R7974

Human and social capital aspects of soil nutrient management, India

Annex A: Literature review

Soil fertility management in semi-arid India: it's role in agricultural systems and the livelihoods of poor people - A review of literature and field experience

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Preface

This review is focused on soil fertility management in semi-arid India. It aims to span issues relating to the role of soil fertility management in agricultural production (part 1) with an emphasis on rainfed cropping, and in the livelihoods of rural families (part 2) who may not have access to land, but are nevertheless involved in aspects of soil fertility management as producers, processors or traders of inputs. Although part 1 is focused on rainfed agriculture, it is recognised that in many areas there is a complex mosaic of irrigated and dryland land which are part of the same system and with important impacts on flows of nutrients. The second part of the review focuses on organic inputs, the use of which is less well understood and documented than inorganic fertilsers. Consequently this part of the review also relies more heavily upon field experiences and the views of field workers, rather than published sources.

The review is a contribution to the project 'Human and social capital aspects of soil nutrient management, India'. This project is supported by the UK Department for International Development (DFID) through the Natural Resources Systems Programme (Project R7974). The review is an interim project document and is intended to be superseded by other project outputs. It concentrates on Karnataka and Andhra Pradesh, two states with large semi-arid areas but both located in southern India, and which form the study areas for the project. However, information from other semi-arid areas in India is also utilised.

The authors objective was to produce a brief and accessible review, rather than to be comprehensive. Readers are directed to other reviews and literature for further information.

Background

The focus on rainfed agriculture, and key challenges

Rainfed agriculture remains high on the development agenda in India. Its contribution is vital to help avoid projected food gaps as a result of increasing populations (typically around 2%) and in supporting the livelihoods of the poorest farming families who do not have access to irrigated land.

Green revolution gains in agricultural productivity, food security and reduced poverty were widely associated with irrigated areas where the benefits of improved seeds and increased use of inorganic fertilisers could be realised. However, the potential for expansion of irrigated agriculture is decreasing as it is increasingly expensive to bring new land under irrigation (largely because water resources are limited) and there are widespread problems associated with overexploitation of groundwater. Groundwater is the most important source for irrigation. As a consequence rainfed agriculture will continue on over 50% of land in most Indian states (for example, irrigated areas were 21.6 and 38.4% in Karnataka and Andhra Pradesh states respectively in 1993-94), and it will remain the focus of much effort to increase productivity and avoid food gaps.

In addition to rising populations and projected food gaps (see for example Bhalla *et al*., 1999), major concerns associated with the future of rainfed agriculture in semi-arid India include decreasing yield growth and yields, negative nutrient balances, and sustainability. Sustainability concerns reflect both the need to increase returns to land and labour while maintaining soil productivity over the long-term, and concerns about negative impacts of inorganic fertilisers on soil quality and pollution. Further concerns at macro-economic level include the ineffective targeting of the governments vast expenditure on agriculture (Bhalla *et al*., 1999). Most government expenditure goes to subsidies for farm inputs, particularly fertilisers, credit, water and electricity.

The policy responses to these challenges include: 'modernisation' of agriculture such as encapsulated in Andhra Pradesh's 2020 vision (including commercialisation, new varieties and GMOs, and continued irrigation development), watershed development programmes to improve the potential of land and develop water resources (some of these programmes are also becoming more poverty and livelihoods focused and include non-land based activities), and subsidies such as the fertiliser subsidy.

Other key reviews that have addressed soil fertility issues from a livelihoods perspective include NRSP project R7458 reviews focused on semi-arid India and global experiences (NRSP, undated; Tanner *et al.*, 2000).

Livelihood systems and strategies

Conroy *et al*. (2001) identified the following key livelihood systems in rural semi-arid India:

- medium/large farmers, primarily dependent on agriculture (mixed but crops usually more important than animals);
- small/marginal farmers, who are primarily dependent on a combination of agriculture (in some cases land may be leased rather than owned) and wage-labour;

- livestock-specialists, for whom animal husbandry is the principal livelihood activity; and
- landless labourers, who are primarily dependent on wage labour, which may be agricultural or not.

Box 1 The rural economy in Karnataka and Andhra Pradesh (after James & Robinson, 2001)

Agriculture is the mainstay of the rural economy in Andhra Pradesh and Karnataka, and agriculture-related activities support the largest proportion of people and provide the largest share of total income to the people. But rice mills, flour mills, and oil presses sit side by side with motor repair shops, provision stores, drug stores and small hotels in the small rural towns. There are also granite and limestone mines in these parts, which provide employment to local labour but export the produce. By and large, private enterprise is dynamic in these rural towns. Transport industries are therefore important, but road links are not always good.

Local produce markets in district towns and tehsil towns are often controlled by market operators, and there are established codes of conduct which ensure the exploitation of those who either don't know or do not have the 'clout' to get a good deal. Commission agents buy produce on auction, and small farmers who venture to sell directly here have little negotiating power and have to take the offered price. Larger farmers have the leverage to negotiate good price with commission agents, often withholding their produce from the market till they get the right price (most usually done in cotton). Others may be able to market in other towns for better prices (for example, Bangalore farmers sold their tomatoes in Kurnool market during the cyclone of 1999 which destroyed a large part of the local crop).

Although agriculture continues to be the backbone of the rural economy and rural livelihoods (see Box 1), there is increasing recognition of the role of non-farm (and non-NR) livelihood contributions. Supplementing agricultural income with casual wage labour is increasingly common as the relevant returns from such employment compared to agriculture improve. The poorest people are likely to be wage labourers and small/ marginal farmers - especially given recent price shocks - resulting in high levels of indebtedness and high suicide rates.

Livelihood strategies can be categorised in different ways. On approach is into intensification and extensification, diversification and migration. Intensification may involve increasing the number of crops and livestock per hectare per year e.g. a second (rabi) crop perhaps through access to irrigation, and/ or increasing the yield of crops and livestock products per hectare . Strategies to improve productivity include soil and water conservation (SWC), the use of high-yielding varieties (HYVs), irrigation, or use of animal feeds (Tanner, 1997). Extensification includes the extension of agricultural areas for example into CPR lands, often wastelands or forest lands. Other farmers have extended their cropping into tank beds. Intensification (see for example Tanner *et al*., 2000) may be driven by population pressure and declining land area, or by markets reflecting increased demand. In reality, a combination of these forces is often at work. At the household level intensification requires more capital (to buy inputs) or labour to be invested (for example in crop rotations, cut and carry feeding etc). These strategies are also likely to be combined, but the poor are typically expected to intensify through greater use of labour (Tanner *et al.*, 2000).

