The Impact of Compost Use on Crop Yields in Tigray, Ethiopia

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Crop cultivation in the northern highlands of Ethiopia is old and still highly diverse

- Many scientists (e.g. Harlan) have reported it to be about 5000 years old
- Implements for handling and processing seed are much older, e.g. 12,000-year old stone sickles. Is crop cultivation also older?
- The number of endemic crops is very high, e.g. coffee, teff, niger seed (noug), Ethiopian kale, enset, anchote
- The diversity of many non-endemic crops is very high, e.g. sorghum, barley, wheat (except bread wheat), finger millet, chickpea, field pea, faba bean, grass pea, sesame, linseed, yams, taro

- There is even an endemic species of wheat, *Triticum abyssinicum*, which is in a supposedly introduced genus
- Radio-carbon dating has shown Tigray, in northern Ethiopia, to have been deforested (for crop production) for at least 2000 years
- European travellers, e.g. Alvares in 1505-1510 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

Since 1974, Ethiopia has been portrayed as a food deficit country – Why?

- Starting from the end of the 19th century, the centralizing state reacting to European colonialism systematically destroyed local governance as a possible ally of colonialists
- Loss of local governance undermined local natural resource management with loss of protection of woody vegetation, lack of repair of old terraces, lack of care for common resources
- Civil war exacerbated this impact
- Gully formation and soil erosion ate away the fertile top soil
- Vegetation recovery was prevented by free-range grazing and need for firewood

Challenges

- Restore soil fertility through compost and help farmers avoid debt paid for chemical fertilizer (DAP and Urea)
- Improve biological and physical water and soil conservation including control and rehabilitate gullies,
- Control, preferably stop, free-range grazing
- Include grasses and fast growing legumes (most successful has been *Sesbania sesban*) for animal forage and compost biomass
- Help local communities restore local control of NRM through by-laws

Experience from Tigray

This approach has been tried in one of the most degraded parts of Ethiopia, Tigray, starting with 4 local communities in 1996.

- In 2003, the population of Tigray was estimated at over 4 million, 85% rural
- Land area, 50,078.64 sq km
- Average land holding less than 1 ha/family
- Average rainfall, 500-700 mm/year, mostly end of June to middle September

Map of Ethiopia with Tigray indicated

Sustainable Agriculture Project

- In 1996, the Institute for Sustainable Development (ISD), together with the Bureau of Agriculture and Rural Development of Tigray (BoARD) funded by the Third World Network (TWN) of Penang, Malaysia, took up the challenge of stimulating 4 farming communities to meet the challenges

Sustainable Agriculture Project cont

- The strategy used was to strengthen local governance and professional expertise through
  - Elected leadership
  - Bylaw development to regulate activities of neighbouring households
  - Regular (at least monthly) meetings to review implementation
  - Secure recognition by formal district and regional administrations and law enforcement agencies for community organization and enforcement of the bylaws
  - Regular training and discussions

Sustainable Agriculture Project cont

- By 1998, environmental benefits became obvious, and the number of communities with which ISD worked started to increase reaching 42 in 2005
- BoARD started using the project approach as part of its extension work throughout Tigray Region with a target of 2000 farmers making compost in 2002
- ISD published a compost manual in Tigrinya

