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# Solid waste management in intensively farmed rural areas: a Western Cape case study

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Waste control in intensively farmed and densely settled rural areas of South Africa poses a particular challenge to integrated waste management policy. In this case study, undertaken in the Western Cape, a survey among 350 rural landowners revealed a typology of the significant amounts of often environmentally detrimental waste generated, and confirmed that inappropriate storage, collection and disposal strategies were employed on rural properties. Disposal sites were generally poorly located, constructed and operated, generating environmental problems. Owners' perceptions of their own practices, their attitude towards participation in alternative waste management schemes, and their service needs are reported on in this article in order to inform service provision strategies. Owners expressed a variety of needs and requirements for public service delivery, as well as a willingness to participate in and to pay for services.

## Afvalbeheer in landelike gebiede waar intensief geboer word: praktyke en probleme in 'n Wes-Kaapse gevallestudie

Afvalbeheer in intensief bewerkte en digbewoonde landelike gebiede in Suid-Afrika skep uitdagings vir 'n geïntegreerde afvalbestuursbeleid. Hierdie navorsing in die Wes-Kaap rapporteer die resultate van 'n opname onder 350 landelike grondeienaars. Die beduidende hoeveelhede afval, wat dikwels omgewingsbedreigend van aard is, word geklassifiseer en 'n analise van die afval bevestig die dikwels gebrekkige praktyke vir die berging, versameling en opruiming daarvan op die eiendomme. Afvalterreine se algemene swak plasing, konstruksie en bedryf skep omgewingsprobleme. Eienaars se eie persepsies oor hul afvalpraktyke, hul bereidheid tot deelname aan alternatiewe afvalbestuurskemas en hul diensbehoeftes word in die verslag gerapporteer om diensleweringstrategieë te help rig. Eienaars vermeld 'n reeks behoeftes vir openbare dienste en indien dit sou realiseer, is hulle bereid is daaraan deel te neem en daarvoor te betaal.

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Most research on waste management is heavily biased towards the situation pertaining in urban environments. Particularly in the developing African context, research and waste management service development focuses almost exclusively on urban waste containment (Olorunfemi & Odita 1998; Puling 2004). This emphasis is understandable for a number of reasons. The convergence of humanity, industry, commerce and services in urban nodes concentrates vast volumes of waste on these sites, creating potentially hazardous health conditions for millions of people. Most urbanites are unable to dispose of their own waste efficiently. Furthermore, the concentration takes place under the jurisdiction of local governments, which usually operate fairly efficient and cost-effective centralised disposal services. Urban concern thus focuses on the excessive consumption of resources, the scarcity of waste disposal space and the efficiency of treatment (Kutlaca 1994).

But what about waste generated in rural areas, especially in a country such as South Africa where some 40% of the population still lives in rural settings? Here the problem of rural waste has been largely ignored, or left to the devices of rural landowners or the occupants themselves. This neglect often leads to the hazardous and diffuse land and water pollution identified in the White Paper (DEAT 2000a) as threatening the health of rural people and posing problems for the environment and for such vital environmental resources as potable water. The suspicion that "[…] poor people and residents in communities of color bear a disproportionate burden of toxic contamination" (Heathcote 1996: 400) ness on rural waste management in this paper.

The waste hierarchy views landfill, the predominant disposal method in rural areas, as the least favoured option for dealing with solid waste, followed by incineration, recycling, re-use and reduction at source. From an economic standpoint, landfill indeed proves to be the most appropriate method in low population density areas (Barrett & Lawlor 1997). Moreover, people's natural response often tends to be that the disposal and handling of rural waste is best left to the rural landowners themselves, since they have developed time-honoured, inexpensive ways of dealing with it. Small wonder that even casual observation often un-

1 The authors wish to thank the anonymous reviewers for their valuable contributions towards improving the quality of the paper.

covers unsightly and environmentally detrimental waste practices in rural areas. Such problems are aggravated in more densely settled and cultivated agricultural regions: not only because of the greater numbers, but also because larger urban centres are invariably close by and rural-based industries generating dubious types and large amounts of waste are more common in such areas.

