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Soif and water conservation under changing socio-economic conditions in the Tembien Highlands (Tigray, Ethiopa)

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Résumé

Différentes techniques de conservation de l'eau et des sols, tant traditionnelles qu'introduites, sont utilisées en Dogua Tembien (Tigré, Ethiopie), dont les principales sont décrites. En dépit de la quasi-absence d'arbres et d'arbustes sur ces structures de conservation, elles provoquent la sédimentation de particules de sol érodées en amont et il en résulte des terrasses de culture.
Il existe déjà des formes hybrides entre la technique récente des murets anti-érosifs et les *daget* (rideaux) traditionnels. Parfois la technique des *checkdam* (microbarrages) est adaptée de façon empirique à des situations particulières.
Les paysans participent à ces travaux de conservation dans le but d'augmenter leur production agricole. Cette participation peut être expliquée par l'accès comparable à la terre, par le bas niveau des taxes sur la terre et par une attention accrue à l'agriculture de subsistance.

Mots-clés

Ethiopie, Tigré, conservation de l'eau et des sols, techniques de conservation, structure foncière, participation paysanne

Summary

The most used traditional and introduced soil and water conservation techniques in Dogua Tembien (Tigray, Ethiopia) are outlined. Despite the nearly absence of trees and shrubs on the conservation structures, upslope eroded soil colluviates and cultivation tenaces are formed.
Some hybrid forms between the recently introduced stone bund and the traditional daget (lynche t) techniques already exist. In some cases, the checkdam technique is empirically adapted to particular situations.
Peasants' participation in these conservation activities is part of their strategy to increase the agricultural production. It can be explained by equal land rights, by low land taxes, and by an increased attention to smallholder subsistence agriculture. Until recently, incentives (Food for W ork) were only marginal.

Keywords

Ethiopia, Tigray, soil and water conservation, conservation techniques, land tenure, peasants' participation

INTRODUCTION

Since the abolition of feudality in the seventies, after many years of war and several famines, there now exists a popular will in Tigray (Northern Ethiopia) to manage the natural legacy; the peasant's participation in soil and water conservation (SWC) is at a high level.

Hagere Selam, mean town of the studied Dogua Tembien *woreda* (district), is situated at an altitude of 2650 m. The nearby villages are almost all situated below the town and only accessible by foot or with a mule.

Geological formations outcropping in the region are of Mesozoic age (Antalo limestone and Amba Aradam sandstone), or tertiary basalt flows (with interbedded lake deposits) and make up subhorizontal layers. One also finds some quaternary formations, made up of alluvium, colluvium and travertine.
Average annual rainfall is 750 mm, concentrated in a few months. Its impact on the soils, having lost most of its natural vegetation by century-long action of human society, and runoff cause soil erosion. The predominance of steep slopes induces a natural vulnerability of the study area to soil erosion, despite a generally low soil

erodibility, which is due to high clay and rock fragment contents. The heavy intensity of rainfall occurring at the very moment of seedtime, when soils are very bare, worsens the soil erosion problem.

Confronted with these difficult conditions, human society was not able to react in an appropriate way. For centuries, the agricultural techniques of the peasants on the Ethiopian highlands have been stagnating. When, in spite of budget priorities in favour of the long-standing bureaucracy and army, investment was made in agriculture, it was especially oriented towards cash crops. There was, therefore, limited agricultural investment in the Highlands, where subsistence production and production for the local market dominate (Foucher, 1985; Stahl, 1990; Mulugetta, 1992). Moreover, under the former *risti* tenure system (land property right transmitted to the supposed descendants of the founder of the village) social differentiation had grown: local elites, feudal lords and the church had the ability to acquire more land and to have land disputes settled in their favour, whereas other people with little or no land worked as share-croppers. Taxes and the often imposed wars also induced impoverishment and incited the farmers to prefer immediate returns, even if it caused more erosion. As a consequence, during the XIX[th]
the trees and shrubs in between the fields and on steep slopes have been cleared, increasing runoff, sheet and rill erosion and gullying.

Hurni (1993) estimates average soil loss in the Ethiopian Highlands at 4 mm yearly and three times as much on cultivated land. Applying the Universal Soil Loss Equation in Dogua Tembien, we obtained an average estimation of 0.9 mm of yearly soil loss through sheet and rill erosion alone and peak values up to 9.75 mm/year (Nyssen, 1998).

