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Urban organic waste markets: responding to change in Hubli–Dharwad, India

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Abstract

Urban organic wastes are an important component of urban and peri-urban agriculture in Southern countries. These wastes include the organic portion of municipal waste (mainly street sweepings and household garbage), livestock manure and wastewater, and are sold via informal markets. The operation of organic waste markets, and their contribution to solid waste management, is not widely documented. As well as making a positive contribution to agriculture, the sale of organic wastes reduces the amount of waste to be collected and disposed of by municipal authorities. The case study of Hubli–Dharwad, India, illustrates how these markets operate and identifies a number of issues which threaten their future. These include the increasing role of the private sector in the collection and disposal of solid waste and moves to evict livestock from large urban areas. Policy measures to support the use of urban organic wastes are suggested.

Keywords: Organic waste; Recycling; Urban agriculture; India

1. Introduction

The growing literature on 'urban agriculture' in the South reflects recognition of its' role in contributing to food production and income generation. Smit and Nasr (1992, p. 141) define urban agriculture as "food and fuel grown within the daily rhythm of the city or town, produced directly for the market and frequently processed and marketed by the farmers or their close associates". They suggest that urban agriculture is "a large and growing industry" which contributes to more

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sustainable resource use through using "urban waste water and urban solid waste as inputs" (1992, p. 142).

Urban organic wastes are used productively in many Southern countries and include much municipal solid waste, collected from households, street bins and street sweepings, vegetable market waste, wastewater and livestock manure. Informal organic waste markets include the sale of municipal refuse (sometimes composted) and the sale of manure from urban dairies and poultry units. They play an important role in urban and peri-urban agriculture by, for example, providing food for livestock and manure for soils, and make a significant contribution to reducing the amount of waste to be collected or finally disposed of at dumpsites. The sale of waste provides an additional source of income for municipal authorities, livestock keepers and hoteliers. The role of such markets in agricultural activities has, however, been insufficiently researched. Furedy and Whitney (1997, p. 1) note that "while waste reuse in agriculture is under-researched everywhere, the paucity of systematic (as against anecdotal) information for Asian cities is notable".

While there is much technical literature on composting municipal solid waste, there are few references to traditional systems of using urban organic wastes. Discussions of urban solid waste management systems also neglect the sale of organic waste. Although the operation of informal markets for urban inorganic wastes, such as glass and plastics, in the solid waste management[1] of cities in Southern countries is widely reported (see, for example, Beale, 1997; Furedy, 1992; School of Public Policy, The University of Birmingham, Department of Social Policy, London School of Economics and Water, Engineering and Development Centre, Loughborough University, 1996), markets associated with organic wastes are not. As the generation and sale of organic waste in urban areas is not widely recognised, farmers and livestock keepers are not considered to be stakeholders in urban solid waste management. The growing literature on urban agriculture may, however, raise awareness of the sale and use of urban organic wastes.

The case study of Hubli–Dharwad illustrates how established, though informal, markets for organic wastes in urban and peri-urban agriculture operate. The article identifies policies which challenge the existence of these markets and suggests ways in which markets could adapt and be supported. These policies include the increasing role of the private sector in solid waste management and plans to evict livestock from large urban areas in India. The article suggests that measures such as exploring composting options that balance quality against price and creating dialogue with livestock owners, particularly to discuss relocation options, could support the use of urban waste and the practice of urban and peri-urban agriculture.

2. Urban agriculture in Hubli–Dharwad

Hubli–Dharwad, a twin city in the north of the southern Indian State of Karnataka, has a population of approximately 800,000. There are two urban centres, separated by about 20 km along the National Highway 4, a major road, linking Pune with Bangalore, the State capital. The

[1] Solid waste management (SWM) encompasses the collection, treatment and disposal of municipal solid waste (MSW). MSW includes wastes from households, street sweepings, commercial properties and markets.

city is administered by a single municipal corporation, which provides the cities' infrastructural services, including solid waste collection and disposal and the maintenance of the underground sewerage systems, covering parts of the city.

