

## WASTE RECYCLING THROUGH URBAN FARMING IN HUBLI-DHARWAD

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### 1. Introduction

Urban agriculture in India is strongly characterised by tradition and links with rural areas. Whilst in some metropolitan cities, low-income communities are growing vegetables on small plots of land, by far the greatest amount of urban agricultural activities involve keeping livestock, particularly in urban dairies. Urban and periurban agricultural activities in India are particularly associated with urban-based sources of waste, both in terms of consuming waste and producing dung. As noted by Furedy and Whitney (1997: 2), "food production using wastes is a widespread tradition in Asian cities".

The population living in urban areas in India is increasing. The population of India is over 850 million and, in 1991, at the time of the last census, 26% of the population was living in urban areas. The urban population of India is forecast to be over 300 million, 30.4% of the total population by 2001, and to rise to 50% of the population by 2025. The number of urban areas has also increased, from 4,029 in 1981 to 4,689 in 1991, and the number of urban agglomerations increased from 3,378 in 1981 to 3,768 in 1991.

Visitors new to India cannot fail to notice the number of livestock in cities and towns, particularly roaming cattle. Pigs and donkeys can also be found roaming freely, and herds of buffaloes and flocks of sheep and goats are led through urban areas on their way to grazing land. Animals left to roam do have owners and return to particular areas, or are fetched by their owners when evening arrives. Cows have a particular importance in Hindu culture and are considered to be sacred.

There are many reasons why livestock can be found in such abundance in most urban centres of India. Tradition is one reason, particularly in the case of buffalo keeping, but also urban centres provide a number of incentives for keeping livestock. 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. Dung from cows and buffaloes is sold to farmers near to the city and is used or sold as fuel for cooking. Traditionally, there have been far more buffaloes than cows in urban centres, as

most people prefer buffalo milk, which is richer than cow's milk, and is better for preparing ghee (similar to butter) and curd. Urban and periurban agriculture provide income-generation opportunities for urban dwellers. Many urban centres in India have maintained strong links with rural, and hence agricultural activities, so that livestock keeping is common and urban dairies are the norm.

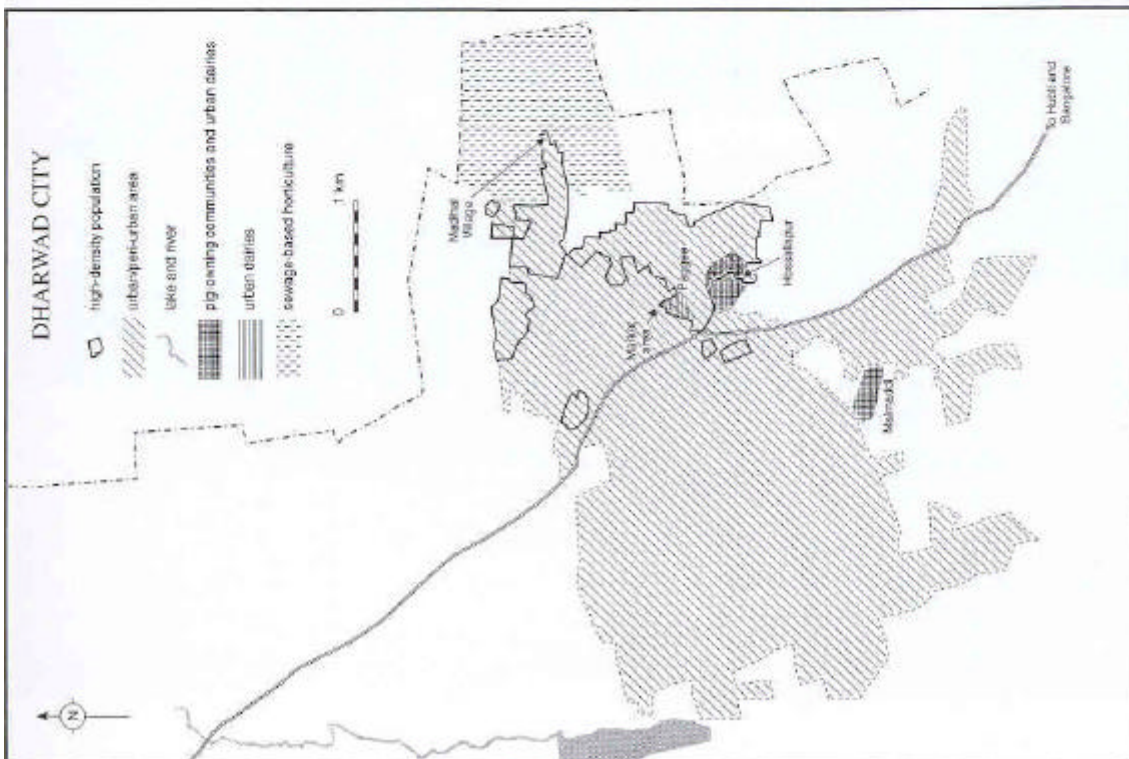
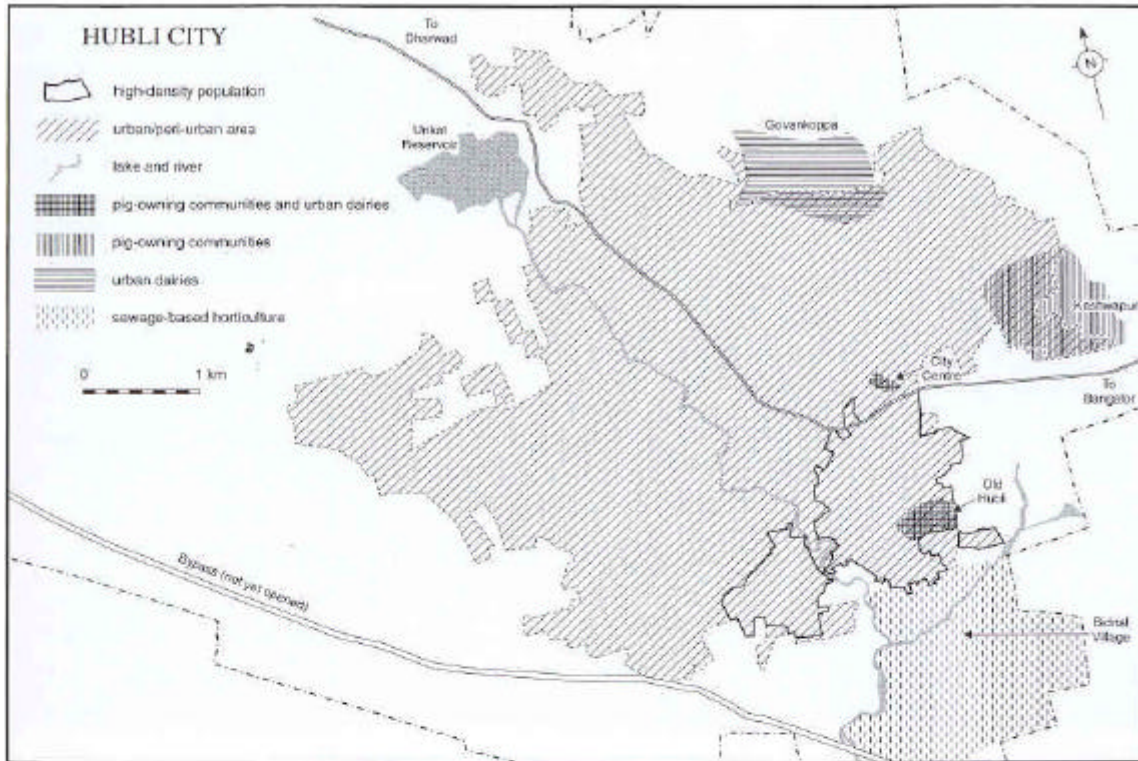
Growing fruit and vegetables is not common in urban centres across India, though there are increasing trends towards middle-class households cultivating small amounts of fruits and vegetables. There is also anecdotal evidence of poorer communities living in slum areas of metropolitan cities, such as Mumbai (formerly Bombay) and Calcutta, growing vegetables alongside railway tracks and in small patches of open land. A lack of space and poor access to seeds, composts/fertilisers and water are constraints to urban vegetable farming; moreover, people have little time outside paid work and other household duties.