The Winelands region of the Western Cape Province represents such an area, where large numbers of agricultural workers live on relatively small, intensively cultivated farms. The location of such farmlands in the urban shadow of the Cape Town Metropole (similar to urban regions elsewhere in South Africa) means that "farms" are often used for residential purposes — either exclusively, or else for generating additional income from tenants, who can commute to urban employment nearby. The fruit and wine industry furthermore generates "wet" agricultural waste at cellars and packing facilities that is often more difficult to dispose of harmlessly, or less desirable for use as composting or fertilising material. Much farm equipment is used and this often produces waste of a toxic nature (such as batteries and tyres), while pesticides and their containers also pose a major disposal problem. Compounding the problems faced in these agricultural regions was, until very recently, the dual rural and urban local government system. Even now this means that farm owners are generally not allowed to utilise the better-run town-centred municipal waste facilities but are forced to dispose of waste as best they can.

South Africa has enacted a range of legislation on environmental pollution, of which the laws on hazardous substances (RSA 1973), general environmental conservation (RSA 1989) and, more recently, environmental management (RSA 1998a), especially regarding water resources (RSA 1998b), are salient. The Environment Conservation Act, particularly in Part IV (Control of Environmental Pollution, sections 19, 20 and 24), and Part VI (Regulations), provides the necessary instruments to regulate environmental protection from poor waste practices. (The Plastic Carrier Bags and Plastic Flat Bags Regulations as gazetted in April 2003 continue this line of legislation). With new environmental policies continually being developed, it is imperative that the momentum in environmental, and specifically waste management research, be maintained. The 1992 Rio Earth Summit provided an initial

momentum, with improved waste management as a prominent global environmental management goal. The Johannesburg Declaration on Sustainable Development (ICLEI 2002), in its section on waste management, urges countries to develop

> … the participation of government authorities and all stakeholders, in order to minimise adverse effects on the environment […] to […] develop waste management systems, with highest priorities placed on waste prevention and minimisation, re-use and recycling, and environmentally sound disposal facilities […] that support urban and rural waste management […].

Examples internationally (cf Collins 1997) and elsewhere in Africa (Dedehouanou 1998; Ogbonna *et al* 2002) show this clarion call is being taken seriously. The integrated waste management approach called for requires the socio-economic aspects of waste management to be understood, as this research endeavours to do in the context of a particular spatio-regional setting in South Africa.

Research into waste management in South Africa is generally conducted from the perspectives of technical management and handling. Perhaps the desired integrated approach requires a recognition that

> … it is becoming increasingly evident that a waste management program, and especially a waste treatment technique, which ignores social aspects, is doomed to failure. Aspects concerning the problem of public acceptance, public participation in planning and implementation, consumer behaviour and changing value systems are no less important than the technical or economic aspects in waste management research and decision-making (Joos *et al* 1999: 221; cf Puling 2004).

The need for "understanding of the societal dimension of waste" (Parfitt & Flowerdew 1997: 232) partly drives this research. Successful implementation of waste management policy in rural areas requires insight into the central issues dealt with in this paper:

- How is the target community constituted and what is its economic base?
- What is the nature of the waste generated?
- What waste management strategies are followed for storage, collection and disposal?
- What problems do these practices cause and how are these perceived by the landowners themselves?

- Would landowners participate in alternative waste management schemes; what are their needs in this regard and what strategies might be imperative in successfully providing such a service?

# 1. Study background

## 1.1 Study area

The Stellenbosch sub-district of the Boland district municipality was chosen as the region for study. It encompasses most of the rural area east of Cape Town between the N1 and N2 national roads and covers roughly 70,000 ha, as depicted in Figure 1. It is densely settled, with the mix of land use types typical of rural-urban fringes and capital-intensive perennial agriculture. Agricultural land uses include the dominant viticulture driving numerous processing wine cellars; deciduous and stone fruit orchards; vegetable cultivation/feeding/packing facilities, and rural commercial outlets. Industry-like agricultural facilities include battery farming of poultry and feedlots for cattle and pigs to be slaughtered at the nearby rural abattoirs which have been licensed in recent years. Non-agricultural land uses include such industries as brick-making and the various bulk-service facilities and institutions that service the neighbouring Cape Town metropole and the booming urban centres (Stellenbosch, Paarl, Somerset West, Strand) in the region. The world-renowned wine industry combines with the exceptional natural beauty of this region to stimulate one of the country's major tourist destinations and hence a burgeoning accommodation industry (guest houses, country lodges, hotels). The generation of significant amounts of waste and its negligent handling have had potentially serious negative implications for the cultivation of internationally marketed and eco-certified agricultural products, as well as for perceptions of the tourism destination at the high end of the burgeoning tourism market.

