

Nutrient Based Subsidy (NBS) & Support Systems for Ecological Fertilization in Indian Agriculture



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Introduction

The intensive agriculture model was introduced in India in the 1960s as part of the Green Revolution. This brought in a package which included massive irrigation projects, new high yielding input responsive varieties and chemical fertilizers. Initially, it did increase production. But now, the food production is stagnating and one has been observing diminishing returns and falling dividends, especially in the agriculture intensive areas of the country.

The chemical and synthetic fertilizers, particularly Nitrogen, Phosphorous and Potassium (NPK), are highly subsidized. 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. 40,338 crore during 2007-08. In 2008-09, it shot up to Rs 96,606 crores. The budget allocation for 2009-10 for fertilizer subsidies was Rs 49,980 crores and is having similar estimate for 2010-11³. This huge rise in subsidy is attributed to inflation, and subsequent price fluctuations in the international fertilizer market. On a real term basis also, the fertilizer subsidy allocation has been showing a rising trend. Huge amount of subsidy allocation provided directly to the industry has led to indiscriminate production and availability while neglecting the locally available knowledge on soil nutrient management. Widespread usage of such fertilizers has resulted in the degradation of natural resource base, especially soil. It is now threatening the food security of the country and has sparked of a debate.

Nutrient Based Subsidy (NBS)

The debates and discussions in academic, civil society and policy circles on the ill effects of chemical fertilizers particularly on food security has now been acknowledged by the Government of India among others.⁴ Following this, the age-old fertilizer policy has been replaced with a Nutrient Based Subsidy (NBS) system for fertilizers with effect from 1st April 2010 “to eliminate the fertilizer use anomaly, arrest soil degradation due to imbalance use of chemical fertilizers and to ensure sustainable production with good soil health. Under the regime the Government also proposes soil test based, cropping system specific fertilizer uses in conjunction with organic and biofertilizers.”⁵ One would expect that this new policy on support system for fertilizers ought to address the following concerns:

- **Soil degradation**
 - decline in organic matter both in terms of quality and quantity
 - damage to the soil physical, chemical and biological properties
 - secondary and micronutrient deficiency
- **Food security**
 - Yield fatigue, that is, lack of yield growth – there is either stagnation or decline
- **Pollution of natural resources**
 - Ground water pollution due to nitrate leaching
 - Inland water bodies – algal blooms adversely affecting aquatic flora and fauna

- **Contribution to global warming**
 - Production and usage of synthetic nitrogen fertilizers release greenhouse gases
- **Farmers' distress due to increasing input cost and injustice to rainfed dryland regions**

Is NBS addressing the concerns?

Before analyzing the effectiveness of NBS to tackle the concerns mentioned above, one needs to understand the other reasons which forced the Government to bring in the new policy.

1 Burden on the Exchequer:

The conventional format of fertilizer subsidy especially the ad hoc concessions for phosphatic and potassic fertilizers was a burden on the exchequer, as these fertilizers are mostly imported and the subsidy amount was dependent on the international market fluctuations. As indicated earlier, it reached Rs 96,606 crore in 2008-09, particularly because of an increase in fuel prices. Through NBS, Government is also trying to avoid this fluctuation. NBS has proposed fixed amount of subsidies per metric tonne whereas under the earlier system the price to be paid by the farmer was fixed and any fluctuation in costs across month and also across production units/import dealers led to a variation in subsidies (Table 1). Urea has been kept out of this new policy, the maximum retail price has been increased by ten per cent to Rs.5310 per metric tonne, but the earlier retention price cum subsidy system continues.

Cover image: "Farmers of Vidharbha region of Maharashtra demand Central Government subsidy for organic fertilizers at Bapukudi, Sewagram, Wardha district, Maharashtra after a public hearing organized by Greenpeace India and Kissan Adhikar Abhiyan on Fertilizer subsidy reforms on 9 November 2009."

⁴This write-up has been prepared based on brainstorming of various stakeholders (that included among others Claude Alvares, R.N. Bisoyi, N. Devakumar, Rajesh Krishnan, Annie Raja, Rajeswari Raina, and Subhash Sharma) held at Young Womens Christian Association (YWCA), New Delhi on 3rd April 2010. An initial draft was circulated among the participants and others (MK Awasthi, Ashok Bang, GV Ramanjaneyulu) for further comments.

²SM is with Indira Gandhi Institute of Development Research, Mumbai and GSR is with Greenpeace, India.

³Budget documents, Government of India – relevant years

⁴Government of India, *Economic survey 2007-08*, Ministry of Finance, p. 20, para 1.65. Also see, B.C. Roy, G.N. Chattopadhyay, *Subsidising food crisis: synthetic fertilizers lead to poor soil and less food*, Greenpeace India, 2009; and R. Tirado, *Chemical fertilizers in our water: an analysis of nitrates in the groundwater in Punjab*, Greenpeace India, 2009.