It is possible that the number of livestock kept in urban centres will decrease because of increasing complaints from residents about offensive smells and potential health hazards, increasing motorised traffic in urban centres, decreasing availability of accessible grazing land, more competition for fresh milk from packaged milk and increasing requirements for local authorities to take action to reduce environmental problems. In turn, in the larger metropolitan cities, like Mumbai, Calcutta and Delhi, the size of the cities, increasing land values and traffic congestion make access to markets for small producers more difficult. This may lead to increasing amounts of vegetables and fruit grown within the urban boundaries, particularly by poorer communities.

In Hubli-Dharwad, many urban dairies continue to operate, pigs roam freely, much to the consternation of many residents and the Municipal Corporation, and periurban agriculture uses many sources of urban waste as soil conditioners.

## **2. The twin-city of Hubli-Dharwad**

Hubli-Dharwad is a twin-city in the north of the southern Indian State of Karnataka, with a population of approximately 800,000. In 1991, Hubli-Dharwad was ranked 44th among India's 308 urban agglomerations. There are two urban centres, separated by about 20 km along National Highway 4. The area that separates the two urban centres, known as Navalnagar, was designated a new settlement to link Hubli and Dharwad in the 1970s. This area has a main railway line and a variety of non-agricultural activities are being developed along it, including industries, offices, warehouses and residential areas.





*Cows feeding from a Municipal Corporation bin (Picture Fiona Nunan)*



The twin-city is in Dharwad District, which, after re-organisation in 1998, has five *talukas*, or subdistricts. It is the second largest city in Karnataka, after Bangalore, the State capital. The twin-city is administered by the Hubli-Dharwad Municipal Corporation (HDMC), which provides the cities' infrastructural services, including water supply and solid waste collection and disposal. The Hubli-Dharwad Urban Development Authority (HDUDA) is charged with implementing the Comprehensive Development Plan, regulating development activities and providing new residential layouts. The two cities provide quite different services, Dharwad has more education institutes and houses the district headquarters, and Hubli is a more industrial and commercial centre. The twin-city therefore has two hubs, which are quite different in nature, with Dharwad having a lower density of population and more open spaces than Hubli.

From 1981 to 1991, Hubli-Dharwad achieved a modest population growth. In 1981, the population was 527,108, rising by 23% to 648,298 in 1991. This was lower than the average growth rate of 36% over the decade for the 21 urban agglomerations in Karnataka State and the national growth rate of 37% of the 308 Indian urban agglomerations. The twin-city covers an area of 191 km<sup>2</sup>, of which around 40-45% of the conurbation land was developed in 1991. The population has risen in the late 1990s to around 800,000, and the density is now around 4,180 persons/km<sup>2</sup>, but still far below the average for Karnataka of 4,985 persons/km<sup>2</sup> and the Indian urban agglomeration average of 5,953 persons/km<sup>2</sup>.

**Table 1: Comparison of urban characteristics of Hubli-Dharwad with India**

|  | <b>India</b> | <b>Hubli-Dharwad</b> |
|--|--------------|----------------------|
| <b>Population</b>                            | 850 million  | 648,298              |
| <b>Urban agglomeration Growth: 1981-1991</b> | 37%          | 23%                  |
| <b>Density</b>                               | 5,953        | 3,395                |

*Source: 1991 census data*

In 1981, there were 52 notified slums in the city and slum dwellers represented 8.68% of the total population. Figures from 1998/99 indicate that the number of slum areas has slightly decreased, with 31 identified and registered slums in Dharwad and 15 in Hubli. The number of people living in slum areas has, however, increased by 17.55% to 16,738. The slum population does not account for all households living below the poverty line. Indeed, it has been suggested that more than 40% of the urban poor do not live in slum areas in India (Shepherd et al. 1998). There are, at present, no other indicators of the location of poor households within Hubli-Dharwad. However, research does indicate that, in India, the urban poor are characterised as having casual employment or self-employment in the informal sector, and that poverty amongst female-headed

households is more serious within urban areas than rural (Shepherd et al. 1998). This raises food-access issues and the potential of urban agriculture to address the food security of the urban poor.