Whilst there are many urban agricultural activities within Hubli–Dharwad, there is little official recognition of its role in contributing to food security and livelihoods. There is, however, some recognition of the role of urban wastes in agriculture, for example, through the sale of municipal waste from dumpsites by the Hubli–Dharwad Municipal Corporation (HDMC). In the case of Hubli–Dharwad, and most other cities in India, urban agricultural activities refer almost exclusively to cattle, buffalo and pig keeping. Peri-urban agriculture in Hubli–Dharwad includes horticulture, particularly using sewage-based irrigation, sheep and goat herding, dairies and poultry units. Staple food crops are also grown close to the city, with farmers having strong links to the urban areas, in terms of using the local markets and buying municipal solid waste and manure from urban dairies, as well as other inputs.

The lack of recognition is largely due to the unofficial nature of urban agriculture and the fact that the authorities within the urban area are not charged with promoting or facilitating agricultural activities in the city. In many cities, some elements of urban agriculture are seen as a nuisance and something to be stopped (t'Hart & Pluijmers, 1996). The generation and use of urban organic wastes contributes to this perception. Livestock (mainly cattle and pigs) roam the streets, searching for organic waste to consume, and contribute to traffic problems and public health concerns. Urban dairies store dung for use as fuel and for sale, taking up space in narrow lanes. In turn, urban dairies provide fresh milk for urban dwellers, particularly useful as many households do not have cold storage facilities, and sell dung to farmers. However, although some aspects of urban agriculture pose dilemmas for urban authorities, the generation and use of urban organic wastes can make a positive contribution to both urban management and food production.

3. The use of urban organic wastes in Hubli–Dharwad

There are many sources of organic wastes within the urban area and, therefore, a number of stakeholders involved in generating and using organic wastes. Fig. 1 illustrates the stakeholders involved and the uses of organic wastes in Hubli–Dharwad.

The diagram supports the argument that farmers and livestock keepers are key stakeholders within municipal solid waste management systems. They are, however, generally excluded from stakeholder analyses within discussions of the reuse and recycling of municipal solid waste (see, for example, Beale, 1997; School of Public Policy et al, 1996).

The use of urban organic wastes in urban and peri-urban agriculture in India includes municipal solid waste (MSW) and livestock manure used by near-urban farmers; the development of centralised composting plants; schemes to encourage neighbourhoods to establish small-scale vermicomposting (using worms to speed up the composting process); and, the use of wastewater, generally untreated, for irrigation. The various sources and uses of organic wastes reflect policies to reduce the amount of waste at dumpsites and the demand for waste materials as soil amendments and livestock feed. The main informal organic waste markets in Hubli–Dharwad involve the sale of municipal solid waste, collected from street bins and markets, and the sale of livestock manure.

