5. Land degradation and resilience in Wollo from the 1930s onwards, as derived from aerial and terrestrial photographs

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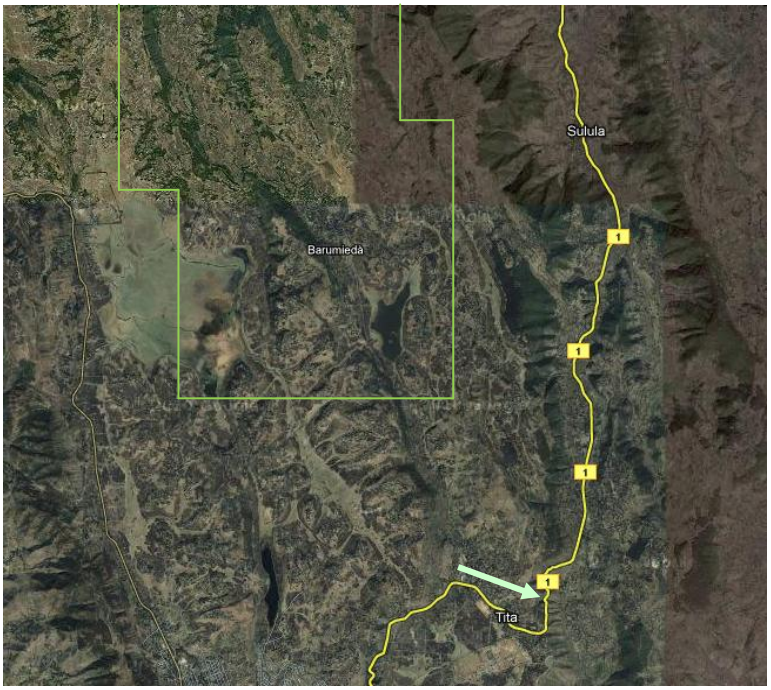

Fig 1. The study area North of Dessie (from Google Maps). Arrow indicates the excursion viewpoint. The approximate area covered by the 1936 aerial photographs is outlined.

Introduction

Popular perceptions in the North Ethiopian Highlands, including Wollo, are that there were many more trees in earlier times (i.e. 1935-1945), as shown in interviews with elders concerning overall changes in numbers of trees, realised in 1997 (Table 1).

Table 1. Perceived changes in numbers of trees, Wollo (after Crummey & Winter-Nelson, 2003)

Peasant Association cluster	More trees then	More trees now	No response	Total
Borru	5	6	4	15
Gerba	18	0	2	20
Gwobeya	4	3	9	16
Sulula	9	6	4	19
T'abisa	4	3	4*	11
T'is Aba Lima	5	0	2	7
TOTAL	45	18	25	88

* One of the T'abisa informants judged that there had been no overall change in tree numbers.

This study makes a multi-temporal and multi-disciplinary assessment of changes in vegetation cover over a period of 70 years, in South Wollo.