The region is semiarid and most agriculture is rainfed. The lack of irrigation facilities influences decisions made regarding crops grown. Mango orchards are seen, for example, as a good investment partly because only a small amount of irrigation is required once the trees are established. The adoption of sewage-based horticulture is one response to the inadequate supply of irrigation facilities around the city.

## **2.1 Urban employment in agricultural activities**

Involvement in agricultural activities ranges from gaining casual work in the urban and periurban areas during peak seasons of demand, such as weeding and harvesting, to owning a dairy within the city. Agricultural activities were categorised as “cultivation”, “agricultural labourer” and “livestock farmer” in the 1991 census. On account of the size and nature of Hubli-Dharwad, some residents rely exclusively on agricultural activities. There is no information in the census data regarding income groups within the agricultural sector, though it is likely that most, if not all, agricultural labourers are lower-income people and many of these are women. The urban female workforce involved in urban agricultural activities was 20% in 1991, compared to the urban male figure of 11%. This represents a significant gender difference in terms of reliance on urban agriculture as a source of income generation.

There may be other factors that can account for the reduction in the number of people relying on agricultural employment within Hubli-Dharwad. Mechanisation is increasing in the villages surrounding the city, reducing farmers’ recruitment needs; the city has grown, taking up agricultural and grazing land; and the density of the population in the city cores, particularly in Hubli, has increased, reducing the scope for keeping livestock in the city centres.

## **3. Urban agricultural activities**

There is no official definition of urban agriculture within Hubli-Dharwad, or recognition of its role in contributing to food security and livelihoods. 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.

Many aspects of urban agriculture are seen as a nuisance and something to be stopped.

The lack of official interest in agricultural activities taking place within urban areas means that there are no records of production levels within the city. Agricultural, horticultural and dairy production figures are recorded only for the district as a whole and it is very difficult to get a breakdown of production levels according to villages or distances from the city. Horticultural products brought to the city for sale are not traced according to where they come from and production figures for vegetables irrigated by wastewater are not available.

The term “urban agriculture” is used here to refer to agricultural activities within the core of the urban areas and, in the case of Hubli-Dharwad and most other cities of India, this refers almost exclusively to cattle, buffalo and pig keeping. Agricultural activities close to the city which have strong links with urban areas in terms of investment, labour, markets and inputs (including organic waste) are referred to as “periurban agriculture”. For Hubli-Dharwad, this 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 and many have strong links to urban areas, particularly in terms of using local markets and buying municipal solid waste and manure from urban dairies. Periurban farming tends to be more commercial, as suggested by the Food & Agriculture Organisation (FAO) definitions of urban and periurban agriculture (FAO 1999).

Many of the agricultural activities undertaken within the urban and periurban areas of Hubli-Dharwad are traditional activities, passed on from one generation to the next. This is particularly the case with livestock keeping, with buffalo and pig owners coming from families that have kept livestock for many generations, often within the urban area.

### **3.1 Urban dairies**

In and around the city there are large and small dairies, with the more commercial dairies (about 20 in number) keeping between 10-20 buffaloes and crossbred cows. Several smaller dairies keep crossbred cattle, but by far the largest number of urban dairies belong to traditional buffalo keepers, known as *gowlies*. Such buffalo keepers may rely on more urban-based work, but keep one or two buffaloes as a source of milk for their family, as an additional source of income, and because they want to keep to tradition and provide a source of security. There are, however, households that rely solely on the milk produced by

buffaloes as their source of income.

In Dharwad, there are several areas where buffalo keepers reside. These include the Paggee area, right in the core of the city, where there are approximately 50 gowli families, Hossallapur and Malmaddi, where there are 150 and 150-200 gowli households, respectively. In Hubli, the situation is more complicated because of the density of city. There are fewer areas within the core of the city where buffaloes are kept, though there are a few sheds opposite the Telegraph Office, which is fairly central. Most other gowli families live on the outskirts of Hubli, for example, in Govankoppa, where there is easy access to grazing land.

The cattle and buffalo populations within Hubli-Dharwad, are high for an urban area.<sup>1</sup> As might be expected from the description of Hubli being a more commercial centre than Dharwad, there are fewer cattle and buffaloes than in Dharwad, though slightly more crossbred cattle. The number of livestock in a location is, of course, a moving target, as more are born and are brought into the area, whilst others die. Table 2 confirms an expected trend: the number of cows and buffaloes are decreasing in the city, though the reduction in the number of crossbred cows seems surprising, if larger, more commercial, urban dairies are opening within the city boundaries. This may, however, be a very recent trend.

**Table 2: Cattle and buffalo population in Hubli-Dharwad**

| Type of animal   | 1990         | 1997        |             | Total for 1997 |
|------------------|--------------|-------------|-------------|----------------|
|                  |              | Hubli       | Dharwad     |                |
| Local cattle     | 11688        | 3237        | 5578        | 8815           |
| Crossbred cattle | 2192         | 417         | 238         | 655            |
| Buffalo          | 9658         | 3125        | 3824        | 6949           |
| <b>Total</b>     | <b>23538</b> | <b>6779</b> | <b>9640</b> | <b>16419</b>   |

Source: Livestock census figures<sup>2</sup>

Gowlies sell milk directly to hotels and boarding houses at a price based on the total solids, and to households either from headloads or in cans mounted on bicycles or mopeds, at around Rs10<sup>3</sup> per litre. Some gowlies milk the buffaloes in front of the consumers, to assure them of the freshness of the milk and that it is not adulterated. Consumers sometimes give loans to gowlies for the purchase of buffaloes, with the loan repaid by taking milk. Milking buffaloes in front of customers is also carried out, for example, in one area of Hubli, where buffaloes are taken to a common area at fixed hours in the morning and evening. The vendors milk their animals two or three times in a span of one or two hours as and when customers visit to purchase milk. A premium price is paid for such fresh milk.

