# Soil Health and Support Systems
## Contradictions and Missing Links

GOPIKRISHNA S R

The soil as a natural resource has always been taken for granted by policymakers. While the government investments continue to support chemical fertiliser-based farming models, this article explores the contradictions in soil health management policies and their impact on farming and food production. It argues that it is high time that the government chalks out a plan to move away from dependence on chemical fertilisers to ensure food security in the country and makes investments to support an holistic ecological fertilisation programme.

The article draws ideas from a series of workshops and conferences organised by Greenpeace India between August 2010 and December 2011 as part of its "Living Soils" campaign. It acknowledges the participants of these workshops/conferences for their inputs. The views expressed here are personal.

Gopikrishna S R (*gopi.krishna@greenpeace.org*) is with Greenpeace India.

The declining vitality of Indian soils and the resultant threat to food security has already been accepted as a critical crisis by Indian policymakers. It is also accepted that indiscriminate usage of chemical fertilisers over several decades and complete neglect of ecological fertilisation led to this crisis. Policymakers also made promises to support ecological alternatives to address the crisis.[1] However, these promises remain on paper and government policies continue to tread the path of chemical-intensive farming and the trend was also evident in the last union budget. The subsidies for chemical fertilisers soared to a new high of Rs 67,198 crore (revised budget estimate for 2011-12, which is expected to go further up by the end of the fiscal year). A similar estimate (Rs 60,974 crore) was made for the next financial year as well.[2] On the other hand, hardly any allocation was made for holistic ecological fertilisation programmes. In this context, this article explores the contradictions in soil health management policies and its impact on farming and food production.

### Soils and Subsidies

The soil is a living ecosystem which supports several life forms. Simple unicellular microorganisms to complex multicellular organisms dwell in this ecosystem. It has been estimated that under favourable conditions, one-tenth of organic matter in soil is made up of soil animals. Thus, a 10 cm of a hectare of soil with 1% organic matter contains roughly 1,500 kg of soil fauna (Rao and Patra 2009). These organisms and the natural cycles operational in the soil play a huge role in maintaining the vigour and vitality of this dynamic ecosystem. Organic matter is the lifeline of soil since it plays a key role in soil functioning, determining soil quality, water holding capacity and the susceptibility of soil to degradation (Feller et al 2001).

However, ever since the green revolution, policy has focused on the major plant nutrients and how to supply it through chemicals. Policies completely ignored soil health and neglected the importance of organic matter. The government heavily subsidised chemical and synthetic fertilisers, particularly nitrogen, phosphorous and potassium (NPK). The amount of subsidy on this has grown exponentially during the last three decades from a mere Rs 60 crore during 1976-77 to an astronomical Rs 62,301 crore during 2010-11.[3] This mindless support has led to indiscriminate use of chemical fertilisers, especially nitrogenous fertilisers, which in turn, led to widespread soil degradation and yield stagnation in the regions which adopted chemical-intensive agriculture,[4] which sparked of a debate.

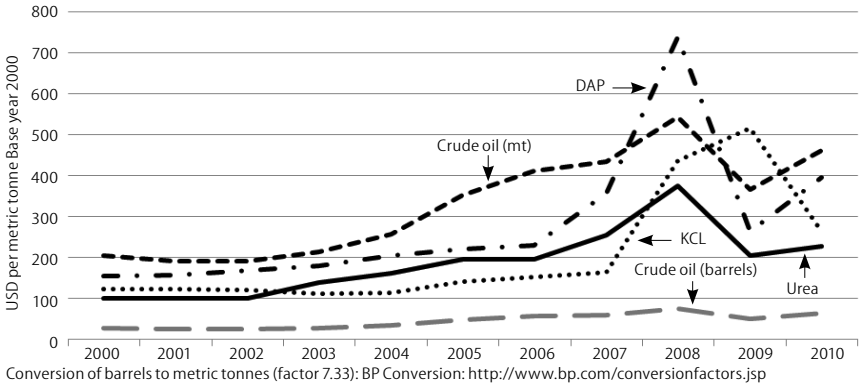
The debates and discussions in academic, civil society and policy circles on the ill-effects of chemical fertilisers on soil health and food security were acknowledged by the Government of India in 2009 and following this the age-old fertiliser subsidy policy was replaced with a nutrient-based subsidy (NBS) system for fertilisers in 2010. The new system of a fixed subsidy based on the nutrient content had a very constricted view of soil health. It neither addressed the issue of declining organic matter nor succeeded in arresting indiscriminate usage of chemical fertilisers. On the other hand, NBS made the crisis worse by decontrolling phosphatic and potash fertilisers, while keeping urea untouched, leading to farmers replacing decontrolled fertilisers with cheaper nitrogen,[5] further jeopardising soil health.

### Linking Farm to Fossil Fuel Vulnerabilities

Synthetic fertilisers' production is a highly energy-intensive process and consumes large amounts of fossil fuel energy. Natural gas, naphtha and fuel oil are the major fuel and feedstock used in nitrogen fertiliser manufacturing. Ammonia and phosphoric acid (a raw material for synthetic phosphatic fertilisers) are also produced by using fossil energy.

