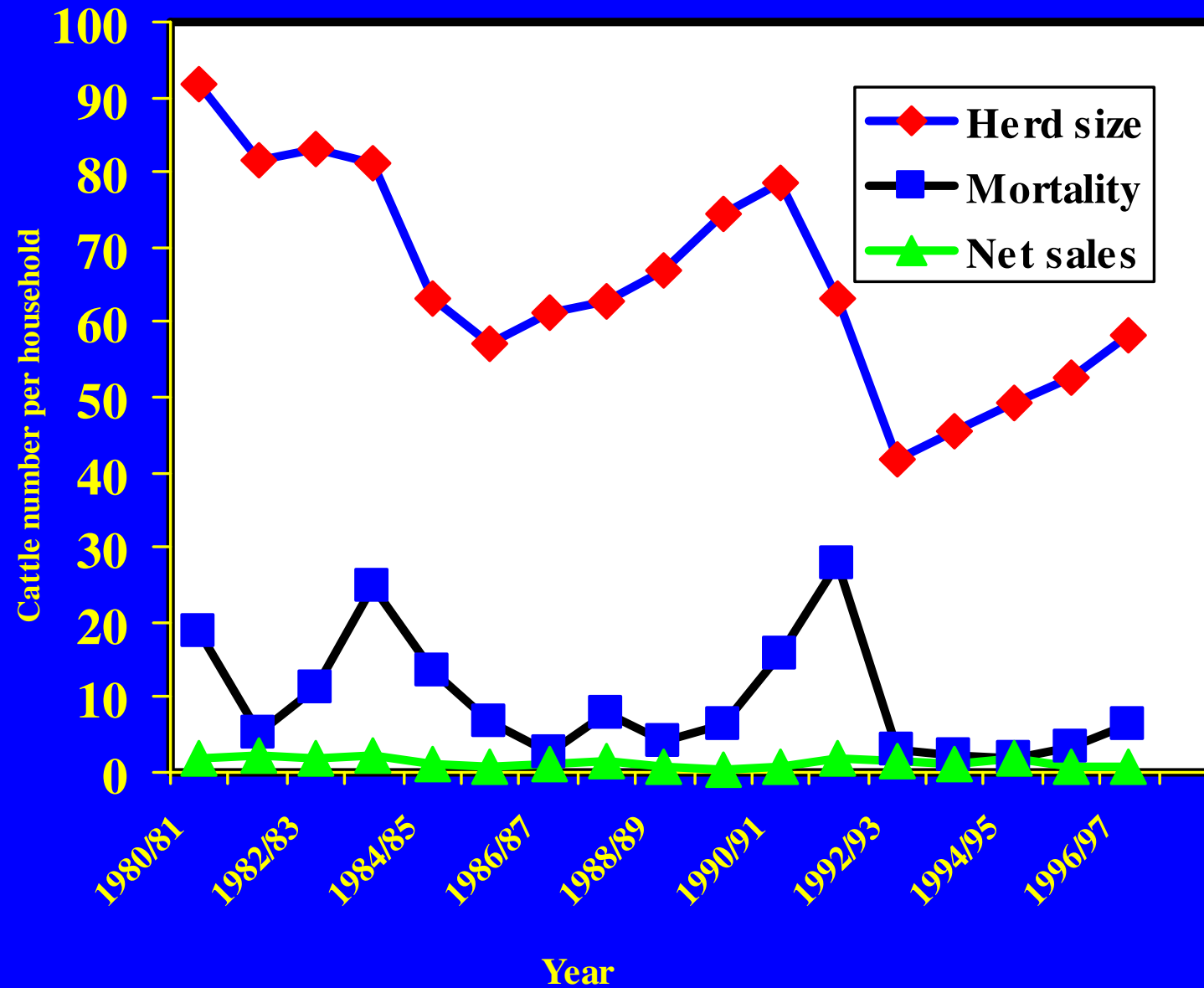
Loss of 37% of herd in 1984-5

Loss of 42% of herd in 1990-1

Loss of 62% of herd in 1998-9



Borana Cattle Dynamics



Major rangeland constraints

- **2. Bush encroachment and other invasive plants**



- **3. Land use/land cover change, rangeland degradation and shrinkage of rangeland territory**

Land use/land cover changes

- **Rangelands complex ecosystems (erratic rainfall) and high rate of vegetation dynamics**
- **Continuous and complex interactions of plant community within the environment**
- **Status of rangelands, causes and direction of changes**
- **Rangeland degradation is one form of land cover modification or change**
- **Land use can be defined as the use of a given land by humans, (on the functional role of land for economic activities).**

Land use/land cover changes

- Land cover refers to the suite of natural and man-made features that cover the earth's surface (Wessels *et al.*, 2004)
- Land cover changes time (human activities and natural disturbance)
- Land use/land cover change plays in climate change **at global, regional and local scales**