This paper investigates traditional and introduced SWC techniques in the light of recently changed socio-economic conditions.

L THE TIGRAYAN APPROACH OF ENVIRONMENTAL REHABILITATION AND SOIL AND WATER CONSERVATION

According to Blaikie, environmental degadation might only be stopped "as an incidental result of other fundamental social changes" (1985). Tricart (1984) affirms that an action which may resolve the problems of the relationship between the Environment and Man must "be situated in the framework of a clear and lasting political will".

What is the depth of the political and socio-economic changes that have occurred in Tigray? Do they allow us to expect a decrease in soil erosion?

The "Proposals for the future", discussed at the 1992 symposium concerning the environmental degradation held in the regional capital Makallè, give a good view of the orientation with regard to environmental protection taken by the present authorities. Keywords are 'self-reliance' and 'participation' (Box 1). Whether, and to which extent, this favours SWC (soil and water conservation) will be analysed in the following pages.

Box 1
The Makallè Symposium on Environmental Degradation in Tigray (1992)

"The only way we will be able to fend off international domination and the accompanying decrease in popular participation is through development which will require our joining in with the world economy while continuing to be self-reliant in the most essential sectors of food production, energy sources and transportation".

A partnership of technicians ("with the necessary knowledge, as equal partners and not as patrons") and peasant farmers should allow a reversal of the accelerated erosion process: "through a natural extension of the present experience with participation, technicians and peasants could collaborate successfully to halt and reverse the deterioration. The technicians would contribute modern scientific and technological knowledge and know-how and the peasants their strength in numbers and their empirical knowledge and know-how. It would then be possible to make the environment of Tigray once more productive and suitable for human and other living beings" (Aseffa et al., 1992).

The mobilisation and participation in the conservation of environment was, from the beginning, based on an analysis of socio-economic and political conditions: "Given an excellent [organisational] infrastructure in every village, the enthusiasm of the people to accept new ideas, combined with the abolition of the *[risti]* land tenure system and the great decrease in [religious] holidays, large conservation programmes could be carried out provided the necessary implements are secured" (REST, 1984).

At the end of the war period, SWC measures in the areas controlled by the TPLF (Tigray People's Liberation Front) were conceived in a way to "always incorporate suitable technical input with existing community skills and experience; cover extensive areas over a short period; have simplicity and meaningfulness; comply with community interest; require minimum external input; allow adjustment and improvement; enable the mass of population to undertake any SWC actively" (Berhane Russia, 1992).

Besides the area closures on many steep slopes, which allow the restoration of the vegetation cover (Nyssen, 1997) , most spectacular is certainly the construction by the communities of stone bunds on the contour in order to obtain cultivation tenaces. We were struck by the accurate way in which peasants explained the working of the stone bunds. These techniques are also known by their children. All this, we were told, is widely discussed during the dry season, when these works are done.

After a sojourn in Tigray, Hans Hurni, who studies soil erosion in Ethiopia since 1974, writes: "actually, the missing financial and other resources in Tigray are replaced by a widespread involvement of the communities, by inputs from men, women and children in SWC activities. For people from outside, this is an impressive and fantastic thing" (Hurni & Perich, 1992).

Participation is an essential element in the elaboration and the layout of SWC; anti-erosive measures to be taken are decided democratically by the community. Rather than imposing the measures, agents of the Agricultural Office will use known cases of environmental degradation to convince the communities of the need for SWC measures.

According to Berhane G/Egziabher, geographer and REST (Relief Society of Tigray) officer, "In Tigray, the heart of the former war zones, people have a very rich experience of challenging economic and social problems collectively. Throughout the war, despite extreme conditions, there were constant efforts by the people to create what they could, and continue to develop themselves under tremendous constraints. Now, with the coming of peace, the participation of the Tigrayan people in rebuilding and rehabilitating their ruined economy is at the highest level ever" (1992).

Possible dangers for this participation are on one hand a decrease of the labour which the farmers consent to invest if there are no quick economic results due to conservation work (Hurni & Perich, 1992), and on the other hand the eventual constitution of an elitist group (through bureaucratisation, or through the accumulation of money or land) which would impose its decisions on the peasants (Hicks & Fitsum, 1992; Aseffa et al., 1992).