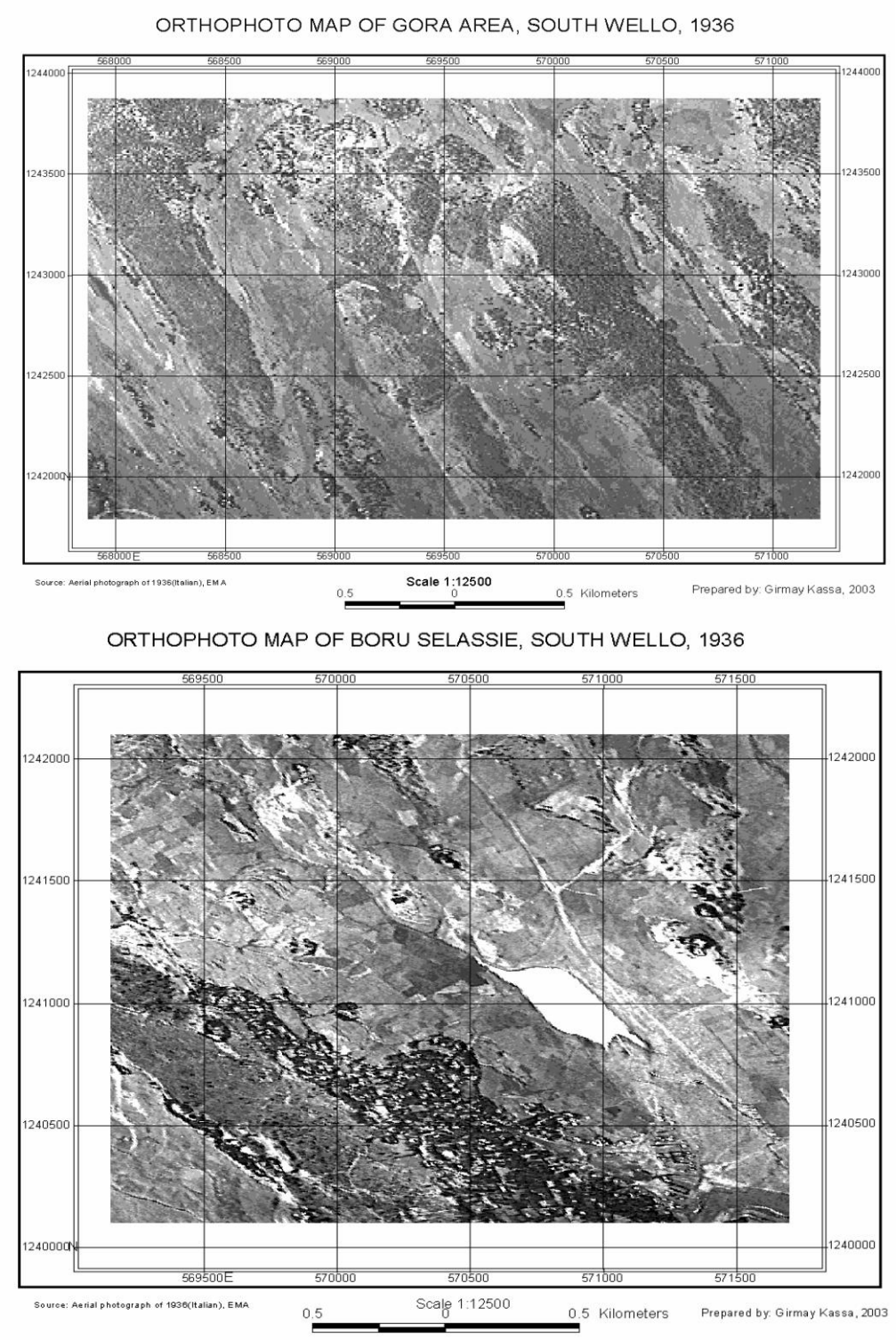

Fig. 2. Orthophotomaps of the study area, realised after Italian aerial photographs, held at the Ethiopian Mapping Agency (Girmay, 2003)

Methodology

Four research methodologies were used:

(1) Qualitative analysis of repeat photographs.

(2) Aerial photo interpretation, starting with historical Italian aerial photos taken in 1936 and kept at the Ethiopian Mapping Agency, and further aerial photos dating back to 1965, 1986 and 1994. The 1936 aerial photographs were interpreted for a 12 km² sample area at Boru Selassie and Gora and separately compared with the recent 1994 aerial photographs to evaluate land use land cover changes, land degradation and population distribution. The aerial photographs were scanned and geo-referenced, the land cover types identified and digitised. Due to high distorsions on the edges, only the central part of the 1936 aerial photographs was used.

(3) Quantitative analysis of repeat photographs. Twenty-three landscapes of South Wollo, recorded on historical photographs in 1937, were rephotographed in 1997 and again in 2009; environmental changes apparent on the matched photographs are analysed through expert rating. Two sample sites, taken from a popular viewpoint in different directions, at different epochs are presented (Figs. 3 and 4) and may be re-photographed in the field by the excursionists.