Rangeland degradation

- ❁ Serious global environmental issues
- ❁ > 250 million people (directly affected)
- ❁ Some one billion people in over 100 countries are at risk ([Adger et al., 2000](#))
- ❁ Affecting productivity in over 80 countries on all continents
- ❁ 1.9 billion hectares of land worldwide (Adel, 1999)

Rangeland degradation

- ✿ In Africa, annual loss of rangeland productivity at **\$7 billion**
- ✿ In Asia, livestock losses from rangeland degradation total **over \$8 billion**.
- ✿ **Africa and Asia two thirds** of the global loss (Lester, 2002)
- ✿ In Ethiopia alone, GDP loss from reduced agricultural productivity is estimated **at \$130 million** per year

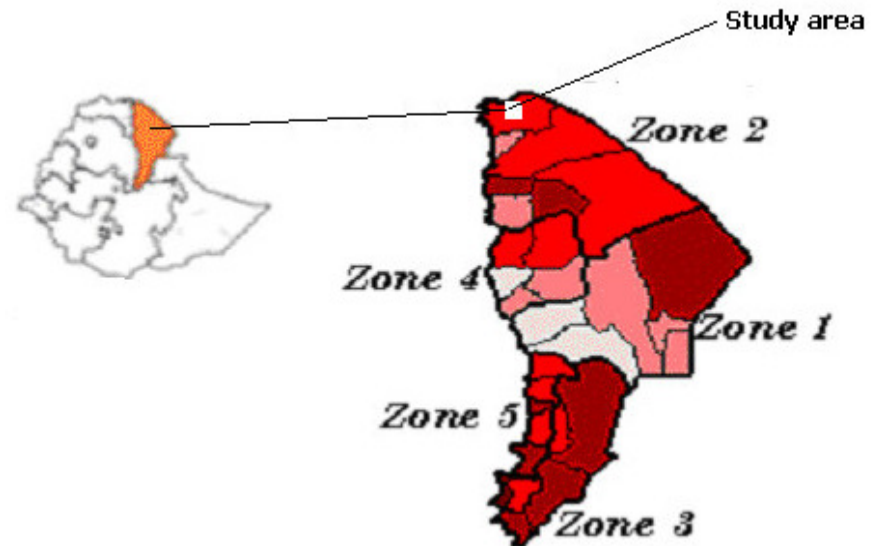
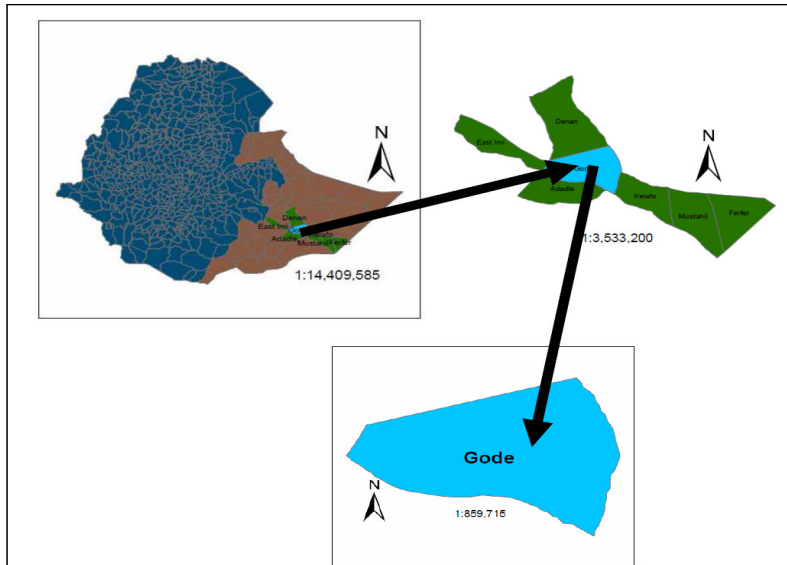
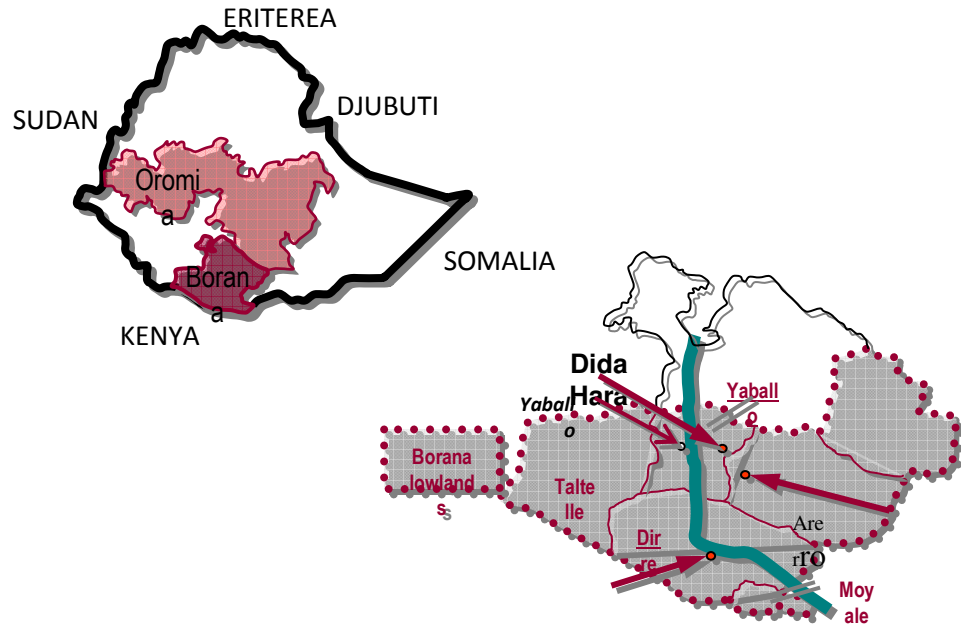
Rangeland degradation

