

Turning the nutrient cycle

In many parts of the world, the productivity of farming systems pivots on animals' ability to convert fodder into manure. In dry regions, crop residues decompose very slowly. Here, mutually beneficial relationships between herders and farmers revolve around each others' need for fodder and fertiliser, using the livestock digestive system to speed up nutrient cycling. Richard Cincotta and Ganesh Pangara report how the manure trade is organised in part of Gujarat in India.

**Richard Cincotta
and Ganesh Pangara**

The Bharavad herders living near Rajkot in Saurashtra Region keep small ruminants, of which about 90% are Maravathi sheep. This native breed produces a coarse wool, best suited for rug weaving. Herd size varies from 40 to 250 head. Income from sheep is generated from sales of animals for meat and from wool, milk and dung. Goats make up the remaining 10% of the herd, and produce mainly milk for household consumption.

Although Bharavad families own houses on the edge of towns and villages, about 10% of them migrate in the dry season to irrigated farming areas in North Gujarat, mostly those families with 200 or more animals. Smaller herds remain in the village, grazing the commons and harvested fields and eating cut fodder.

The farmers in the area cultivate 1-3 ha of rainfed land, which is largely dedicated to cash crops. While tractors operate in almost every village, many farmers prefer animal draught and maintain their own bullock for plowing and sowing. During the initial period of monsoon rains, the "long" rains or *kharif* season, groundnuts are sown. In the shorter *rabi* season, farmers plant cotton, wheat, *bajra* (millet) or groundnuts.

The farmers rely mainly on dung for nitrogen fertilisation and replacement of soil organic matter in their fields. Inorganic phosphate and urea are used sparingly.

Dung collection

A characteristic of the Saurashtrian countryside is the Bharavad corral area: a confused maze of living cactus fences and cartpaths at the outskirts of each village. Each corral, 300-600 m² in area, is designed for easy dung collection. Dirt floors are levelled, and one or two shallow pits are dug for piling dung.

To minimise dung losses, herders maximise confinement of their animals, which are brought back from grazing before 6 pm and only leave the corrals around 10 am. After the animals have been taken out to graze by the men, the women sweep the

dung into small piles and later into the nearest pit. When farmers are ready to buy dung, the content of these pits is carried in buckets to larger pits outside the corral. With their bullock carts, farmers haul the dung away.

Near the end of the dry season, just before planting, herds occasionally remain overnight in fields to deposit dung directly. This saves farmers the time and labour usually required to transport and apply manure. The animals are then either fed crop residues left at the field, or herders are paid an equivalent amount of cash. Although overnight stays are relatively infrequent in the village, interviewed Bharavads suggested that this farmer-

herder arrangement occurs more regularly on irrigated farmland along migration routes.

Market for soil fertility

Herders estimate that they can collect a bullock cartload of dung pellets from a herd of 200 sheep and goats in about 3 days. This quantity (around 100 kg) can then be traded for a cartload of baled millet or wheat straw. This is enough to feed 200 small ruminants for about one day. The remainder of their diet is obtained from meagre "wild" forage resources on degraded village commons, from standing stover and fallow weeds, or from fodder traded for farm labour.

In Saurashtra, most of the common grazing land was distributed among landless villagers during land reforms in the 1950s. All that remains for common grazing is in river floodplains, along roadsides and in hedges. During harvest, Bharavad men and women work in return for cash or fodder. Farmers commonly reserve crop stover and fallow weeds for herders with whom they regularly deal in manure and labour.

Bharavads did not complain about the present terms of trade for either manure or labour. They felt that, if trade became unfair, there were always other farmers with whom they could deal more favourably. Farmers also seemed satisfied with the present exchange arrangements.

Interviewed farmers were nearly equally split in their opinions of sheep and goat dung as fertiliser. About half believed that it was more expensive than chemical fertilisers for the amount of annual return, but thought that it was valuable because of its ability to promote good soil texture in local clays. Other farmers believed dung to be less expensive than chemical fertilisers, especially compared to urea, a quick-releasing nitrogen-rich fertiliser. However, several farmers said that a disadvantage of dung application was its tendency to harbour weed seeds.

Development considerations

Although improperly managed livestock can cause land degradation, the importance of animals in "turning the crank" on the nutrient cycle should not be overlooked. If a stalk of fodder is fed to goats, sheep or cattle, in less than 72 hours it is torn, chewed, soaked, decomposed by fermenting bacteria in the front chambers of the stomach (the rumen and reticulum), chewed again, attacked by acid in the latter part of the stomach, squeezed through the intestinal tract, attacked by bacteria again and deposited on the ground. Left to its own on the soil surface, years can e-



Figure 1: Map of India and Gujarat State. The Bharavad pastoralists who were studied live in the Saurashtra Region near Rajkot. Around 10% of them regularly migrate to North Gujarat during the dry season, seeking water and forage.