Box 2 Characteristics of farming systems in NE Karnataka (Pound, 2000)

In watersheds where the Karanakata Watershed Development Society (KAWAD) are working some of the key characteristics of farming systems include:

- considerable **variation** between farmers (and farming families) according to location (between and within watersheds), size of farm, type of land (irrigated or rainfed), soil types and other factors, such as financial situation, aptitude, and family size, composition and health.
- farming systems are generally **intensive**, with considerable recycling of internal inputs (for example, use of compost and manure, pongamia as green manure) and use of external inputs (especially seeds, hire of tractors and labour). All farmers in all categories used chemical fertilisers.
- access to **water** for irrigation (even an acre) has a major impact on potential income and financial and food security
- Larger farmers produce a greater range of products and grow cereal grains for home consumption and sale, spreading **risk**. Small and marginal farmers are more vulnerable and mostly dependent on groundnut and off farm/ non-farm income for survival. These farmers often purchased staple foods from revenue from main cash crop. Serious impacts when poor returns to groundnut.
- Most marginal and small farmers, and some of the larger farmers, regularly use **loans** from landlords, merchants and co-operative societies at high interest rates. If harvest if poor there is a serious risk of indebtedness. Farmers who take loans are often forced to sell at harvest when prices are low.
- **Off-farm** and **non-farm activities** such as tailoring, labouring, commissioned sale of livestock, bicycle repair and hiring bullocks) are crucial to livelihoods of smaller farmers.
- Farmings systems have evolved over a long period resulting in sophisticated **integration** of components. Cropping is dependent on manure (although all farmers all used inorganic fertilisers) and draft from livestock, while livestock are dependent on crop straws as well as grazing of stubbles and grasses. House construction, cooking and the making of farm implements are dependent on farm-grown trees. Some farms are less integrated than others with one weak component (e.g. few trees or no bullocks) making these families more vulnerable to stress (e.g. drought) and reducing the options available.
- a wide **variety** of food and cash crops are grown, but the number grown by marginal farmers in red soil areas can be as few as one (groundnut) grown in only one season (kharif). In contrast, a farmer with irrigation and black soils may grow up to 15 separate crops over all three seasons.
- Many farming practices are traditional, but there is a keen desire to **learn** and **innovate**, especially amongst smaller farmers.

Diversification is often associated with reducing risk and coping with vulnerability, some of the key characteristics of livelihoods in semi-arid areas. Farrington & James (2000) for example, discuss the diverse ways in which the poor earn their livelihoods in rural India and how watershed development projects can support diversification through short-term employment, forestry, pasture development, livestock development and micro-enterprise development.

Migration, often over long distances to major urban centres such as Hyderabad and Mumbai is an important off-season activity when alternative local employment is not available.

The connectedness of strategies is important, for example, the investment of income derived from migration in agricultural activities.

Farming, and in particular more intensified farming systems, is clearly the key livelihood system associated with soil fertility issues. Pound (2000) described farming systems in semi-arid Karnakata as 'a mixed farming system, dependent on the integration of livestock, crop, tree and off-farm/ non-farm activities in both private and communal lands, and symbiosis between landless and farming families'. This includes farmers who need labour and manure, and landless who depend upon land for employment, stubble-grazing and crop by-products for their livestock.

Farming is part of a livelihood system, in which activities and strategies are inter-connected, and such that inputs from soil fertility may be funded from sources outside of income generated from agriculture – through remittances or through subsidised government, private and third sector programmes. Previous farming systems analysis, such as Pound (2000), examine linkages with activities and enterprises beyond the farm, and hence there is considerable overlap between farming systems and livelihood analysis. The next section (and Box 2) describe some of the key aspects of farming systems in semi-arid areas. It does not aim to be comprehensive but focuses on aspects of most relevance to later parts of this report focused on soil fertility management.

Box 3 Farmers and Labourers (after James & Robinson, 2001)

Agriculture is the mainstay of the overwhelming majority of Indian villages. Most of the land, however, is concentrated in the hands of a few large and well-off farmers, while about 80% of the farmers cultivate about 20% of the land. These are the poor and marginal farmers with land holdings below 1 hectare (2.5 acres), who often have fragmented land holdings (because of sub-division on inheritance), frequently of poor soil quality, and with limited access to water. Such farmers typically cultivate only one rainfed crop in kharif (sown in June-July). Studies have shown that it is extremely difficult for a farmer with 1hectare or less of land – even given the best of seeds, agro-chemicals and water - to earn enough in a year to keep a family of 5 (the average family size here) to keep them above the poverty line.

Hence most of these farmers (and definitely their wives and daughters) look for alternative sources of livelihoods when they cannot cultivate their own fields. Earlier most used to work on larger farmers' fields as agricultural labour, especially during the second (rabi) and third (summer) cropping seasons. Some used to migrate to nearby towns and cities in search of work. More recently, however, migration seems to have increased. Villages in Andhra Pradesh (Dhone mandal, Kurnool district) report a shortage of agricultural labour because they are migrating to factories in nearby towns.

But it is not just the small farmers and their families who work on larger farmers' lands or migrate in search of work. About 20% of the typical village population comprises landless labour, who were available to work on larger farmers' fields. During the off-season, they also work as truck loaders in neighbouring towns, returning to their villages with daily wages. Today, several of them migrate for longer periods of time search of work outside the village.

Key aspects of farming systems

Perhaps the most important characteristics of semi-arid farming systems are the objectives or motivations of farming families. These include food security, insurance against risk, and profit maximisation (Conroy *et al*., 2001). Other studies and field experiences have also shown that household food security is the first concern of farmers when they decide on their

cropping pattern. Important risk spreading measures include diversification (Farrington & James, 2000). Gulati & Keeley (1991) showed that with respect to crops grown, farmers are on the whole most responsive to pricing factors.

Access to land

The main land holding and tenure categories include land owners, tenants, share croppers, and encroachment on CPR lands. In both Karnataka and Andhra Pradesh past encroachment of wastelands has subsequently been regularised in some cases and government investment utilised to improve these poor quality lands. The poor have less secure access to land for cropping and are consequently more dependent upon CPRs (for pasture, fodder, timber, and NTFPs) although these are diminishing in quantity and quality.

The average landholding in drought prone states is 2.6 ha (Conroy *et al*., 2001) but increasingly is not equally distributed. Most holdings are less than 2 ha in size and landholdings are often less than 1 ha. The poor have the least productive land and usually no irrigation so have generally not benefited directly from increases in land under irrigation (see box 3). Landholdings are decreasing as a result of an increasing population which provides pressure to intensify or diversify. There is a significant landless population.

Box 4 Drylands, dalits and dreams: washed away by irrigation

A group of 15 farmers, the poorest group in the village Pastapur, came together to lease in a land of nine acres from a big farmer from the village, Mr Raghupati Reddy. All their life, these women had worked only rainfed lands, mostly marginal lands. For the first time, through the *sangham* they had formed with assistance from the Deccan Development Society, an NGO in the region, they had got access to credit to pay the lease amount of Rs. 27,000 @ Rs.9,000 per year which worked out to Rs.1000 per acre per year to the landlord to rent his land for three years.

This was truly dream come true. The land was large enough….. nine acres. The soil was black. *Moga Bhoomi* – male soil as it is called in this region. There was an open well which had a record of good water yields. The farmer was growing sugarcane, turmeric, ginger - all dream crops - on his land. Crops which are called *Moga pantalu*, male crops.

With dream in their eyes, the group took up agriculture on this land. They started growing potato on this land on the first year. In the summer of the second year, the water level in the well dipped badly. The well had to be deepened. This cost around Rs.9000. And then the motor pump got burnt. This meant a repair expense of Rs 2000.

The lease set back the women's group by five years. Not only that they did not get any profit, they had to invest some of their own previous savings to get out of the lease.