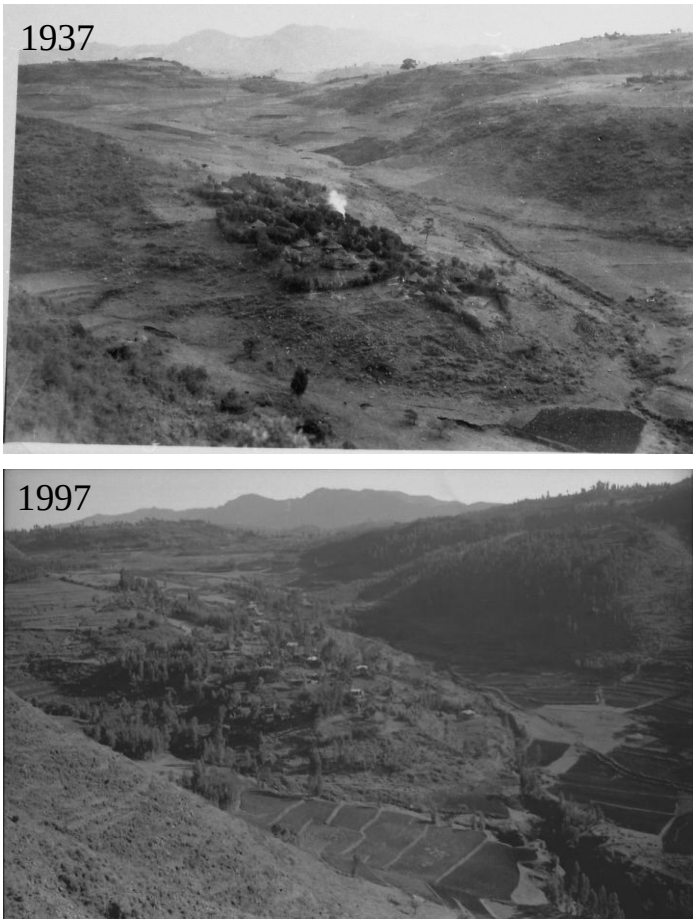

Fig. 3. Tita in 1937 (top - photo A. Maugini, © Istituto Agronomico per l'Oltremare, Firenze) and in 1997 (bottom - photo D. Crummey) (Crummey, 1998)

(4) Historical analysis on the basis of field interviews with 88 informants in South Wollo who lived through the landscape changes documented in the repeat photos. Informants were selected on the basis of age (born about 1930) and residence in villages documented by the photos. The attempt at gender balance among informants fell short - 49 males and 39 females participated in structured but free-form interviews.

Fig. 4. View from Tita towards Kombolcha. Top: in 1937 (Gortani and Bianchi, 1973); bottom: in 1997 (Crummey, 1998).

Results and discussion

1. Land use and cover trends, as observed on repeat photographs

The land use and cover changes that can incidentally be observed in the field by comparison to historical photographs (Figs. 3 and 4) are under way of analysis through expert rating (cfr. Nyssen et al. 2009). General tendencies in landscape changes include an improved vegetation cover between 1937 and 1997 and again after 1997. Evidence of soil and water conservation follows a similar trend. Impacts on hydrology can be observed when comparing ephemeral streams on historical photographs (Fig. 3) with the current situation.

2. Changes to population density and land use since 1936

Observations by repeat photography are in line with results of aerial photo interpretation. Population density estimated from house counting in the sample area of Boru Sellassie was 298 persons/km² in 1936 and increased to 628 persons/km² in 1994 (Table 2). In the wider Boru-Metero area, a similar trend was observed (Fig. 5).

Table 2. Population density based on house count of the wider Boru-Metero area in 1965, 1986 and 1994, and for the Boru Selassie and Gora sample areas in 1936 and 1994 (after Girmay, 2003).

Study area	Year	Assumed family size	Number of household	Interpolated population number	Cultivated land (ha)	Area of the study (ha)	Agricultural density	Population density (person/ km²)
Boru Meteo	1965	4	1351	5404	1385.9	3088	389.93	175.00
	1986	5	1601	8050	1526	3088	527.52	260.68
	1994	4.5	2172	9774	1532	3088	637.99	316.52
Boru Sellassie	1936	4	382	1528	260.44	513	586.70	297.85
	1994	4.5	778	3501	329.5	513	1062.52	682.46
Gora Area	1936	4	79	316	267.35	717	118.20	44.07
	1994	4.5	580	2610	350.31	717	745.05	364.02