- ❁ **Problems of rangeland degradation perceived differently**
- ❁ **Local land users VS researchers and government officials**
- ❁ **Rangeland degradation Conditions of ↓ biological productivity of land resources (Wessels *et al.*, 2006)**
- ❁ **Capitalize on the works of 3 graduate students**

Objectives of the studies

- ✿ **To have a better understanding of LULCC and rangeland degradation using different techniques**

Methodology



Study procedures

Community perceptions about land-use/land cover changes, rangeland degradation

Informal surveys, secondary data, group discussions, pre-tested semi-structured questionnaires, personal observations

Stratified and simple random sampling of household heads

Vegetation and soil

Gradients (From settlements)

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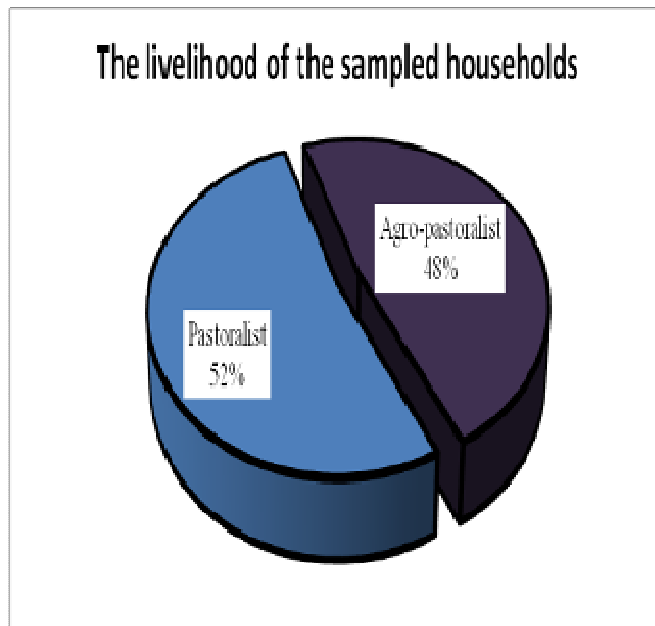
Study procedures

Vegetation sampling by soil and grazing types (Fluvisols, Leptosols and Gypsisols; communal, enclosure, riversides

- **Sampling blocks**
- **Land-use/land cover changes and degradation**
- **Aerial photographs, ETM+, SPOT satellite image**
- **1967-2006**

Major findings

Livelihood of the households and rangeland condition (Gode, Somali)



61.7% (cultivation)
38.3 % (No cultivation)

