Environment & Development Series 10

The Impact of Compost Use on Crop Yields in Tigray, Ethiopia, 2000-2006 inclusive

Sue Edwards, Arefayne Asmelash,
Hailu Araya and Tewolde Berhan Gebre Egziabher

TWN
Third World Network

The Impact of Compost Use on Crop Yields in Tigray, Ethiopia, 2000-2006 inclusive

Sue Edwards, Arefayne Asmelash, Hailu Araya
and Tewolde Berhan Gebre Egziabher

TWN
Third World Network
Penang, Malaysia

The Impact of Compost Use on Crop Yields in Tigray, Ethiopia, 2000-2006 inclusive

is published by
Third World Network
131 Jalan Macalister
10400 Penang, Malaysia
Website: www.twnside.org.sg

Printed by Jutaprint
2 Solok Sungei Pinang 3, Sg. Pinang
11600 Penang, Malaysia

ISBN: 978-983-2729-91-4

Contents

Acknowledgements

The Institute for Sustainable Development (ISD), Ethiopia would like to thank the Food and Agriculture Organisation (FAO) of the United Nations for its financial support to increase the number of observations and have them analysed as well as inviting two of the authors, with the senior author presenting the preliminary results at the International Conference on Organic Agriculture and Food Security, held 2-5 May 2007 at the FAO, Rome. ISD would also like to thank the Third World Network and the Swedish Society for Nature Conservation for continuing to support its work with farmers and agricultural professionals in Tigray.

At the personal level, ISD thanks Lette Berhan Tesfa Michael for carefully entering the data, and Drs Kindeya Gebre Hiwot and Fitsum Hagos of Mekele University for analysing the data and discussing the results with the authors.

Finally, ISD would like to thank the Bureau of Agriculture and Rural Development in Tigray and their experts and development agents who collected the data, and, last but not least, the farmers who participated and allowed their crops to be sampled.

This paper was first written for the FAO in 2008, and is republished here with kind permission.

Chapter One

INTRODUCTION

History of crop cultivation in Ethiopia

CROP cultivation in Ethiopia has a long history of at least 5,000 years (Clark, 1976), and implements for cutting and grinding seed have been found in Stone-Age sites, such as Melka Konture by the Awash River in central Ethiopia, dating back much earlier. Just when crop cultivation started in Ethiopia has not been determined, but its long history is also reflected in the high agricultural biodiversity, including endemic crops, the best known of which is the cereal teff (*Eragrostis tef*). The high diversity in crop species and genetic diversity within crops is a reflection of the environmental and cultural diversity of Ethiopia (Engels & Hawkes, 1991).

Many crops that are known to have their centres of origin in the fertile crescent of south-west Asia, for example durum wheat (*Triticum durum*), now have their highest genetic diversity in Ethiopia. The treatment of *Triticum* for the *Flora of Ethiopia and Eritrea* recognises a highly variable endemic species, *T. aethiopicum*, which is more usually considered as a subspecies or variety of *T. durum* (Phillips, 1995). Other important crops with high genetic diversity in Ethiopia include the cereals—barley (*Hordeum vulgare*), finger millet (*Eleusine coracana*) and sorghum (*Sorghum bicolour*); pulses—faba bean (*Vicia faba*), field pea (*Pisum sativum* including the endemic var. *abyssinicum*), chick pea (*Cicer arietinum*) and grass pea (*Lathyrus sativus*); oil crops—linseed (*Linum sativum*), niger seed (*Guizotia abyssinca*), safflower (*Carthamus *tinctorius*) and sesame (*Sesamum indicum*); and root crops—enset (*Ensete ventricosum*), anchote (*Coccinia abyssinica*), 'Oromo or Wollaita dinich' (*Plectranthus edulis*), and yams (*Dioscorea* spp.). Over 100 plant species used as crops in Ethiopia have been identified (Edwards, 1991).

European travellers, e.g. Alvares at the beginning of the 16th century (Alvares, 1961) and later ones, describe the productivity and health of the highland agriculture—crops, domestic animals and people—and compare this with the depressed situation in much of Europe at that time. Poncet (1967), who visited Ethiopia between 1698 and 1700, described his experience with the words, 'no country whatever better peopled nor more fertile than Aethiopia'. He describes even the mountains he saw as all well cultivated 'but all very delightful and covered with trees'.

However, since 1974, Ethiopia has been portrayed as a food-deficit country with its people and animals suffering from drought and famine. In January 2002, over five million people were identified as being food-insecure, and this number had risen to around 14 million by the end of the year because of the failure of the rains in much of the eastern parts of the country.