II. PEASANTS' MOTIVATION

Interviews concerning the peasants' motivation for SWC work were based on literature; the questions were prepared in advance but were adapted for each interview. One farmer in his sixties was more thoroughly interviewed. Moreover, when the occasion arose, when a peasant walked with me, or invited me to his house, I often questioned him on soil erosion in his fields and on agricultural practices.

A. Increase of agricultural production

For these farmers, the first and sometimes unique motivation for SWC work, quoted spontaneously, is the conservation of the village's fields and the increase of agricultural production. Sometimes, I asked them if it was not more profitable to work in Makallè during the dry season rather than to build stone bunds; again the answer was that they know very well the advantages of SWC work. This seems to have been the subject of many a discussion.

However if asked how to increase agricultural production, the farmers always talked about agricultural techniques : ploughing in time, crop rotation, legume crops, ploughing enough times, weeding, and natural and chemical fertilisers. Spontaneously, soil conservation was not quoted as a possibility to increase agricultural production. This last question concerns in fact the possibility to obtain short term results whereas SWC gives rather medium and long term results: increase in productivity can be rapid in the case of gullies whose extension has been stopped and which are filled up; but in the case of sheet and rill erosion, productivity loss is not visible from one year to another.

For these reasons, it is sometimes suggested that the peasants be incited to carry out this work which has only medium and long term results, by meeting their short term needs with food aid *(Food for Work).*

B. Food for Work and SWC work

Food for Work may however mean, as observed elsewhere in Ethiopia (Herweg, 1993; Stahl, 1993; Getachew, 1996), that the fariner considers SWC work as paid work and not anymore as improvements made to their fields by responsible farmers. This problem has been known for a long time (Hunting, 1976a) and it looks as if former governments above all introduced *Food for Work* as a compensation for the lack of peasants' confidence.

In Hagere Selam and its surroundings, in 1994, only some fifteen kg of cereals, on average and per year, were given as an incentive for conservation work to every member of farmer's households who took part in it. In community discussions, this was said to occupy only a very secondary place. The major part of *Food for Work* was in fact attributed to landless people (see Box 3) for whom this is an essential income and who make up 20 % of the workforce involved in community work (REST, 1992).

Besides, it is necessary to complement deficient yields with a certain quantity of cereals. This is done in order to keep the most needy people living in the villages during

the whole year so that they can participate in rehabilitation work and -in the medium tenu- overcome dependence on structural food aid.
A comparison of agricultural production and food aid received in Dogua Tembien (data by Dogua Tembien Agricultural Office and REST Hagere Selam), indicates that during the dry year 1993, the inhabitants of Dogua Tembien had 8 million kg of basic food at their disposai, of which 6 were produced by the farmers. Food aid and *Food for Work,* that year, made up a quarter of the consumption. Absence of this help would effectively push many people to the towns, where they would anyway depend on food aid, in addition to having abandoned their fields.

Recently, we noted however that *Food for Work* is taking a more important place in rehabilitation. One can only hope that this will not affect the priority given to SWC, nor the peasants' motivation, hence the quality of the conservation work.

III. ANCESTRAL SOIL AND WATER CONSERVATION TECHNIQUES AND NEW DYNAMISM

A. Tigray's lynchettes or *daget,* an ancestral SWC technique

Confronted with soil erosion in their fields, two methods were traditionally used by the farmers: to evacuate runoff water outside the fields or to favour infiltration.
The first involved the diversion of excess water towards gullies, footpaths or pasture land. It is even said that some farmers diverted the water into their neighbours' field! This concentration of runoff water led to the overdeepening of the gullies, and the transformation of paths into gullies.

A real traditional soil and water *conservation* technique are the *daget:* 50 cm to 3 m high lynchets between the fields (Fig. 1) with a more or less large grass strip on its shoulder. These lynchets, not always on contour, correspond to lower limits of pre-land reform plots. The word *armo* which I previously (1995, 1997) used for these structures is inappropriate : *armo* stands for any plot limit, even an alignment of stones without any riser.