The conventional view held by development planners is that the absence of irrigation is the key hurdle in dryland farming and if irrigation is available it will save dryland farming from the obvious risks it faces. But the new and more formidable risks that accompany irrigation are overlooked: collapsing wells, falling groundwater levels in many areas, the undependable power supply and its dangerous fluctuations, frequent motor burnout and the costs involved. The mainstream development planners have somehow ignored these aspects. But the experience of dalit women farmers of Pastapur village in Medak District of Andhra Pradesh disproves this conventional view.

Source: Deccan Development Society

Land transactions are often linked to dowry payments and indebtedness.

Soils and land quality

The main soils include alfisols (red soils) and vertisols (black cotton soils).

Key soil characteristics in SAT India include (Singh *et al*, 1998):

- Low soil organic matter levels due to rapid mineralisation, and inherently low fertility
- Nitrogen is universally deficit, followed by phosphorus, and then zinc deficiency on some locations. Potassium deficiency is rare in semi-arid areas.

Is soil fertility declining? This is an almost impossible question to answer. Soil productivity has certainly improved, reflected in improved yields (Singh *et al*., 1998) but also reflects many other factors and may be based upon 'mining' of nutrients. A better question is where are people making SFM investments, what type of investments and what are the associated trends?

Water

Water for irrigation is a resource of over-riding importance in terms of productivity, profitability and security (Pound, 2000). Irrigated yields and returns are much higher than for rainfed crops. Even one protective irrigation has a major impact. As well as greater returns to

irrigated cropping, the number of crops during the year can also be higher. Batchelor *et al.* (2000) in NE Karnakata report irrigated vegetable net revenues of around Rs10000 per ha in rabi and Rs18000 in summer, compared to returns of around Rs5000 per ha for the most profitable rainfed crop (groundnut on red soils; although DDS report higher potential returns for bio-diverse rainfed systems in Medak District which also place more value non-grain components of production). They suggest returns on black soils are often less in this area, although these soils suit different crops. In practice, actual areas cultivated reflect returns, but also subsistence and or fodder values.

As discussed above, well over half of the land in SAT India is rainfed. Rainfed production produces more income and forms an important part of livelihood systems of a larger number of people (Batchelor *et al.*, 2000). Rainfed agriculture is also likely to be the largest user of rainfall (Batchelor *et al.*, 2000). Recommendations to improve the use of rainfall in rainfed arable cropping include reducing soil evaporation and increasing production per unit of water (more crop per drop) for example by selecting appropriate crops, and in-situ moisture conservation.

Access to irrigation can be an important route out of poverty for poor farming families, although there is the risk that higher returns will not compensate for the investments made in wells, pumps and other infrastructure especially if rainfall is poor and as groundwater levels fall due to overexploitation (see Box 4). The ghastly suicides by more than 500 farmers in Warangal district of Andhra Pradesh where small and marginal farmers went in for irrigation to grow cotton and were unable to suffer the losses committed suicide has been a shocking chapter in Indian agriculture. But for the farmers without irrigation, it is still the greatest dream. Watershed programmes have also induced a false complacency that water resources could be vastly augmented to serve irrigated regimes in rainfed areas.

Crop choices

In SAT regions, cereals are most important (59%) but declining in area, followed by oil seeds that have increased markedly to 23% and pulses (18%) (Conroy, 2001). The rise of oil seeds, described as the yellow revolution, has received relatively little attention. However, the cost of oil seed production in India is relatively high, and producers have been hit hard in recent years by falling prices as the agricultural economy has been liberalised (Gulati and Keeley, 1991). There are also changing preferences, strongly influenced by the skewed promotional and lending policies of the government. These include, shifts from coarse grains such as sorghum (jowar), millets (ragi) and maize to wheat (e.g. in Maharashtra) and rice (e.g. in Andhra Pradesh). But sorghum consumption still remains high in rural Karnataka and parts of Telangana district of Andhra Pradesh. Other trends include a shift towards cash crops (e.g. coconut in parts of Karnataka and sugar cane in Medak District of Andhra Pradesh.

What influences crop choice, and what is forcing change? Possible strategies include to minimise labour inputs (e.g. where there is an alternative income), economic decisions (e.g. market prices), food security, or strategies to mine nutrients from rented land, or to minimise water requirements/ maximise WUE (Seva Mandir, 2000 cited by Conroy et al. 2001).

Interventions can have many unintended consequences. The dynamics associated with changing crop choices and impacts are complex.

Livestock

Roughly 70% of rural families in India own some livestock (Conroy *et al*., 2001). And at a national scale, livestock populations are increasing (and demand for livestock products is projected to increase strongly). However, at a regional scale and within the semi-arid areas in particular the situation is very different and much more complex. Within Andhra Pradesh for example, livestock increases are focused in coastal areas (and peri-urban areas?). In both northern Karnataka and western Andhra Pradesh livestock populations are falling.

The poor favour small ruminants especially goats and local breeds of milch animals. Although poor families tend to own few cattle, the numbers of poorer families owning cattle are apparently increasing. Usually unsecured grazing rights are a major constraint, affected by expansion of cultivated lands into grazing areas. However poorer people make up for this by bringing back fodder from the fields where they go for weeding.

Trends in drought prone areas (Conroy *et al*., 2001) include a relative increase in buffaloes and goats, but decline in cattle. Reasons include the lesser importance of animals as a source of draught power in cultivation (although they remain vital for poor farming families) and pumping water, reduction in farm size, declining area of CPR lands (Conroy *et al*., 2001) and changing patterns in labour availability. This has important implications for the availability of manure. In NE Karnataka, Pound (2000) reports a large reduction in all livestock from the 1940s to present associated with increased intensification. Tanner *et al.* (2000) describe a shift to stall feeding as cropping is extended and the impacts on access of the poor to manure unable to collect supplies from grazing lands.

Nutrient inputs

Increased fertilizer use has been one of the main drivers in productivity gains in agriculture in India. Use has increased from a total 0.07 million tonnes NPK (N+P2O5+K2O) around 1950 to 18.4 million tonnes in 2000 (http://www.fadinap.org/india/consumption-n.htm accessed 2/8/01). This was equivalent to 0.55kg/ha in 1950 compared to 90 kg/ha in 1999 (http://www.fadinap.org/india/perhectare-con.htm accessed 2/8/01). The major fertilisers by volume consumed are urea, SSP, MOP, and DAP. However, consumption has been heavily focused on irrigated areas.

Singh *et al.* (1998) reviewed studies that have assessed inorganic fertiliser use in dryland SAT districts. Inorganic fertiliser use has increased but remains generally low on rainfed crops. Approximately only 10% of total use (or 10 kg NPK/ha/yr on average) is on rainfed crops, although some studies also show higher rates up to around 25 kg/ha (rainfed sorghum at Hyderbad). Higher application rates are typical for some cash crops such as cotton. However, there is generally poor information on actual (inorganic) fertiliser use rates, and also on information on actual organic inputs. These figures are based upon data approximately 10 years old, and there may have been significant changes over the past decade. Fan & Hazell (1999) quote higher rates with rates of application increasing from 3 and 7 kg/ ha in 1970 to 38 and 46 kg/ha respectively by 1995 in high- and low-potential rainfed areas (but with only relatively small changes during the period 1990-95). These higher rates, calculated on a district basis, may well be due to inclusion of significant irrigated areas (dryland districts were up to 25% rainfed)

Fertiliser production costs are high (and producers inefficient) and the government subsidises producers in order to make sure fertiliser is available to farmers at low controlled prices (even so prices have risen and are out of reach of many farmers). Decontrol of the fertiliser industry

is currently an important political issue. Potassium and phosphate fertilisers have already been decontrolled.