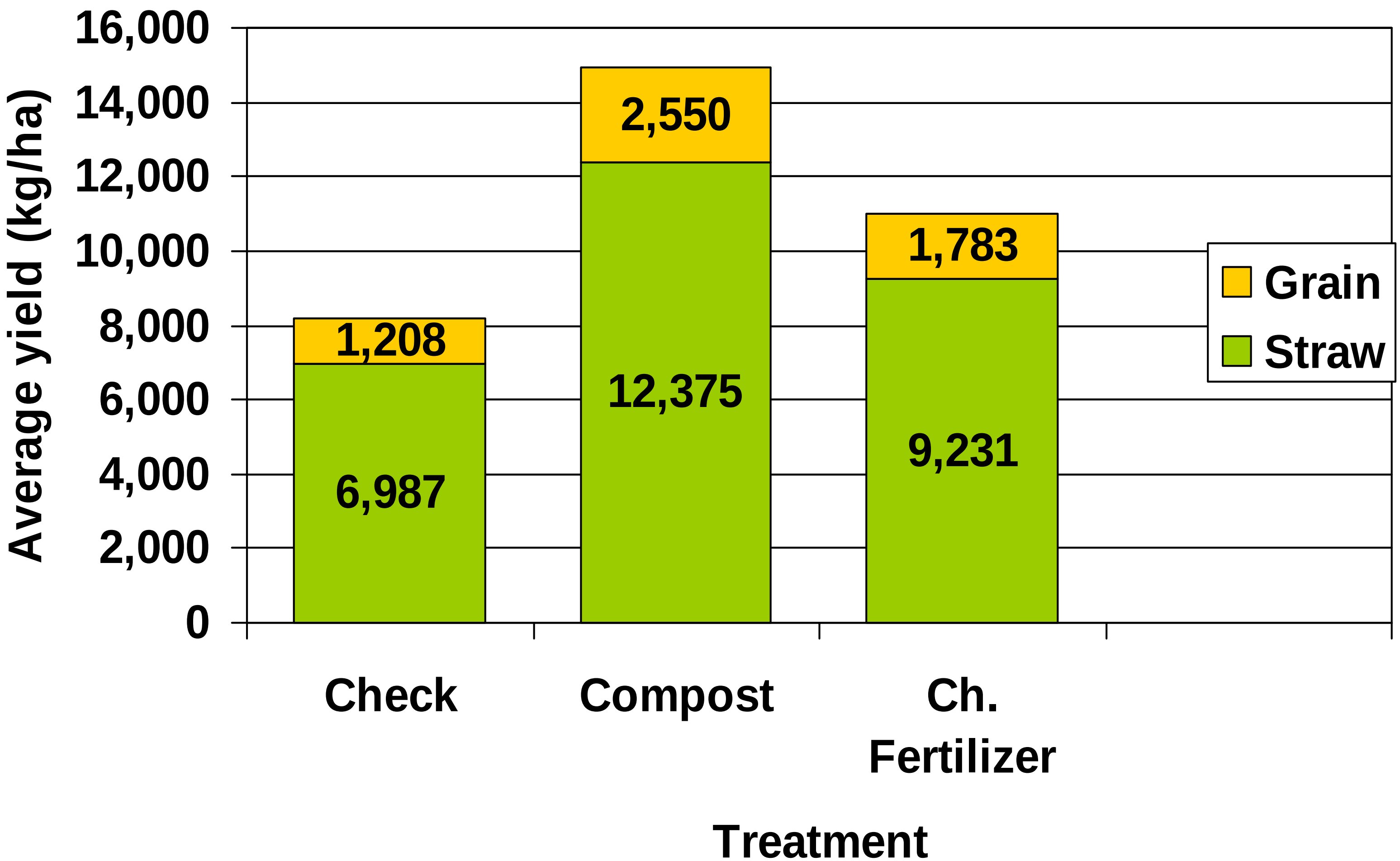
Data collection and analysis

- In 1998, ISD started to collect grain and straw yields from the communities where it worked
- Sampling followed FAO's recommendation: 3 one-metre square plots chosen to reflect the crop condition of a field at harvest; grain and straw were weighed and recorded separately, and kept by the farmer
- From 2001 through 2005, data for 14 crops were collected each year from a total of 779 fields (an additional 195 fields were sampled in 2006/07 with support from FAO)
  - 7 crops were grown in 30 or more fields (see Table 1) and their data subjected to statistical analysis
  - The remaining 7 crops had data from less than 30 fields and were excluded from the initial analysis
  - Data from all the crops were used to generate the overall impact of compost (Figure 1)

Table 1: Average yields for seven crops in Tigray, 2001-2005

	Average yield (kg/ha)					
Crop type	Check (no input)		Compost		Chemical fertilizer	
	Grain	Straw	Grain	Straw	Grain	Straw
Faba bean	1,544	7,199	3,535	13,998	2,696	11,350
Barley	1,161	6,927	3,535	13,670	1,832	8,269
Wheat (durum)	1,313	6,464	2,374	10,740	1,760	8,453
Teff	1,179	7,384	2,791	12,193	1,774	11,096
Maize	1,843	13,545	2,401	17,840	3,031	14,363
Hanfets	858	6,706	3,895	10,187	1,199	6,712
Finger millet	898	4,177	2,496	12,148	1,297	6,665
Hanfets is a mixture of barley and durum wheat						

Figure 1: Average yields for grain and straw for all crop samples, Tigray, 2001-2006



Statistical analysis

- Data for grain and straw yields (Table 1) were subjected separately to linear regression analysis using the program called STATA
- The null hypothesis was that growing the crops on fields treated with chemical fertilizer (DAP and Urea), and fields treated with compost would give yields not different from those grown as checks (i.e. where neither chemical fertilizer nor compost had been applied)

Results

- Yields of both grain and straw for all crops in fields with chemical fertilizer applied are higher than in check fields ($p>99\%$)
- Yields of both grain and straw in fields for all crops with compost applied are higher than in check fields ($p>99\%$)
- The differences in yields of both grain and straw of the crops analysed individually were also significant
- Fields treated with compost gave higher yields of both grain and straw than those treated with chemical fertilizer (Figure 1)

Results cont.

- The ratio of grain to straw was highest for harvests from fields supplied with compost (17.1% of total yield) followed by chemical fertilizer (16.1% of total yield), followed by check (14.7% of total yield)
- In Tigray Region, the use of chemical fertilizer decreased from 13,700 to 8,200 tonnes between 1998 and 2005, but grain production increased from 714,000 to 1,300,000 tonnes. This indicates the extent of increase in compost making and use
- It is not only the increase in food production that matters, but also the freedom the farmers have from buying inputs and being able to rely on their own locally developed and adapted varieties

Implications for future work

- Variety selection for increasing yields with rising soil fertility should start from the farmers' own best varieties and not just those bred to respond to only chemical fertilizer
- The crop genetic diversity should be maintained and studied in depth in situ
- Niche markets should be developed for farmers' varieties grown organically, e.g. *Triticum diccocum* for high protein, *Pisum sativum* var *abyssinicum* for flavour

- Techniques for improving compost making and transportation (including the use of organic waste from urban centres)
- Developing multipurpose leguminous crops for borders of fields, green manures, improved animal feed

Thank you