⁵ Right to Information (RTI) response from Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, Ref No.9-1/2009/NCOF/1678, dated 11.03.2010.

Table 1
Subsidy of Fertilizers under NBS and their Comparison with 2008-09

Fertilizers	(Rs per metric tonne)		
	2008-09 (minimum)	2008-09 (maximum)	2010-11 (NBS)
Di Ammonium Phosphate (DAP)	11022	53056	16268
Mono Ammonium Phosphate (MAP)	10508	53056	16219
Triple Super Phosphate (TSP)	9848	47317	12087
Muriate of Potash (MOP)	7595	29804	14692
Ammonium sulphate	-3917	10110	5195
Complex fertilizers			
16-20-0-13	5610	34737	9203
20-20-0-13	4914	36620	10133
23-23-0-0	6869	25039	11386
10-26-26-0	18264	42069	15521
12-32-16-0	14845	44293	15114
14-28-14-0	13722	39945	14037
14-35-14-0	14924	46828	15877
15-15-15-0	12087	24998	11099

Source: Fertilizer Statistics, 2008-09, Fertilizer Association of India, November 2009, pp.1-187-I-188. File No.33011/1/2010-MPR dated 16th March 2010, Ministry of Chemicals and Fertilizers, Government of India, http://www.fert.nic.in/docs/mtsubsidy_17032010.pdf

Note: Complex Fertilizers indicate the combination for Nitrogen (N)-Phosphorous (P)-Potassium (K)-Sulphur (S). For each fertilizer the subsidy (rates of concession) varies across months and across production units/importers, the minimum and maximum are selected from all possibilities. The negative amount for Ammonium sulphate for minimum in 2008-09 is as reported.

2 Fertilizer industry Association opted out of the concession system for P&K fertilizers:

Fertilizer industry always had problems with the earlier concession system for Phosphorous and Potassium (P&K) fertilizers. According to the Ministry of Chemicals and Fertilizers, "Before Nutrient Based Subsidy, upto 31.3.2010, concession for P&K fertilizers was based on normative cost formula given by Tariff Commission and import parity for DAP/MAP/TSP. The Fertilizer Association of India has been raising various issues with the Department (Fertilizers) from time to time. The concession scheme for P&K fertilizers is voluntary in nature. Only those who seek to obtain concession need to sell under the scheme. As such opting out of the concession scheme would have been voluntary on the part of fertilizer producers/importers."⁶ Thus it is quite obvious that the industry wanted a change in the old system, and the Government brought in a new policy which is quite appealing to the industry.

3 NBS: Old wine in new bottle

The new system of a fixed subsidy based on the nutrient content

will do away with the vulnerabilities associated with fluctuations in the international market prices. This move will also appease the industry as the fertilizer prices (except for urea prices) are decontrolled and the industry can decide on the prices. Immediately after the NBS was made effective, industry raised the price of Di-ammonium phosphate (DAP) and Muriate of Potash (MOP) by Rs 600 a tonne.⁷ The impact of this price rise along with the 10% hike in urea prices on soil health and its socio-economic implications on the farmers need to be assessed.

Decline in soil organic matter and deficiency of secondary and micro-nutrients was a major issue which led to yield stagnation. The new policy doesn't address these concerns. The NBS is applicable only for the three macro nutrients – nitrogen (N), phosphorous (P) and potassium (K), one secondary nutrient – sulphur (S) – and only two micro nutrients – zinc (Zn) and boron (B). Organic fertilizers are not eligible for subsidy, whereas an investment in organic fertilization practices could have solved both the issues.

⁶RTI response from Ministry of Chemicals and Fertilizers, Government of India; File No. 15011/26/2005-MPR (Vol.III) dated 5th April 2010. The acronyms DAP, MAP and TSP denote Di Ammonium Phosphate, Mono Ammonium Phosphate and Triple Super Phosphate respectively.

⁷Harish Damodaran, Fertiliser cos increase prices of DAP by Rs 600/tonne, *The Hindu Business Line*, 12 April 2010, <http://www.thehindubusinessline.com/2010/04/12/stories/2010041251521200.htm>.

In short, NBS is meant for supporting the same old chemical fertilizers produced by the industry. This does not seem to address the concerns of ills of chemical fertilizers as envisaged. It will be so even if the subsidy is given to the farmer through direct cash transfer in lieu of chemical fertilizers purchased that have been produced by the industry. It does not encourage alternative eco-friendly farmer and farm centric methods of supplying nutrients as well as enriching the biomass which are vital for improving soil health. It is a continuation of the industrial appropriation of agriculture.⁸ The NBS is old wine in new bottle!