The population of the district is distributed among 56 rural census wards, each containing an average of 137 households, according to the latest census. The total population of 7 652 households (29 994 people) inhabiting the district at a density of 60/km$^2$ emphasises the potential household waste generation capacity.

## 1.2 Study design and data

As Parfitt & Flowerdew (1997) point out, the requirements for data and waste statistics vary at the local, regional, national and global levels, according to the demands of policy and system planning requirements at each level. This study's focus falls somewhere between the local and the regional levels, with a questionnaire survey conducted in 1996 among 350 individual landowners from a total of 430 properties identified in the district. The questionnaires were distributed by the personal drop-off-and-mail-back method to improve response frequency and to ensure data quality. Of the returned questionnaires, 176 (a satisfactorily high 50% response rate) were found usable. This response was not only statistically, but also in its spatial distribution, representative of the landowner universe studied (Steyl 1996). Questionnaires were, as directed, largely completed by landowners themselves (75%) and the rest by estate managers or tenants, ensuring a high degree of authenticity for responses (cf Barr *et al* 2001).

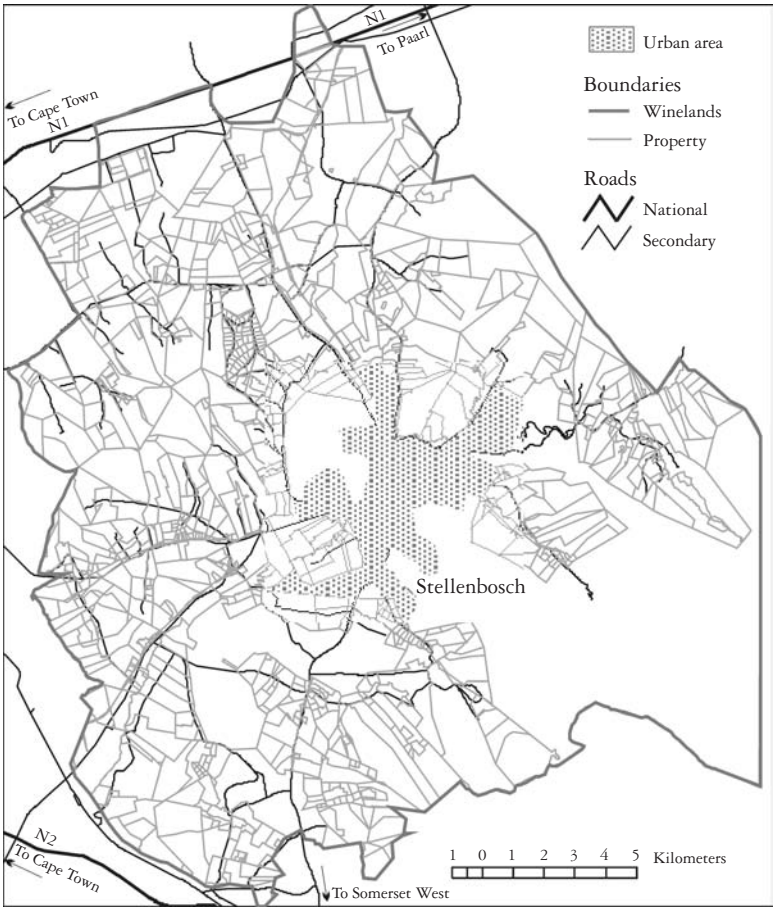
Nearly a quarter of the surveyed properties were used for non-agricultural purposes, with 17.3% being exclusively residential. Agricultural cultivation (vineyards, orchards, vegetables and flowers) was the main industry on the majority (72.0%) of properties, although 43% practised two or more types of economic activity. The variable size of operations on the various properties surveyed was evident from the range in the number of resident families: between one and eighty, with an average of 11.4 families per property. The full spectrum of property sizes was included in the responses, ranging from a minimum of 1ha to a maximum of 1200ha, with an average of 87.8ha.

# 2. Current waste generation and management practices

Any waste management strategy has to commence from a situation analysis, establishing answers to the following basic questions:

- What waste is generated and in what quantities?
- Which waste management strategies currently prevail?
- Are these management strategies sound, or do they require policy intervention?