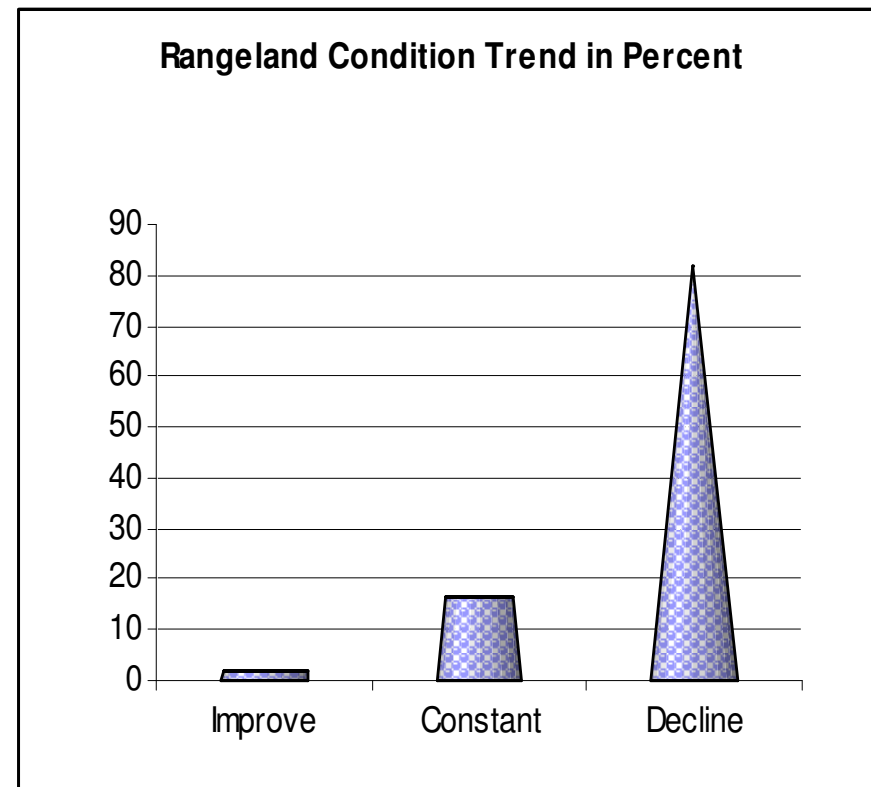


Table . Direction of land cover changes and causes of rangeland degradation in Gode, Somali

Land cover types	F (N)	%	Direction of LULCCs	No. of causes of rangeland deterioration	Number of respondent	Percentage	Rank
1 Grass land cover	65	72.2	Decreasing	1 Drought	43	21.6	1 st
2 Bush land cover	57	63.3	Decreasing	2 Overgrazing	42	21.1	2 nd
3 Woodland cover	53	58.9	Increasing	3 Shortage of moisture	35	17.6	3 rd
4 Cultivated land	56	62.2	Increasing	4 Weakening of social institutions	30	15.1	4 th
5 Degraded land	60	66.7	Increasing	5 Population growth	12	6.0	5 th
				6 Cultivation	11	5.5	6 th
				7 Type of land ownership	11	5.5	6 th
				8 Uncontrolled burning of rangeland	9	4.5	7 th
				9 Urbanization	6	3.0	23 rd 8 th

90% of the sampled HHs

Land use/land cover changes and their percentage (%) (Gode, Somali)

Land use/ land cover type	1973		1986		2001		2005	
	(Km ²)	%	(Km ²)	%	(Km ²)	%	(Km ²)	%
Degraded land	8	4	15	7	20	9	17	8
Grass land	114	54	96	45	85	40	82	39
River	3	1	3	1	3	1	3	1
Settlement	2	1	4	2	9	4	12	6
Bush land	68	32	54	26	48	23	44	21
Woodland	17	8	36	17	40	19	43	20
Cultivated	0	0	4	2	8	4	11	5
Total	212	100	212	100	212	100	212	100

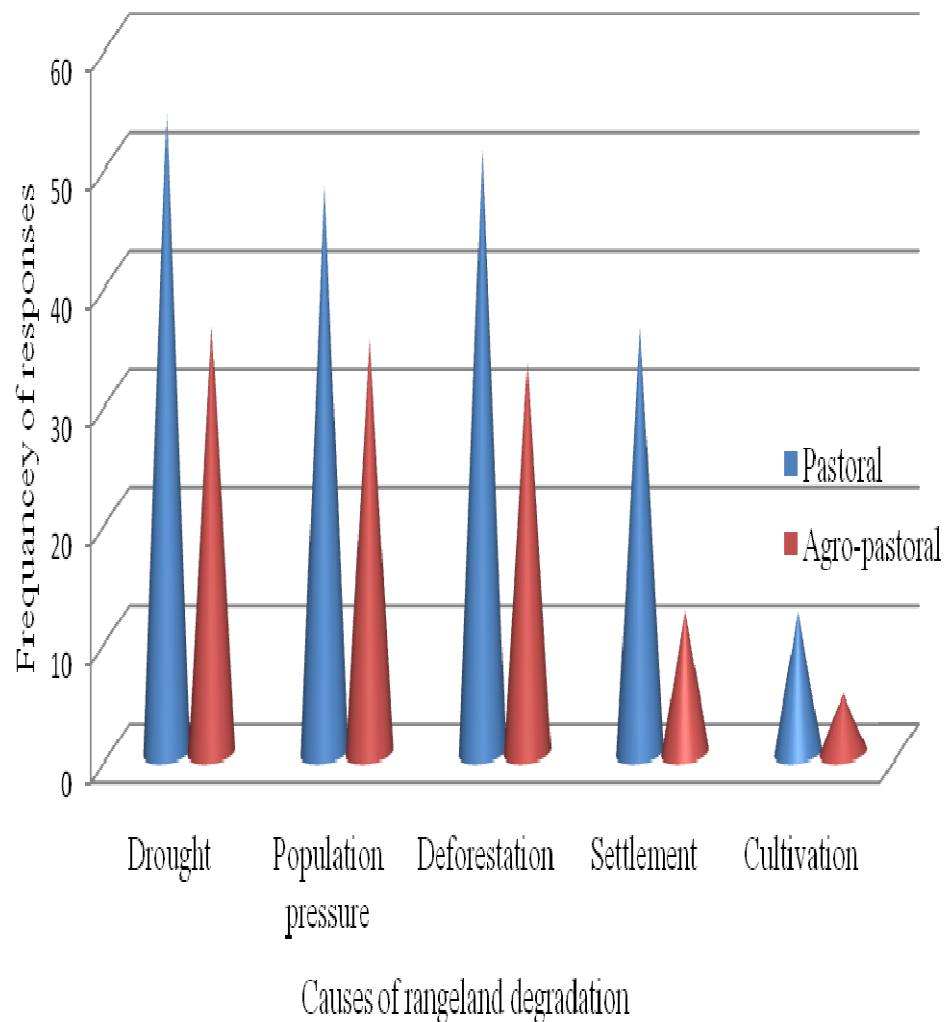


Figure. Major Causes rangeland degradation in Abala (Afar, North East Ethiopia)