The main source of fodder for urban dairies is from the adjoining rural areas, where sorghum is grown extensively. Dry fodder is sold for around Rs 10-15 for a bundle of sorghum stalks. The urban dairies purchase fodder during the harvest season and store it for use during the year. Grasses are also grown and brought to Hubli-Dharwad for sale as fodder. Bundles are sold for around Rs 5-10 for 15-25 kg. The owners of large urban dairies have their own resources for growing fodder, including cereals, legumes and fodder grasses. Additionally, food waste from hotels and cafés and vegetable waste are fed to the buffaloes.

There are a number of constraints to keeping buffaloes and cows within the urban areas. These include the lack of space, particularly within the core of Hubli city, which is more congested than Dharwad, declining access to grazing land and to drinking and washing water, and a decreasing supply of fodder, as more land around the city is taken for residential, commercial and industrial development. Livestock owners within the city can access veterinary care for their animals. One of the main problems of keeping cows within the city and allowing them to roam freely for food is the ingestion of “foreign objects”, from hairpins to coins. Such objects pose a considerable hazard to cattle, and possibly to pigs, though pig owners find it more difficult to access veterinary care.

### **3.2 Urban scavenging pigs**

Hubli-Dharwad has a significant number of scavenging pigs. These are owned by a number of quite distinct communities within the city. These include the Hindi *gollar* communities and the Bhils community from the Punjab, whose main occupation is turning scraps of metal into utensils. The keeping of pigs in Hubli-Dharwad has been under threat from the Hubli-Dharwad Municipal Corporation. In response to complaints about roaming pigs and potential health threats, the Corporation has been rounding up pigs and sending them out of the city, to a forest area around 10 km away. The pig owners believe it would be too expensive to keep the pigs penned in and bring feed to them.

As with buffalo keeping, pig owning is a tradition, handed down from generation to generation. Pig-owning communities can be found in several areas of Hubli-Dharwad. Within Dharwad, such communities live in areas such as Malmaddi, Saraswatur and Hosallapur. Many buffalo owners also live in Malmaddi, and the dumpsite is located in Hosallapur area. In Hubli, the locations include Old Hubli, the Settlement (locally known as Setalment) area and Keswapur. Again, buffalo owners and even sheep and goat herders can be found in similar areas, particularly Old Hubli. The locations may be due to tradition, but also proximity to areas where pigs can roam for food.

The Livestock Survey conducted in 1997/98 estimated the number of pigs to be 1,473 in Dharwad and 2,254 in Hubli; in 1990, the figure for the twin-city was only 839. However, more realistic estimates put the figure at around 20,000, which roam in herds of between 10 and 500 pigs. The underestimate of the official figures may be due to the owners themselves not knowing the actual number of pigs in their herd, as this can change from day to day. Owners may also be afraid of admitting the real number of pigs owned. Pigs are not welcome in the cities, despite the service they provide in consuming organic waste and excreta.

Pigs represent a source of cheap protein for certain social groups which consume pork, as they rely on low-cost sources of feed – street rubbish, waste from hotels and restaurants, soil and vegetation. Pigs are sold for Rs 15-20 per kg liveweight and Rs 35-50 per kg pork. The pigs, or pork, are transported to the consuming markets in Goa and at Hassan, Mangalore and Bangalore, in Karnataka.

### 3.3 Sheep and goats

The keeping of sheep and goat is confined to the outskirts of the twin-city. These animals are often kept by people who migrated from villages to the urban areas. There are far more goats than sheep in Hubli-Dharwad. Goats are easier to feed. They eat the loppings of trees, for example, the remains of which are taken by herders for use as fuelwood.

**Table 3: Sheep and goat population in Hubli-Dharwad**

|              | 1990          | 1997/98 |         |       |
|--------------|---------------|---------|---------|-------|
|              | Hubli-Dharwad | Hubli   | Dharwad | Total |
| <b>Sheep</b> | 558           | 696     | 1192    | 1888  |
| <b>Goats</b> | 4139          | 1266    | 2417    | 3683  |

*Source: Livestock census figures*

According to the figures from the Livestock Surveys, the number of sheep kept within the city boundary has risen dramatically during 7-8 years, whilst the number of goats has fallen. The availability of grazing land may affect the population of sheep within the urban boundary in the future, as may the availability of other employment opportunities. The access to markets, selling sheep directly to consumers, may also provide some explanation for the increase in their numbers.

### 3.4 Horticulture

The area given to horticultural crops within the periurban areas of Hubli-Dharwad is increasing. There are, however, a number of constraints to the cultivation of horticultural crops. These include the lack of irrigation water and the lack of storage facilities for the produce within the urban area. The lack of irrigation facilities is partly overcome by the use of sewage water flowing within streams, from both Hubli and Dharwad, which is particularly useful, as installing borewells is expensive. The lack of storage facilities means that good access to markets is critical.

Small producers within 7-10 km from the cities carry small quantities of produce by headloads and sell directly to consumers in the fruit and vegetable markets. Those within a distance of over 10 km carry their produce in carts, or travel by bus or train, and sell to wholesalers in the urban area. Farmers may also belong to the Karnataka Horticultural Producers Co-operative and Marketing and Export Society in Hubli. This organisation has members from throughout Dharwad and Bijapur (further north in Karnataka) Districts and sells produce on behalf of their members, at no cost, though a deposit is paid by members and profits are shared between members.