Other issues associated with fertiliser use include:

- adulteration concerns - fertilisers are often reported to have lost their 'potency', and
- the important links between use of fertilisers and other inputs such as improved seeds and irrigation.
- concerns of farmers about the loss in soil quality in drylands when chemical fertilisers are used.

Money to buy inputs (seeds, fertilisers, pesticides etc.) is often obtained as loans from moneylenders at high interest rates. Farmers are often obliged to sell back crops at low prices, and indebtedness to moneylenders is a major problem (Conroy *et al.*, 2001).

Chemical fertiliser is subject to aggressive promotion by the government and commercial salesmen. It is associated with government-promoted interventions that include the introduction of chemical responsive varieties in crops like sugarcane, sunflower, potato, cotton etc. Most of the seeds and subsidies for these crops come with a package of fertilisers and pesticides. If you accept the crop you also accept the package and then on it are a treadmill getting off which is nearly impossible. Coupled with these interventions are the financial lending policies. Only if you grow the crops prescribed by the government can you get credit. And if you grow the prescribed crops you have to follow the prescribed package.

Moreover, every time a natural disaster like excessive rains or floods or famine affects the farmers, the relief that government can think of comes only in the form of so-called improved seeds and a bag of chemical fertiliser. One of the most important facilities that farmers perceive in the chemical fertiliser use is the ease of operation. It does not need raising a heap all through the year, no need to hire a bullock cart to transport it to the field, no need to hire labour to load, unload and spread it on the field. In comparison chemical fertilisers are godsent. It is just a couple of bags which can be transported to the field on a bicycle or sometimes even on their backs. And then one person can spread it on the field. Moreover, it can be purchased on credit. The icing on the cake is that government provides a subsidy for its purchase.

Markets

Key market factors include:

- Crop prices have often not met rising costs of production, resulting in lower margins for example the cost of urea increased from Rs2760 (exclusive of local taxes) in 1992-93 to Rs 4000 in 1998-99 http://www.fadinap.org/india/Retail.htm.
- Prices of oil seed crops in particular have fallen with severe impacts on farmers, for example, groundnut farmers in Anantapur (Conroy *et al.,* 2001).
- Irrigated agriculture remains much more viable although costs are also increasing and risks are high

Key policies

Some of the key policies influencing soil fertility management strategies are:

- control of fertiliser prices – the fertiliser industry receives the subsidy, not farmers (who benefit from lower prices), however there is pressure to reform system and decontrol prices,
- subsidies on feeds (Tanner, 1997),

- food policies (e.g. the public distribution system that can facilitate switches to cash crops),
- irrigation development,
- electricity pricing – especially the availability of cheap electricity for pumping groundwater (there is the major use of electricity in India).
- WTO-related policies, impacts on crop prices and choice

Readers are referred to the policy review for further details.

Role of soil fertility management

The subsequent parts of this review address the role of soil fertility management in farming systems (part 1) which focuses on farmers' objectives, constraints, and needs, and in the livelihoods of people involved in laboring, trade and other activities associated with the soil fertility business (part 2). Of course, these need not be two mutually exclusive categories of rural families, and the same people may be involved in both sets of activities

Part 1: Soil fertility management in semi-arid farming systems

This part of the paper, aims to review the available literature (and draw upon other sources) to address five key questions:

- In semi-arid farming systems, how important is SFM to the livelihoods of poor farmers, compared to other constraints?
- What opportunities exist for farmers to improve SFM?
- What are the key constraints faced by farmers in improving SFM?
- What are the most effective interventions or best opportunities to support farmers to improve SFM?
- What is th*e* institutional and policy context to support farmers to improve SFM?

It is written with a livelihoods-framework in mind and in each section consideration is given to the assets available to farmers (natural, social, human, physical, financial), the vulnerability context (for example, the semi-arid climate and drought risk) and other external factors - policies, structures and institutions. Special emphasis is given to human and social capital issues. Human capital comprises the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. Social capital reflects the resources upon which people draw in pursuit of their livelihood objectives including networks, membership of groups and relationships of trust, reciprocity and exchanges.

It is difficult to find agreement amongst the literature or stakeholders on most of these questions and an initial attempt is made to contrast different views between stakeholders such as government scientists and NGO workers, poor farmers and less poor farmers. This aims to promote discussion, and it must of course be recognised that a wide range of views exists within each of these types of organisations.

In semi-arid farming systems, how important is SFM to the livelihoods of poor farmers, compared to other constraints?

Pound (2000) identified 13 constraints to improved production in parts of semi-arid Karnataka:

- limiting groundwater resources
- limiting rainfall amount, distribution and reliability
- soil limitations to arable production
- insufficient fodder for livestock
- limited awareness of technical options on the part of [watershed development] project staff
- limited access to reliable sources of information for farmers
- top down introduction of new options, which limits understanding by farmers of concepts that underpin the options
- limited access to some inputs required for adoption of existing options
- indebtedness (and cost of borrowing) for all categories of farmers
- high cost of medical care
- weak collective action (e.g. in management of common lands or in addressing worsening groundwater situation)
- dependence on government

- limited non-farm employment opportunities in rural areas

Only one of these is directly soil-related, although a number of others such as limited access to information and indebtedness could encompass soil fertility related aspects. However, it is important to recognise that soil fertility concerns are not the most pressing issues faced by smallholder farmers, and improving soil fertility is at best only one of several options for which there is genuine demand.

What opportunities exist for farmers to improve nutrient management?

There are a large number of options available to farmers to improve nutrient management, and most of these are well documented either through the conventional scientific literature or alternative sources such as the Honey Bee Network (http://www.sristi.org) which documents indigenous knowledge and the experiences of farmer innovators. Options broadly include strategies to add more nutrients into the farm system, and strategies to reduce unproductive losses of nutrients from the system (through processes such as volatilisation, and leaching):

- Nutrients added to the farm system may be in the form of inorganic (e.g. fertilisers) or organic materials (e.g. manure and composts), and include animal feeds and fodder and other materials collected from CPR lands (which lead to increased manure supply). Nutrients may be source from outside the farm (e.g. chemical fertilisers) or from within (e.g. FYM from a manure heap).
- Reducing losses of nutrients involves practices such as crop rotations, cultivation of cover crops, and cultivation of trees to access nutrients from deeper soil layers

Inorganic inputs

Inorganic fertilisers get a lot of attention in some circles. They are relatively easy to research, and in many cases are the only way to provide the amounts of nutrients required. Organic materials are simply not available in large enough quantities in some locations, or labour inputs are prohibitive. As noted above fertiliser use remains relatively low but is increasing in rainfed areas. Inorganic fertilisers are not sufficiently accessible to poor and marginal farmers due to cost, and many farmers are also concerned about impacts on soil quality (water pollution concerns are a further issue). Lack of affordable credit is a major constraint. Loans are often at high interest rates, and result in high levels of indebtedness during poor years.