Starting in the second half of the 19th century, efforts to build an administratively centralised Ethiopian state as a reaction to European colonialism in other parts of Africa systematically destroyed local community governance because it was suspected that such communities could become possible allies of colonialists. Loss of local governance undermined local natural resource management with loss of protection of woody vegetation, lack of repair of old terraces, and general undermining of any attempts at communal management of natural resources. The feudal landlord system was maintained with the bulk of the population existing as serfs. As Ethiopia entered into the world market, these landlords mined the land resources with nothing going back to the land. Civil war exacerbated these impacts. The most visible physical impacts have been gully formation eating away the soil with vegetation recovery prevented by free-range grazing and the unregulated felling of trees for firewood and other purposes.

There were no inputs in technologies or ideas to help these smallholder farmers improve their productivity. They had to continue to rely for their survival on their indigenous knowledge and the rich agricultural biodiversity that they had developed, but were unable to continue effectively using collectively for fear of political reprisal.

Then, in 1974, Emperor Haile Selassie and the feudal system of control over farmers and their land was removed in a revolution that organised the whole population into local, nominally self-governing, organisations with their own elected officials. Under the military government, called the 'Derg', there were massive efforts at land rehabilitation through mass mobilisation for soil and water conservation, planting of tree seedlings, and the provision of external inputs through cooperatives. However, administration remained centralised and coercive – overall productivity did not increase. The farmers continued to be ordered about and exploited as had been done under the over-centralised feudal regime. There were also frequent and disruptive redistributions of land. The farmers had no possibility for taking collective decisions on natural resources management and no interest or incentives to invest in improving their land.

In 1991, the military government was overthrown. A new constitution that required decentralisation of power and encouraged local community governance was adopted in 1995. In 1993, the Sasakawa-Global 2000 approach was launched to provide high external inputs — principally chemical fertiliser — to farmers. As from 1995, this programme was taken up by the National Extension Programme of the Ministry of Agriculture and Rural Development. At the beginning, fertiliser cost was subsidised, but as from 1998, the subsidy has been removed and the local price of diammonium phosphate (DAP) and urea, the chemical fertilisers used in Ethiopia, has doubled. Overall grain production in the country as a whole has increased each year since 1998. However, this has not benefited the people living in the drought-prone areas of the northeast and east, who continue to depend on aid. These people have become chronically food-insecure requiring annual inputs of aid as food. Whilst this food may save lives, it does not and cannot replenish productive assets that would enable people to reduce their poverty.

ISD's project on sustainable agriculture

It was against this background that, in 1995, the Institute for Sustainable Development (ISD) developed a project to work with local farming communities of smallholder farmers in Tigray using an ecological, low-external-input approach. The major challenges addressed in the project were to:

- Restore soil fertility through making and using compost, and help farmers avoid debt paid for chemical fertiliser;
- Improve biological and physical water and soil conservation in crop land including thecontrol and rehabilitation of gullies;
- Control, preferably stop, free-range grazing to allow more grass, herbs and trees to grow;
- Include grasses and fast-growing legumes in areas treated for soil and water conservation. The most successful has been the small multipurpose indigenous tree, *Sesbania sesban*, planted for animal forage and compost biomass in the rehabilitated gullies and on the bunds between fields. There has also been a rapid

re-establishment of indigenous plants, particularly shrubs and trees, in the hillsides protected from grazing animals.

- Help local communities restore local control and effective management of their natural resources through the development and enforcement of their own by-laws.

Although Tigray has an area of over 50,000 square kilometres, previously malaria prevented most of the population from living at the lower altitudes, but now all parts are being inhabited owing to effective malaria control measures. In 2003, the population of Tigray was estimated to be over four million, with most of the households being found above the 1500 m altitude. Most households are rural practising mixed crop/livestock agriculture. A socio-economic survey of some farming communities carried out by ISD in 2001 found that the average cultivated land per household is less than one hectare, usually distributed in three to five small, separate parcels.

Average annual rainfall is 500-700 mm. The precipitation occurs mostly during a short summer (end of June to mid-September) rainy season, often falling as intense storms.

ISD started the project in 1996 with four local communities. By 2006, ISD was following up on the project activities in 57 local communities in 12 of the 53 *weredas* (districts) in Tigray, the majority in the degraded lands of the central and eastern parts of the Region. A *wereda* (district), the lowest level of government administration, is divided into *tabias*. A *tabia*, with its elected representatives, runs the day-to-day affairs of the local communities under its jurisdiction.