Environmental indicators

Environmental concerns and soil health has become important

concerns in agricultural production systems. There is a need to understand and analyse environmental impact indicators before bringing in any new policy which has direct or indirect impact on agro-ecosystems. A recent study citing a review of 300 plus published reports identified 18 such indicators: floral diversity, faunal diversity, habitat diversity, landscape, soil organic matter, soil biological activity, soil structure, soil erosion, nitrate leaching, pesticide residues, carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), ammonia (NH₃), nutrient use, water use and energy use⁹ Further, it has been shown that with organic farming 12 of these indicators perform significantly better and none perform worse. At a broader level, a comparison between chemical fertilization and ecological fertilization are given in Table 2.

Table 2
A comparison of Chemical Fertilization and Ecological Fertilization

Parameters	Chemical Fertilization	Ecological Fertilization
Nutrients	Synthetic and chemical, fossil fuel dependent, mostly imported	Natural, eco-friendly and locally available
Soil health	Declining organic matter/biomass, poor physical, chemical and biological properties, poor microbial activity	Build up of soil organic matter/ biomass, good physical, chemical and biological properties, increased microbial activity
Yield	Yield fatigue continues	In Irrigated intensive agriculture areas, comparable or slightly lower yields with conventional system in the initial year and yield increases and sustains once soil is completely rejuvenated. In rainfed systems, yield increases.
Fertilizer Subsidy to Farmer	Incidence is on Industry through it there could be impact on the farmer. Burden on Government will continue to exist.	Currently non-existent
Cost of cultivation and farmers' livelihood	With no investment on alternatives and with a rise in fertilizer prices due to reduction going high due to cut in subsidy the cost of cultivation will go up. Farmers' livelihood situation worsens	Reduction in cost of cultivation. Improvement in Farmers' livelihood
Pollution and health hazards	Contamination of drinking water leading to health hazards	Reduced pollution
Social equity	Dryland farmers and farmers practising eco-friendly agriculture are kept out	Dryland farmers and farmers practising eco-friendly agriculture also benefit
Food subsidy (Rs 55578.18 crore 2010-11)	Likely to increase with declining production due to poor soil health	Could decrease because of sustainable yields due to improvement in soil health
Subsidy on import of pulses (Rs 200 crore for 2010-11)	No impact	Investments in leguminous crops (especially pulses) which can fix atmospheric nitrogen can help save the money spend on subsidy for pulse imports.
Local self governance- Panchayti Raj Institutions	No role in the completely centralized system set at the national level- contradicting the State government's constitutional responsibility	Crucial role and capacities for assessing, procuring and supplying agro-ecosystem specific bio-fertilizers and organic manures
Gender	Alien to chemical fertilizer knowledge and use systems	As it is integrated with livestock, local bio-diversity and small ruminant knowledge. Women can have opportunities for income enhancement

Note: For some relevant discussion see Appendix A1 and A2.

⁸Harriet Friedman, Distance and Durability: Shaky Foundations of the World Food Economy, *Third World Quarterly*, 1992, Vol. 13, No. 2, pp. 371-383. Also see, Tim Lang, Crisis? What Crisis? The Normality of the Current Food Crisis, *Journal of Agrarian Change*, 2010, Vol. 10, No. 1, pp. 87-97.

⁹ P. Ramesh, Mohan Singh and A. Subba Rao, Organic farming: its relevance to the Indian context, *Current Science*, 2005, Vol.88, No.4, pp.561-568.

Along with these outcome indicators, some products and practices like composting, green manuring, cover crops, legume rotations, biofertilizers and biodynamic preparations (liquid fertilizers) including non-pesticide management among others are integral parts of organic farming. These have positive links to yield as also economic returns to farming. As against this, input-intensive cultivation can have adverse environmental and health implications.

One should strengthen our agricultural statistics so that data on such indicators, products and practices are available at national, state and even local levels. Availability of such data even through some sample based systems will be a good beginning and help us evaluate their linkages with the economy and agricultural system in general and the mandate of NBS in particular. In the absence of any data we give a hypothetical example (Table 3).

enterprising farmer from Yavatmal, Vidarbha region of Maharashtra. Mr Sharma adopted chemical intensive farming, reaped some benefits in the initial years and faced its vulnerabilities during the later part. When these vagaries of chemical intensive farming pushed him to indebtedness, he adopted nature-friendly farming with the focus on integration of five things: soil, water, seed, crop cycle and labour relations. He is now successful, happy and contented. One of the unique features of his model of farming is that he sees soil as the most critical component of farming and does all that is possible to keep it healthy and lively. He cultivates three crops in a year, one crop (mostly leguminous crops) exclusively for the soil which is completely incorporated into the soil, adding biomass and valuable nutrients (more details of the case study are in Appendix A3).