Indicators of rangeland degradation	F (N)	(%)
Poor livestock condition	51	56.6
Decreased grass cover	78	86.6
Decreased abundance of trees	77	85.5
Declining herd size	71	78.8
Increased bare ground	73	81.1
Decreased milk production	51	56.6
Increased gully	27	30

Abala (Afar)

- **Seasonal migration**
- **The system of classification of rangelands (communal, enclosures)**
- **Allocation of grazing lands for different seasons does not exist**
- **No strong follow up in rangeland management**

- **100% energy source (Fuel wood)**
- **43.5% -----Herbaceous vegetation losses**
- **39.5%-----woody vegetation losses**
- **9.5%-----Wildlife losses**
- **7.5%-----Soil losses**

Table . Land use/ Land cover changes (ha) from 1986 to 2006 in Aba'ala district

Land use/cover Types	Area (ha)				Change in (ha)	Change in (%)	Direction
	1986	%	2006	%			
Cultivated land	2153.6	29.64	4113.96	56.94	1960.36	27.29	Increased
Bush land + Grass land	3338.19	45.95	1127.38	15.60	-2210.81	-30.35	Decreased
Bare land + Settlement	825.98	11.37	1368.65	18.94	542.67	7.57	Increased
Shrub land + Wood land	946.92	13.03	615.67	8.52	-331.25	-4.51	Decreased
Total	7264.68	100	7225.65	100	-39.03		

Causes of land-use/cover changes (Southern Ethiopia)

- **Population pressure**
 - **Size of present households 5 times 30-40 years back**
- **Woody plant encroachment and ban on bushfire**
- **Cultivation**



Figure . Camels grazing on woody encroached rangeland in one of the vicinities of study areas

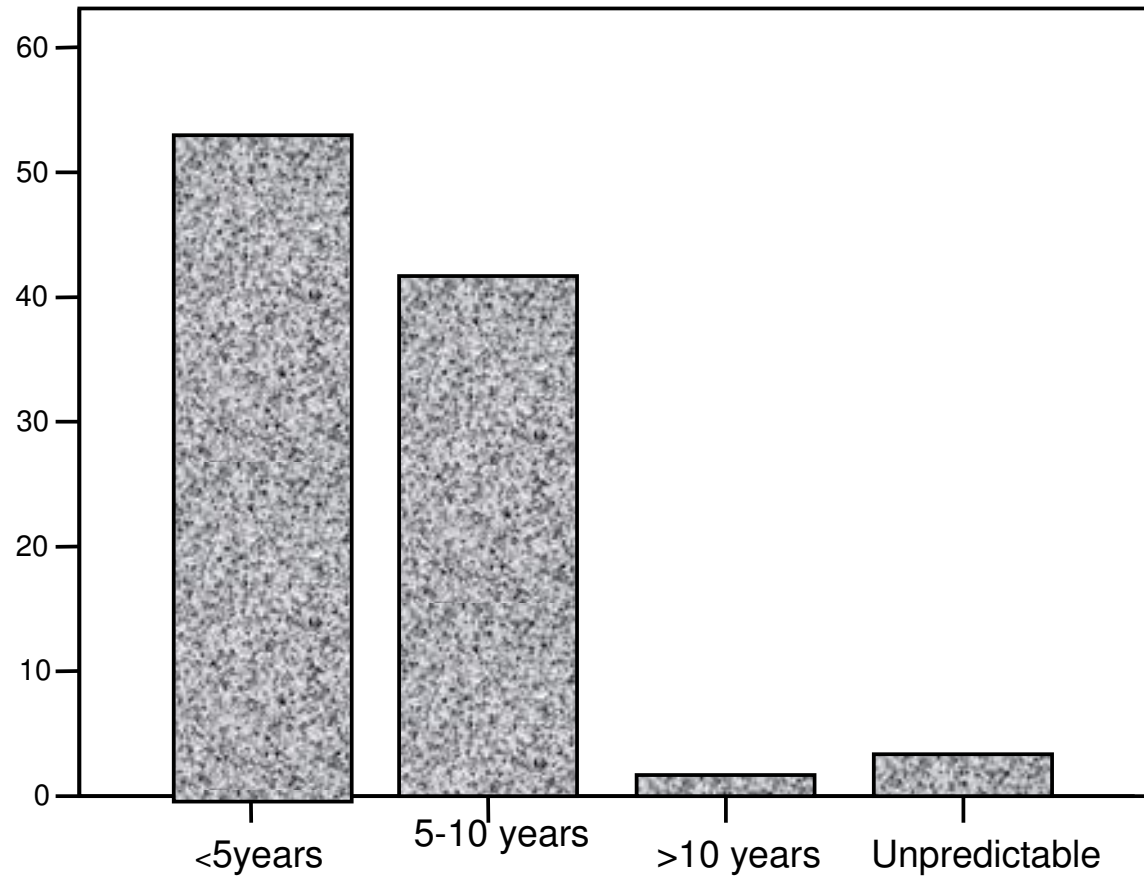


Figure. The frequency of occurrence of drought in sampled household as perceived by the pastoralists (% of respondents)