From the beginning, the project has been implemented in partnership with the Tigray Bureau of Agriculture and Rural Development (BoARD) and has been funded by the Third World Network (TWN), an international NGO network with its head office in Penang, Malaysia. In 2006, TWN published the experiences of the Tigray Project (Araya & Edwards, 2006). This included some of the data from monitoring the impact of compost and chemical fertiliser on crop yields in farmers' fields in Tigray. Up to and including 2005, yield data had been collected from 779 plots in farmers' fields.

In 2005 and 2006, the Swedish Society for Nature Conservation (SSNC) also provided funding to ISD for its work in Tigray. This included the publishing of a poster on the making of compost to support the compost manual in Tigrinya (the local language) published in 2002 (Asmelash, 1994 EC), and distributed to all 53 *weredas* of the Region.

In 2006, the FAO Natural Resources Department provided funding to help collect additional yield data from 195 plots in farmers' fields during the 2006 harvesting season, and pay for entry and statistical analysis of the data.

Chapter Two

MATERIALS AND METHODS

THE objective of the project was to find out if an ecological approach could help restore soil fertility and raise crop yields, particularly for farmers in degraded areas. In 1998, yields were recorded from the fields of farmers in four communities that started work with ISD in 1996 – (O) in Table 1. The results were encouraging (Annex in Edwards, 2003), and the BoARD requested ISD to continue to monitor the impact of compost on crop yields. Hence, starting from 2000, yields have been taken from plots in farmers' fields in 19 communities in eight of the 53 *weredas* of Tigray Region. The majority of the communities (17) are found in the drought-prone areas: Alamata of the Southern Zone (two communities), and all parts of the Eastern (six communities) and Central (nine communities) Zones of Tigray. The soils of these areas are generally poor and the rainfall is erratic. However, two communities are found in better-endowed areas: Adi Abo Mossa in the valley of Lake Hashenge of Southern Tigray where the soils are deep, rainfall more reliable and some farmers have larger cultivated areas and large herds of cattle, and Adi Aw'ala in Western Tigray where the rainy season is generally 2-4 weeks longer than the rest of the Region. Adi Abo Mossa was included in the project because of a concern that increased use of chemical fertiliser could lead to eutrophication of Lake Hashenge.

The fields for taking the yield samples were selected with the farmers and chosen to represent the most widely grown crops, each of which had been grown with compost, or with chemical fertiliser, or without any input (the check). The amount of compost applied ranged from

Table 1: List of local communities from which crop-yield data were taken between 2000 and 2006 inclusive

Zone	Woreda	Tabia	Communtiy
Southern Tigray	Ofla	Hashenge	Adi Abo Mossa (O)
	Alamata	Lemat	Adi Abo Golgi
		Seelam Beqalsei	Seelam Beqalsei
Eastern Tigray	Sa'esi'e Tsada Amba	Sendeda	Tsebela
		Mai Megelta	Zeban Sas (O)
		Agamat	Gu'emse (O)
	Kilte Awla'elo	Mai Weyni	Sherafo
	Atsbi-Wonberta	Hayelom	Gergera
			Enda Maino
Central Tigray	Tahtai Maichew	Mai Berazio	Adi Nefas (O)
		Akab Se'at	Adi Gua'edad
		Ruba Shewit	Adeke Haftu
		Mai Siye	Mai Tsa'ida
		Kewanit	Hagere Selam
		Adi Guara	Tselielo
		Adi Hutsa	Kenef
	Kolla Tembien	Guroro	Shimarwa
		Miwts'e Worki	Adi Reiso
Western Tigray	Tahitay Adyabo	Adi Aw'ala	Adi Aw'ala
Total	**8**	**18**	**19**

Key – (O) refers to communities where work started in 1996/7, the others joined the project later.

the equivalent of 5 to 15 tonnes per hectare. It was assumed that farmers had applied the recommended rates of urea and DAP, i.e. 120 kg/ha.

The method used to collect the yield data was based on the crop sampling system of the FAO. Three one-metre square plots were harvested from each field to reflect the range of conditions of the crop. The harvested crop was then threshed and the grain and straw were weighed separately. For comparison, all yields were converted into kg/ha.

Most cereals are harvested leaving quite a long straw in the field (up to 20 cm) because domestic animals are put to graze in these fields as soon as the harvest has been collected. The data were recorded along with the name of the farmer, the crop and the treatment, the location and the date. The farmer kept the straw and grain. The harvested straw is important because it is the main source of animal feed during the dry season, and the animal manure and straw are important raw materials for making compost.