Table 3 Comparison of Chemical intensive fertilization and ecological fertilization						
	Year	Input	Output	Net Return	Consumption	Cumulative savings
Chemical fertilization	1	2.0	4.0	2.0	1.3	0.7
	2	2.0	4.0	2.0	1.3	1.4
	3	2.0	4.0	2.0	1.3	2.1
	4	2.0	0.0	-2.0	1.0	-0.9
Ecological fertilization	1	1.0	2.0	1.0	1.0	0.0
	2	1.0	3.0	2.0	1.2	0.8
	3	1.0	3.5	2.5	1.3	2.0
	4	1.0	1.0	0.0	1.0	1.0

Note and Source: Based on similar discussions in S. Mishra, Risks, farmers' suicides and agrarian crisis in India: is there a way out? Indian Journal of Agricultural Economics, 2008, Vol. 63, No. 1, pp.38-54.

Under chemical fertilization we assume that the per annum value of input is 2 units and output is 4 units giving a net return of 2 units and from this consumption is of 1.3 units and savings is 0.7 unit. Say, in the fourth year there is drought leading to output loss then the cumulative savings at the end of three years would not be enough to compensate for input costs and provide for consumption. This can lead to negative savings or reliance on loan from moneylenders at a higher interest burden.

As against this, under ecological fertilization the per annum value of input is 1 unit and the output is 2 units in the first year, 3 units in the second year and 3.5 units in the fourth year and also gives 1 unit of output in the drought year. Consumption would be 1.0, 1.2 and 1.3 units in the first, second and third years respectively. Even a relatively lower output has a better capacity to smoothen consumption in a bad year without resorting to any loan.

Now, we draw up from the experience of Mr Subhash Sharma, an

There are a number of such successful experiments spread across the country. Given that the country is witnessing a larger agrarian crisis, they need to be scaled up and replicated across the length and breadth of the country. Such an exercise is possible only with the effective involvement of the state that works in tandem with civil society.

Support Systems for Ecological fertilization¹⁰

1. What needs to be supported?

1.1 Compost-preparation and recycling of farm and urban waste

The Government support to compost production comes through National Programme on Organic production (NPOP) and certain schemes of the agricultural and horticultural department. This support is very minimal and scattered. There needs to be a more coordinated approach to promote composting and use of these products in mainstream agriculture. All the crop residues which

¹⁰For an overview of policy intervention in selected countries and the by the central and some state governments in India see Appendix A4.

are normally burnt in intensive agriculture areas of the country needs to be recycled. The *in situ* composting also needs to be supported. Support for compost production needs to be included in the mainstream fertilizer subsidy system. This can also find synergy with the Mahatma Gandhi National Rural Employment Guarantee Scheme (MREGS).

1.2 Pulses production

Pulses are leguminous crops which can fix atmospheric nitrogen. Promotion of these crops will also help India to save on import subsidy on pulses and this move can also add to the nutritional security of the country.

1.3 Green manuring and biomass application to the soil

It is quite obvious that biomass is a critical component to maintain soil health, and hence Government needs to support cultivation of green manure crops and trees. Government should support cultivation of green manures in one season to be incorporated into the soil.

1.4. Biofertilizers

Biofertilizer are substances which contains living microorganisms which are capable of providing nutrients through nitrogen fixation or by solubilising phosphorous. Good quality agroecosystem specific biofertilizers needs to be produced and distributed. Subsidy support needs to be provided for the same.

1.5. Liquid fertilizers

Studies at Organic farming research institute in Shimoga, Karnataka has shown that liquid fertilizers like beejamrutha, jeevamrutha, panchagavya etc can increase yield in conjunction with organic fertilizers and also can improve the biological and physical properties of the soil. Government should do more research on these formulations and provide subsidy support to promote their use.

1.6. Livestock as an integral component of the farm

Livestock is an integral component of an eco-friendly farm and considering the fact that the cattle population is dwindling rapidly in the farms and mostly getting concentrated in industrialized dairies, Government need to step in with support so that livestock becomes an integral component of the farm. This move will also contribute to the livelihood security of the farmer.

There also needs to be support for special flooring for cattleshed to facilitate the collection of cattle urine, which is otherwise largely lost or wasted because of 'kaccha' (ordinary mud) flooring. Cattle urine is a rich source of Nitrogen, besides most of the 12 other essential elements of nutrients including trace elements. It is helpful in pest management as well.

1.7. Labour subsidy under MREGS

Organic fertilizer production and ecological fertilization practices can open up lot of employment opportunities in rural areas. Hence a provision for labour subsidy can be brought in under the MREGS.

