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Nature and causes of land degradation in the Oromiya region: A review of literature

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Introduction

The objective of the paper is to identify the nature of and principal factors causing land degradation in the Oromiya region and to provide empirical evidence relating to land degradation based on available literature and secondary data. This will lead to identification of gaps in knowledge about land degradation processes and its causes, and to development of hypotheses about possible pathways to intensify agriculture in a sustainable way. These hypotheses will be tested with field data collected at later date.

Oromiya is located in the central part of Ethiopia extending from 3°20'N to 10°35'N and from 34°05'E to 43°11'E, with a total land area of 353,690 km^2. It constitutes about 31.2% of the total land area of the country, making it the largest of the 14 regions of Ethiopia.

The region has variable topography consisting of a high and rugged central plateau, which is divided into two by the Great East African Rift Valley, and the peripheral lowlands. Elevation in the region ranges from less than 500 to over 4300 m above sea level, with the highlands[1] constituting about 48% of the region's area. Mean annual temperature ranges from 10°C to 22°C in the highlands and from 22°C to 30°C in the lowlands. Annual average rainfall in the region ranges from 200 to over 2100 mm.

The total human population in the region was 20.5 million in 1998 and has an annual population growth rate of 3%; the livestock population is estimated to be about 18.7 million tropical livestock units (TLU). The highlands host more than 80% of the total human population and 70% of the livestock population in the region and account for over 90% of the cropland. Almost 90% of the economic activities of the region are concentrated in the highlands.

Causes and effects of land degradation in Oromiya

The major forms of land degradation in the region are deforestation, soil erosion and soil nutrient depletion. Some of the proximate and underlying causes of land degradation are discussed below.

Soil properties: Soils vary in their resistance to erosion. For instance, Inceptisols and Vertisols by their very nature are fragile and sensitive to both geological and man-made

1. Highlands are defined as those areas >1500 m above sea level.

erosion. These soil types are among the major soil groups in Oromiya covering the Chercher highlands (Harerge), the central highlands and basins in western Oromiya where soil degradation rates are also observed to be high.

Climatic factors: Major climatic factors that determine soil erosion in the region include rainfall and wind. Rainfall intensity is more important than rainfall amount in causing erosion because a high proportion of rainfall occurs in a short period. Sheet and rill erosion are by far the most widespread kinds of erosion and are more significant to agricultural production than other kinds of erosion. Rainfall with an intensity exceeding 7.6 cm/hour (h) for 5 minutes (min), 3.6 cm/h for 15 min, 2.5 cm/h for 30 min, or 2.0 cm/h for 60 min is classified as an excessive and erosive rate of rainfall. Rates much higher than these threshold levels are common in the region and such intense rainfall events caused about 50% of the total soil loss from some test plots in the region.

Soil formation vs. loss rates: Estimated rates of soil formation in Ethiopia vary between 2 and 22 tonnes/hectare (t/ha) per year, while soil loss rates range from 51 to 200 t/ha per year (dominantly from 51 to 100 t/ha) in some parts of Sidamo and the Bale highlands, and from 100 to 200 t/ha per year on sloping cultivated land in parts of Illubabor.

Vegetation and land cover: Generally, erosion rates are lowest in areas of undisturbed forests. The removal or destruction of vegetative cover and frequent tillage lead to soil erosion. Due to decreases in the degree of vegetation cover, increased tillage that leave the surface smooth, the large number of livestock and their frequent trekking for water and grass, and poorly constructed roads, both water and wind erosion are becoming serious problems in Oromiya, especially in the rift valley and associated lowlands. Recent estimates indicate that 3.1% of the natural forests in Oromiya are lost annually. A study in three Peasant Associations (PA) of Adaba and Dodola (Bale zone) during 1993–97 showed that the annual rates of deforestation were 1.6%, 9.4% and 5.6%, respectively. Another study conducted during 1996–98 in the Belete forest and the Gera forest of Jimma zone showed that the annual rates of deforestation were 9.5% and 4.7%, respectively.

Nature of economic activities and land use practices: Different types of economic activities and their associated techniques of production or practices cause varying levels of land degradation. For instance:

- In the Metu area, a test plot covered by teff, which requires fine tillage, exhibited runoff almost four-times higher than that of a plot under maize (runoff = 437 vs. 112 mm) under the same slope conditions (both gradients = 18%). Forest coffee on much steeper slopes (gradient 51%) showed the least runoff throughout the test period, with a maximum of only 36 mm. Over 81% of soil erosion in Chiro *wereda* has been attributed to practices such as cultivation on steep slopes, runoff from surrounding fields, cattle tracks and footpaths, and defective soil conservation measures.
- An equivalent of about 22.6 to 28.5 million giga joules (GJ) of energy from animal dung is used for fuel in the region each year. Use of dung as fuel means denying the soil of this effective conditioner and fertiliser. This practice is most pronounced in areas where forest cover has more or less disappeared and where an acute fuel short-

age is occurring, as in East Shewa, North Shewa, West Shewa, Arsi and Bale. Some other local practices for soil management are also decreasing in importance.