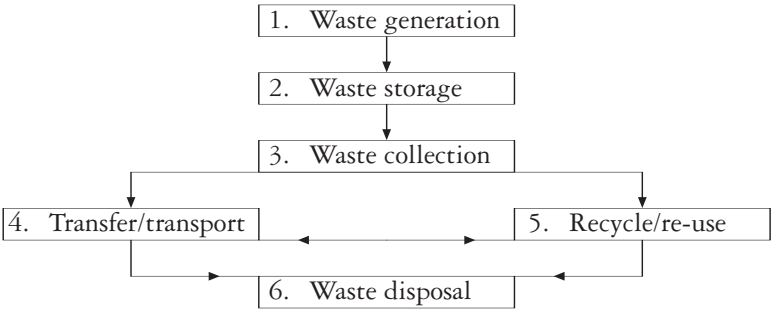
Figure 1: The study region in the urban shadow of Cape Town



- Which landowner and property characteristics explain any variability in practices and perceptions and therefore need to be considered during policy formulation and implementation?

These issues are addressed in the following sections, in which elements 2, 3 and 6 (in particular) of the waste management process elements depicted in Figure 2 will be dealt with. Most of these issues may have social, economic and/or technical (operational/engineering) aspects but this paper will deal mostly with the social aspects related to the rural setting.

Figure 2: Elements in the waste management process (Tchobanoglous *et al* 1977)




## 2.1 Waste generation

The types and categories of waste distinguished vary in line with the aims of a survey. When incineration is researched as an alternative disposal method, the combustibility composition of waste is central. Since the type and volume of household waste can be calculated from standard figures reported for urban waste generation per household in the literature (cf Cargo 1978; Rudzitis 1982; Parfitt & Flowerdew 1997), this study's questionnaire did not attempt to measure that category, but rather "industrial" waste (here defined to include agricultural waste) only. Since 88% of all economic activities surveyed are agricultural in nature, this sector is by far the major contributor to the waste stream in the study region. Questions were posed on the volume and seasonal distribution of industrial waste, but responses from only

20% of about 50 non-agricultural industries were obtained, preventing accurate calculation of the total volumes. The discussion here will be limited to the typology of industrial waste (organic and inorganic) only, mainly generated by the agricultural sector.

### 2.1.1 The organic waste stream

In this intensively farmed district the production of produce-based organic waste, the category which Parfitt & Flowerdew (1997) label as "putrecibles", is substantial. An earlier study calculated the volume of solid waste from the wine industry in the region as being in excess of 13,000 tons annually (Kunneke 1995). Wine production from 1,000kg of grapes generates 110kg of solid waste in the form of grapeskins, pips, stalks and prunings (Steffen *et al* 1991). Most agricultural waste production, with the exception of that of animal origin, is produced in a seasonally cyclical pattern with peaks at various times of the year: prunings in winter, and harvesting waste in late summer. Unfortunately, responses regarding figures for animal waste were poor, preventing the calculation of volumes for animal husbandry. However, these lapses were not considered too serious, since such organic waste can normally be disposed of on rural properties in a largely environmentally friendly manner.

In the study region, composting is widely used for the permanent disposal of organic wastes, re-entering it into the environment as a fertiliser and soil conditioner. Almost 60% of vineyard waste, 25% of orchard waste, 71% of vegetable waste and all animal manure is composted. The rest is dumped or even burned. As such, organic waste does not feature in the remainder of this paper.

### 2.1.2 The inorganic waste stream

Waste items in this category include pesticide containers, farm chemicals, paint, plastics, metal and glass containers, motor oil, tyres, old batteries, asbestos and metal plates, glass, wires, ropes, old metal and plastic-based piping, building rubble, and packing materials (plastic, paper, cardboard, glass and metal). Pesticide containers enter the waste stream almost all the year round and represent the most problematical waste element — making up one-quarter of the weight categories reported, identifying this as a serious problem. The inorganic waste volumes reported in the survey amounted to an annual total of 130,000 kg:

indeed a serious disposal problem in the context of the low response rate in this category. The municipal disposal site handles 70,000 kg of urban waste of all types per week, so if the total rural contribution, estimated at 200,000 kg per annum, were added, it might increase the total annual intake by no more than 5%. Despite the already limited landfill space in the region, it would seem feasible to absorb this amount.

The disposal of inorganic waste takes place on the property in 93% of cases and the usual methods reported are burning and dumping, with pesticide containers being removed by specialist companies in only 6% of cases. Used motor oil is reportedly sprayed onto gravel roads for dust containment. These materials contaminate the air and end up in underground water, streams and river run-off, where they threaten the healthy growth and reproduction of a variety of biotic life forms.