1.8. Eco-bonuses /Soil health bonuses

Farmers who contribute to the food security of the country with minimal damage to the environment need to be rewarded. Eco/soil health bonus can be one option. The money for this can be generated by imposing taxes and levies on those farmers who maintain poor soil health due to excessive chemical usage.

2. Institutional Imperatives

The Indian farmers who are largely small and marginal having less than two hectares need institutional support. A successful model of this is the Society for Elimination of Rural Poverty (SERP) of Andhra Pradesh where Non-Pesticide Managed (NPM) agricultural practices have been taken up in a large scale through federation of self-help groups (SHGs).¹¹ This kind of a model needs to be worked out for ecological fertilization practices which can be scaled up and this should be facilitated through the National Rural Livelihood Mission (NRLM) in the rest of the country. In addition, there is scope to integrate many activities that are farmer and farm friendly through the MREGS. There is also a case to make District Agricultural Plans effective in spirit and not in letter only by starting village-based plans through peoples' involvement.

Considering the urgent need to restore soil health and sustain production, Government needs to develop a broad based institutional mechanism involving Gram Panchayats, Krishi Bhavans, Farmer co-operatives, civil society, rural industry, Self Help Groups (SHGs) and line department operating at the grass root level with a national coordination system for supporting ecological fertilization practices.

In other words, planning should not be techno-centric, target oriented with selective perception of yield for short term gains; rather, it should be farmer-centric, try to reach everybody, and broader perspective encompassing multiple indicators for both short term and long term benefits.

¹¹For more details on SERP and NPM, please visit: <http://www.serp.ap.gov.in/CMSA/about%20us.jsp>

Appendix

A1. Potentials of Ecological fertilization¹²

Farm Yard Manure (FYM):

Long term experiments on different fertilizer levels and FYM in alfisols at Bangalore (Karnataka), Palampur (Himachal Pradesh) and Ranchi (Jharkhand) indicated that, incorporation of FYM resulted in build up in Soil Organic Carbon.¹³

Application of FYM have improved soil physical conditions viz., stable soil aggregates, density, soil moisture holding capacity and soil air movement. The beneficial microbial population and enzyme activities were enhanced significantly on application of FYM. Further availability of Zinc level has increased with FYM treatment. The rate of depletion for other micronutrient was less in treatment that received FYM.¹⁴

Application of FYM alone or with fertilizers was found to be sustainable. FYM with 100% NPK recorded 3573 kilogram/hectare in finger millet (kg/ha, mean of 10 years) has maintained its productivity around 3100 kg/ha even during last 10 years of 25 years of study with a sustainable yield index (SYI) of 0.90 compared to FYM + 50% NPK was around 2900 kg/ha with SYI of 0.79 only. FYM stabilized around 2400 to 2500 kg/ha with SYI of 0.65. Application of FYM alone or with fertilizers has improved physical, chemical and biological properties of soil.¹⁵

Green leaf manure (GLM): The study at Dryland Agriculture Project, UAS, Bangalore indicated that there was maximum response of 142% over control was observed in green leaf manure (GLM) to supply 50% N through GLM + 50% N through NPK.¹⁶ Similarly higher sunflower yields were recorded with 50% N through GLM.

Incorporation of GLM will improve Soil Organic Matter Bulk density of 1.45 mgm⁻³ with 100% NPK decreased to 1.32 mgm⁻³ with Green Manure + 50% NPK.¹⁷ Reduction in bulk density and improvement in aggregate stability, extractable carbon, sugar and microbial biomass was recorded.¹⁸ Improvement in soil porosity and maximum water holding capacity (MWHC) was recorded with Green Manure application in vertisols.¹⁹

With green manuring population of N fixers and phosphate solubilises increased considerably.²⁰ Another study recorded a significant increase in the bacterial population and microbial biomass of N in the soil amended with green manures.²¹

The mean of three year data on groundnut revealed that

significantly higher pod yield, haulm yield, 100 kernal weight and shelling percentage recorded with incorporation of glyricidia compared to other treatments. Similarly mean of three years data on finger millet revealed that significantly higher grain yield, straw yield, earhead length, and number of fingers per earhead was observed with the incorporation of eupatorium as compared to other green leaf manures.²²

Growing of glyricidia as green manure crop on bunds at 2 metre distance can yield biomass of 6 tonne/hectare (t/ha) and it would be around 8 t/ha/year in garden land. Similarly production of green biomass on road side avenue plantation and along the railway tracks will yield large amounts of green biomass.²³

Intercropping of sunhemp and diancha in between maize rows has resulted in production of 16 t/ha of green biomass. Similarly when green manure crop was grown in the basins of guava, cashew has resulted in 6-10 kg/basin in about 45-50 days period.²⁴