Horticulture has increased in area and number of crops, where wastewater from Hubli-Dharwad can be used to irrigate crops. This is a key example of the flow of waste from urban to rural, and the reciprocal flow of fruits and vegetables to the urban area.

### 3.5 Sewage-based farming systems

As there are no sewage treatment plants in Hubli or Dharwad, the sewage flows out of the urban areas in pipes, which eventually feed into streams. Around 60 million litres of wastewater are generated in the twin-city per day (Hunshal et al. 1998). The sewage is used by farmers for irrigation, by installing pumps on manholes. The water is generally used for horticulture. The wastewater is used in areas around Hubli including Bidnal, Gabbur, Old Hubli, Budarasingi, Mavanur, Katnur, Giryial, Balagah and Veerapur. Some of these villages are up to 30 km from Hubli and many farmers feed pipes for a few km to use the wastewater. Around Dharwad, the untreated sewage is used by farmers at Madihal and Hirekeri to grow vegetables, *jowar*, groundnut and chillies.

Vegetable plots tend to be small, typically 0.6-0.8 ha, but they are intensively cropped, with 4 or 5 crops a year. The vegetables grown include cauliflower,

cucumber, beetroot and spinach beet. It is estimated that yields with the use of sewage water are 25-50% better than crops grown with water from borewells (Hunshal et al. 1998). Other than the increase in yields, farmers also benefit from having to rely less on erratic rainfall, providing greater security. Farmers are able to take advantage of the number of crops grown throughout the year by charging more during off-season periods (Hunshal et al. 1998). The wastewater from the two cities is also often used to wash vegetables in the market places, as the outlets form the most convenient source of water in the market areas. This practice may further contribute to health concerns over consuming sewage-irrigated vegetables.

The amount of chemical fertiliser needed is low, though the amounts of herbicide may increase, on account of prolific weed growth. The increase in the number of weeds may be due to the fertile nature of the sewage water, but may also simply be due to the increased availability of water in areas that were traditionally rainfed. The increase in the number of weeds also has implications for the labour requirements of a farm, adding to either direct costs of hired labour or opportunity costs of household members.

Farmers using sewage water should pay the Corporation Rs 50 a year, but most farmers do not pay the charge, even though they would recognise that this is a very low charge. If treated sewage water becomes available in the future, some charge will have to be levied to contribute to treatment and distribution costs.

There are health concerns about consuming such produce. Although there does appear to be a higher incidence of some heavy metals, such as iron, copper and zinc in gourd, mustard, spinach, cauliflower and radish, the findings were not linked to health impacts. The concentration of lead in produce was, however, found to be above critical limits in studies in Calcutta, raising concerns about the consumption of sewage-irrigated vegetables. Other problems resulting from the use of sewage irrigation include weeds becoming mixed with herbs when sold in the markets, dark roots on produce and, as a result of continuous irrigation, the soil is becoming increasingly saline (Hunshal et al. 1998).

Although it is not clear that farmers are very concerned about potential health effects of using sewage water for irrigation, it is clear that there are potential problems. The health of the labourers working in the fields is of most concern, firstly due to pathogens in the wastewater, but also due to the increased use of pesticides, particularly if protective clothing is not worn. There are additionally concerns for consumers, in terms of residual pesticides in the produce and the existence of pathogenic microbes, as well as heavy metals.

It is very difficult to research the potential health effects of working with wastewater, as allowing for many other factors, such as income, housing and genetic factors, makes epidemiological studies fairly complex. A small study was conducted in Madihal, near Dharwad, and in Hale Gabbur, near Hubli, to look into the health effects on farm labourers. There did appear to be a high incidence of skin diseases in the sample studied, but the study was too small for significant conclusions to be drawn. Furedy and Whitney (1997:8) acknowledge the difficulty of conducting epidemiological research, as the workers most at risk "live in poor sanitary conditions and may be malnourished as well".

### **3.6 Rural-urban linkages**

Rural-urban linkages in the Hubli-Dharwad city region include: investments in mango orchards by urban dwellers to reduce tax burdens; increased opportunities for marketing of produce through the use of bus and train routes; fodder brought into the urban areas for livestock; and the potentially conflicting demands for urban wastes for use as fuel sources and as a soil conditioner. The cycle of nutrients through the use of urban waste in agricultural activities has long been a key example of urban-rural linkages within Hubli-Dharwad, as in many other city regions of India. There are well-established, though informal, markets in urban waste.

Rural-urban linkages are a crucial part of urban and periurban agricultural activities undertaken in Hubli-Dharwad. The flows of fodder, wastes, labour and investment between the rural and urban areas form a critical component in maintaining food security and livelihoods within the city region. Many of the flows exist because of inadequate enforcement of legislation and a lack of environmental services. Such flows include the sale of sewage that has filled a recreation tank in Dharwad, the sale of market waste to farmers (waste that should belong to the Municipal Corporation) and the sale of municipal solid waste, which reduces the amount of waste in the dumpsites.

