

# The prospects of reduced tillage in tef (*Eragrostis tef* Zucca) in Gare Arera, West Shawa Zone of Oromiya, Ethiopia

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## Abstract

Soils in Ethiopia are traditionally ploughed repeatedly with an oxen-drawn plough before sowing. The oxen ploughing system exposes the soil to erosion and is expensive for farmers without oxen. This study was undertaken to assess agronomic and economic impacts of alternative, reduced tillage methods. Field experiments were carried out on a Vertisol and a Nitisol for 2 years to study the effect of zero tillage, minimum tillage, conventional tillage, and broad bed furrows (BBF) on the yield of tef (*Eragrostis tef* Zucca). No significant differences in tef biomass and grain yields were observed between the treatments on both soils in the first year. In Nitisol in the second year, yield was lower in the zero tillage treatment as compared to the other treatments. No difference in yield was observed between single plough, conventional, and BBF. On Vertisol, the yields were higher in BBF as compared to the other treatments. The yields on Vertisol were 1368, 1520, 1560 and 1768 kg ha<sup>-1</sup> for the zero tillage, minimum tillage, conventional tillage and BBF treatments respectively. More than twice as much grass weed was observed on zero tillage treatment as compared to the BBF treatment on both soils. Zero tillage gave the lowest gross margin on both soils whereas BBF gave the highest gross margin. The gross margin on Nitisols for the zero tillage and BBF treatments were –108 and 1504 Birr/ha respectively and corresponding numbers for the Vertisol were 520 and 1924 Birr ha<sup>-1</sup>. On Vertisol there were no significant difference in gross margin between minimum tillage and conventional tillage. Minimum tillage is an interesting option on Vertisols, particularly for female-headed households as it reduces the tillage cost. It may also improve overall productivity of the farming system because it allows partial replacement of oxen with cows and reduces soil erosion.

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## 1. Introduction

In the Ethiopian highlands, agriculture based on cultivation of cereals is thought to have occurred for at least 7000 years (Ehret, 1979). Tef is a major staple food and cash crop for the smallholder farmers and is

annually cultivated on about two million hectares of land. The crop covers 30% of the total area of cereals and about 26% of the area cultivated to annual field crops (Hailu and Seyefu, 2001). Intensive seedbed preparation with five to eight passes of a plough, each pass being perpendicular to the previous one, is usually practiced for tef (*Eragrostis tef* Zucca) (Fufa et al., 2001). The traditional plough (locally called the maresha), pulled by a pair of oxen, is used by smallholder peasant farmers throughout the country

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(Goe, 1990). Soil tillage is practiced to make a fine seedbed, control weeds, loosen the soil and improve infiltration, but also causes substantial water and wind erosion (FAO, 1998). Tillage induced erosion due to multiple passes with the maresha, without considering difference in topography, soil type and agro-climatic zone, has been regarded as the main factor of land degradation and loss of productivity in the Ethiopian highlands (Hurni and Perich, 1992). Total soil erosion in Ethiopia is estimated at 1.4 billion ton per year and half of this originates from cropped land, constituting only 13% of the country's total area (Hurni, 1993).

The widespread utilisation of animal drawn implements has created a situation where oxen are a fundamental resource for crop production, as the primary reason for keeping cattle in crop producing areas of Ethiopia is for animal traction (Shiferaw, 1999). About six million oxen are used to plough close to 10 million ha of land annually (Zinash, 2000). The estimated cultivated land area per draught oxen is low, only 1.7 ha, compared to 12.9 ha for Sub Saharan Africa (Nyagumbo, 1998). Oxen tillage was probably a more feasible practice in the past, when landholdings were larger and pastures more abundant (Aune et al., 2001).

Tillage systems that reduce soil disturbance and leave a minimal crop residue cover on the soil surface, often referred to as conservation tillage systems, can be

a solution to the problems associated with tillage-induced erosion (Fowler and Rockstrom, 2001). Therefore, a shift to conservation tillage might be the best approach for reducing soil erosion and the dependence on oxen for tillage. Studies in Ethiopia, Zimbabwe and elsewhere have shown that conservation tillage can reduce soil loss to a large extent (Astatke et al., 2003; Fowler and Rockstrom, 2001). In addition, on-farm and on-station experiments in different parts of Ethiopia have revealed promising results with zero and minimum tillage systems with wheat (*Triticum aestivum*), maize (*Zea mays*), and sorghum (*Sorghum bicolor* (L.) Moench) (Asefa et al., 2004; Sasakawa Global, 2001; Astatke et al., 2000). However, there is a paucity of information regarding the effect of tillage in tef. The objectives of this study were (i) to assess the effects of different tillage systems on the yield components of tef on a Vertisol and a Nitisol in central Ethiopia and (ii) to propose alternatives to the traditional tef land preparation method.

## 2. Materials and methods

### 2.1. The study site

The study was undertaken in Gare Arera (Dendi district (09°03' N, 38°30' E) West Shawa Zone of Oromiya Regional State, central Ethiopia, located

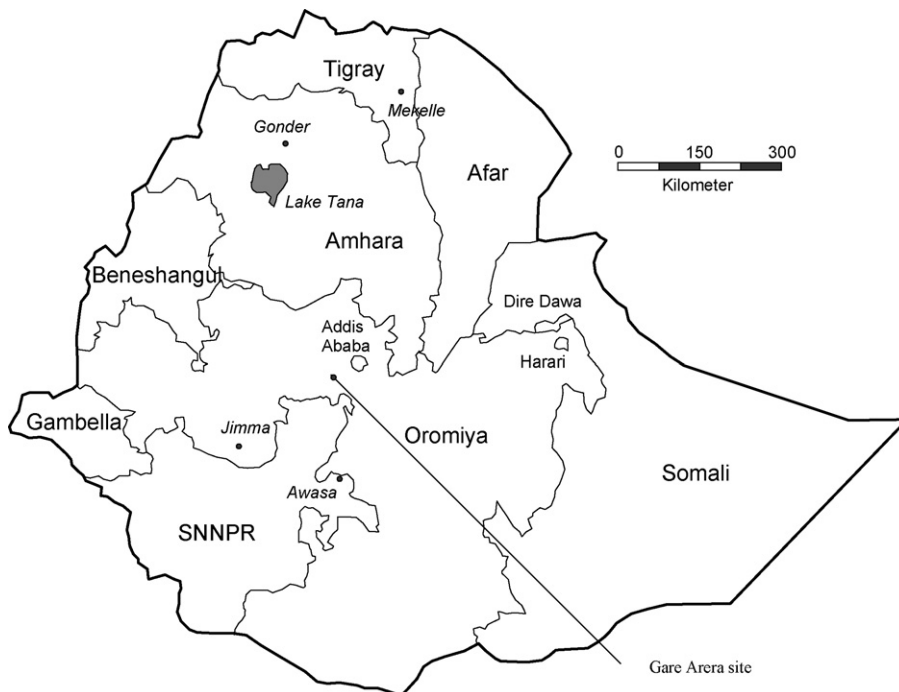


Fig. 1. Map of Ethiopia and the Gare Arera site.

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