Table . Land use/ cover changes from 1967 to 2002 in Yabello district of Borana Rangelands, Ethiopia.

Land use/cover patterns	Land use/land cover change (total area coverage (ha) and their percentage)						Changes in land use/land cover in percent			
	1967		1987		2002		1987-1967	2002-1987	2002-1967	Changes per year
	Area	%	Area	%	Area	%	%	%	%	%
Grass cover	3945	34	3249	28	3017	26	-6	-2	-8	-0.23
Woody cover	3365	29	3597	31	4177	36	2	5	+7	+0.20
Cultivated land	580	5	696	6	928	8	1	2	+3	+0.09
Bare land	2436	21	2552	22	1856	16	1	-6	-5	-0.14
Settlement	1276	11	1508	13	1624	14	2	1	+3	+0.09
Total	11602		11602		11602					

Table. Land use/land cover changes from 1967 to 2002 in Areero district of Borana rangelands, Ethiopia

Land use/cover patterns	Land use/land cover change (total area(ha) and their percentage)						Changes in land use/land cover in percent			
	1967		1987		2002		1987-1967	2002-1987	2002-1967	Changes per year
	Area	%	Area	%	Area	%	%	%	%	%
	Area									
Grass cover	12314	57	7500	34	5073	23	-23	-11	-34	-0.97
Woody cover	4921	23	7941	36	8382	38	13	2	15	+0.43
Cultivated land	0	0	0	0	1324	6	0	6	6	+0.17
Bare land	2995	12	3750	17	3970	18	5	1	6	0.17
Settlement	1828	8	2867	13	3309	15	5	2	7	+0.20
Total	22058		22058		22058					

Table 12. Soil physico-chemical properties under three soils and grazing types of the Gode district (Somali)

Soil Parameters	Soil types			Grazing types		
	Fluvisols	Leptosols	Gypsisols	Communal	Enclosure	Riverside
Sand %	61.8±7.9 ^a	70.0±2.0 ^a	69.5± 7.3 ^a	66.2±8.3 ^{ab}	61.2±5.5 ^b	73.3±4.5 ^a
Clay %	17.1±5.4 ^a	8.7±1.2 ^b	16.0±3.2 ^a	14.7±3.8 ^a	16.3±4.7 ^a	15.3±3.1 ^a
Silt %	21.1±6.3 ^a	21.3±1.2 ^a	14.5±4.3 ^a	19.1±4.7 ^{ab}	22.5±6.7 ^a	11.3±1.5 ^b
Texture	Sandy loam	Loamy sand	Sand	Loamy sand	Sandy loam	Loamy sand
pH	8.6±0.20 ^a	8.6±0.13 ^a	8.7±0.16 ^a	8.6±0.10 ^a	8.7±0.15 ^a	8.5±0.46 ^a
EC (ds/m)	0.14±0.02 ^a	0.14±0.04 ^a	0.12±0.03 ^a	0.13±0.03 ^a	0.14±0.03 ^a	0.14±0.01 ^a
OM %	1.88±0.46 ^{ab}	1.35±0.19 ^b	2.28±0.3 ^a	1.65±0.18 ^b	2.82±0.74 ^a	0.95±0.26 ^c
TN %	0.14±0.05 ^a	0.07±0.04 ^a	0.10±0.05 ^a	0.07±0.03 ^b	0.14±0.04 ^{ab}	0.19±0.12 ^a
AP (mg/Kg)	5.13±1.27 ^a	4.18±0.61 ^a	5.54±0.88 ^a	3.93±0.69 ^b	7.56±1.39 ^a	3.74±1.33 ^b
K (mg/Kg)	2.53±0.56 ^a	1.61±0.43 ^a	1.80±0.70 ^a	2.04±0.45 ^a	2.32±0.62 ^a	2.02±0.89 ^a

Table. Soil chemical characteristics at three different distances from settlement in Aba'ala District (Afar)

Sample sites		chemical characteristics					
		PH	%OC	% OM	K (mol/kg)	P (mg/kg)	% N
1	Near	7.3	1.82	1.34	0.125	1.57	0.216
	Middle	7.5	0.78	1.35	0.158	1.29	0.278
	Far	7.7	1.35	2.33	0.133	3.75	0.256
2	Near	6.9	0.25	0.43	0.148	0.95	0.149
	Middle	7.6	1.2	2.07	0.095	1.37	0.068
	Far	7.4	1.46	2.52	0.122	1.09	0.181
3	Near	7.2	0.92	1.57	0.087	4.97	0.074
	Middle	7.2	1.19	2.05	0.102	1.48	0.098
	far	7.6	0.67	1.16	0.145	1.43	0.148