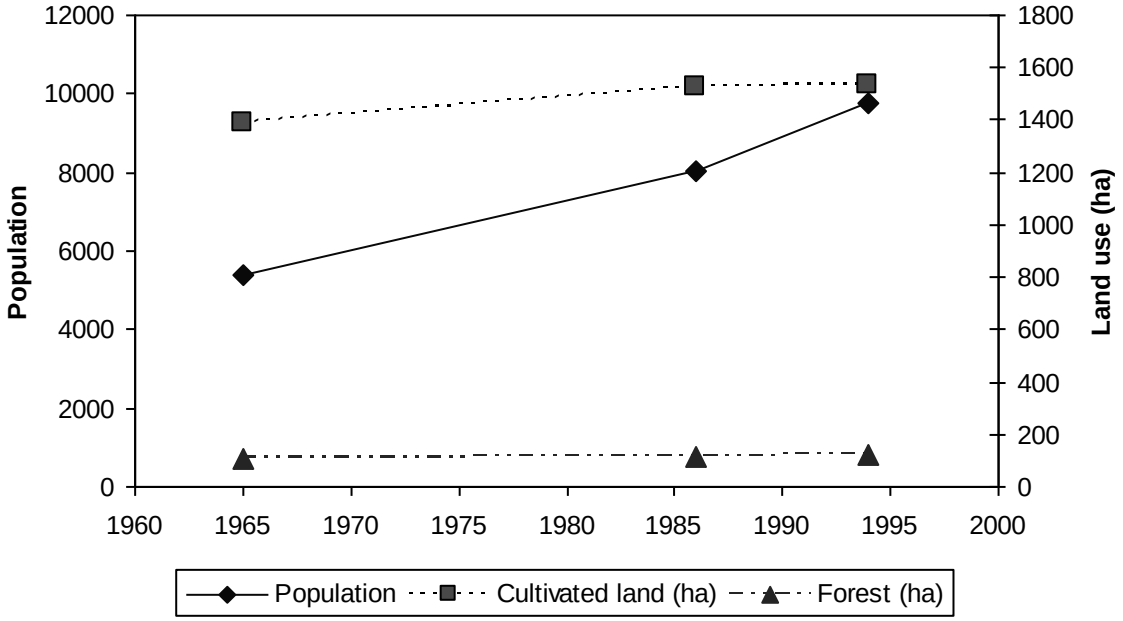

Fig. 5.Changes in population and major land use / land cover classes in the wider Boru-Metero area from 1965 to 1994 (after Girmay, 2003)

Since 1936, there has been an expansion of cultivated areas, essentially through the amendment and cultivation of marginal (bare) land and drainage of swampy areas. The area occupied by various types of permanent vegetation remained roughly the same until 1994, although a shift took place towards mixed forest and private woodlots.