**Table 4: Rural-urban linkages within the Hubli-Dharwad city region**

| Linkage                            | Examples   |
|------------------------------------|--|
| Natural resource-based commodities | <ul style="list-style-type: none"> <li>• commercial mango production very close to the city for national markets;</li> <li>• declining flow of fuelwood;</li> <li>• increased bus- and train-based small-scale supply of fruit and vegetables to the city;</li> <li>• fodder brought into the city for cattle and buffaloes.</li> </ul>  |
| Labour                             | <ul style="list-style-type: none"> <li>• development of bus-based intensive commuting up to 20 km;</li> <li>• shortage of labour for agriculture: failure of agricultural wage levels to adjust, hence extreme inequality and significant level of absolute poverty.</li> </ul>  |
| Investment                         | <ul style="list-style-type: none"> <li>• speculative, unevenly distributed land purchase process; significant variation in land value trends;</li> <li>• land purchased for mango production to avoid taxes;</li> <li>• increased use of (often toxic) agrochemical inputs for agriculture;</li> <li>• increasing mechanisation and replacement of buffaloes/draught cattle;</li> <li>• privatisation of common land.</li> </ul> |
| Energy                             | <ul style="list-style-type: none"> <li>• declining local energy production; compensated by increased inflow of liquid petroleum gas (LPG) and subsidised electricity;</li> <li>• limited scope for renewable or decentralised energy because of subsidy structure and scarcity of recyclable waste materials.</li> </ul>   |
| Waste                              | <ul style="list-style-type: none"> <li>• wastewater increasingly used for high-value crop production: increased pest and weed problems observed;</li> <li>• dung sold by urban and periurban dairies, poultry units and sheep and goat herders to farmers;</li> <li>• slaughterhouse waste, municipal solid waste and market waste sold to urban farmers.</li> </ul>   |
| Water                              | <ul style="list-style-type: none"> <li>• urban tanks in decline; increased use of groundwater, especially in periurban areas;</li> <li>• some danger of aquifer pollution from sewage system;</li> <li>• urban sewage polluting streams;</li> <li>• demands for more reliable water supplies in the urban area and potential conflicts with demands for more irrigation facilities.</li> </ul>                                   |

Source: Adapted from University of Birmingham et al. 1998a.

#### 4. Food security, nutrition and health

The main reasons for keeping livestock in urban areas include generating income, keeping animals as an economic asset and having access to dung as a source of fuel. The contribution to food security appears to be limited. The contribution to income generation is illustrated by selling milk and sheep to local markets, and pigs to markets in other parts of Karnataka and in other states.

Production data is recorded only at district level, and this may well miss out

small-scale production, where milk is sold to neighbours, often in small quantities. Although there are data on the number of livestock within the city during the time of the censuses, the figures do not say whether all buffaloes and cows are producing milk, and these figures would be subject to change within a short period. There is, additionally, seasonal variation, with buffaloes and cows producing more milk during the rainy season, when there is good grazing land available.

From the data given in Table 2, it is possible to estimate the contribution of urban dairies to the milk supply of Hubli-Dharwad. According to the livestock census of 1997, there were 16,419 cows and buffaloes in the city, of which around half may be lactating. There are variations in milk production between cows and buffaloes (with cows generally producing more) and between seasons. One could estimate that, on average, each animal produces 3-6 litres a day. This would produce between 24,630 and 49,260 litres, or 0.03- 0.06 litres per person. The 1990 livestock census data would give figures of 35,307 and 70,614 litres a day. The population of Hubli-Dharwad in 1991 was 648,298, suggesting that production levels would be around 0.055 and 0.11 litres per person. These figures are quite low, suggesting that milk imported from rural areas via the Karnataka Milk Federation dominates the urban milk market.

The consumers of milk produced in the urban area come from a wide range of areas. They include low-income consumers who purchase small quantities, but also middle-income households, who may prefer the richer buffalo milk to the treated and packaged milk, and who may purchase milk as a tradition, buying from the same family from generation to generation. Very few households within Hubli-Dharwad have refrigerators, so they want to store milk for only a short period of time. The delivery of milk twice a day by gowlies helps to ensure that milk is fresh and safe.

There does not appear to be evidence that urban agriculture substantially improves access to food in Hubli-Dharwad for the very poor. There may, however, be some slight improvement in nutritional status on account of the presence of small urban dairies, where small quantities of milk can be purchased, or perhaps even exchanged for other produce or services. Households with one or perhaps two buffalo must also benefit nutritionally, providing the buffalo is lactating. It appears that poorer households keeping buffaloes sell more of the milk produced and keep back less for home consumption. It could well be that opportunities for increasing access to food through keeping livestock may be offset by the need to obtain as much income as possible to buy other food, and non-food, items.

The use of sewage water in irrigating vegetable crops undoubtedly increases the area given to horticulture. Without the use of sewage water, and with no replacement of such a source of irrigation, the cultivation and availability of vegetables would decrease. Sewage-based horticulture is, therefore, an important source of produce and nutrients within the city.

There are a number of health risks associated with urban and periurban agricultural activities in Hubli-Dharwad. These include the use of untreated wastewater, posing health risks for farm labourers and, potentially, to consumers, the use of municipal solid waste as a soil conditioner, which may include pieces of glass and some hospital waste, and roaming pigs, which are perceived by some to pose a threat to health, though this is unsubstantiated in Hubli-Dharwad.

## **5. Urban agriculture and the urban environment**

The relation between urban agriculture and the urban environment is most pronounced in the generation and use of organic wastes. The effects on the soil from using sewage water should not be detrimental with respect to heavy metals, as there are few significant industries within Hubli-Dharwad, and industries may not have access to the underground drainage system anyway, as it does not cover the entire city. There are a number of other sources of organic waste utilised by urban and periurban farmers, municipal solid waste and animal dung being the two key sources of urban waste.

### **5.1 The use of urban organic wastes**

Different types of organic wastes play a key role in urban agriculture. Organic wastes from hotels, cafés and markets are fed to animals, which roam freely, consuming waste around municipal bins and in the market places. Wastewater is used by farmers on the outskirts of the cities, mainly to grow vegetables for the local markets. Municipal solid waste is sold to farmers near the cities for use as a soil conditioner. Other sources of urban waste sold to periurban farmers include market and slaughterhouse waste, and sewage waste, which is collected in a recreation tank in Dharwad. This is collected by nearby residents and sold to farmers, providing a source of income to low-income households, though the Corporation does have plans to restore the tank. The sale of decomposed sewage waste from underground drainage pipes is another example. Finally, livestock manure is stored in urban areas and sold to farmers, providing a source of income to the livestock owners and another source of organic matter for the farmers, which is often in short supply.