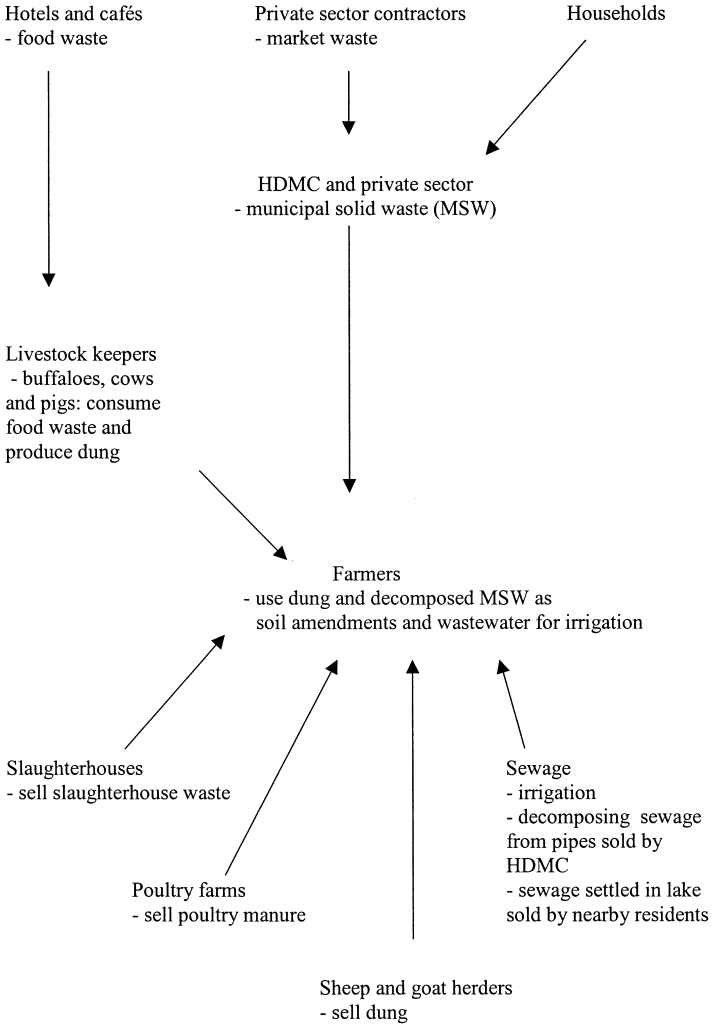

Fig. 1. Stakeholders and sources of urban organic wastes.

4. The sale of municipal solid waste

The sale of unsorted and, often, untreated MSW is not widely documented. Whilst there have been a few studies of urban waste being sold to near-urban farmers, it is likely that the practice has always been more extensive than reported. Lewcock (1994) describes how farmers near Kano, Nigeria, paid waste collection staff to take urban waste to their fields. In India, Snell (1999) and Furedy (1999) have noted the use of MSW by farmers near the city of Hyderabad. Snell (1999, pp. 1, 2) refers to records of the sale of composts, made from dry refuse and nightsoil, to farmers in the 1950s and 1960s, under the jurisdiction of the Health Department of the Municipal Corporation. By the late 1960s demand had decreased, due to high prices and transportation problems. It is not

clear what became of this practice, but a centralised large-scale composting plant, constructed in Hyderabad in the late 1970s, is likely to be replaced and other schemes, such as small-scale vermicomposting involving neighbourhoods and non-governmental organisations (NGOs), are being developed.

Composting urban waste in India has a long history and government intervention to promote this practice can be traced to the 1940s and the early 1970s, when the national government initiated a scheme to revive urban composting (Selvam, 1996, p. 3). Most of the plants developed under the scheme have closed down due to high production costs, inappropriate technology, inadequate maintenance and poor marketing (Selvam, 1996, p. 4). Furedy and Whitney (1997, p. 10) note that "there have been repeated managerial failures in the large-scale composting of municipal organic wastes and the promotion of organic waste recycling" in South and Southeast Asia and ascribe this to "among other things, poor marketing, contamination of the end product, and a commitment to high-tech mechanical compost plants". Although there have since been examples of more successful plants (see Selvam, 1996), there are also increasing numbers of neighbourhood composting schemes across India. These have been developed in response to the inadequate provision of waste collection services by municipal authorities, but have also resulted from efforts to support waste pickers (Beale, 1997; Furedy, 1996; IDD, 1998; Snell, 1999).

In Bangalore, for example, a number of NGOs support neighbourhood schemes, where waste pickers are employed to collect waste door-to-door, sell or dispose of the inorganic wastes, and put the organic wastes in local vermicomposting pits. Such schemes are not easy to maintain. Household involvement may be sporadic, as many people believe that it is the municipal corporation's responsibility to collect waste and do not want to make additional payments. Beale (1997, p. 955) also suggests that, in South Asia, "wet", organic, waste "is considered polluting and a job for others born to such work", which creates another constraint to the separation of waste materials "at source".

The experiences of other Indian cities provide insights to the changes taking place in Hubli–Dharwad and provide lessons for how the municipal authority may respond to solid waste management problems. The need to have a good understanding of waste markets is one lesson arising from previous experience, particularly from the demise of large-scale centralised composting plants.