Table . Range condition scores (LSM+SE) in different soil and grazing types (Gode, Somali)

	Soil type			Grazing type		
	Fluvisols	Leptosols	Gypsisols	Communal	Enclosure	Riverside
BC	6.08±1.23 ^a	4.50±0.55 ^b	6.84±0.95 ^a	5.56±0.99 ^b	7.38±0.77 ^a	5.00±1.63 ^b
GC	5.33±0.78 ^b	2.83±0.75 ^c	7.00±0.86 ^a	4.28±0.84 ^b	9.10±0.66 ^a	1.75±0.96 ^c
SC	3.14±0.34 ^a	3.00±0.00 ^a	3.54±0.51 ^a	2.67±0.35 ^b	4.38±0.25 ^a	2.75±0.50 ^b
SE	2.56±0.47 ^a	1.50±0.55 ^b	2.96±0.46 ^a	1.28±0.46 ^b	4.75±0.50 ^a	1.75±0.50 ^b
WV	5.47±0.81 ^b	8.38±0.82 ^a	9.33±0.85 ^a	5.90±1.56 ^b	9.67±0.45 ^a	1.75±0.50 ^c
TS	22.58±3.63	20.21±2.67	29.67±3.63	19.69±3.09	35.28±3.74	13.00±4.09
RC	Fair	Fair	Good	Fair	Excellent	Poor

BC=basal cover, SC=soil compaction, SE=soil erosion, WV=woody vegetation, GC= grass species composition score, TS=total score and RC=rangeland condition.

(^{abc} Means within a row with different superscripts are significantly different at P < 0.05)

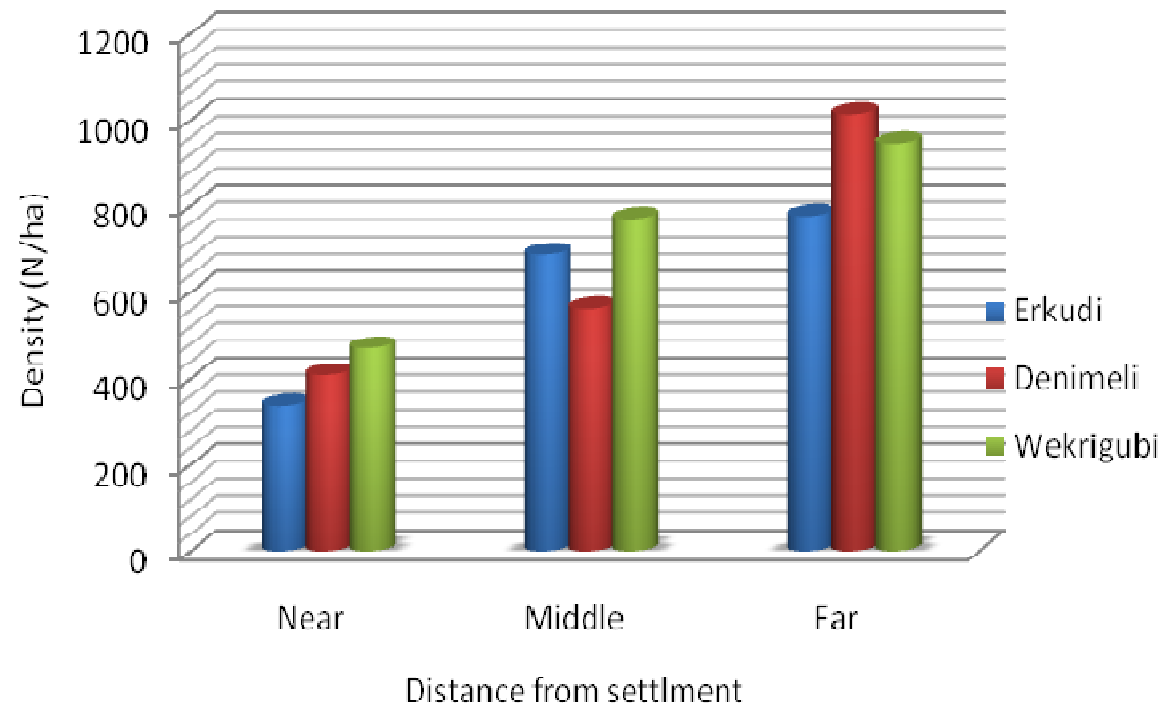


Figure. Woody vegetation density (N/ha) in three villages at three different distances from settlement in Aba'ala district