CHAPTER THREE

RESULTS AND DISCUSSION

BETWEEN 2000 and 2006, grain and straw yield data were taken separately from 974 plots. The names of the 11 crops from which observations were recorded are given in Table 2. But four of these were dropped from the final statistical analysis because each had less than 10 observations. This left seven cereal and two pulse crops in the final statistical analysis.

Table 2: List of crops from which yield data were recorded, 2000-2006

Crop	Scientific name	Remarks
1. Barley	*Hordeum vulgare*	Many farmers' varieties are grown
2. Durum wheat	*Triticum durum*	The most widely grown wheat
3. Finger millet	*Eleusine coracana*	Not grown as widely as in the past
4. Hanfets	*Hordeum vulgare+ Triticum durum*	A mixture of barley and durum wheat grown in areas prone to erratic rainfall and generally poor soils
5. Maize	*Zea mays*	Grown more for the fresh cobs than the grain

6. Millet	*Eleusine coracana*	The same as finger millet — less than 10 observations were recorded under this name
7. Sorghum	*Sorghum bicolor*	Grown more widely in the western lowlands than the highlands
8. Teff	*Eragrostis tef*	Ethiopia's endemic cereal with many varieties
9. Chick pea	*Cicer arietinum*	Not very widely grown — less than 10 observations were recorded
10. Faba bean	*Vicia faba*	The most widely grown pulse, also known as horse bean
11. Field pea	*Pisum sativum*	More often grown mixed with faba bean than by itself
12. Haricot bean	*Phaseolus vulgaris*	A recent introduction by the BoARD — less than 10 observations were recorded
13. Horse bean	*Vicia faba*	The same as faba bean — less than 10 observations were recorded under this name

The data were analysed using the statistical programme, STATA. The average grain and straw yields converted from g/plot to kg/ha for each treatment for the nine crops are given in Table 3. The table also gives the number of observations included in the analysis for each crop and treatment. The average grain and straw yields as kg/ha for the seven cereal crops, based on the averages for each crop, are shown in Figure 1.

The data for the nine crops were subjected to linear regression analysis by treatment based on the values obtained from fields where compost was applied, chemical fertiliser (DAP and urea) was applied and no input (check) was applied. The null hypothesis used was that the treatments have no impact on the yields. The probability that this null hypothesis could explain the results was found to be less than 0.05. In other words, the confidence limit was found to be above 95%. The increase in grain yields in fields where chemical fertiliser was applied was significantly higher (95% confidence limit) than in the fields where no input (check) was applied, and the grain yields in fields where compost was applied were also significantly higher (95% confidence limit) than in the fields where chemical fertiliser was applied. The significance in the differences among the straw yields for each treatment was similar. The differences among treatments in the yields of each of the crops were also similarly significant.

Except for field pea, the compost generally doubled the grain yield when compared to each respective check (Table 3). The difference was significant (95% confidence limit). The application of compost also increased straw yield compared to the check, but not to the same extent as it increased grain yield (Figure 1).

The use of compost also gave higher yields than the use of chemical fertiliser, though differences in the yields from compost and from chemical fertiliser were not as great as the differences between the use of compost and the check. For sorghum and faba bean the yields from the use of compost and chemical fertiliser were similar. But the yield difference for all the other crops was greater with that from the compost treatment being always higher than that from the use of chemical fertiliser.

The proportion, expressed in percentages, of the grain in the total harvested yield (grain + straw) for each of the nine crops is given in Table 4. For the cereal crops, the percentages of the grain in the

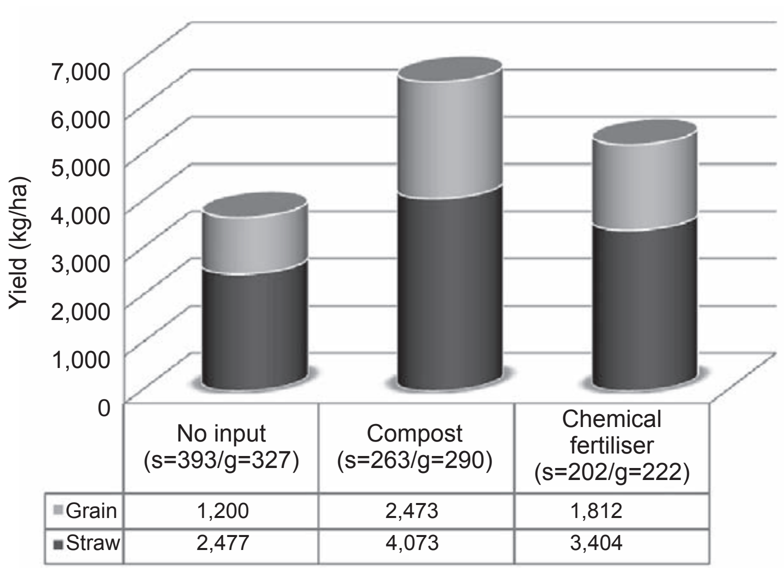
Table 3: Average yields by treatment in kg/ha for 9 crops in Tigray, 2000-2006 inclusive