4.1. Auctioning waste in Hubli–Dharwad

The Hubli–Dharwad Municipal Corporation has sold waste to farmers for many years. There are municipal dumpsites in both Hubli and Dharwad, from which waste has been sold through annual auctions, from Dharwad, or by tractor-loads[2] mainly from the Hubli site, taken by farmers for an agreed price. Selling the waste clears space for more garbage and raises revenue for the HDMC. However, the sale of waste has declined in recent years, largely due to increasing amounts of plastics, increasing labour and transport costs and the availability of chemical fertilisers. The cost of the waste is not a constraint, as the waste from Hubli has been available free of charge at times.

[2] One tractor load carries about $1\frac{1}{2}$–2 tonnes.

Waste arriving at the dumpsites is not sorted into organic and inorganic materials, due to insufficient numbers of labour and supervisory staff. The dumpsite in Dharwad consists of 372 pits, dug in the early 1960s, approximately 100 of which are set aside for waste collection every year. Over the years the pits have increased in size and at present have a capacity of about 10 to 15 tractor loads of garbage. At the Hubli dumpsite, the waste is dumped in heaps in marked areas and around 750 such heaps can be dumped at the site. Records show that between 30 and 95 pits were sold each year in auctions at the Dharwad dumpsite between 1986 and 1992 (University of Birmingham et al., 1998). This represents between 300 and 1400 tonnes of waste, which is quite a small amount compared to the total entering the dumpsite, estimated to be about 50 tonnes a day in 1997. Even if the amount entering the dumpsite during the period 1986–1992 was significantly less, the amount of waste sold is relatively low. Waste is kept in pits for at least a year before sale so that the waste has been exposed to one rainy season and some decomposition has taken place.

No auctions have been held at the Dharwad dumpsite since 1997 due to the lack of staff to prepare the pits for sale. There are no plans to recommence the use of auctions. Wealthier farmers still purchase MSW by contacting the HDMC and arranging for collection and buy tractor loads of waste for between Rs. 25 and 30.[3] Purchasing the waste in this way may be more convenient for farmers, as it enables them to buy the waste at a time most suitable for them.

Farmers find it increasingly difficult to employ casual labour to separate and spread the waste as urban employment opportunities have pushed up wage rates, generating another constraint to the use of urban waste. Farmers with large land holdings, about 20 acres and above, are the main purchasers of MSW. Small farmers generally only use pit compost, produced using household waste, crop residues and livestock manure. The use of MSW is, however, threatened by the private sector using the waste for more sophisticated composting, developing a product that is out of the reach of most local farmers.

4.2. Private sector composting

In 1997, the HDMC advertised for private sector companies to tender bids for the provision of solid waste treatment facilities. The preferred tender included plans for two plants, with capacities of 3000 tonnes in Hubli and 1000 tonnes in Dharwad, to vermicompost waste, generating income from the sale of compost.

The company, Hubli Biotechnologies, has been leased one acre of land to commence composting, but has yet to receive permission to conduct composting on a larger scale. The company is using old waste from the Hubli dumpsite and is composting the waste and enriching it with poultry manure, distillery sludge and dung. They manufactured about 800–1000 tonnes of compost between September 1998 and February 1999 and, by March 1999, had sold 600 tonnes at Rs. 2600 per ton. The product was sold to farmers in Belgaum (further north in Karnataka), Andhra Pradesh and Tamil Nadu (other states in India). This is extremely expensive when compared to the purchase of untreated and unsorted MSW, around Rs. 25–30 for $1\frac{1}{2}$–2 tonnes, though there are no associated transportation or labour costs for the purchasers. The quality of the product is much higher due to the removal of contaminants and the addition of manures.

[3] Rupee (Rs.) 41: US $1 (approximately).