There are a number of advantages for the Municipal Corporation arising from these informal waste markets. These include the removal of much wet organic waste from the streets and bins, the revenue from selling waste, which, in turn, creates more space at the dumpsites, and the use of dung as a cooking fuel, reducing the demand for fuelwood and liquid petroleum gas (LPG). Although animals in the urban area do contribute to hazards, they serve a useful role in solid waste management.

## **5.2 Water**

The number of lakes, or tanks, within the urban area has declined over the last twenty years. The water supply to the city is constrained by electricity (for pumping the water out of the reservoirs) and water shortages. Water is generally pumped into the city only every three days, and, then, only for a few hours at a time.

Some areas of the city are served by borewells, of which there are around 800, about half of which have potable water.

The reduction in the number of tanks in the urban area must have affected the number of livestock maintained, as tanks are crucial for watering and washing buffaloes and cows, particularly for owners with a small number of livestock. In terms of time and availability, it may be difficult to obtain adequate amounts of water from public taps and borewells. It is likely that the declining number of tanks has affected the microclimate of the area.

## **6. Contribution of urban agriculture to the household economy**

Urban agricultural activities contribute to employment and income, and save resources in terms of purchasing milk, in particular. Being located in urban areas, there are greater opportunities for other work, though some households have maintained links with rural areas. Poorer households who keep buffalo may find that, in times of hardship, they have to sell their livestock. This has long-term implications, as it is very expensive to buy buffaloes (around Rs15,000), and it would be difficult to get re-established as an urban dairy. Keeping livestock also provides a reliable source of fuel for households, as some of the dung is used as a cooking fuel. Using dung reduces the need to purchase fuelwood or LPG, providing an additional saving to household costs. This would also be lost if the buffaloes were sold, increasing household costs as well as potentially reducing access to milk.

It is unlikely that employment beyond owners of livestock, farmers and the casual farm labourers discussed above is significant. The sale of milk from the small urban dairies is generally undertaken by family members, though more commercial urban dairies and milk booths do create employment and some owners of larger numbers of pigs employ people to keep track of their roaming animals. Income from milk varies according to how many animals are lactating and the quality of the fodder. At Rs 10 per litre, a family owning buffalo as their main source of income may bring in around Rs 150-200 per day. Income is also derived from selling dung, sold at between Rs 300-400 per tractor load (which is around 4 tonnes). Each animal produces almost one tractor load of dung a year.

The marketing of horticultural produce is broadly the same for produce grown close to the city and further away. Though small farmers living close to the city have easy access to markets, farmers with access to a bus route into the city can still bring in produce relatively frequently. This is particularly important in Hubli-Dharwad because of the lack of cold-storage facilities. Produce has to be sold quickly and, therefore, frequently. Some farmers employ people (generally women) to sell fruit and vegetables on their behalf in the markets and alongside the main roads. This is on a casual, or informal, basis.

The sale of food waste by hotels is unofficial, as is the sale of waste from poultry farms and slaughterhouses. Livestock keepers and farmers make contracts to obtain wastes and, though there are no formal markets, it does appear that much of the urban waste is used productively. The generation and use of urban wastes does not appear to create much employment, but bribes are paid, for example, to hotel employees for them to save the waste.

## **7. Gender aspects of urban agriculture**

According to census data, there are far more women involved in urban agriculture than men. However, it does appear that fewer and fewer women are depending on urban agricultural activities, which may be due to the availability of other income-generating activities, either formal or informal, which they can undertake within the context of other household duties. Agricultural activities do, though, remain a significant employment opportunity for the urban female workforce<sup>4</sup>. Male employment in casual farm labour decreased as more males took up urban-based casual employment, particularly construction work (University of Birmingham et al. 1998).

As far as livestock keeping is concerned, there does not appear to be any straightforward relation with gender roles in the urban areas. Many households in urban areas tend to rely on a number of income-generating activities and the care of livestock may fall to household members with time available to care for the animals. However, it does appear that male members of households (either husbands or sons) tend to be responsible for delivering milk to customers from urban dairies and are responsible for looking after pigs.

Responsibilities for tending sheep and goats within the urban and periurban areas do not appear to fall necessarily to either males or females. Again, there may be an element of responding to opportunities. Opportunities for informal and casual employment may be quite different for men and women, and these opportunities may be taken into account when deciding which to pursue and who takes responsibility for livestock.

The purchase of urban wastes, from municipal solid waste to dung, is a male responsibility, though there may be an element of decision-making within farming households over when to buy waste, how much and from where. It is also not clear how income arising from urban agricultural activities is distributed within households. The different gender roles may, in turn, influence access to income from such activities.

## **8. Existing policies regarding urban agriculture**

As there is no official recognition of urban agriculture, there are no policies within Hubli-Dharwad that support or encourage this activity. There are, however, a number of responsibilities of the urban authorities that affect urban agriculture. These are land-use planning, environmental health, issuing permits to keep more than ten livestock, and the maintenance of urban infrastructure. Land-use planning is conducted by the Hubli-Dharwad Urban Development Authority, which draws up a Comprehensive Development Plan every 10 years or so. Within the plan, land is zoned into different uses. The Authority maintains a green belt around the city, where agricultural land remains but, even in these areas, developers can request changes to the Plan.

The urban authorities are charged with maintaining the infrastructure of the urban area, including keeping streets clean and delivering drinking water to urban dwellers. Although these activities may not always be as effective as desired, there is concern that the presence of livestock in the urban areas makes such responsibilities even harder to fulfil. The Environmental Health officers of

the Hubli-Dharwad Municipal Corporation have been attempting to shift hundreds of pigs out of the city for about 10 years. The pig owners' association went to the High Court and obtained a "stay", but in 1997 the High Court revised its decision in favour of the Municipal Corporation. The municipality began catching 50-60 pigs per week in 1997. This has prompted some pig owners to sell their pigs before they are seized.

There is legislation regarding keeping livestock in urban areas. The Karnataka Municipal Corporations Act 1976 sets out that permission is required to keep more than ten animals within a corporation area. The annual fee is a minimum of Rs 200, which is paid by poultry and commercial dairy owners. There are very few permitted dairies or poultry farms in Hubli-Dharwad.