	Average Yield (kg/ha)					
Crop type	**Check**		**Compost**		**Fertiliser**	
	Grain	**Straw**	**Grain**	**Straw**	**Grain**	**Straw**
Barley	1,115	2,478	2,349	4,456	1,861	3,739
	(n=56)	(n=52)	(n=57)	(n=55)	(n=36)	(n=35)
Durum wheat	1,228	2,342	2,494	3,823	1,692	3,413
	(n=73)	(n=67)	(n=61)	(n=57)	(n=48)	(n=45)
Finger millet	1,142	2,242	2,652	4,748	1,848	3,839
	(n=16)	(n=16)	(n=14)	(n=13)	(n=8)	(n=7)
Hanfets	858	2,235	1,341	3,396	1,199	2,237
	(n=31)	(n=31)	(n=31)	(n=31)	(n=29)	(n=29)
Maize	1,760	3,531	3,748	4,957	2,900	3,858
	(n=31)	(n=20)	(n=41)	(n=31)	(n=25)	(n=13)
Sorghum	1,338	2,446	2,497	3,662	2,480	4,433
	(n=14)	(n=13)	(n=11)	(n=10)	(n=5)	(n=5)
Teff	1,151	2,471	2,143	3,801	1,683	3,515
	(n=106)	(n=94)	(n=75)	(n=66)	(n=71)	(n=68)
Faba bean	1,378	2,121	2,857	4,158	2,696	3,783
	(n=20)	(n=17)	(n=23)	(n=24)	(n=3)	(n=3)
Field pea	1,527	1,201	1,964	1,625	0	0
	(n=9)	(n=9)	(n=9)	(n=9)		

'hanfets' ia a mixture of barley and durum wheat

(n = number of records for each treatment and crop)

Figure 1: Average grain and straw yields (kg/ha) for 7 cereal crops, based on the averages for each crop, Tigray, 2000-2006 inclusive



(s= number of observations for straw yield

g= number of observations for grain yield)

harvest are given in Figure 2. The data are only indicative because, as noted earlier, the farmers usually leave long stubble up to 20 cm tall from their cereal crops in the field for domestic animals to graze on. However, for faba bean and field pea all the above ground biomass is harvested. The results show that compost not only increases the overall biomass yield, but also increases the proportion of the grain to straw in the yield. The most striking crop is field pea where the proportion of grain in the total yield exceeded 50% for both the check and the compost treatment, but the field pea 'check' was probably grown in fields that had received compost in previous years – see the discussion below. For all the other crops, the proportion of grain

Table 4: Total biomass and percentage grain by crop in Tigray, 2000-2006 inclusive

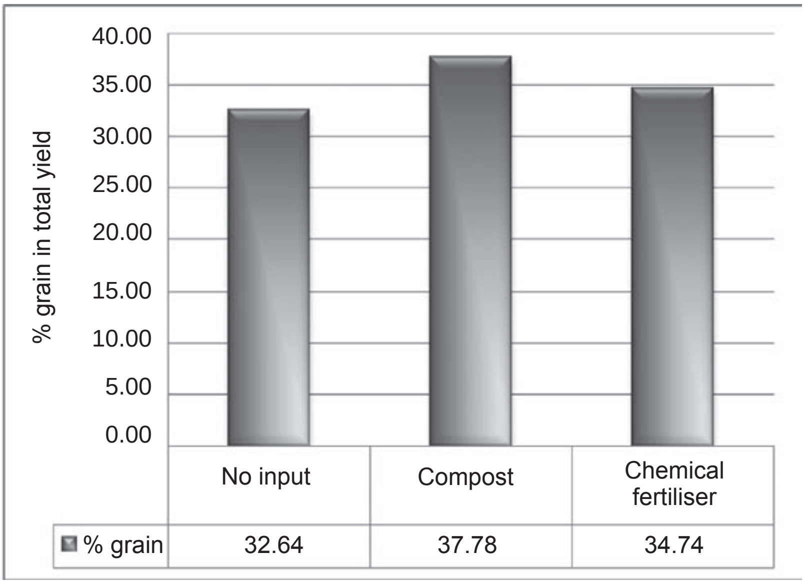
Crop type	**% Grain in total biomass yield (kg/ha)**					
	Check		**Compost**		**Fertiliser**	
	% Grain	**Total**	**% Grain**	**Total**	**% Grain**	**Total**
Barley	31	3,593	35	6,805	33	5,600
Durum wheat	34	3,570	39	6,317	33	5,105
Finger millet	34	3,384	36	7,400	32	5,687
Hanfets	28	3,093	28	4,737	35	3,436
Maize	33	5,291	43	8,705	43	6,758
Sorghum	35	3,784	41	6,159	36	6,913
Teff	32	3,622	36	5,944	32	5,198
Faba bean	39	3,499	41	7,015	42	6,479
Field pea	56	2,728	55	3,589	0	0