The use of old waste by Hubli Biotechnologies potentially conflicts with the traditional purchase of waste by farmers in villages close to Hubli. The company is concerned that local farmers are still allowed to purchase waste from Hubli dumpsite at Rs. 25–30 a tractor load, using waste that would otherwise be available for the company. In turn, farmers from nearby villages have complained that the company is using too much of the waste and selling their product to farmers in other parts of Karnataka and in other states. Although there is much waste at the dumpsite, enough to satisfy both sets of demands for a few years, the issue raises questions about who will have access to the waste in the future.

4.3. The future of the MSW market

The MSW market has changed in recent years. The market was built on good communications (the HDMC used local newspapers and pamphlets to let farmers know about auctions and the sale of waste), the ability of the HDMC to undertake some separation of waste, the high proportion of organic waste and waste sold at an affordable price (even taking into account transport and labour costs). The market has since been threatened by:

- The increasing proportion of inorganic wastes, particularly plastics. This has made the hire of labour and tractors by farmers a greater problem as more waste has to be purchased to get the same amount of usable material.
- The inability in recent years of the HDMC to separate waste at all and prepare pits for auctions.
- Increasing labour costs due to competition from urban employment opportunities.

Although demand has declined, it does still exist. The HDMC is faced with financial constraints and demands for improved waste collection and disposal. The demand of farmers for MSW has to be balanced against other waste management responsibilities, particularly improving the environmental standards of the dumpsites.

The HDMC has responded to its inability to provide adequate waste treatment facilities by seeking private sector involvement. Private sector companies are becoming increasingly involved in solid waste collection and treatment in developing countries. A number of reasons are cited for this increasing role. Batley (1996, p. 723) suggests that local governments in countries of the South are responding to:

- the lack of financial resources for investment;
- donor influence (particularly through structural adjustment programmes); and,
- examples of other countries.

Lee (1997), however, suggests that the main motivation in Asia appears to be the mobilisation of private investment, due to the lack of financial resources available to the public sector. In Hubli–Dharwad, this has certainly been the case, with the local authority being prevented from employing more staff by the state government, due to financial constraints. The demand for authorities to meet increasing responsibilities for environmental standards has also been an incentive for inviting the private sector to collect and treat wastes.

The involvement of the private sector potentially threatens established waste markets. Although the compost derived from MSW may be of better quality, the price puts it out of the reach of many farmers, particularly those relying on rainfed agriculture. Expensive soil amendments are more

likely to be purchased in irrigated, higher income areas. Measures to support the sale of municipal waste to local farmers would require political support at a local level and require the designation of clear access rights to waste beyond the municipal corporation.

4.4. Who will get access to waste in the future?

The involvement of the private sector requires the municipal authority to create access to, and rights over, solid waste, thereby restricting access to other groups. At present, once in the street or in municipal bins, solid waste belongs to municipal authorities. It is, generally, their responsibility to collect waste and dispose of it in accordance to legislation. Access is not, as yet, denied to informal waste pickers collecting recyclable materials or to animals eating waste. Access to waste at dumpsites is, however, more strictly controlled. Waste pickers gain access to dumpsites in many cities, often through a system of contracting property rights (Bose & Blore, 1993), whilst access to waste by farmers is controlled by the municipal corporation, certainly in Hubli–Dharwad. Although it may be possible to maintain access to some of the (untreated) waste for local farmers, this may not be compatible with moves to improve the environmental and public health aspects of solid waste treatment and disposal and to contract out waste collection and treatment to the private sector.

The decision over who gets access to waste, therefore, has to be political, though access rights should reflect and support policy objectives, environmental or financial. The creation of a better compost product, with contaminants removed and manures added, solves a waste management problem for the local authority, but creates a soil management problem for many local farmers. Although demand for MSW has declined in recent years, it does still exist. The lack of adequate alternative sources of organic matter maintains the demand for MSW despite the increasing amounts of contaminants.