I. A soil and water conservation technique

Older farmers quote spontaneously these *daget* as a technique implemented to decrease soil erosion; besides, they marked off the plots and supplied grass and hay for the cattle.
Daget are sometimes considered as 'natural boundaries'; this might induce misunderstanding on its genesis since the grass strips and the risers appear to have been consciously maintained, generation after generation. At the lower plot limit, a strip, about 2 m wide, was never ploughed : runoff velocity was reduced by the grasses, which facilitated infiltration and deposition of sediments. Year after year, the *daget* continued to grow. In Kenya, one has measured (Kiepe & Young, 1992) that grass strips of 1.6 m wide, planted with trees (every 3 m) and alternating with 5 m wide fields, involve, in a period of six years, the creation of about 40 cm high risers and a decrease of the field's slope from 13.8 % to 6.8 %. This structure functions thus as a vegetative barrier. These *daget* are similar to lynchettes existing in Europe, which also result from mass transportation induced by temporarily bare soils (Nyssen et al., 1998).

2. Destruction of daget

Since recent famines, the farmers have ploughed many *daget* in order to increase immediate agricultural production. If, at present, the riser subsists, the grass strip is now only 10 to 50 cm wide anymore (exceptionally, it can still be larger than one metre). But especially the smaller lynchets have also been levelled.
During the 1978 land reform, *daget* were still very present, but part of them was not preserved by the layout of the new plots. The 1990 redistribution aimed at giving land of equal value to ail the farmers and *daget* were even taken into account to a lesser extent. If a lynchet was situated in the middle of a newly delimited field, the farmer may have been tempted to plough it completely to increase the arable surface and to recover accumulated fertile soil. Moreover, the plots have become smaller which also causes the cultivation of *daget.*
Today the subject is said to be discussed in village assemblies and more care will be taken of *daget* during a next land distribution. Development bodies also insist on the necessity to incorporate these traditional tenaces in the present terracing programme (BNREP & REST, 1994).

B. Recently introduced SWC techniques

Box 2
More on SWC techniques in Ethiopia

Three case studies about indigenous SWC are published in Reij *et al.* (1996). Krüger *et al.* (1997) give a comprehensive inventory of some traditional SWC systems in Ethiopia.
More information about introduced SWC can be found in Hurni's handbook (1986) which proposes about twenty techniques adapted to the conditions of the different agroclimatic regions of Ethiopia. Hunting (1976a) advises SWC measures for the fields of Central Tigray in function of the slope and a publication by BNREP & REST (1994) presents technical advice given to SWC agents in Tigray. Kuiper & Spaas (1994) have studied these measures in the Adwa region.

1. Stone bunds

The aims of the stone bunds are : 1) prevention of the accumulation of runoff water along the slope; 2) colluviation and decrease of the slope steepness (Fig. 2); 3) water infiltration which contributes to a visibly better growing of the crops and to watertable rising.
This technique existed traditionally in a scattered way on the Ethiopian Highlands (Buxton, 1949; Huffnagel, 1961).
The communities started systematically building stone bunds in the upper part of the village territories in 1991. On the contour, these bunds often follow plot limits, they may increase the height of existing *daget,* but it is not rare that they move away from it when the fields' orientation is not on the contour. Year after year, new bunds are added with the aim of covering the whole territory. At present, one can make the (conservative) estimation that in Dogua Tembien more than half of the fields have stone bunds.
Fifty cm wide, rooted in the soil by 10 to 50 cm and reinforced at the up hill side by a filling with smaller stones, the stone bunds reached a height of some 50 cm in 1994. The farmers often talked of it with pride. The height of the bunds is to be rised as soon as 50 cm of colluvium has been deposited, which is frequently the case (1997). On some places this did not happen -or the structures were raised only by some stones taken out of the field during ploughing- and the bunds have been overtopped by runoff and collapsed.
Knowing that during a day of community work, 20 people build a bund with a length of 100 m and that the recommended interval between stone bunds is 20 m on a 5 % slope and 10 m on an 18 % slope (BNREP & REST, 1994), one realises the effort which is necessary to treat watersheds.
A ground for discussions in the peasants' communities is the distance between stone bunds, as the bunds are renowned for accommodating mice. The protection or the (re)introduction of their predators could partially resolve this problem (Nyssen, 1997).