## 2.2 Waste storage, collection and removal

From an environmental management perspective, the most important issues in waste management are the manner in which waste is stored during generation and prior to removal, and how often removal takes place. These and the related issues addressed in the rest of this paper refer to the handling of inorganic industrial waste in combination with household waste on rural properties.

### 2.2.1 On-site waste storage

The type of waste container used is significant because various methods offer differing levels of containment security for the prevention of littering. The omnipresent black plastic bag is economical, but tears easily and might preferably be used in combination with bins, thereby obviating frequent washing of the bins. In this study, 20% of respondents used bags only, nearly 60% used the more appropriate bins only, with only 23% opting for the best option of combining the two methods. Apparently the importance of secure containment is better realised with an increase in the size of operation: owners of smaller properties are more likely to use bags only, while those with larger properties housing many families, resulting in a more significant waste problem, tend towards bin use. The particular type of industry has no consistent influence on the choice of container.

### 2.2.2 Waste removal frequency

To avoid overflow, bins need to be emptied and waste generally needs to be removed at least once a week (cf Kirov 1975; Palm 1991). 75% of all respondents in the sample removed waste at least weekly, while 11% did so at monthly or longer intervals; an undesirable practice. Although not overly pronounced, there seems to be a tendency for bin users (counter to expectations) to remove waste more frequently — an indication that bag-only users are generally more negligent in waste management. Similarly, larger concerns remove waste more regularly than smaller ones, probably because more effort and systematic planning go into dealing with the larger-scale problem. Again, the particular type of industry has no consistent effect on the frequency of removal. In the study region, ample evidence of the detrimental aesthetic and health effects of bag-use coupled with low removal frequency, leading to waste accumulation, has been photographically documented (Steyl 1996).

## 2.3 Waste disposal practice

Apart from the relatively short-term sojourn of waste in on-site storage, it is the long-term disposal thereof that poses the most serious potential threat to human beings and the environment. In the absence of an enforced waste management policy and with owners being left to their own devices, there are bound to be intricate relationships governing the choice of disposal methods, the use of disposal agencies and the money which owners are willing to spend on waste management.

Since rural respondents in the study were denied gratis access to the local municipal waste dumps and could make only limited use of the service provided by the district municipality, they had to devise their own disposal solutions — mostly on their own land. Analyses indicate that disposal on the property itself is more likely to be the norm for larger properties or where larger numbers of households are resident, as well as where agriculture is the main land use. This means that on-property disposal accounts for the bulk of waste generated in rural areas. Only limited volumes are disposed of at regional sites; even though, as Table 1 indicates, 20% of respondents made use of these.

Concerning on-site disposal methods, the majority of landowners simply burn their waste from time to time. While this may seem the appropriate and most cost-effective solution, one needs to remember that open-air burning of mixed waste, which may contain toxic materials, is quite different from controlled incineration. The practice causes serious aesthetic and related disturbance over wide areas, particularly when palls of evil-smelling smoke waft across a densely inhabited area which is also marketed as a tourist destination. Small wonder that many respondents complained bitterly about such frequent occurrences. Yet, people feel trapped by the lack of alternatives, as expressed by one respondent: "We have to burn all rubbish at present, which is a highly unsatisfactory way to dispose of refuse".

Table 1: Final waste disposal options reported by respondents

| Disposal method | n | % |
|---|---|---|
| Transport to local authority disposal site | 30 | 19.9 |
| Surface dump on own property | 18 | 11.9 |
| Burn waste on own property | 80 | 53.0 |
| Bury waste on own property | 5 | 3.3 |
| Burn and then bury waste on own property | 11 | 7.3 |
| Recycle waste | 7 | 4.6 |
| Total | 151 | 100.0 |

A significant number of respondents (mainly smaller landowners producing small amounts of waste) incurred the cost of buying into the central disposal facilities provided in the region, but 80% still followed their own practices. On-property burying or simply surface dumping of waste occurs frequently, especially among larger landowners. Burying does have the advantage of removing waste from direct contact with human beings and wildlife, as well as preventing wind scattering. However, cases of dumping of waste on the banks of the Eerste River have been photographically recorded (Steyl 1996). Besides the poor impression, such practices are obviously detrimental to water quality and hence to the health of human beings and wildlife alike (Wood *et al* 1974). The fact that so few owners consider recycling confirms a trend among South Africans in general, namely to prefer virgin ma-

terial use, probably because they are ill-informed about recycling schemes (Ninham Shand 1993). In keeping with international trends, where the more affluent and/or environmentally sensitive sectors of society (often living outside city limits) are likely to practise recycling (Hamburg *et al* 1997), such practitioners here clearly form an isolated group of owners occupying smaller properties exclusively for residential purposes and therefore having little impact on total waste handling patterns in the district.