Box 5 FYM and skills

FYM growing is not, in general, a highly skilled job. People do not perceive it as an intelligent person's task. In fact many names like *Pentappa* or *Pentamma* in Andhra Pradesh, *Tippaiah* or *Tippamma* in Karnataka or *Kuppuswamy* or *Kuppamma* in Tamil Nadu are indicative of total surrender : telling the God that I am like a compost heap, of no value of no skill. On the other hand, FYM is the most treasured part of farming. Comparable only to seeds. In fact the beginning of the farming season in the Deccan is marked by the worship of the manure heap : *Penta Pooja*. The woman of the house lights a lamp, breaks a coconut, sprinkles vermillion and turmeric [*Kumkum* and *haldi*], two most reverential tools of workship and does an *haarti*, turning a lighted lamp in circular motion in front of the heap. Exactly the way she worships the most important god in the Hindu pantheon. This indicates that the status of the FYM heap is the same as the status of the family god.

These two opposing positions are living and simultaneous, a mysterious contradiction of the people's culture. While the waste part of the manure heap is recognised in naming of people, the enormous ecological contribution of recycling wastes is acknowledged in worshipping the composted heap. However there are cases where people have brought in other skills to improve their compost. For e.g. bringing in dry leaves, adding lime into the compost, adding wastes not found in their own household rubbish etc. Such enterprising people in the village have a recognition for themselves.

Organic inputs

A wide range of organic inputs are utilised. These include: composts, vermicompost, manure (stored as FYM or from herding animals on arable lands), crop residues, by-products such as coir dust (Selvaraju *et al*., 1999), urban waste, green manures, and legumes that fix nitrogen (often much of plant is harvested, but typically some residues are returned). These inputs may be derived from materials within the farm or from elsewhere. Typically organic inputs require labour intensive processing to provide nutrients in the right quantities and form, and transport.

Opportunities exist to maximise the use of organic inputs through good management: practices such as mixing in manure to improve decomposition or residues (see Box 5). However, management often appears to be poor. Why? Associated labour requirements are one key factor. Tanner (1997) reports potential losses associated with stock-piling and broadcasting, probably due to labour constraints associated with more precision placement. Transport is another important constraint. Typically storage facilities are not a constraint and space is traditionally made available in villages. Everyone is permitted to use some space in the village for compost. However bigger farmers have traditionally captured some common lands and have greater access for space for manuring, fodder keeping etc. Most of this manure is used for their own agriculture and not sold. Even the poorest and the most deprived are not grudged a manure space of their own. Sometimes it may be a bit far from their house. This may inhibit composting to some extent, but not significantly. Strong social rules also prevent theft of manure (Box 6). Animal husbandry practices are important e.g. using bedding to absorb urine.

Key issues associated with the use of organic fertilisers include:

- access to manure is tightly controlled (Tanner, 1997),
- links between livestock owners and arable lands. Tanner (1997) reports a decline in traditional shepherding arrangements due to high prices charged by pastoralists,

Box 6 Social rules and manure

As one walks down any village in the dryland India, one does not fail to spot dotted rows of compost heaps lined on the roadside, at the backyards of houses and in specially enclosed *kallams* compost yards. Sometimes the heap is separated from its owner by several hundred meters. But the fact that such a heap is in wide open and is unwatched by anyone does not result in the theft o any part of the compost. One of the most significant social rules that governs grown FYM in rural India is that stealing the compost is the most heinous of all crimes. There are hardly any recorded thefts of the manure from the heap.

By and large the social capital neither supports nor negates the fertiliser business. However close the kin is, one does not get the manure for free or on loan. Whatever else, plough bullocks, plough and other agricultural instruments or seeds, maybe accessed on loan or as a help. But never FYM. Probably the underlying belief that a person who can't even grow his manure is worth no help. But in transportation and spreading manure, the kinship relations are great use. They may lend a bullock cart for transportation, if there are a lot of people in the family, the activity will be easier and faster. All these factors help significantly.

- Interactions between energy and agricultural needs - competition for dung, crop residues (Parikh & Ramanathan, 1999). Dung cakes often saved for the rainy season.
- importance for specialist crops where taste is a key factor e.g. spices,
- role in helping prevent pest and disease losses,
- sources of materials are limited especially in areas where CPRs provided key sources due to decline in area and productivity of CPRs (Jodha, 1986, Pasha, 1992)
- limited manure supply is a widespread problem (e.g. Tanner, 1997) and competition for use as energy source
- uptake of some interventions may be heavily linked to subsidies e.g. vermicomposting.
- inputs to system in purchased feeds (Tanner, 1997)
- other amendments (not really just organic) include the application of fertile soils from de-silting of tanks which is a traditional practice e.g. in Karnataka (see Box 7). This is affected by changes in policy which encourage desilting by contractors, although its use by farmers is not explicitly encouraged.

Box 7 Collection of silt from village tanks in Karnataka, India

Village tanks form a key part of traditional water harvesting systems throughout India. They provide drinking water for livestock, and irrigation water for intensive cultivation of paddy rice and other crops. But the tanks are also important sources of fertile sediment, which is collected and returned to the land. It is used to maintain soil fertility, particularly in the areas where high-value and important crops are grown. In Karnataka, the sand and silt deposits are often collected and applied to coconut gardens. Sediments are also used for other productive activities including brick-making. Sometimes the sediment is 'sold' by village watershed committees with the revenue being used to fund development activities and provide loans to villagers.

Improving nutrient cycling

Practices include:

- agroforestry to capture nutrients from lower soil layers,
- rotations,
- green manures,

- tillage practices,
- improved fodder supplies leading to more livestock (strategy reported by Tanner, 1997).

Integrated nutrient management (INM)

INM (or integrated soil fertility management) is widely accepted in international and Indian scientific circles as the most appropriate SFM strategy for rainfed farmers. Patra *et al*. (2000) for example report better herb and oil yields with INM practices compared to use of organic or inorganic inputs alone. Scoones and Toulmin (undated) review recent thinking on the role of INM (see also Brinn *et al*., 1999). Importantly as well as mixing organic and inorganic inputs, INM is associated with a broader philosophy. This emphasises the need for context-specific and adaptive responses necessitating new skills and new partnerships between researchers, extensionists and farmers. However, it can be argued that INM is targeted at symptoms and not causes (Tanner *et al*., 2000). The approach also requires good quality organic materials.

Erosion, and soil and water conservation

Erosion contributes to a loss in soil fertility, especially as the organic and finest (and most fertile) soil fractions are susceptible. Soil and water conservation (SWC) works such as bunding to control erosion will therefore help maintain soil fertility, and can provide an incentive for investment in soil fertility (use of fertilisers etc) often associated with more intensive cropping. Watershed development projects focus largely on soil and water conservation measures, usually physical structures and tree planting. Land configuration practices (such as tied-rdges) in combination with improved nutrient management can also significantly improve productivity (Selvaraju *et al*., 1999). In Bihar/ West Bengal, Tanner (1997) reports on a SWC strategy to improve soil fertility linked to knowledge of upland/ lowland nutrient flows.

What are the key constraints faced by farmers in improving nutrient management?