'hanfets' ia a mixture of barley and durum wheat

in the total harvested yield ranged from 28% for hanfets to 35% for sorghum in check fields, from 28% for hanfets to 43% for maize in fields treated with compost, and from 32% for finger millet and teff to 43% for maize in fields where chemical fertiliser had been applied.

In 1998, when the first set of data were collected from plots in the four original communities, except for maize, the grain yields of the cereals from the fields without any inputs (checks) were all below 1 tonne a hectare: 395-920 kg/ha for barley, 465-750 kg/ha for durum wheat, 760 kg/ha for finger millet, 590-630 kg/ha for hanfets, and 480-790 kg/ha for teff (Annex in Edwards, 2003). In the seven-year data set, only hanfets had an average grain yield below 1 tonne a

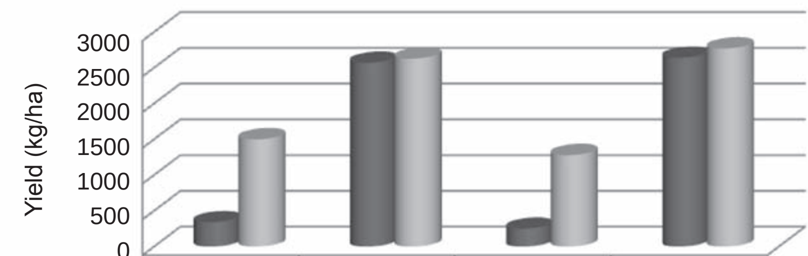
Figure 2: Averages of cereal grain yields/crop/treatment as proportions of their respective grain + straw yields/crop/treatment, averaged over all the 7 cereal grains and expressed as percentages, Tigray, 2000-2006



hectare (858 kg/ha). The average check yields for all the other cereals ranged from 1,115 kg/ha for barley to 1,760 kg/ha for maize. The four original communities had been making and using compost for 10 years, and all the others had been using compost for 3-5 years, and the higher average check yields were probably due to the residual effect of the use of compost in previous years.

The impact of compost on restoring soil fertility is well illustrated by data for grain yields of the pulses, faba bean and field pea, shown in Figure 3 for Adi Abo Mossa. The difference between the yields for the check fields and fields that had received compost was very large in 1998, but in 2002 there was hardly any difference – for both crops

Figure 3: **Yields (kg/ha) for faba bean and field pea from** Adi Abo Mossa, 1998 and 2002



Crop & year	Faba bean 1998	Faba bean 2002	Field pea 1998	Field pea 2002
Check	340	2570	250	2640
Compost	1500	2630	1280	2770

and both treatments, the grain yields were over 2 tonnes a hectare. This similarity in yields is also seen for field pea in the seven-year data set in Table 3.

The residual effect of compost in maintaining soil fertility for two or more years was soon observed and appreciated by the farmers. They are thus able to rotate the application of compost on their cultivated land and do not have to make enough to apply to all their cultivated land each year.

The reduction of difficult weeds, such as Ethiopian wild oats *Avena vaviloviana*, and improved resistance to pests, such as teff shoot fly, have also been noted by the farmers. These impacts from the use of compost, including better resistance to crop diseases, have also been found with farmers practising organic agriculture in France (Chaboussou, 1985).

One reason that compost has been able to significantly increase yields could be the fact that the farmers are still using their own varieties (also referred to as landraces), which have been selected by them in an organic environment where overall soil fertility is more important than just the amounts of the two major nutrients, N and P, supplied by urea and DAP. Dr Stephen Jones (personal communication) of the Washington State University and his colleagues have been breeding wheat for organic agriculture and they find that varieties that give high yields under organic conditions are different from those that give high yields with chemical fertiliser inputs.