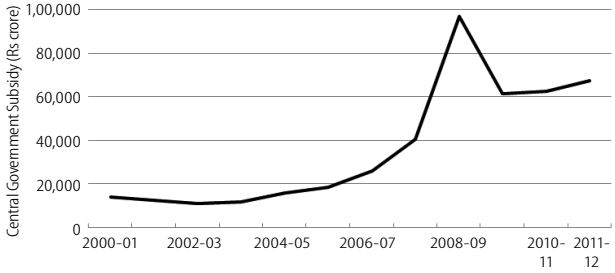
According to scientific estimates fossil fuel production peaked in 1960 (Ivanhoe 1995), i e, oil extraction is no longer

**Figure 1: Global Price History of DAP, Urea, KCL and Crude Oil** (2000-10)




Conversion of barrels to metric tonnes (factor 7.33): BP Conversion: http://www.bp.com/conversionfactors.jsp
Source: The World Bank: GEM Commodities Databank. http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=1175

**Figure 2: Subsidy Allocation** (2000-01 to 2011-12)




Source: Fertiliser Association of India and relevant union budget documents.

capable of keeping pace with the increasing demand. This situation is triggering an unprecedented increase in fossil energy prices, which makes the entire food production distribution system highly vulnerable (Günther 2000).

The fuel-fertiliser link has been discussed much in relation to food price rise in 2009, following which several modelling studies were undertaken by scientists across the globe. A modelling study (Chen et al 2010), which analysed weekly fertiliser and oil prices between 2003 and 2008 confirmed that the percentage changes in five fertiliser prices (namely, mono ammonium phosphate, urea, ammonia, phosphoric acid, muriate of potash) due to 1 percentage change in the crude oil price are relatively larger, and consequently, the sensitivity of the five fertiliser prices to oil prices increased, and were statistically significant. This also explains why global fertiliser prices reached their peak in 2008, as the crude oil price reached a high level in 2008. Figure 1 shows the trends in six fertiliser prices corresponding to the crude oil price during the period 2000-10. Prices of most of the fertilisers peaked during 2008 along with the oil prices.

The subsidy allocations of the Government of India have also fluctuated with the fossil fuel prices. Subsidy spending shot up to Rs 96,606 crore in 2008-09, coinciding with a peak in fossil fuel prices (Figure 2). Thus, the chemical fertiliser-dependent farming and subsidy system linked not only our food production systems, but also our government exchequer to the vulnerabilities of fossil fuels.

Prime Minister Manmohan Singh has recently highlighted the issue in one of his speeches[6] and urged the leading agricultural scientists to look for organic alternatives to chemical fertilisers to avoid excessive reliance on hydrocarbon (fossil fuel) inputs. However, no significant investment followed.

## Not Helping Soil Health

The indicators used for formulating policies are often based on the crops cultivated and are not soil based. For example, according to the *Economic Survey 2009-10* (p 186):

> The per hectare consumption of fertilizers in nutrients terms increased from 105.5 kg in 2005-06 to 128.6 kg in 2008-09. However, improving the marginal productivity of soil still remains a challenge. This requires increased NPK application and application of proper nutrients, based on soil analysis.[7]

Here, the indicator used to assess the consumption per hectare of chemical nutrients is based on the gross cropped area (GCA). GCA is calculated by adding land area as many times it is cultivated in a year. Counting cultivated land more than once raises the total sown area and hence the average consumption appears low, and based on this the Planning Commission is recommending the use of more chemical fertilisers. It is to be noted that the same piece of land receives the fertilisers when it is cultivated twice or thrice, and hence, the area is not divisible by the number of crops employed in that piece of land.

**Table 1: Fertiliser Applied Per Unit Land Area – Comparison between Per Hectare of Gross Cropped Area and Net Sown Area**

| Year | NSA ('000 ha) | GCA ('000 ha) | Fertiliser Consumption ('000 tonnes) | Fertiliser Consumption (kg/ha of GCA) | Fertiliser Consumption (kg/ha of NSA) | Difference in Consumption (per ha) |
|---|---|---|---|---|---|---|
| 2005-06 | 1,41,490 | 1,93,050 | 20,340 | 105.36 | 143.75 | 38.39 |
| 2006-07 | 1,39,950 | 1,93,230 | 21,651 | 112.04 | 154.70 | 42.66 |
| 2007-08 | 1,40,860 | 1,95,830 | 22,570 | 115.25 | 160.23 | 44.98 |

Source: Department of Agriculture and Cooperation.

Fertiliser consumed per hectare of net sown area (NSA) would have been a better indicator while formulating soil health policies. This gives a better understanding of the amount of fertilisers applied per unit of land area.[8] It is also to be noted that internationally the average consumption is calculated per hectare of arable land and as per the Food and Agriculture Organisation's definition[9] the double-cropped area is counted only once while measuring arable land.