Research scientists efforts generally focus on providing new knowledge to farmers (to add to human capital) and to improve genetic material (to improve natural capital). Plant and soil scientists, most importantly within the extensive ICAR system:

- generally focus on achieving productivity gains,
- usually acknowledge plant nutrition constraints such as N, P, K deficiencies or lack of micronutrients as the key constraints (as well as water stress) to improving productivity in rainfed lands,
- often argue that farmers do not adopt recommendations, although the possibility that this may be because recommendations are not appropriate or specific enough to local circumstances is increasingly recognised (Swarup & Gaunt, 1998),
- generally believe that new technologies or practices are required e.g. better recommendations, new crop varieties including GMOs, and biofertilisers,
- sometimes promote participation of farmers, but usually only at initial stages in identification of problems and needs and less commonly in developing solutions,
- increasingly recognise INM as the most appropriate approach (e.g. Singh *et al.,* 1998) and that organic inputs are of vital importance (but are harder to quantify and study).

Although the NGO sector represents a broad range of organisations with many different philosophies and approaches, NGOs:

- are often driven by a strong ideology,

- recognise both 'formal' scientific knowledge (from research stations etc.) as well as farmers knowledge – often based itself upon good science,
- focus on what works and is the felt need of with farmers, who they generally are close to,
- often subsidise interventions, and 'hard sell' options (farmers are either in or out of the programme, and membership can be associated with acceptance of conditions). Arguably such approaches are necessary to counter propaganda from the government and mainstream science that promotes corporate interests with the powerful backing of the media,
- recognise poverty as key overriding constraint, access to assets such as water, grazing lands etc. and are likely to acknowledge impacts of price shocks,
- often emphasise training and skill development,
- are more representative of civil society e.g. food futures citizen jury for example (IIED, 2001),
- promote organic methods e.g. vermiculture and in some cases may actively discourage use of inorganic fertiliser,
- have limited access to information on options in suitable forms,
- often, with some notable exceptions, encourage little critical reflect on uptake, and there is a danger to focus on 'bean counting' e.g. number of farmers involved, number of pits for vermiculture etc.

Box 8 Visions of small and marginal farmers in AP

The key conclusions reached by a citizens jury – reflecting their 'vision' – included a desire for:

- Food and farming for self reliance and community control over resources.
- To maintain healthy soils, diverse crops, trees and livestock, and to build on our indigenous knowledge, practical skills and local institutions.

And opposition to:

- The proposed reduction of those making their livelihood from the land from 70%-40% in Andhra Pradesh
- Land consolidation and displacement of rural people
- Contract farming
- Labour-displacing mechanisation
- GM Crops - including Vitamin A rice & Bt cotton
- Loss of control over medicinal plants including their export

Source: IIED (http://www.iied.org/agri/IIEDcitizenjuryAP1.html) accessed 3/8/01

Some of the constraints recognised by farmers are summarised in Box 8.

Policy-makers in government:

- are focused on food security at macro-level, modernisation and economic development,
- tend to focus on more easily understood and quick fix inorganic options to improve crop productivity,
- pay little thought given to impacts of interventions, such as the 2020 vision in Andhra Pradesh, on complex farming systems and livelihoods.

What are the reasons for poor uptake of technologies and recommendations? Two key issues and gaps that fieldwork could focus on are labour requirements and access to information:

Labour requirements and returns to labour

Organic methods such as vermicomposting tend to be labour intensive, but labour requirements and returns to labour are not well understood. Often the impacts are on women's time. Returns may be insufficient for practices (and improved methods) to be viable in many circumstances unless subsidised. Subsidies may be provided in some cases, and this could be a policy recommendation.

Access to information

Is information not available or not appropriate? And what are the most effective mechanisms by which farmers gain information? Pound (2000) reported that other family and farmers were the most important sources of information. And what are the reasons for limited access of particular groups to knowledge about nutrient management practices and other inputs?

A third gap emerging, is perhaps the consequence of interventions on the systems, through complex interactions and relationships. This would include the factors driving declining livestock populations, often labour related, and the consequences for SFM.

What are the most effective interventions/ best opportunities to support farmers to improve nutrient management?

Options to support farmers to improve nutrient management include:

- development of new technologies and practices – for example fertiliser recommendations that include mixed organic and inorganic inputs (including clear analysis of costs and benefits), land configuration measures and fertiliser inputs, and new varieties. Whilst still important, given past levels of uptake, development is only justified if access to reliable and impartial information is improved.
- improving access to information (both farmer and 'externally-derived' technologies) – opportunities exist to expand indigenous knowledge and farmer innovation (following approaches such as the Honey Bee Network), improve the extension system to include farmer's manuring practices etc. and to utilise the media to disseminate this information,
- improving access to inputs and services (infrastructure, credit, fertilisers) including enhancing the role of the private sector, and improving rural roads and transport to help input supply and market access. A level playing field by giving the same credits and subsidies to organic fertilisers as to the industrially produced fertilisers would enhance the options farmers available to farmers.
- reforming markets (crop and input prices) to promote stability and sustainability, including supporting farmers to develop local markets over which they have more control and influence.
- watershed development and integrated rural development initiatives – impacts in well-implemented programmes include improvement in human and social capital, and improved crop yields (Kerr *et al*., 2000).
- promoting biodiverse systems that can provide higher overall returns than are often recognised.
- land tenure and security for farmers providing incentives to invest.

What is the institutional and policy context to improving nutrient management?

This section addresses two key issues: the capacity and focus of research and extension services, and fertiliser subsidies.

Research and extension services

Research services include the ICAR system (extensive, well funded, geared to publication, limited farmer participation and with a focus on new technologies), ICRISAT (with a focus on breeding, but participatory breeding efforts it is recognised that this is often not local enough), and agricultural universities (generally poorly funded). An emerging hypothesis if that technologies coming out of the research system are not valid to semi-arid resource-poor farmers.

Extension is essentially not existent for most farmers. KVKs work with very small numbers given the size of districts. An emerging hypothesis is that 'there aren't effective mechanisms to get technologies arising from the research system to farmers (even if technologies are appropriate)'.

Fertiliser subsidies

The current inorganic fertiliser subsidies are a positive disincentive for organic fertiliser use. The government uses every conceivable policy instrument to promote chemical fertiliser. This has a historical connection with the earlier socialist mixed economy of India wherein fertiliser industry was symbolic of the commanding heights of the socialist economy. Therefore it was very important for the government to protect and promote the fertiliser industry which was also a symbol of the Green Revolution and hence a symbol of the liberation of the country from the shackle of food imports and therefore from the neo colonising forces. In this patriotic fervour what was forgotten was that the small and marginal farmers were being yoked into a new bondage : industrial fertiliser which was not the priority choice. And that this has a long-term consequence for agricultural ecology and sustainable farming systems.

In the context of the present crisis in dryland agriculture, a better policy instrument would be to make it possible for farmers to access credit with equal ease to purchase whichever form of fertiliser they want: FYM, vermicompost or synthetic fertiliser. This would go a long way in helping small and marginal farmers to steer clear from purchasing synthetic fertilisers only because they are available on credit and/or government supplies them in every case of distress. Every time there is a crop loss or natural disaster, one of the first thing government offers is free chemical fertilisers. This steers the smallholder farming into a direction, which may not be to the liking of farmers and may be against their interests.

Part 2: The role of the soil fertility 'business' in the lives of poor people in semi-arid India

The role of nutrient transactions in generating income earning opportunities for the landless whilst enhancing nutrient cycling efficiency has been recognised in Eastern/Western KRIBHCO Indo-British rainfed farming projects (Tanner, 1997). For example, the shift to stall feeding as cropping has been extended affects access of poor to manure who can't collect from grazing lands. But these families can get involved in processing for example, women buying manure and selling compost. Tanner *et al.* (2000) also includes a case-study of nutrient transactions between herders and arable farmers.