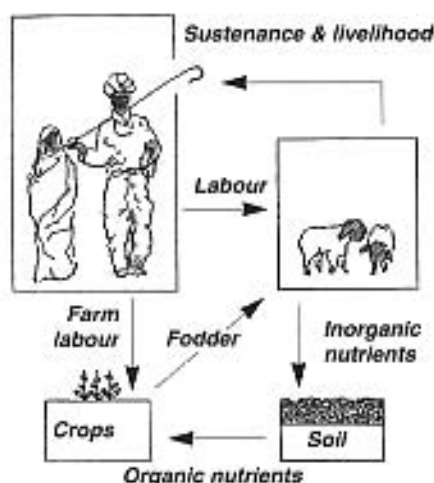


Figure 2: The connections between Bharavad pastoralists, their herds and village cropping. Bharavads trade livestock manure and labour for fodder. Their place at the "hub" of the nutrient cycle makes them important participants in the village agroecosystem.

lapse before crop residue encounters an equivalent amount of physical and chemical decomposition.

While the manure trade is already functioning well, further research may clarify the nutritive benefits and costs that accrue to herder and farmer, and may point to possibilities for improvement. Dung could perhaps be composted to kill weed seeds. The nutritive value and digestibility of straw could be increased by applying ammonia or by supplementary feeding of urea-molasses blocks. However, these technologies require additional inputs of labour and materials which may be infeasible or unprofitable. [Editors' note:

Moreover, increasing the digestibility of a limited quantity of feed would reduce the amount of dung produced.]

At present, Saurashtran herders do a respectable business by trading plant growth for animal productivity. Because fertiliser subsidies are likely to be cut in India, herders may find even greater demands for organic manures in the future. The degree to which local Bharavads have organised the nutrient trade points toward possibilities for pastoralists in other low-external-input farming systems to assume a role as "brokers of soil fertility".

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Manure to transport manure

In the North Eastern District of Botswana, a participatory rural appraisal clearly revealed the great importance of livestock in supplying manure for cropping. Manure produced mainly by goats, cattle and donkeys is collected in kraals near the homesteads and transported to the fields with donkey carts. The people who do not own donkey carts hire them from neighbours who do, and give them manure to pay for the manure transport services.

According to local people, about 5 donkey carts of manure are needed annually per acre to maintain soil fertility. However, few people keep enough livestock to be able to achieve this. The insufficient supply of manure and the high costs of supplementary mineral fertiliser are viewed as major problems by the crop farmers.

It is difficult to expand livestock holdings in order to produce more manure, because village areas are restricted by the commercial freehold farms, labour is limited by rural outmigration, particularly of young males (65% of the households are female-headed) and the remittances from these men are so small that little capital can be invested in livestock. Ways have to be found to step up manure production.

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Neela Mukherjee's longer article on 'Livestock, livelihood and drought', from which the above was extracted, can be obtained from ILEIA.

Water controls grazing

In the Thar desert of India, the local people developed a system of harvesting water for livestock and human consumption in tobas. To construct a toba, a depression with soil of low porosity is selected. If there is no natural depression but a good catchment, an artificial one is dug.

In Sattasar village in Rajasthan, for example, there are 6 tobas, in addition to the village water supply. The tobas are 8-16 km from the village, and each belongs to a different group. The size of the groups varies from 1 to 20 families.

With the onset of the monsoon, the families and the animals move to the tobas. Each toba group takes pride in being efficient water-users, but the water in most tobas lasts for only 4-5 months. People may get permission to use other tobas but, once their toba water is exhausted, they more commonly depend on the village water supply and have to graze their herds around the village.

The toba system allows dispersal of livestock during the short wet season, and the limited water supply prevents overgrazing in the areas around the tobas.

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In southern Somalia, surface water is collected in dug-out depressions called waros. The waros are protected by a thorn fence so that animals cannot go directly to the water. The herds of camels, cattle, sheep and goats are watered in troughs, and people have to carry the water from the waro to the trough. This limits the number of animals that can be handled by one family.

The waros have to be cleaned from time to time. For this, the user families have to provide labour. Those families who do not are punished and have to pay a 3-year-old camel to be slaughtered for the people who do the work. After a second refusal to participate, the family may be excluded altogether from using the waro.

Like in India, most waros do not last for the whole year, so that the grazing pressure in a particular area is limited by the availability of water. This system is fairly effective for limiting the number of goats, sheep and cattle in an area, but camels can travel very long distances between water source and pasture.

Nevertheless, the access to water determines the access to pasture, so not all people are happy with government water projects, which effectively open up the pastures for all livestock-keepers - whether they are willing to work or not.

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