Liquid fertilizers : Use of liquid manures viz., panchagavya, Jeevamrutha, Beejamrutha and biofertilizers in paddy with and without compost was studied at Shimoga indicated that, paddy yield obtained under organic farming was equal to station yield. Application of Panchagavya and Jeevamrutha to paddy at monthly interval has resulted in lush green colour of the crop and the crop was fairly free from pest and diseases. Further, the microbial population viz., N fixers, P solubilisers and actinomycets were very high compared to control plots.²⁵

Weeds: Weeds like chromolaena and parthenium produce substantial quantities of biomass which can be used either as compost or as green manure. Use of weeds as compost in finger millet and groundnut have shown that yield has substantially increased to a larger extent and was superior to or equal to FYM application.²⁶

Urban wastes: Recycling of decomposable material through bio composting is of significance. Several methods of composting have been evolved for treatment of urban wastes. Peri urban/urban agriculture mainly focusing on vegetable production offers a scope for their utilization. Besides, bio compost would serve as the best seedling media for production of healthy seedlings. The soil nutrients are mined and transferred to urban areas through the process of crop production. Bio residues contain all the available plant nutrients, which are needed for agriculture. Hence, it is essential to return the nutrients back to rural areas so as to sustain the soil fertility.

¹²This has been prepared by N. Devakumar, Professor of Agronomy, University of Agricultural Sciences, Bengaluru.

¹³Muneshwar Singh in Proceedings of soil organic carbon stocks and soil organic matter management in relation to soil quality and climate change, 2007. L-17 P 1-8.

¹⁴N Vasuki, SB Yogananda, DC Preethu, K Sudhir, SM Jayaprakash, Impact of long term fertilizer application on soil quality, crop productivity and sustainability – two decades experience, 2009

¹⁵G.N. Gajanan, Ganapathi and M. A. Shankar, *Relevance of organic matter for sustainable crop production in dryland – A success story for 25 years*, 2005

¹⁶Annual Report, National Watershed Development Project for Dryland Areas, UAS, Bangalore, 2001

¹⁷MA Bellaki and UP Badanur Long term effect of INM on properties of vertisol under dryland agriculture, *Journal of Indian Soil Science*, 1997, 45(3): 438-442

¹⁸M. Prabhakar, S.S. Hebbar and Prasannakumar, Green manuring in rainfed vegetable and fruit production systems, in: Potentials of green manuring in rainfed agriculture, 2002, pp. 79-88.

¹⁹H. Pathak and M.C. Sarkar, Nitrogen supplementation with rice straw in an ustocherept. *Journal of the Indian Society of Soil Science*, 1997, Vol. 45, pp. 103-106

²⁰S. B. Kute and H.S. Mann, Effect of green manuring on the composition of soil and wheat crop and balance of major plant nutrient in soil after the crop, 1969, *Journal of Agricultural Sciences*, Vol.39, pp. 10-17.

²¹F. Azam, K.A. Mallik and M.I. Sajjad, Transformation in soils and availability of plants of 15N applied as inorganic fertilizer and legume residues, *Plant and Soil*, 1985, Vol. 86, pp. 3-13.

²²M.A. Shankar, B.R. Premalatha, G.N. Gajanan and Radhakrishna, *Green manure – A source of organic matter to maintain and enhance the crop yields and soil fertility for drylands*, UAS, Bangalore, 2006.

²³A.M. Krishnappa, P. Ramana Gowda and Y.S. Arunkumar, Sugmentation of biomass production for organic farming. In Organic farming and sustainable agriculture, Proceedings of national seminar held at UAS, Bangalore 9-11 Oct. 1996, pp: 33-45.

²⁴Monthly report of Organic Farming Research Centre, Shimoga, UAS, Bangalore. 2008

²⁵N. Devakumar, G.G.E. Rao, S. Nagaraj, S. Shubha, Imran Khan and S.B. Goudar, Organic farming and activities of Organic Farming Research Centre. A bulletin by UAS, Bangalore. 2008. pp 18-27.

²⁶T.V. Ramachandra Prasad, R. Channabasavegowda and V.K. Kirankumar, Some complements for sustainable farming systems. In proceedings of symposium on sustainable agriculture for drylands on the Deccan Plateau, held at UAS, Bangalore. 2005, pp. 300-308.