This part of this review considers the 'soil fertility business' from the perspective of different groups involved. It focuses on organic fertilisers, and is based upon experience from Medak District in Andhra Pradesh.

Categories involved in management of organic fertilisers

In the villages of the Deccan, a variety of farming systems and livelihoods are dependent upon manure production and manure management. And new markets are emerging. They form an amazing matrix of the rural society and in some ways reflect in a microcosm other existing social relationships. Categories of people involved in the organic fertiliser business include:

- Landless people without livestock
- Landless cattle owners
- Small holder farmers
- Shepherds
- Collectors
- Middlemen and consultants

Landless people without livestock

This is a major category of people for whom composting is an important income source. They build their compost heaps with their household wastes which include kitchen wastes, ash and the normal rubbish which collects inside the home as well at the housefront and some cowdung residues from the smearing of the housefront as ritual activity.

Altogether an average houshold may generate about two cartloads of waste per year. The demand for the product is slightly lower than other composts because of the absence of catalytic agents like cattle dung and urine. But since the compost content itself is not something that needs much breaking down, the price does not differ much from the other forms of FYM. Such materials get 20% less price per cartload in comparison to the normal heap. The price for a cartload of FYM in Zaheerabad region for example varies from village to village and depends upon demand and supply. The lowest price in the year 2000 was around Rs.50 cartload (about a tonne) and the highest price commanded was around Rs.120.

Box 9 Moving herds: shifting cattle ownership in drylands

Over the last two decades, cattle ownership has dramatically changed hands in the dryland region. Historically bigger farmers were the owners of the largest herds, sometimes between 50-70 animals. A majority of them were raised not so much for their milk or draught power but for their manure since all farming was non-chemical and the soil fertility value of the dung was high.

The large herds were looked after by labour who could be either bonded or hired on a cheap annual contract. Most of the time, the poorer people borrowed money from their landlords, the *Kaapus* [saviour] to meet their emergencies. Most emergencies were either in the form of a wedding in the family or illness . Unable to repay the debt that was constantly compounded by rising interest, the poor would work as dedicated servants, looking after the herds, cleaning the cattleshed, collecting the dung and dumping it in the heap. The duty of up to 4-5 servants in the *kaapu's* house was only to look after the cattle. By and large *these herders were* from the scheduled castes and *were* mostly older children in the age group of 10-15.

Over time, the period of such an abundant supply of dedicated servants came to a halt. Government laws and social education as well as activist work forced parents to admit their children in schools. This created labour scarcity in the villages, especially in the 'cattle-care' sector. Concurrently adult labourers were confronted with a wider labour market providing other options than being be bound to one farmer or to a single contract. Because of these reasons labour for cattle-care has become scarce. As a result, most big farmers have sold away their herds and now hardly own one or two pairs of cattle.

While the bigger farmers were being impacted negatively by government policies, a reverse trend was taking place in relation to the scheduled caste people who form the poorest sections of the rural society. A series of welfare and affirmative programmes initiated by the government gave them subsidies and credits to purchase cattle, both milk animals like buffaloes and draught animals like plough bullocks. Increasingly more of them became cattle owners. They had the social capital to take care of the cattle in terms of family or group labour. If one poor family had 3-4 cattle, one person in the family usually an older child would graze them. Many of their neighbours would also hand over their one or two animals to this person to graze. In return he would be paid some money every month. This system worked to both people's advantage. In the process of taking care of his family cattle, he also earned an extra income looking after his neighbour's cattle.

Source: Deccan Development Society

Landless cattle owners

Mostly belonging to the Scheduled Castes, there is a significant category of landless cattle owners. Perhaps 50% of them have become cattle owners over the last decade. A majority of them have been benefited by the welfare programmes of the State which concentrated on helping the SCs to own milk and draught animals throughout 1970s and 80s (Box 9).

The very nature of their occupation makes it easier for them to rear cattle. All people in this category go wage labouring as weeders in other farmers' fields. This helps them collect enough fodder for their animals. Every woman returns from weeding with a headload of fodder. This is the grass she has weeded from the field through the day. In irrigated areas, labourers are also usually allowed to cut green fodder (such as sugar cane leaves).

This category is the major supplier of the FYM. The high concentration of dung in their FYM attracts a good price and on an average they can earn up to Rs.100-120 per cartload every

season. An average heap can collect about ten cartloads if they have one animal, or up to about 15 cartloads if they have two per year. Therefore they earn up to Rs. 1000 – Rs.1500 per season equivalent to roughly about the amount of wage they earn in a month or 45 days depending upon the part of the region they belong. Near Zaheerabad town in the region, which is the sugarcane belt, lean season wages are around Rs.20-25 for women and Rs.35 for men. About 25 km from the Zaheerabad town, wages are as low as Rs. 15 for women and Rs.25 for men.

However cattle ownership amongst poor families is also being threatened because all the children in the house are now encouraged to go to school. While this is undoubtedly a very welcome measure to liberate children from having to work as family labour and to lose their schooling, it also has a serious implication both for farming and livelihoods. This probably needs a reorganisation of the village labour or educational system (see Box 10).

Small holder farmers

This is another major cattle owning population. But most part of their FYM is used in their own farms. Very few of them are in a position to sell their manure. However through the activity of accumulating FYM, they are able to save about 50% of their farming expenses every season. This is a major gain.

A majority of these farmers do not use chemical fertilisers in their agriculture. They all share a perception that application of chemical fertilisers will reduce their dry, rainfed lands to the status of ash by burning it out. Hence the hesitation to apply chemicals on their farms.

Projected into future, this practice of relying completely on natural fertilisers for their farming can be the major source of their possible prosperity if organic foods get a premium price as evidenced in the present food consumption trends.

Shepherds

Shepherds are the source of the best quality FYM. There are two variations in the community. The pure pastoralists who keep moving with their herd in search of water and fodder and hence have no time for farming. By the very nature of their occupation, they cannot stay at one place for a long time, time enough to collect the manure from their herds and raise an FYM. But their earning from the manure is even better.

They are the most welcome guests in any harvested field and are invited to graze their animals. And they get paid for that! In fact for each day their herd stays on the land, they are paid around Rs.50 per herd (the herd size is often 20 to 50 animals) as well as their food for the day.

Box 10 School or cattle ? Hard livelihoods and harder options

Tuljamma from village Potpally was too frail for her 12 years of age. Always shy and withdrawn it was very difficult to make life spring out of her. She was enrolled by her village sangham into *Pachasaale*, the Green School run by the Deccan Development Society for older children. Tuljamma was a regular student for almost a year and blossommed beautifully. One day she stopped coming to the school. A week passed and she was not to be seen.

I went to her tiny one roomed thatched hut to talk to her parents. Her 30-year old mother Anjamma, looking ten years older than her real age was cooking rice on a wood stove. The six feet square kitchen had hardly any place for me to walk in and sit. Therefore I sat on the threshold to ask her why Tuljamma had been taken off the School. Anjamma told me that her younger daughter had been admitted into the village school because the school teacher had come and said that it was compulsory to enrol her child into the school. Consequently there was noone to take care of the animals at the home. Therefore she had withdraw Tuljamma from the Green School even though she did not like it one bit.