In 1997, we observed in several places that farmers consolidate stone bunds with a grass strip on its upper side, in the same way as is done with the traditional *daget.* It seems possible here to overcome the conflict between catchment-wide SWC programmes and local technology; this is often not the case in other areas in Africa (Reij et al., 1996),

2. Checkdams

The technique used to stop gullying is checkdam building: little dams of a height of up to one metre are established at regular distances on gully bottoms. These dams are at first built in the upper part of the gullies, to avoid destruction by flash floods.
When the depression behind it is filled with sediments, the checkdam is raised. In several places in Dogua Tembien, one can see the location of former gullies filled in this way. Besides the expansion of arable land (which are sown after some years of recovery), these little dams also favour infiltration and decrease runoff speed and quantity.

In 1994, and even more in 1997, we observed some checkdams partially or totally destroyed by water (Fig. 3), due to their poor quality and/or to a lack of anti-erosive measures upslope.

3. Sediment trap on the riverside, a peasants' empirical finding

North of Dingilet village, a seasonal river crosses the resistant Amba Aradam sandstone formation by a high waterfall. Further upstream, where its bed is made up of alluvium and colluvium, this river is degradating as a result of increased runoff. But, right above the waterfall, it flows on very hard rock and banks are eroded.
To gain ground on the river, in 1992, the farmers built a wall of about a metre high, resting on the rock and parallel to the bank (Fig. 4). Downstream, this wall joins the bank and closes the 'compartment'. Invaded during floods, in two years, one metre thick sandy sediment was deposited in it as a result of the strong slowing down of water. In 1997, the stone walls had been extended and raised; onions were grown on part of the newly created plot.
Officers of the Agicultural Department in Hagere Selam did not know this technique; it had not been taught to the farmers. It is likely that the peasants, knowing the

introduced checkdam technique and having appreciated its efficiency, modified it to gain land on a river which is still too strong during floods to install dams on its whole width.
This new technique is an example of the way farmers, confronted with the degradation of their environment, adapt their techniques. Such empirical inventions usefully complete traditional and introduced techniques (Blaikie & Brookfield, 1987, 31).

4. Search for the best possible correspondence between plot limits, daget and bunds

It seems important to let the stone bunds follow the *daget* if these are on (or almost on) the contour. In his handbook, Hurni suggests, as a first step before the lay-out of bunds, to look if there are traditional tenaces, possibly to increase their height and, if they are discontinuous, to close the gaps between bits of tenaces (1986, 31).
During a next land reallocation, moving the limits of certain fields to make them correspond to the position (or the future position) of *daget* and stone bunds, would decrease the number of bunds installed in the middle of the fields. This would incite the farmers to double the bunds with a vegetation strip, which is traditionally only established at the lower plot limit.
We also think that trees and shrubs are important for the maintenance of tenaces and/or *daget* which are composed of fine particles and whose slope is much steeper than the natural slope. Roots strengthen the lynchet; bearing leaves during the rainy season, this woody vegetation also sucks water out of the material's pores, decreasing the Archimedes' pressure which, in the case of substantial soil moisture, provokes the collapse of these structures. Tree planting on field boundaries is considered in Tigray (particularly with leguminous trees like indigenous and exotic *Acacia* as well as *Sesbania),* but it means persuading the farmers to protect the concerned plots from stubble grazing for some years (Mitiku, 1994, personal communication).

C. The integrated treatment of watersheds

The described technical measures are part of a global approach to catchment development aimed at decreasing erosion, increasing the water infiltration rate and, subsequently, increasing the agricultural production. This watershed management programme includes, besides the already described mechanical measures, area closure on steep slopes and the promotion of fodder harvesting *(cut* & *carry)* rather than free grazing.
From our observations in some villages of Dogua Tembien it emerges that stone bunds and often checkdams, built in seven years on important parts of village territories, are efficient for SWC and that a great number of steep slopes have been closed to cattle.
The principal subsisting problems, with regard to the anti-erosive treatment of catchments, seem to be the nearly absence of trees and shrubs on bunds and field limits, grazing on certain steep slopes (especially if they are situated close to important villages), an under-estimation of the possible role of *daget,* and the collapsing of some checkdams.

IV. AN EXPLANATION FOR RENEWED SOIL CONSERVATION DYNAMISM

Until not so long ago, the peasants' impoverishment and Jack of agricultural extension induced a behaviour that favoured soil erosion (Stahl 1974, 1990; Nyssen, 1995). Which are the changes that can explain the present mobilisation for SWC in Tigray ?