4.5. Policy options

There are a number of ways in which the use of MSW by local farmers could be supported. Subsidising the high-quality compost to farmers who have bought waste in the past is one option, though this would require support from the municipal authority. Alternatively, some waste could be kept back for local farmers, or waste composted in a way that balances cost against quality. Several types of compost could be produced, providing a balance between quality and price.

Not all farmers need a high-quality product, as demonstrated by the continuing demand for highly contaminated waste. Although costs would rise if some separation was carried out, this would be balanced against the costs of hiring labour by individual farmers and of transporting a large amount of inorganic waste materials to fields. If a lower-quality compost was produced, the reduction in costs could create a larger, and more local, market, thereby supporting urban and peri-urban agriculture and local food and commodity markets. Other measures that could be taken include setting up source separation schemes and small scale decentralised composting plants.

The development of source separation schemes, where households divide their garbage into organic and inorganic materials, is one of the key approaches adopted in many Indian cities to reduce solid waste management problems. Many schemes have been developed by NGOs, working

closely with neighbourhood communities to improve the collection of waste and provide income to young people and women employed by such schemes.

Source separation is recognised as potentially contributing to higher quality municipal waste compost. Furedy and Whitney (1997, p. 2) stress the need to encourage source separation of organic and inorganic wastes at the household level as the only way to improve the safety and efficiency of composting urban waste. However, they (1997, p. 13) note the examples of pilot source separation schemes in Asia which have failed due to inadequate household co-operation. Source separation schemes may involve organic waste being taken to either centralised composting plants or small-scale pits, often involving vermicomposting.

In Hubli–Dharwad, there has been an attempt to promote source separation, with the HDMC working with local NGOs. Pilot schemes were developed in several parts of Hubli and Dharwad, with committees formed to manage the employment of waste collectors and collecting fees from households. It has been found, however, that residents are often reluctant to get involved, seeing it as the job of the HDMC to arrange waste collection, and that it is difficult to retain workers as there are many other casual employment opportunities. The development of successful source separation schemes requires adequate financial backing and good service delivery from the municipal authority. Financial incentives for participating households may also be necessary.

Decentralised composting plants may also have a role in responding to solid waste and soil management problems (see, for example, Zurbrugg & Aristanti, 1999), though the need to understand farmers' preferences for composts remains. Decentralised composting carried out on a smaller scale than centralised plants, is located close to sources of waste, thereby reducing transport costs, and may use low-cost technology and much manual labour. The scope for its use in India could be explored, particularly through NGOs and civil society organisations.

5. Livestock in cities

An area where significant changes are also threatened is in livestock keeping in urban areas. Many urban residents, in Hubli–Dharwad and in other Indian cities, complain about roaming livestock, including cows and pigs. Livestock can be found in abundance in most urban centres of India, due to traditional occupations, particularly in buffalo keeping, and the existence of several incentives. These include sources of fodder, such as food waste from hotels and vegetable waste from markets and homes, and easily accessible markets, particularly for fresh milk from urban dairies.

Livestock manure generated in the urban and peri-urban areas includes poultry, pig, sheep and goat manure, and cattle and buffalo dung. Pig manure is not greatly utilised as the pigs roam freely and do not usually have a specific place for penning. As a result their waste cannot be collected in significant quantities. This may change in the future as the HDMC is forcibly evicting pigs from the city, due to complaints about their threat to human health and contributing to traffic chaos. Penning pigs is one solution, but would be costly in terms of finding land and bringing food to the pigs (University of Birmingham, University of Nottingham and University of Wales at Bangor, UK and University of Agricultural Sciences, Karnataka University & SDM College of Engineering and Technology, 1998).

There are well-established, though informal, markets for cow and buffalo dung, used to enrich soil or as fuel for cooking. Farmers wanting dung visit localities within the city to look for supplies and, over time, establish contacts. Tractor loads of dung are sold for Rs. 300–400, providing additional sources of organic fertilizer and contributing to the return of nutrients to the soil. The generation of dung in the urban area reduces the demand for fuelwood, the most common source of fuel for cooking in low-income urban households in Hubli–Dharwad.