A2 Soil Health improvement through ecological fertilization

Table: A2.1 Soil Health Improvement during a period of 5 years

Parameters	Comparative Improvement		
	Control level	Improved level	Improved level compared with control (in percent)
Organic matter (Humus) %	1.25	4.60	368%
Cation Exchange capacity (CEC)*	35.16	44.91	128%
Total Nitrogen, N %	0.073	0.267	378%
Available Phosphorous (Kilogram/hectare) %	22.45	50.43	225%
Available K (Kilogram/hectare) %	100.00	435.00	435%
Porosity %	39.23	47.16	120%
Available water holding capacity AWC w/w%	14.46	19.59	135%

Note and Source: Niranjana Maru & Ashok Bang, 2007, Soil health and fertility improvement in their model of sustainable, self-reliant organic, biodiverse, eco-agriculture. Presented in The National Workshop on New Paradigm for Rainfed Farming "From Impoverishment to Empowerment: With Productivity, Profitability & Sustainability for Farmers & Farming" Sept 2007, at ICAR, New Delhi.

* CEC of organic matter [humus of Carbon:Nitrogen (C: N) = 10:1] is 300-400 C mol

A3. Case Study

Subhash Sharma

Mr Subhash Sharma is an enterprising farmer from Yavatmal, Vidarbha region of Maharashtra who started chemical intensive farming from mid 1970s. This gave him good returns till mid 1980s and yield of cotton per acre had reached around 12 quintals. However from mid 1980s the yield started declining and it reached to about three quintals by mid 1990s. The yield decline was quite obvious in all crops namely cotton, jowar, wheat, grams and vegetables. While the yield fell down sharply, the production cost had risen steeply. Indebtedness led to loss of his land to the sahuakar (local money lender) and he started afresh by leasing in land from his brother and by taking to natural farming practices.

While adopting natural farming in 1994, he decided to phase out the use of chemical fertilizers over a number of farming seasons. He also did a comparative exercise and used four bags per acre of chemical fertilizers in one plot and one bag per acre in another. He realized that the yield from both the plots were same, the only difference being increased weed growth in the plots where 4 bags of chemical fertilizers were used. Further he used one bag of chemical fertilizers in half of his land and in the rest no chemical fertilizers. By the year 2000, he concluded that yield from natural plots was substantially higher than those where chemical fertilizers are used. The cost of production in plots where chemical fertilizers were used was much higher than the natural plots.

In the last 15 years he has made substantial progress. Today, in

2010 he has 25 hectares of lands under cultivation (through increased leasing in of land), he has 75 workers with him to whom he gives bonus from his returns, and he made a profit of Rs.15 lacs in 2009, a drought year!

His cultivation practices are based on the integration of five things: soil, water, seed, crop cycle and relationship with labour. He uses a crop mix in all his fields and never adopts monoculture. He cultivates labour intensive crops in three different time frames of 60-65 days, 100-110 days and 180 to 200 days, each with the aim of enriching soil. The residual biomass from the first crop of 60-65 days was used as covering for the next crop. This covering later decomposes into organic manure. This also makes topsoil moist and makes it less dependent on irrigation. He also adopted water conservation methods and planted trees in his farm which were critical components which added to his success. He has 20 cattle and also resorts to the use of liquid fertilizers.

A4 Policy intervention by State and Central Governments and International

A4.1 Cuba – Food Security through ecological fertilization

After the 1959 revolution, Cuba has been practicing a chemical intensive agricultural model, supported by subsidized agri chemical inputs from erstwhile Soviet Union and its Eastern European allies. After the collapse of Soviet Union, the flow of external inputs came to a halt. The US trade embargo made things worse. But with the help of a group of forward looking scientists and strong political will, Cuba chose the alternate agricultural pathway which is low external input intensive and

eco-friendly. Now the country is food secure.²⁷

Two important strands to sustainable agriculture in Cuba have emerged:

- intensive organic gardens in urban areas of three types – self-provisioning gardens in schools and workplaces (autoconsumos), raised container-bed gardens (organoponicos), and intensive community gardens (huertos intensivos);
- Sustainable agriculture on both large and small farms in rural areas.

Both have made a significant contribution to total food production. In 1994, for example, organoponicos, autoconsumos and huertos intensivos were producing some 4200 tonnes of food per year. By 1999, this had grown to 727 000 tonnes. Both the number of gardens and per area productivity has increased. One measure of effectiveness of sustainable agriculture to produce the necessary food is the aggregate data on caloric intake. This was 2 600 kcal/day in 1990, fell to some 1 000–1 500/day soon after the transition (with severe food insecurity), and has risen to an average of 2 700 kcal/day by the end of the 1990s.²⁸

A 4.2 Switzerland – National policy for Sustainable Agriculture

Supported by the referendum results where 70 percent of the public opted for a sustainable agriculture policy, Swiss Government brought in a policy reform in the late 1990s. The Swiss Federal Agricultural Law was reframed in 1992 to target subsidies towards ecological practices, and then amended in 1996 as the 'Agricultural Act 2002'. This policy offers three different levels of public support depending on the sustainability of agriculture.