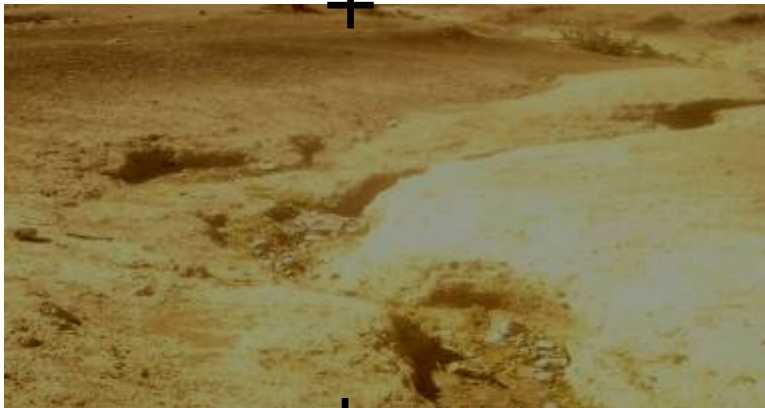
Table . Range condition scores (Mean \pm SD) of different land use types in Borana rangelands, Southern Ethiopia.

land use types	Means of range condition factors							
	GC	BC	LC	AG	NS	SE	SC	TRSC
<i>Warra</i>	4.08 \pm 1.93	2.29 \pm 1.11	3.10 \pm 0.07	2.85 \pm 1.37	2.68 \pm 1.38	2.39 \pm 0.94	2.31 \pm 0.84	19.78\pm5.99
<i>Kalo</i>	4.75 \pm 2.27	3.92 \pm 1.51	3.25 \pm 0.11	3.64 \pm 0.72	2.50 \pm 0.89	3.29 \pm 0.69	3.31 \pm 0.81	24.43\pm4.21
Ranch	7.25 \pm 1.71	5.96 \pm 0.56	3.20 \pm 0.18	3.94 \pm 0.42	2.81 \pm 0.38	3.81 \pm 0.33	3.90 \pm 0.26	30.87\pm2.89
Pond	2.60 \pm 1.65	4.48 \pm 2.16	1.00 \pm 0.00	3.10 \pm 0.94	1.70 \pm 0.83	2.50 \pm 0.76	3.05 \pm 0.79	18.43\pm6.06

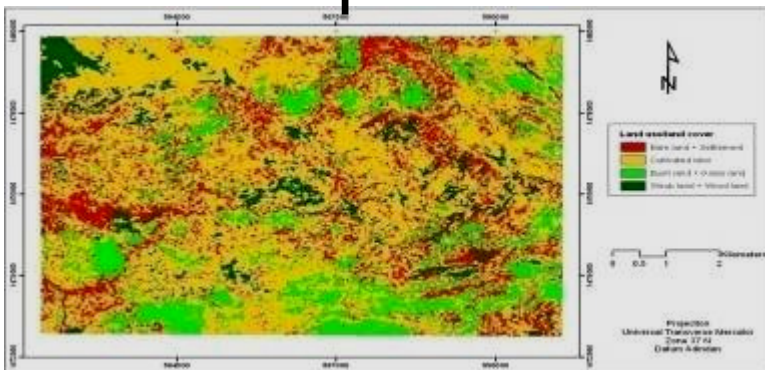
CONCLUSION



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LU/LCC and
Range land
degradation

Recommendations, research and development interventions

- **Use of combination of techniques best to better understand land use/land cover changes and rangeland degradation.**
- **The communities and the other stakeholders should give due attention in rehabilitating degraded rangelands through different techniques**
- **Community empowerment is crucial to effective range management**
- **Community based natural resource management with due attention to the role of women and looking for alternative source of energy**

Recommendations, research and development interventions

- **Rangeland utilization and management strategies should aim to maintain best conditions of the rangeland and minimum impacts of the environment including soil characteristics.**
- **Management and development interventions for the rangelands should incorporate participation of the community to ensure effective production, realization of the potential of the rangelands and development of the rangeland.**
- **Proper implementation of the population policy (family planning) and educate and empower women to control their own fertility**

Recommendations, research and development interventions

- **The LU/LCC and LD were based on temporal variation, therefore, further studies need to be undertaken spatially and temporally in large areas and including policy issues**
- **Both the economic and ecological analysis should be studied among the different land use/land cover forms and priority should be given to the ones most important to the community and the environment as a whole**
- **Land use suitability studies.**
- **Study on appropriate methods of rehabilitating degraded rangelands**
- **Soil seed bank study**

Recommendations, research and development interventions

- **As the studies were based in one season, detailed biological studies need to be undertaken on herbaceous, woody and soil layers**
- **The utilization practice, biomass production and chemical composition and characterization of major feed resources**
- **Regular inventory of rangelands and monitoring land use/land cover as well as trend in range conditions should be undertaken as a tool to improve the conditions of rangeland resources and environment.**
-

Recommendations, research and development interventions

- **Research should focus on understanding the mechanisms of encroachment, properties of the individual encroaching plant and their control method**
- **Conservation of the rangeland resources and maintenance of diversity is helpful to make the range resources sustainable.**
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Thank you