The Supreme Court of India produced an Interim Report in 1998, making recommendations for improving solid waste management in cities. One section of the report refers to the "cattle nuisance" in cities, and recommends imposing a ban on "stray" cattle and the phasing out of sheds within cities of a population greater than 500,000. Buffaloes are generally kept in stalls and are led out to grazing 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 obviously have an extremely detrimental effect on the livelihoods of small urban dairy owners. It would also increase the market opportunities for more commercial dairies on the edge of the city with greater access and resources to obtain fodder, and yet with relatively easy access to the urban market.

## **9. Constraints and opportunities**

There are a number of problems associated with urban and periurban agricultural activities in Hubli-Dharwad, some of which have been noted in previous sections. Livestock contribute to traffic chaos, are at risk from ingesting "foreign objects" and there are sometimes problems accessing grazing land and adequate fodder. However, livestock also consume a lot of organic urban wastes, and cows and buffaloes provide fresh milk to the urban market.

**Table 5: Advantages and disadvantages associated with keeping livestock in Hubli-Dharwad**

|   | <b>Advantages</b>   | <b>Disadvantages</b>   |
|---|---|--|
| <b>Input supply / production</b>            | <ul style="list-style-type: none"> <li>• availability of vegetable waste;</li> <li>• availability of sewage water.</li> </ul> | <ul style="list-style-type: none"> <li>• lack of water;</li> <li>• lack of fodder and grazing land.</li> </ul>   |
| <b>Transformation and commercialisation</b> | <ul style="list-style-type: none"> <li>• dung as fuel and fertiliser;</li> <li>• access to markets.</li> </ul>                | <ul style="list-style-type: none"> <li>• lack of storage.</li> </ul>   |
| <b>Management</b>                           | <ul style="list-style-type: none"> <li>• consume organic waste and some night soil.</li> </ul>                                | <ul style="list-style-type: none"> <li>• traffic chaos;</li> <li>• blocking storm drains;</li> <li>• lack of space to keep livestock and store fodder and dung.</li> </ul> |

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), as some dung cakes are sold as well as being used in the urban dairy households. The dung and poultry droppings are also sold to farmers close to the city, providing additional sources of organic fertiliser and contributing to the return of nutrients to the soil.

Urban-based wastes and the market presented by the urban area present opportunities for horticulture around the city. In the absence of sewage-based irrigation, there would undoubtedly be less horticulture around the city on account of the inadequate water supply, including the lack of maintenance and draining of lakes. Horticulture is also constrained by the lack of storage facilities in the city, though this may be an opportunity that is exploited by farmers able to raise numerous crops through using wastewater. They increase their prices in off-seasons, something which they might not be able to do if there were storage facilities.

The lack of recognition of the role of urban agricultural activities within Hubli-Dharwad poses a particular obstacle to the future support of this sector. There do not appear to be any plans to support the development of agricultural activities within the urban area, in part because urban authorities are not charged with supporting these activities. Such a role would have to be decided at a national or state level and additional resources given to local authorities. The lack of authority associated with urban agriculture is exacerbated by the lack of co-ordination between organisations with potential interests in this area. The institutions with interests in urban and periurban agriculture include the Municipal Corporation, the Urban Development Authority and the Departments of Agriculture, Horticulture and Animal Husbandry.

There are no non-governmental organisations (NGOs) involved in supporting urban agricultural activities within Hubli-Dharwad, perhaps reducing the ability of people involved in urban agricultural activities, such as pig owners, in effectively promoting their cause to relevant authorities. Support from NGOs might also help urban farmers to gain better access to credit and other inputs, including advice.

## **10. Perspectives for the development of urban agriculture**

There are a number of current and expected initiatives that will further constrain the opportunities for keeping livestock in the city. This will force many households to change their livelihood strategies, which for some households will be quite challenging, as they have come from generations of livestock keepers, particularly the gowlies.

There is much research that could be done to contribute to supportive policies, both for cities of the size of Hubli-Dharwad and for the metropolitan cities. There is a long tradition of certain agricultural activities within urban areas in India, notably livestock keeping, though many urban dwellers have maintained links with rural areas, owning land that may be cropped by themselves or rented out to others.

The extent of urban and periurban agricultural activities has implications for many policy areas, including waste management, land-use planning and market support. It is crucial that these are adequately understood to inform policy-making in these areas. There is, additionally, a need to improve communication between livestock owners and urban authorities. If a dialogue could be established, some of the constraints to keeping livestock in cities, both current and expected, could be reduced. In turn, the problems associated with the livestock, real and perceived, could be reduced.

There is a need for greater guidance on the role of agriculture in urban areas from national government for municipal corporations and other urban authorities. In turn, more data on the extent of agricultural activities in urban areas would guide policy-making. Data is needed on the levels of production, the contribution to livelihoods and the problems arising from urban agriculture. The links between urban agriculture and household food security and livelihoods could be further researched, providing information for better-informed decision-making, both for households and urban authorities.

A number of issues could be addressed to improve the conditions of urban and

periurban agriculture. These include the treatment of wastewater, exploring options for penning pigs and options for improving the use of municipal waste by near-urban farmers without making it prohibitively expensive. The availability of credit and extension advice for people involved in urban agriculture would help to support this important sector in Indian cities.

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- 1 Recorded in Livestock Surveys undertaken in 1990 and 1997-98.
  - 2 The 1990 figures were recorded as Hubli-Dharwad, whereas the figures for 1997/98 were for Hubli and Dharwad cities separately. The livestock census is carried out by survey and is a snapshot of the number of livestock in India.
  - 3 The exchange rate is approximately Rs 40 to US\$1.
  - 4 This is consistent with a study conducted in 1997, which found that female occupation within casual farm work has increased relative to male employment within periurban areas.

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