**Table 2: Consumption of Fertilisers in Punjab**
(2007-08, Per Hectre)

| | |
|---|---|
| NSA ('000 ha) | 4,174 |
| Area sown more than once ('000 ha) | 3,695 |
| Total cropped area/GCA ('000 ha) | 7,869 |
| NPK ('000 tonnes) | 1,768 |
| NPK per hectare of GCA (kg/ha) | 224.6 |
| NPK per hectare of NSA (kg/ha) | 423.6 |

Source: Annual Administrative Report, 2008-09, Department of Agriculture, Punjab.

From Table 1 it is also clear that there is considerable difference between the two indicators. The difference is even more pronounced when one looks at state level data. Table 2 represents the data from Punjab. In 2007-08 the difference between the two indicators was 199 kg/ha.

## Way Forward

From the above discussion it is clear that the soil as a natural resource has always been taken for granted by policymakers. Of late there has been an acknowledgement of the soil health crisis and promises have been made. But investments continue to support a chemical fertiliser-based farming model. It is high time that the government makes investments to support a holistic ecological fertilisation programme and chalks out a plan to move away from the dependence on chemical fertilisers to ensure food security in the country.

Ecological fertilisation is often neglected citing reasons such as non-availability of biomass and high labour costs associated with such practices. However, few resources have been invested thus far in evaluating species, in improving cultural practices, and in devising appropriate implements for growing and harnessing plant biomass for soil health improvement. It is true that many practices associated with ecological fertilisation are currently labour-intensive. But little thought has gone into developing this labour-intensive nature of ecological fertilisation as an opportunity to generate rural employment opportunities. Government investment needs to go into grass roots institution-building, research and incentive mechanisms to support ecological fertilisation in a holistic manner.

### NOTES

1 Union Budget Speech, Government of India, 2011, p 10, paras 60 and 61 and Planning Commission (2011): *Faster, Sustainable and More Inclusive Growth: An Approach to the Twelfth Five-Year Plan*, Planning Commission, Government of India, October, pp 70-71.

2 Union Budget Speech, 2012 and Planning Commission, Government of India, 2012.

3 Union Budget, relevant years.

4 B C Roy, G N Chattopadhyay and R Tirado (2009), *Subsidising Food Crisis: Synthetic Fertilizers Lead to Poor Soil and Less Food*, Greenpeace India, available at http://www.kisanswaraj.in/wp-content/uploads/subsidising-food-crisis.pdf

5 Ajay Modi (2012), "Partial Freeing of Fertiliser Prices Leads to Urea Overdose" in *Business Standard,* viewed on 20 April 2012 (http://business-standard.com/india/news/partial-freeingfertiliser-prices-leads-to-urea-overdose/ 470600/).

6 "We must also recognise the risks of an excessive reliance on hydrocarbon inputs in increasing agricultural production and we should explore more systematically organic alternatives…" – Prime Minister Manmohan Singh on 16 July 2011 (ICAR foundation day). Viewed on 20 April 2012 (http://pmindia.nic.in/speech-details.php?nodeid=1042).

7 Planning Commission (2010), "Agriculture and Food Management" in *Economic Survey 2009-10*, Chapter 8, p 186, Planning Commission, Government of India, viewed on 20 April 2012 (http://indiabudget.nic.in/es2009-10/chapt 2010/chapter08.pdf).

8 O P Rupela and S R Gopikrishna (2011), "Of Soils, Subsidies and Survival: A Report on Living Soils", Greenpeace India, viewed on 20 April 2012 (http://www.greenpeace.org/india/en/publications/The-Living-Soils-Report/).

9 Arable land is "land under temporary crops (double-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years)", viewed on 20 April 2012 (http://www.fao.org/waicent/faostat/agricult/landuse-e.htm).

### REFERENCES


Chen, Ping-Yu, Chia-Lin Chang, Chi-Chung Chen and Michael McAleer (2010): "Modelling the Effect of Oil Price on Global Fertiliser Prices", Working Paper No 55/2010, Department of Economics and Finance, College of Business and Economics, University of Canterbury.

Feller, C, J Balesdent, B Nicolardot and C Cerri (2001): "Approaching Functional Soil Organic Matter Pools through Particle-Size Fractionation, Examples for Tropical Soils" in R Lal, K M Kimble and R F Follet (ed.), *Assessment Methods for Soil Carbon Advances in Soil Science* (Boca Raton, The US: Lewis Publishers), pp 53-67.

Günther, F (2000): "Vulnerability in Agriculture: Energy Use, Structure and Energy Futures", paper presented at INES conference, Department of Systems Ecology, Stockholm University, KTH, Stockholm, 15 June.

Ivanhoe, L F (1995): "Future World Oil Supplies: There Is a Finite Limit", *World Oil*, October, pp 77-88.

Rao, D L N and A K Patra (2009): "Soil Microbial Diversity and Sustainable Agriculture", *Journal of the Indian Society of Soil Science*, Vol 57, No 4, pp 513-30.