A. Comparable access to land

I. The Tigrayan leasehold system

As the TPLF extended its control over Tigray, a new land tenure based on regular redistributions between all the farmers of the village was introduced, replacing *risti* and 10 years of land reform, imposed from Addis Ababa. Such a redistribution was organised in 1990 in Dogua Tembien (Box 3). The principle is taken from an ancient form of communal ownership, *tchigurafgoses* or *shehena,* which prevailed in certain regions of Tigray and Eritrea. Every 5 to 8 years, a land redistribution took place in order to meet the needs of the new members of the community, absent landholders losing their rights (Nadel, 1946; Stahl, 1974; Bruce, 1976). Today, the redistributions are organised by the *baïto,* the elected council, and no more by "the big men", who often manipulated the system (Bauer, 1973).
During my discussions with the farmers, I heard complaints about the small size of the allocated land, but the principles of equal shares and redistribution were generally not questioned. This leasehold system has recently been fixed by the new Ethiopian constitution (1994, Art. 40)

Box 3
Land reallocation in Dogua Tembien

Agents of the local Agricultural Office give the following precisions concerning the practical organisation of land distribution: "Land is allocated according to the composition of the household and depends also on the total area of available agicultural land in the village territory and of the number of inhabitants. Land allocated to the farmers is composed of several plots (often three), in order to give similar access to different soil and slope qualities, and to different distances from the village. The fields are allocated by partial lottery. Those who improve their fields (manure, tree plantation and/or protection) have priority during the allocation of that particular plot". Interviewed farmers said that they received the same plots during the 1990 reallocation.
"Everybody has similar fields; there are however 'rich' farmers: if somebody has a surplus of cereals for one reason or another (good luck, use of better agricultural techniques), he will sell these cereals during the pre-harvest shortage; the next year, he will have some money to pay daily labourers working on his fields". "There are also landless people: former soldiers, returnees to their village after having been refugees in the Sudan or forcibly displaced to southern Ethiopia, youngsters who have reached an age where they are able to run their own farm". In 1997, seven years after the previous allocation, the need for a redistribution is felt. Especially in the bigger villages and in Hagere Selam, social differentiation has increased: some farmers have become traders or craftsmen and do not need fields anymore. "Land reallocation is necessary, but it will not go without conflicts".

2. Foreign pressure in favour of land privatisation

A report by the Madison Land Tenure Centre gives an extensive survey of rural land tenure issues. It is marked by the authors' preferences for land privatisation. For this purpose it invokes parallel phenomena of the military *Derg's* land reform. Problems with villagisation, corruption, forced peasant association membership or quota deliveries may however not cover up the main issues which were the seizing of large landholdings and land distribution among the peasants. Though the authors seem to agree on this ("one of the most successful land reforms in history", resulting in "a far more promising basis for the development of a modern agriculture than the bimodal pattern of large, tenant-farmed feudal holdings and small peasant farms" - Bruce et al., 1994, .56), they suggest the abandonment of "the idea that everybody has the same right to land".

The authors note that there is no will for privatisation among either the peasantry or the governing coalition : state ownership of the land, leasehold to small farmers and the maintenance of equity gains resulting from land reform are a well-established will. Experience in Tigray is used as a model in other regions (e.g. presently land is redistributed in the Amhara region).

A more or less controlled privatisation is favoured by Western-oriented economic advisors as well as businesspeople. One can fend foreign-sponsored conservation projects in Ethiopia based upon a strategy where the first point is the 'abandonment of the land-for-all attitude' (Berhanu & Uncovsky, 1996). Invoked argument is mainly the perceived tenure insecurity: if peasants fear that their land might be distributed to somebody else, no investments (conservation, manure, tree planting) would be made on fields away from the homeplot. In fact, before land reform, there was already very little investment in plots away from the homestead; it is an old problem, related to stubble grazing and to cropsharing. The *shehena,* precursor of the present-day system, was submitted to the same critiques. Nadel (1946) considered, however, that an important incitement to good management of the farms in this tenure was the fact that "one loses his land if it is neglected, to the contrary of what happens in the case of *risti* property where rights are not lost in case of land abandonment or neglect". Nowadays, priority in land allocation is given to those farmers who invest in their plots.
The Tigray example (for more than 10 years) invalidates the argument of land neglect due to reallocations.