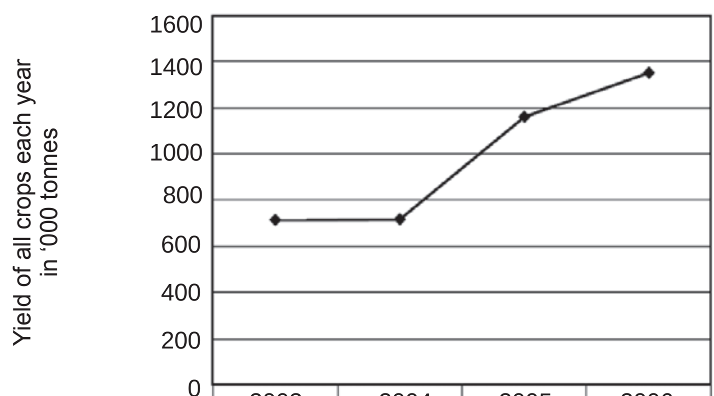
Other reasons that farmers have been ready to adopt making and using compost are that it enables them to avoid the financial risk of taking chemical fertiliser on credit, and that the compost is available when it is needed – chemical fertiliser is sometimes delivered late.

Chapter Four

CONCLUSION

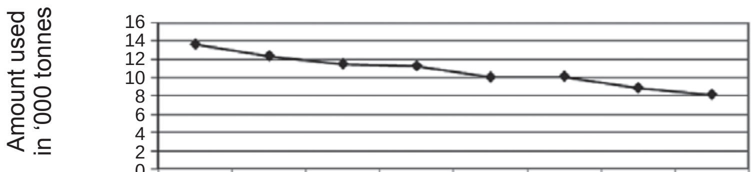
SINCE 1998, the Bureau of Agriculture and Rural Development of Tigray Region has adopted the making of compost as part of its extension package and by 2007 at least 25% of the farmers are making and using compost. A reflection of the success of this approach is that between 2003 and 2006 grain yield for the Region almost doubled from 714 to 1,354 thousand tonnes (Figure 4). Since 1998, there has also been a steady decrease in the use of chemical fertiliser from 13.7 to 8.2 thousand tonnes (Figure 5).

Figure 4: Total recorded crop production in Tigray, 2003-2006



	2003	2004	2005	2006
Crop yield in '000 tonnes	713.95	716.96	1,162.20	1,353.79

Figure 5: Total use of urea and DAP in Tigray, 1998-2005



Year	1998	1999	2000	2001	2002	2003	2004	2005
Urea/DAP in '000 tonnes	13.71	12.43	11.54	11.32	10.09	10.17	8.90	8.17

Making and using compost is also being promoted in other regions of the country, particularly through the 'Community-based Participatory Watershed Development' project of the Ministry of Agriculture, and the Land Rehabilitation Project of the Environmental Protection Authority, which has been supported through three successive phases of the Country Cooperation Programme of the United Nations Development Programme (UNDP).

There is also a need to involve plant breeders and farmers together in participatory plant breeding in order to explore and develop the potential of the farmers' varieties to give consistent high yields under an organic agriculture system, i.e. where compost is made and used regularly by the farmers.

References

Alvares, F, 1961. *The Prester John of the Indies*. Hakluyt Society, London.

Asmelash, Arefayne, 1994 EC (2002 GC). *Dekuaie tefetro: intayn bkhmeyn* (Making compost: what it is, and how is it made). In Tigrinya. Tigray Bureau of Agriculture and Natural Resources and Institute for Sustainable Development, Addis Ababa, Ethiopia. (EC = Ethiopian calendar, which is eight years behind the European Gregorian calendar).

Chaboussou, Francis, 1985. *Healthy Crops: a new agricultural revolution*. Translated from French by Mark Sydenham, Grover Foley & Helena Paul, and published in 2004 by Jon Carpenter Publishing, Charlbury and the Gaia Foundation, Brazil and London.

Clark, J. Desmond, 1976. 'Prehistoric populations and pressures favouring plant domestication in Africa', in: Harlan, Jack R., Jan M.J. de Wet & Ann B.L. Stemler (eds), *Origins of African Plant Domestication*. Mouton Publisher, The Hague.

Edwards, Sue B., 1991. 'Crops with wild relatives found in Ethiopia'. In: Engels, J.M.M., J.G. Hawkes & Melaku Worede, 1991. *Plant Genetic Resources of Ethiopia*. Cambridge University Press, Cambridge.

Edwards, Sue, 2003. *Natural Fertilizer*. Institute for Sustainable Development, Addis Ababa.