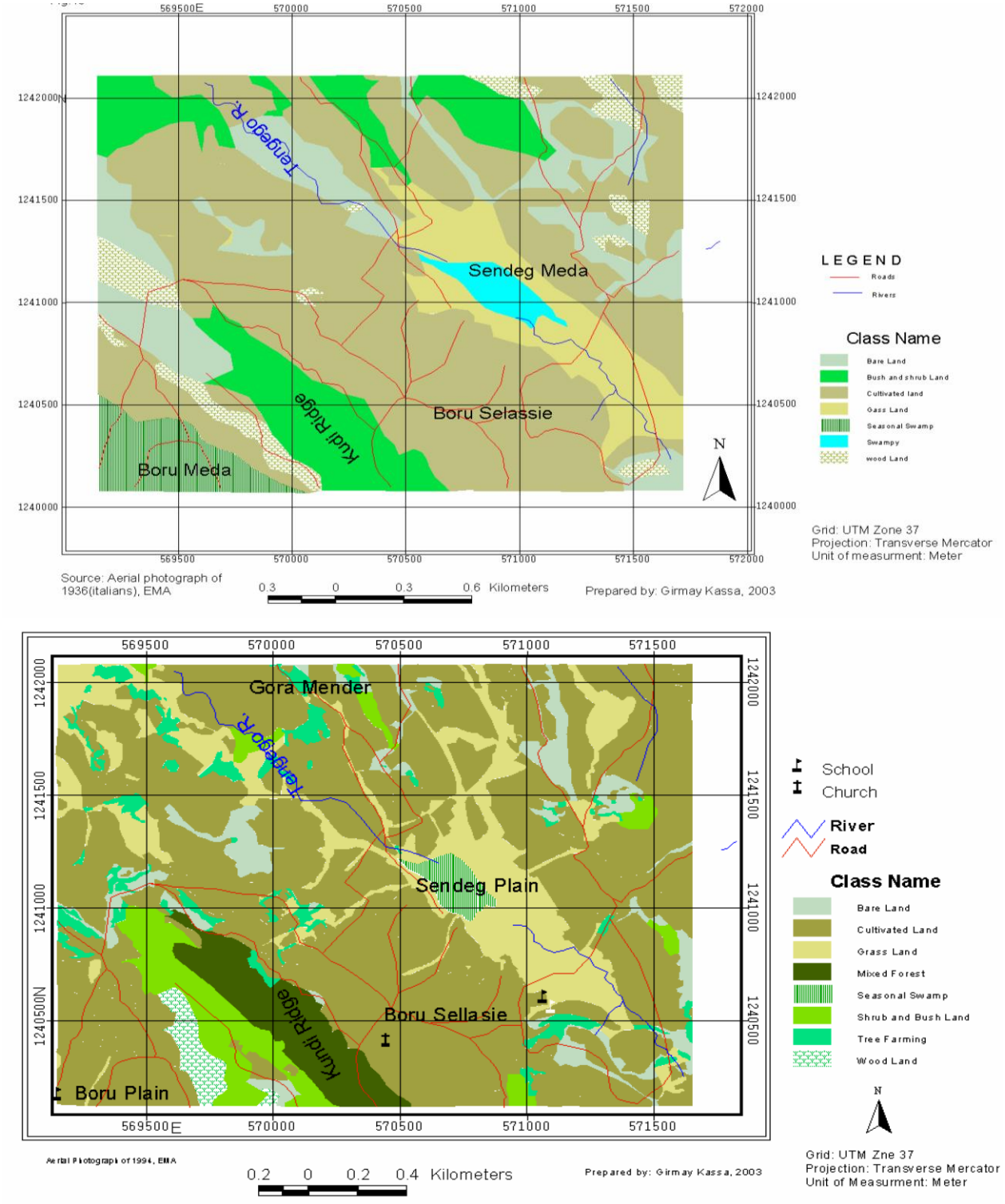

Fig. 6. Land use/cover in Boru Selassie sample area in 1936 (top) and 1994 (bottom) (after Girmay, 2003).

Table 3. Land use/cover changes in Boru Selassie sample area, between 1936 and 1994 (after Girmay, 2003).

Land use /Land cover type	Land use/Land cover area changes				Changes in land use/ Land cover (in ha)
	1936		1994		1936-1994 (ha)
	Area (ha)	%	Area (ha)	%	
Bare land	70.48	13.76	27.58	5.37	-42.9
Bush & shrub land	70.40	13.74	27.36	5.33	-43.04
Cultivated land	260.44	50.83	329.95	64.25	+69.51
Grass land	54.04	10.55	72.64	14.14	+18.6
Mixed forest	0	0	23.69	4.61	+23.69
Tree Farms	0	0	20.31	3.96	+20.31
Swampy area	7.95	1.55	0	0	-7.95
Temp. Grass land	22.53	4.40	5.51	1.07	-17.02
Wood Land	26.51	5.17	6.52	1.27	-19.99
Total	512.35	100	513.56	100	

The most significant land cover change was the increase of tree farming of Eucalyptus trees. In the wider Boru-Metero area, it covered only 1.6% in 1965 and increased to 4.7% in 1986 and 4.6% in 1994. This change was the result of afforestation and exclosure establishment in the 1980s, as well as the increase of financial income gained from sale of fuel wood and poles that initiated farmers to plant Eucalyptus trees around their homestead and on their farms.

3. Farmer resource management: capacity and constraints

In contrast to the view of a tradition-bound peasantry entrenched in unsustainable farm practices, survey data and farmers' narratives demonstrate that resource-poor peasant farmers are modifying and developing their production systems. The farmers of Wollo are not passively caught in a trap of increasing land scarcity, declining land quality and intensified poverty and hunger. Our results also indicate variation in their ability to innovate, despite the narrow band of resource differentiation. For example, woodcutting remains a source of livelihood for a handful of people with the most limited resources of land and capital, while the development of market gardens and tree plantations is dominated by the more successful, entrepreneurial farmers.

Overall we gained the impression that, poor and hard-pressed as they are, the farmers of northern Ethiopia are not desperate, nor have they forsaken sound farming practices. On the contrary, they have a truly astonishing range of knowledge of soils, seeds and seasons. Their sense of themselves, and of the value of their culture and institutions, was quite intact. They expressed themselves clearly, drawing on a rich store of metaphors. Their lives are stories of innovation, adaptation and adjustment, and, if the wider forces working on them are not always clear to them, they face those forces with resolve, a sense of irony and humour and an admirable capacity for work (after Crummey & Winter-Nelson, 2003)

Farmers have not been the only tree-planters in Wollo. Governments are also responsible for the increase in forest cover since 1937. The Derg closed hilltops and hillsides and embarked on huge tree-planting schemes. It implemented policies, which radically restricted, where they did not halt altogether, local exploitation of woods for grazing and fuel. The government which replaced the Derg has kept those policies in place and expanded them, involving local communities. But a

close observation of the landscape also reveals intricate patterns of tree-planting and tree nurture, which can only be attributed to local farmers (after Crummey & Winter-Nelson, 2003).

Conclusions

Increased vegetation cover in these mid-elevation areas is the result of farmer initiatives as of the 1930s and intense rehabilitation activities since the 1980s. The implementation of physical soil and water conservation follows the same trend. The positive changes that result from these conservation activities in the north Ethiopian highlands are an issue of global concern as they show that (1) in this study area direct human impact on the environment seems to be more important than potential effects of climate change and (2) population increase would not necessarily lead to severe land degradation.

Acknowledgements

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