The role of manure produced in urban areas in peri-urban agriculture is significant, as organic matter for soil management is always in short supply. The competing demands of agricultural waste for use as a source of fuel and as a soil improver, and increasing mechanisation, reducing the need for draught livestock, has led to a decline in the availability of organic matter produced in more rural areas.

There are a number of problems with keeping livestock in urban centres, including obtaining sufficient fodder, access to grazing land and water (both for drinking and washing buffaloes and cows) and storing waste for sale. The difficulties experienced by urban authorities include roaming and herded animals contributing to traffic chaos, dung and fodder in storm drains, complaints about smell and concerns about health hazards, particularly resulting from pigs left to roam, who are suspected of carrying some diseases.

Such is the level of concern that an interim report (focusing on solid waste management), published in 1998, of the Supreme Court in India recommended that cattle should no longer be allowed to roam freely in cities with a population of more than 500,000. Referring to the "cattle nuisance" in cities, the report suggests that:

> No stray cattle should be allowed in cities above 5 lac[4] population. All existing cattle sheds, vadas and go-shalas[5] should be removed in phased manner from such cities. Until then no animals should be allowed to move around the streets. They should be stall-fed and the waste produced in such stables should be disposed of by the cattle owner on daily basis at the community storage sites. Owners of these animals should be suitably charged for the disposal of such trade waste in the municipal system (1998, p. 66).

Buffaloes are generally kept in stalls and are led out to graze by their owners, and therefore do not roam freely. If, however, the phasing out of cattle sheds were to include sheds for buffaloes, this would have a detrimental effect on the livelihoods of small urban dairy owners. There would also be implications for the disposal and generation of waste in the city, both in terms of consuming food and vegetable waste and in terms of generating dung, which is then sold on to farmers. This source of dung for use as a soil amendment may be replaced by bigger commercial dairies, but these may, in turn, have their own land on which the dung is used.

5.1. The future of the sale of livestock manures

The HDMC is concerned about the role of livestock in the urban area, as are many other corporations in India. The authority is charged with keeping streets clean and maintaining roads

[4] One lac, or lakh, equals 100,000.

[5] Vadas and go-shalas refer to other cattle shelters including pounds where roaming cattle are taken. Their owners have to pay a fine to take the cattle out of the pound.

and traffic flow, for example, both of which may be hampered by roaming animals. The Corporation may be required to phase out stall-fed livestock in the urban area, if the recommendations in the 1998 Interim Report of the Supreme Court on solid waste management become legislation.

Livestock play an important role in consuming food and vegetable waste and in generating dung for sale as a fuel source and as a manure. It is possible that as the constraints increase in magnitude, urban dairies will move to the outskirts of the city, to areas where such constraints are less of a problem. In turn, access to food and vegetable waste may become more problematic as the distance to sources of such waste increases.

If local authorities are going to support the sale of urban wastes, there must be some support for livestock in cities. Their role in urban areas should be fully explored and options for improving livestock management discussed with livestock owners. Support for livestock in cities may, however, require some relocation of urban dairies, and pig owners may have to restrict pigs to certain areas of the city, if penning is impossible. Land-use planning may be helpful in identifying areas where urban agricultural activities could be more suitably located than others, particularly when done in consultation with livestock owners. If the Government of India intends to support urban agriculture, as suggested at a meeting of the Food and Agricultural Organization's Committee on Agriculture,[6] the role of livestock in urban areas should be explored as an opportunity as well as a problem.

6. The future use of urban organic wastes

The increasing role of the private sector in solid waste collection and treatment and moves to evict livestock from large urban areas have been identified as the main threats to farmers' access to urban sources of organic wastes in Hubli–Dharwad. A number of policy options have been suggested to minimize the detrimental effects of such threats. These include subsidising more expensive composts for local farmers; developing a compost product that balances price against quality; developing low-cost decentralised composting plants, particularly in partnership with NGOs; and developing mechanisms to encourage greater dialogue between urban authorities and livestock keepers and farmers. However, as the diversity of practice across India is not known, a number of questions remain.