3. The impact of a possible land privatisation on SWC

In the villages, land reform is considered to be positive and there is an opposition to privatisation due to the fear of desperation sales and subsequent domination by rich landlords (rich farmers or investors who buy the land from the poorest) and unequal access to land.
The ancient cropsharing system (which presently mainly subsists as a social security net, allowing e.g. old people or widows to have an income from their field by renting it out) would quickly be extended. Again, there will be the problem of absentee landowners who are not caring for the land and crop-sharers who are not investing as only part of the fruits of their work is of benefit to them.

The creation of a class of landless people and the subsequent rural depopulation might lead to the neglect of agriculture. Observation of village economies in the Ivory Coast led to the conclusion that migration to urban centres is, principally, the propensity of young potentially

active people, which reduces the family workforce (Faussey & Vimard, 1991).
Furthermore, the most efficient conservation measures need watershed-based community work: "bringing about community participation would usually require a more equal pattern of land ownership and control (...), that is, require redistributive land reform. Cooperation is rarely found to succeed amongst those who are unequal in material terms since it becomes difficult both to ensure an equal distribution of costs and benefits" (Agarawal, 1980). Unequal landshares would have as a consequence that most farmers will not readily do SWC work, as improved yields will only be of benefit to some amongst them.
Moreover, the Kenyan example shows that when land is private property, and without redistribution possibilities, it is impossible to close off fields situated on steep slopes, because farmers affected by this measure cannot profit from any readjustment (Thomas, 1988). Landless peasants would even be tempted by the cultivation of communal land up to then used as pasture land (Redclift, 1984, 72).

4. Land tenure : a conclusion

Comparable access to land, observed in Dogua Tembien, maximises the community's motivation for conservation work. The Tigrayan approach to leasehold and land reallocation, taking into account improvements made by the farmers, allows to combine the social and environmental advantages of the periodical redistributions while avoiding the disheartening of the most active farmers. It is also encouraging to note that Ethiopia could resist foreign pressure and fix collective property and the impossibility of alienating land in its new constitution.

B. Taxes are low

Research in Ethiopia shows that "policies or other factors that reduce income in farming, make soil conservation more difficult" (Styczen, 1987). Fortunately, due to inflation, the amount of the land tax seems not to have changed much for years. Rates range between 15 and 20 Birr/year. This small range in the amount paid per family is explained by similar farm sizes. In the beginning of the seventies, the *average* amount was similar (Hunting, 1976b). In real terms, because of the absence of indexation, the size of this tax has thus greatly decreased: in 1974, this tax was equivalent to more than 50 kg of wheat; today, the tax corresponds to 10 or 12 kg of wheat (prices observed in September-October on Hagere Selam market by Hunting (1974) and by the author in 1994 and 1997).

C. Increased attention to agricultural development

"Developing the agricultural sector would require a change of priorities in national development policy in favour of the rural sector. This change could open the door to better access to agricultural extension and rural services for small-scale farmers in Tigray. It could lead to a situation where a greater percentage of the national budget is used for rural development than is presently the case" (Hurni & Perich, 1992).
From the sparse budget data, one can mainly retain the reduction of expenditures on armed forces from the long-standing 50 % to 10 %, the stabilisation of import expenditure and a decrease in the external debt ratio. Subsequently, there is an increase of spending on health, education and the economy (Anon/EIU, 1996). Investment in agricultural development is obvious. In the villages one meets newly trained agricultural extension agents, seed banks are built, there is a better fertiliser availability (threatened however by the liberalisation of its price). The achievement of food self-sufficiency was the main subject at the recently held 5th assembly of the Regional Council of Tigray, with a large attention given to SWC. The first dozens of earth dams are built in the region as a part of the preparatory project for the establishment of 500 dams before 2006 (Nana-Sinkam, 1995; Anon/Woyin, 1997).

In 1996 a bumper cereal harvest was realised in Ethiopia. Besides above average precipitation which was well distributed over the growing season and geographically (but, however, less than during the previous year), the increase in food production is also attributed to increased fertiliser and seed use, reduced pest infestations and the facilitation of trade (Anon/IGADD, 1996; Anon/EIU, 1996).
Due to a lack of rain, the 1997 harvest was less important - but during our field visit in September and October 1997, agents of the different administrative and development bodies were very busy with crop assessment and the planning of food aid (partially from stocks built up in 1996). Drought-stricken *woredas* (districts) in Tigray, like Raya-Azebo, received support (particularly under the form of grazing rights) from other *woredas.* There was an atmosphere of challenging the problem rather than one of a 'catastrophic famine' as announced by press agencies in August 1997. In January 1998, we could observe that famine had been avoided.