The next one hour was spent in talking to her and arguing why she should put Tuljamma back in the school. She had no hard arguments to support her action. She was feeling guilty but she had no option. The play on her face of the red and yellow light from the woodfire burning in her stove clearly delineated the cruel dilemma she was going through. At the end of an hour's pleading, she finally said she would try to send back Tuljamma to the School

Two days later Tuljamma turned up at the School. I was delighted. I asked her how did it happen? She said in a flat voice that her mother had sold away their livestock. My delight died on the spot. Was the school a solution or a problem for Anjamma? I have never resolved the question yet.

But one person who seems to have brilliantly resolved this question is Lalu Prasad Yadav, the much maligned, constantly ridiculed former Chief Minister of the state of Bihar in North India. Yadav who comes from the family of traditional cattleherds can clearly empathise with the dilemma of people like Anjamma. Therefore he started what he called *Charvaha School* in Bihar. The cattleherding children could drive in their cattle into these schools. The schools would stock fodder, offer grazing land, drinking water and caretakers for the cattle within the school campus even while the children attended their classes. In the evening when the children returned homes they could drive back their cattle with them. It was a win-win situation for parents, children, cattle and education.

There are instances of bigger farmers paying up to Rs.10,000 for ten acres (Rs.1000 per acre) to let the herd stay on their lands. This activity would involve penning the herd (if the size of the herd is about 100) on different patches of lands over a period of about a month. Each night the herd of 100 animals can fertilise about one quarter of an acre. Therefore to cover an acre it would roughly take between three to four days.

The second category among the shepherds is the settled people who have smaller herds between 25 and 50. Invariably they are landowners in their own right. Therefore, in the Zaheerabad region, shepherds are not known to sell their FYM. Most of the time, they use it for their own lands. However when they decide to sell any part of their manure heap, they attract the highet price, sometimes up to Rs. 150 per cartload.

Collectors

In the midst of all these categories coexists another amorphous category of collectors whose job is only to collect the dung and let the others to do the processing. *Junglee* is the person

who herds the village cattle by charging between Rs.20 and Rs.30 per animal per month. In his herd he has between 20-50 animals on an average. This means he gets an income of up to Rs.500-1200 per month by herding and grazing these animals on the village commons.

This person herds *only* the buffaloes and cows. He is not given the charge of grazing the family bullocks since the bullocks are too precious to be handled by a *common* person. It has to be the exclusive charge of a member of the family or an exclusive servant.

The *junglees* also derive a significant part of their income from the dung of the cattle they herd. Normally it is the man and the woman who together go with the herd. While the man herds the cattle, the woman's exclusive job is to collect the dung as and when it is deposited by the cattle. She carries a basket with her and follows the herd all through their journey. When the basket gets filled, it is immediately put in a heap on the ground. Once the animals start their journey homeward, the woman starts bringing all her small heaps together into a bigger heap. Her heap is *pure dung* and hence is most valued.

Anyone needing a part of the heap or full heap can negotiate with the *junglee* and buy it from the person. If the herd size is around 50, the *junglee* collects about one cartload of dung per day. This brings him a monthly income of up to Rs.2000. Ramappa, a *junglee* in Pastapur village, because of the proximity of Zaheerabad town, earned u pto Rs.3000 per month by supplying a cartload of dung at Rs.100/- to rooflayers in house construction who need cattle dung.

It is not always cash transactions. Sometimes the bigger farmers can also get some small amounts of this heap for a variety of favours returned, which may include:

- small loans,
- access to vegetables in their farms,
- small timber,
- fodder, and
- thatching material

There are also another set of collectors who are probably a more recent phenomenon. This is special boys and girls employed by bigger farmers exclusively to collect the dung at spots wherever cattle collect for grazing. This is mostly done with the dung of the smaller herds grazed by the servants of the landlords. Such collectors may be employed at up to Rs.600 per month.

Middlemen and 'consultants'

As the market for FYM is growing, it has also given rise to a new category of middlemen. These people advance money to purchase FYM heaps in the village and collect them in season to sell it to major buyers. They offer a number of services:

- purchasing a heap at competitive prices,
- hiring a truck/cart/tractor etc.,
- getting the manure loaded with their own labour,
- finding a buyer and unloading in the designated destination with their own labour.

In the bargain they earn up to Rs.100 as their commission per heap. If in a season they are able to negotiate up to 20 heaps, they make an earning of up to Rs.2000, which may equal two months of average wage earnings. This practice is still at a small scale but might emerge as an

important enterprise especially where there are specilist markets for organic fertilisers, such as in ginger growing areas.

There are also consultants in the profession. People who know the size of the various heaps because they constantly observe them from the time the compost pit is dug. Hence they are aware of its depth and the volume of manure it can hold. With this knowledge, they advise the buyers of what the manure quantity and quality in the pit would be. This helps the buyers not to make a blind guess and offer a price which is commensurate with the quantity of the manure in the heap. In return for their advice, the consultants get a small fee, probably Rs.20-30 per heap.

Markets for manure

As described earlier, raising manure composts is a major activity. But most of the time this is done on a small scale. There are no known industrial-size activities in the region (also these may become important in peri-urban areas). And most manure is not sold. One cartload of FYM sells for between Rs.75 to Rs 120. In an average village like Pastapur with its 450 households and a population of about 3500 persons, there are at least 400 FYM pits and a total generation of about 5000 tonnes of FYM. This means that the total value of FYM is around Rs.300,000 to Rs.350,000. This is almost double the budget allotted to the Panchayat (the Village Council) by government.

Trade is increasing, as larger and specialist farmers have less FYM of their own. In recent years, ginger growers have become major buyers of FYM. Most of them are large farmers who do farming for cash. Since ginger attracts a good price they see this as a very profitable venture. When their chemically grown ginger started getting rejected in the market for its *bad smell* or smelllessness, as well as getting damaged by root rot, they rediscovered the virtue of FYM and started buying it in good measure. In recent times, horticultural consultants have also been advising grape growers to use FYM in place of chemical fertilisers in order to get a better price for the grapes. If this trend catches on, it can mean another major market for FYM in the region.

Sale of manure may be for cash or in exchange for:

- small timber
- green fodder
- part of the produce from the land for a certain number of years.

Thereby sale of FYM serves many purposes including construction of houses/cattleshed, animal husbandry and food security. However, the trade is not necessarily ‘desirable’ for all sellers, who are well aware of the loss of nutrients involved. Many small and marginal farmers who do sell manure, see this very much as a coping strategy in the face of undesirable circumstances such as medical expenses for a sick member of the family.

Competing uses

But for the rainy months, all the dung is normally used to shore up the manure heap. It is a highly valued commodity and is not wasted. All of it must go into their agriculture for fertilising soils. Another major use of dung is in smearing the housefronts. This is a cosmetic, ritual and anti-pest activity rolled into one. At least once a week all front yards are cleaned up and smeared with dung. A lot of dung is used as fuel during the rainy months especially in villages where the fuelwood crisis is high. There are also people, mostly landless, who sell

dungcakes to the cartwheels makers who are a major user group for this. There are not many reported cases of successful biogas interventions. There were big efforts in the eighties but most failed. Later small volume biogas plants came on the scene. But for want of adequate technical support at the village level, they also disappeared. Since then there are not many cases of use of dung for biogas production.

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