- Generally, the rate of mineralisation is high in the absence of natural cover, as when topsoil is exposed to unusual extremes of temperature and humidity. There is evidence that soil organic matter content increases as the length of fallow period increases, whilst it decreases as cultivation period becomes longer. In the Metu area, Illubabor zone of the Oromiya region, soil organic matter content decreased from 20% to 7% in less than 3 years of continuous cultivation as a result of mineralisation.
- About 52% of the total land in the crop–livestock system of the highlands is used for grazing and browsing. Current estimates indicate that the total feed requirement in the region is higher than the naturally available feed potential. Accordingly, the feeding balance estimation made based on fodder unit (FU) reveals that there is a significant deficit (23.5%) of feed supply in the region, resulting in overgrazing of pasture lands at least in some parts of the region.

Population pressure and poverty: Population pressure has led to cultivation of marginal land and steep slopes, causing land degradation. The level of poverty of people, their level of knowledge, perception and attitudes, and degree of infrastructure and local market development also impact on land degradation. For example:

- Throughout highland and mid-land Chiro, eastern Oromiya, despite a guideline to cultivate only lands with slopes with gradients below 35%, increased population pressure has forced farmers to cultivate areas with gradients of 50%, thereby contributing to the degradation process. In Melkedera PA of Ambo *wereda* in Oromiya, population increased by 25% between 1984 and 1994. Moreover, resettlement in 1984–85 is reported to have increased the population of Sor *awraja*, Illubabor, by up to 12%, leading to pressure on land and its quality.
- In some parts of the region, increasing population pressure has led to fragmentation of land and intensive cultivation without better quality inputs and this has led to degradation. A study in Dizi catchment in the Metu area showed that in 1957 and 1982, respectively, the amount of cultivated land was 30% and 41% of total area or 38% and 51% of the land available for cultivation, causing the crop:fallow cycle ratio to decrease from about 1:2 to 1:1 over this period. About 29% of the families in Ambo *wereda* do not have access to land, while at least 30% of the households hold less than half a hectare of land. A survey in Agucho village in West Harerge showed that cultivated land per capita decreased from 0.29 ha in 1983 to 0.12 ha in 1988.
- People's level of poverty also determines their behaviour in terms of conservation or degradation of natural resources. For instance, due to the increasing poverty in Melkedera PA in Ambo *wereda*, reliance on off-farm activities including marketing forest products has become common practice for the people. A forest dependency survey conducted in the area showed that 22% and 33% of the households in the PA are occasional and regular dependents on forest, respectively, for their livelihoods.

Land tenure policies: Land tenure has, over the years, been one of the most important institutions that affect land management decisions in Oromiya. Theoretically, tenure security and investment in land, and hence better management of land including use of

appropriate technologies are positively related. Land tenure security has been poor generally under all the three political regimes in recent periods: the feudal, Derg and current regimes. During the feudal period, the Emperor confiscated and granted all the lands as and to whom he chose. During the Derg and current regimes, rural farmlands belong to the people but are controlled by the government. As a result, there have been frequent redistributions by the government to accommodate new families. For instance, in Tiyo *wereda*, there have, on average, been 3.5 land redistributions per household while 17% of all PA members have experienced five or more redistributions since their first allocation in the mid-1970s. Such uncertainty would be expected to reduce incentive for investment in better management of land.

Research and extension policies: The history of agricultural research and extension in the region is not very long. Moreover, research and extension activities throughout the past periods have concentrated on crop improvement and productivity increasing technologies and inputs. Conservation *per se* has received little attention. Also, research and extension have served the large-scale private and state-owned commercial farms rather than the smallholder sector. Consequently the vast majority of smallholder farms has benefited very little from research and extension programmes. Some efforts have been made by both government and development agencies to introduce conservation technologies but these technologies were not sustained once the outside initiatives and support were discontinued.

Effect of degradation on productivity: As erosion reduces crop productivity, the degree of control of erosion declines due to decreasing vegetative cover. Therefore, once crop productivity begins to decline because of soil degradation, land degradation becomes self-perpetuating. Crop yields on severely degraded soil are much lower than those on protected soils because erosion reduces soil fertility and water availability. In West Harerge, a 72% yield reduction of barley was observed as a result of soil erosion over a 15-year period.

Possible pathways of sustainable land management in the region

The major factors that may determine comparative advantage of different development pathways include agricultural potential, market access and population density. In terms of agricultural potential, Oromiya region falls into three broad agro-ecological zones: a high potential cereal zone, a low potential cereal zone and a perennial zone. Vertisol soils are a major land resource in the high potential cereal zone but major constraints in this zone are water-logging and drainage. In the low potential cereal zone, low productivity, high risks and limited options are constraints. In the perennial zone, soil acidity is a general problem. Each agro-ecological zone has domains with a combination of population density and market access gradients, which also define opportunities and constraints. Therefore a diversity of situations exist in the region requiring identification of different sets of appropriate technology options, and policy and institutional support mechanisms. However, policy options may be more general and widely applicable than

technology options. For example, intensification of cereal production using high quality external inputs and expansion of perishable cash crops may form two major strategies for the high potential cereal zone with good market access. In the low potential cereal zone with low market access and a low population density, an appropriate strategy may be to increase the productivity of the mixed crop–livestock system by improved management of grazing lands and woodlots, and integrated soil nutrient management on cultivated land. Given that this area is inherently degraded or of low fertility, special attention for improvement of soil quality may be needed. The potential of these possible pathways will be validated through household- and plot-level surveys.