The extent of the sale of urban organic wastes in Southern countries needs to be better documented and analysed. A greater understanding of the mode of sales, who has bought waste and whether markets have changed as they have in Hubli–Dharwad would contribute to improved policy-making and would provide information for governments wishing to support urban and peri-urban agriculture whilst also responding effectively to solid waste management problems.

The impact of the private sector, undertaking both waste collection and treatment services, on traditional urban organic waste markets should also be explored. Do all farmers lose out, or do some benefit from the sale of market waste collected by the private sector, or by better quality

[6] Source: email correspondence with Rachel Nugent, Food and Agricultural Organization, Rome.

composts derived from MSW? What are the implications for soil management in agriculture around cities that have traditionally used urban waste as a soil amendment?

The threat to livestock keeping in urban areas posed by complaints from residents and from the Supreme Court inquiry presents questions regarding the role of livestock in urban waste management. The consumption and generation of waste by livestock should be taken into consideration when looking at the spatial location of urban dairies and policies relating to roaming livestock.

Research and policy advice would have to take into account the challenges facing municipal authorities in improving waste collection and treatment services and in working within severe financial constraints. The reconciliation of competing demands (environmental, financial and increasing food production) requires imaginative solutions, incorporating new partnerships between stakeholders. A greater understanding of traditional systems and how they have changed over the years would enable policy responses to take account of local needs and preferences, and may provide greater support for urban and peri-urban agriculture.

A briefing paper published by the World Bank suggests that agricultural productivity could be increased through the use of urban wastes to improve soils. The paper suggests that "the widespread adoption of recycling technologies has been hindered by undeveloped markets, transportation costs, health and cultural issues, and inadequate regulations" (AGRAF, 1997, p. 2). Whilst these points are important in the development of solutions to address waste management and soil fertility needs, it is crucial that existing waste markets are recognised and understood. The introduction of new technologies has, in the past, produced products that are too expensive for many farmers (see Selvam, 1996, for example). The quality of the product required should be investigated as part of market research. In Hubli–Dharwad, for example, although demand for MSW has reduced in recent years, many farmers still purchase the waste, despite contamination by plastics and glass.

Contamination of MSW remains a significant problem, and, as noted by Furedy and Whitney (1997), the separation of different types of waste at source is recommended as the most efficient way of producing a good quality compost. The costs involved in this may be prohibitive and ensuring that an adequate number of households participate in schemes is difficult, as illustrated by a number of neighbourhood collection and composting schemes (see, for example, Furedy, 1992; Beale, 1997). Such schemes require significant support from authorities, despite the role of NGOs, to demonstrate financial backing and improvement in waste collection and disposal.

The use of urban wastewater by farmers has not been discussed as its use in Hubli–Dharwad does not operate as a market. Wastewater is taken from streams into which sewage, collected via the underground sewerage system, flows. The wastewater is used opportunistically by those farmers that can access the streams and, whilst some pay a small fee to the HDMC (around Rs. 50 a year), many do not. There may be greater opportunity to develop a more consistent charging structure for the use of wastewater when treatment plants are constructed. Greater support for the use of wastewater would increase vegetable production for the city and, when treated, could be kept separate from river water. In the absence of sewage-based irrigation, there would probably be less horticulture around Hubli–Dharwad due to inadequate water supplies. Plans to treat wastewater have been stalled by a lack of finance, but did take into account the use of wastewater by farmers. There are, of course, health concerns arising from the use of wastewater and the increased use of herbicides resulting from weed growth, though risks would be reduced with the use of treated water.

There is, therefore, a need to support measures that can address urban waste and agricultural needs simultaneously. The use of urban organic wastes, particularly MSW, should be acknowledged within discussions of solid waste management and the role of farmers recognised and understood. The growing recognition of the role of urban and peri-urban agriculture in providing food for local markets, creating employment and soaking up urban organic wastes may provide the impetus for such an integration of policy objectives.

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