- Tier one- support for specific biotypes, such as extensive grassland and meadows, high-stem fruit trees and hedges
- Tier two – support for integrated production with reduced inputs, meeting higher ecological standards than conventional farming.
- Tier three - support for organic farming.

There are five minimum conditions necessary for farmers to receive payments for integrated production, and 'ecological standard' of performance:

1. Provide evidence of balanced use of nutrients with fertilizer matched to crop demands and livestock farmers having to sell surplus manures or reduce livestock numbers.
2. Soils must be protected from erosion - erosive crops (e.g. maize) can only be cultivated if alternated in rotation with meadows and green manures.
3. At least 7 percent of the farm must be allocated for species diversity protection through unfertilized meadows, hedgerows, or orchards.
4. Use of diverse crop rotations.
5. Pesticides have to be reduced to established risk levels.

A 4.3 India State Agricultural policies

A 4.3.1 Sikkim – Subsidy cuts to sustainability

The Government of Sikkim has adopted an organic policy in 2003 and is planning to go completely organic by 2015. The plan is also to phase out the use of chemical fertilizers by 2010-11.

As per the concept paper "Going for Organic Farming in Sikkim" published by Department of Agriculture, Govt. of Sikkim in May 2003, the first step was to discourage the use of chemical fertilizers. In order to achieve this Government of Sikkim immediately withdrew the State Government subsidy on fertilizers. From 2006-07 onwards, the transport and handling subsidy and commission to the retailer was also withdrawn.

Table A4.1 Cost of fertilizers in the State as a result of withdrawal of subsidy (Rs/tonne)					
Fertilizer	Price before 2003 @ 40%	2003-04 @ subsidy 30%	2004-05 @ subsidy 20%	2005-06 @ subsidy 10%	2006-07 (Full price)
Urea	3124.60	3645.47	4166.25	4687.03	5207.81
DAP	6053.09	7061.94	8070.78	9076.62	10088.48
MOP	2081.33	3361.55	3841.77	4321.99	4802.21

Source: "Going for Organic Farming in Sikkim", May 2003

²⁷Ivette Perfecto, The transformation of Cuban agriculture after the cold war, *American Journal of Alternative Agriculture*, 1994, Vol. 9, pp 98-108.

²⁸Food and Agriculture Organization (FAO), *What examples of enabling policies have been implemented by governments to support sustainable land management and SARD? 2002*

The Government has adopted a seven year plan to phase out the use of chemical fertilizers, by slowly and steadily replacing chemical nutrients with organic sources.

Table A4.2
Nutrients use as chemical fertilizer and replacement by organic sources

Year	Nutrients supplied by chemical fertilizers (MT)		Nutrients replaced by organic sources (MT)		Percent increase in consumption of organic sources
	N	P	N	P	
2003-04	675	400	75	45	10
2004-05	540	320	200	125	30
2005-06	432	256	318	189	40
2006-07	347	205	403	240	50
2007-08	139	123	542	322	80
2008-09	125	44	667	401	80
2009-10	66	09	733	436	90
2010-11	Total nutrient requirement replaced by organic sources				

Source: "Going for Organic Farming in Sikkim", May 2003

A4.3.2 Other States

Several states in India have off late adopted forward looking eco-friendly organic agricultural policies. Kerala, Andhra Pradesh, Karnataka, Maharashtra, Orissa. All these policies try to promote integrated organic nutrient management systems. Every policy agrees that livestock is an integral part of a sustainable farm. Organic agricultural policy of Andrapradesh supports the following:

- Promotion of fodder and pasture development to enhance the availability of biomass
- Nutritional support to the productive livestock
- Support to supply cattle/buffaloes on subsidy basis when ever required
- Support for awareness building among farmers/livestock owners
- Provision of health care support to livestock
- Promotion of gosadanas in villages for taking care of old and unproductive animals for dung and urine which contribute to organic farming

4.4 Taxes/Levies on chemical fertilizers with resources redirected to eco-friendly farming

Environmental or 'eco' taxes seek to shift the burden of taxation away from economic 'goods', such as labour, towards environmental 'bads', such as waste and pollution. The market prices for agricultural inputs and products do not currently reflect the full costs of farming. Environmental taxes or pollution payments, however, seek to internalize some of these costs, so encouraging individuals and businesses to use resources more

efficiently. Such green taxes offer the opportunity of a 'double dividend' by cutting environmental damage, particularly from non-point sources of pollution, whilst promoting welfare.

Fertilizer taxes have been introduced in several countries, and are of the order of £0.06–0.25 (US\$0.1–0.4) per kg of nitrogen, phosphorus and potassium in Austria, Norway and Sweden.²⁹

²⁹Raja J. Chellaiah, Paul P. Appaswamy, U. Shankar and Rita Pandey, Eco taxes on polluting inputs and outputs, 2007, p. 157

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