Engels, J.M.M. & Hawkes, J.G., 1991. 'The Ethiopian gene centre and its genetic diversity', in: Engels, J.M.M., J.G. Hawkes and Melaku Worede (eds). *Plant Genetic Resources of Ethiopia.* Cambridge University Press, Cambridge.

Araya, Hailu & Edwards, Sue, 2006. *The Tigray Experience: a success story in sustainable agriculture*. Environment & Development Series 4. TWN (Third World Network), Penang.

Phillips, S., 1995. 'Poaceae (Gramineae)', in: Inga Hedberg & Sue Edwards (eds), *Flora of Ethiopia and Eritrea*, Vol. 7. Addis Ababa and Uppsala.

Poncet, C.J., 1967. ‘A narrative by Charles Jacques Poncet of his journey from Cairo into Abyssinia and back, 1698-1701’, in: Foster, W. (ed) *The Red Sea and Adjacent Countries at the Close of the Seventeenth Century*. Kraus Reprint Ltd, Nendeln, Lichtenstein.

Titles in the TWN Environment & Development Series

No. 1 Globalisation & The Crisis of Sustainable Development *by Martin Khor (68 pages)*

No. 2 International Environmental Governance: Some Issues from a Developing Country Perspective *by Third World Network (40 pages)*

No. 3 Mekong Tourism – Model or Mockery?: A Case Study on 'Sustainable Tourism' *by Anita Pleumarom (52 pages)*

No. 4 The Tigray Experience – A Success Story in Sustainable Agriculture *by Hailu Araya and Sue Edwards (52 pages)*

No. 5 Putting Farmers First in Sustainable Agriculture Practices *by Hira Jhamtani (32 pages)*

No. 6 Enduring Farms: Climate Change, Smallholders and Traditional Farming Communities *by Miguel A Altieri and Parviz Koohafkan (72 pages)*

No. 7 Small Farms as a Planetary Ecological Asset: Five Key Reasons Why We Should Support the Revitalisation of Small Farms in the Global South *by Miguel A Altieri (24 pages)*

No. 8 The Food Crisis, Climate Change and the Importance of Sustainable Agriculture *by Martin Khor (24 pages)*

No. 9 The Case for Sustainable Agriculture: Meeting Productivity and Climate Challenges *by Lim Li Ching (32 pages)*

No. 10 The Impact of Compost Use on Crop Yields in Tigray, Ethiopia, 2000-2006 inclusive *by Sue Edwards, Arefayne Asmelash, Hailu Araya and Tewolde Berhan Gebre Egziabher (32 pages)*

THE IMPACT OF COMPOST USE ON CROP YIELDS IN TIGRAY, ETHIOPIA, 2000-2006 INCLUSIVE

In 1996, the Institute for Sustainable Development (ISD) in Ethiopia started a project with the Bureau of Agriculture and Rural Development of Tigray Region to work with local farming communities of smallholder farmers in degraded areas to rehabilitate their environments and improve agricultural production based on ecological principles. The project included training the local experts and farmers to make and use compost in place of chemical fertiliser. The results, which have been encouraging, are documented in this paper.

In 1998, the Bureau of Agriculture and Rural Development of Tigray Region adopted the making of compost as part of its extension package. By 2007 at least 25% of the farmers were making and using compost. Between 2003 and 2006 grain yield for the Region almost doubled. Since 1998, there has also been a steady decrease in the use of chemical fertiliser.

Making and using compost is also being promoted in other regions of the country. In 2008, the Ministry of Agriculture reported that around two million (16%) of the highland farmers were using compost as part of their efforts to increase food crop production for food security in Ethiopia.

Sue Edwards, Arefayne Asmelash and **Hailu Araya** are Director, Project Officer and Sustainable Community Development Team Leader, respectively, of the Institute for Sustainable Development (P O Box 171-1110, Addis Ababa, Ethiopia). Correspondence can be addressed to Sue Edwards and Hailu Araya (sustaindeveth@ethionet.et/sustainet@yahoo.co.uk/ hailuara@yahoo.com). **Tewolde Berhan Gebre Egziabher** is Director General of the Environmental Protection Authority, P O Box 12760, Addis Ababa, Ethiopia. E-mail: esid@ethionet.et

TWN ENVIRONMENT & DEVELOPMENT SERIES

is a series of papers published by Third World Network on the increasing challenges to the relationship between the environment and development, in particular those posed by the process of globalization, liberalization and new technologies. It aims to advance a Third World perspective of analyses, strategies and proposals for reforms of policy, practice and institutions, at both the international and national levels – towards greater social justice, equity and ecological sustainability.

ISBN 978-983-2729-91-4

9 789832 729914