CONCLUSION

The present-day approach of soil and water conservation in Tigray, including the active participation of the concerned populations, the supple collaboration between technicians and farmers, the essential principle of counting on one's own forces, the access to land facilitated by reallocations, and a carefully thought-out food aid, seems to be a realistic and efficient approach to the struggle against soil erosion by water. Progress is huge as compared to the feudality and *Derg* era.

Concepts like the catchment-based approach and the favouring of water infiltration, as well as stone bund and checkdam technology seem to be acquired. There is also some hybridisation between the traditional *daget* and the introduced stone bund techniques, even if the possibilities of the former are not fully used.

Conservation work and the introduction of adapted techniques need however funds and materials; subsistence agriculture and the struggle against soil erosion should logically be among the Ethiopian government's budget priorities.

One cannot insist enough on the seriousness of the soil erosion problem in Dogua Tembien and in Tigray. But, referring to earlier quotations of Blaikie and Tricart, socio-economic changes seem to be fundamental enough, the political will to mobilise against soil erosion in Tigray so well confirmed, that one can, carefully, join Hurni and Perich's conclusion with regard to environment : "There is a positive process going on in Tigray" (1992, 17).

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Fig. 1 - A *daget* is a lynchet between two fields, with a grass strip on its shoulder (Amba Gwasot, near Daerere, September 1997).

Fig. 2 - Some years after the construction of this stone bund, the accumulation of colluvium gives a subhorizontal look to the upslope field (N of Harena, Sept. 1994).

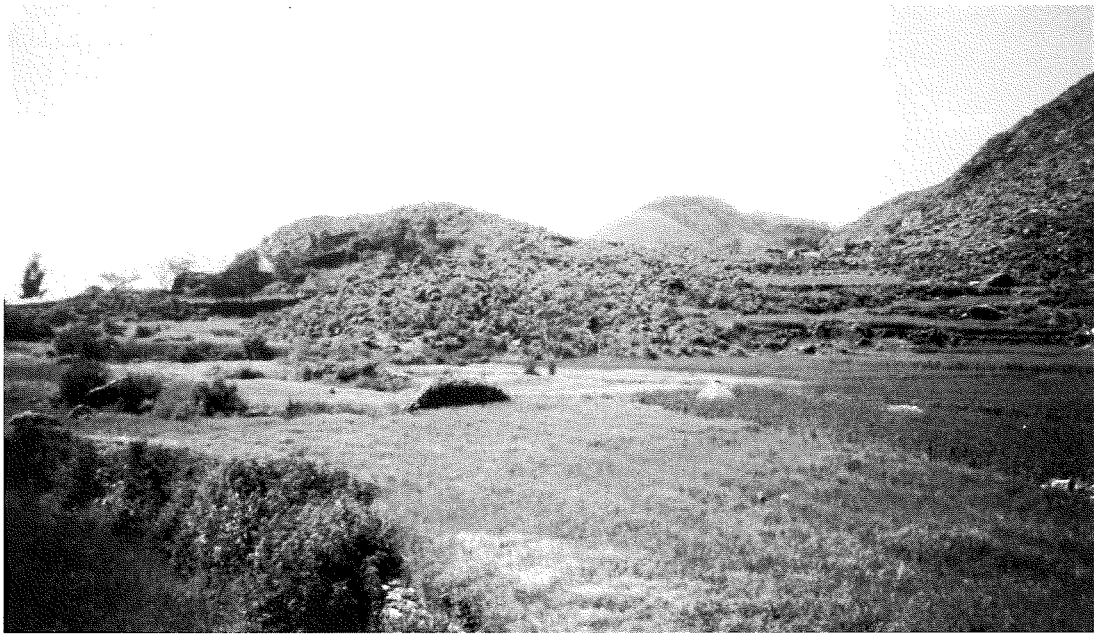

Fig. 3 - Checkdams in a partially filled gully close to Mai Zahla nursery in Dingilet (left: in 1994). In 1997 (right), most of the dams were by-passed or destroyed by floods.

Fig. **4** - Sediment trap built by the farmers to the North of Dingilet (September 1994).