### 2.3.2 Disposal agencies

The virtual absence of waste disposal services is made evident by the fact that only 10% of respondents have their waste removed by the local authority. A further 5% make use of private disposal contractors, with the vast majority taking care of disposal themselves. No statistical association with explanatory variables could be detected.

### 2.3.3 Disposal cost

At a time when the average municipal ratepayer paid R250 per year for waste disposal, similar costs were estimated by respondents to reach R1 700 per property in the rural area. Cost per household living on the property, calculated at R145 per year, equals only 58% of the urban cost. While appreciably lower than the urban figure, this is still a significant expenditure. Furthermore, 10% (all handling disposal themselves) reported no disposal cost, clearly ignoring such items as transport and labour. The maximum cost estimated reached R18 000 per year — indeed a substantial amount. These discrepancies demonstrate the extent to which the real cost of rural waste disposal is often negated or simply not fully or accurately calculated. Additionally, the environmental cost of waste disposal is rarely calculated.

As may be expected, there is a direct relationship between operation size and disposal cost — the larger, the more expensive. No such relationship with specific types of industry was evident. What did come to light was the expected correlation between cost and removal frequency: the longer the frequency, the lower the cost estimates were. Disposal measures have associations as well: for burying and dumping, a slightly higher cost was reported, while the cost of burning and the cost of disposal at regional sites are estimated as being lowest. Of encouraging

significance is that recyclers reported the lowest disposal cost of all, although it is unclear whether this is because the reported costs reflected that the resale value of recyclables had been deducted.

Having discussed most of the operational and economic aspects of rural waste storage, the emphasis of this study now shifts to the point of impact in the environment — the disposal site on rural properties.

## 2.4 Disposal sites on rural properties

The situation at the 110 properties (63% of the total) where on-site disposal sites were reported will now be classified according to type and operational practice, followed by an evaluation of the site's suitability.

### 2.4.1 Types of disposal sites

A wide variety of sites is operated in the study area. In Table 2 these are classified according to the description provided by the owner and ordered in sequence of desirability. Apart from the nearly 10% who dump waste on the surface, a significant proportion uses waste to alleviate another environmental problem, namely erosion. While the erosion-prevention function may be fulfilled, this type of siting is guaranteed to become environmentally unfriendly, since dongas act as drainage lines and hence undesirable products leached from the dumps are likely to be channelled downstream.

The large majority of dump sites are variously described as "gravel pit", "trench", "sand pit", or "garbage pit" — the common denominator being that a pit is dug for the purpose, but without any special effort to contain waste leaching, which makes it less than ideal in design. It also became evident that larger waste generators are more likely to resort to the latter type of disposal site and thus pose an even larger environmental threat. Special preparations for environmentally sound dumping are evident in about 11% of cases where the construction of waste sites conforms to some containment design principles, either by clay-lining pits or by building sites that provide environmental protection.

Table 2: Type description and suitability rating of waste dumps reported

| Site description | % of total | Own rating of sites* Unsuitable (%) | Suitable (%) | *n* |
|---|---|---|---|---|
| Surface dump on the river bank | 2.0 | 50.0 | 50.0 | 2 |
| Other surface dumping | 7.1 | 42.9 | 42.9 | 7 |
| Filling up an erosion donga | 15.3 | 46.7 | 33.3 | 15 |
| Unlined, prepared garbage pit | 64.3 | 32.0 | 33.3 | 63 |
| Specially prepared, lined garbage pit | 5.1 | 60.0 | 40.0 | 5 |
| Built waste containment structure | 3.1 | 0.0 | 33.3 | 3 |
| Controlled dump site on another property | 3.1 | 0.0 | 66.6 | 3 |
| Total | 100.0 | | | 98 |

* Suitability according to how efficient the owner rated the site as being, in terms of location and functional construction, to contain and render waste environmentally harmless and nuisance-free.

If one considers the plethora of harmful substances, such as oven and drain cleaners, furniture and car wax, moth balls, disinfectants, paint thinners and batteries (Cassel 1988) that may be contained in ordinary household waste, and then adds the weed killers and pesticides and their containers used on rural properties, the necessity for proper waste containment at such sites is obvious. It is also obvious that the 89% of sites in the study area where no special containment structuring is employed, pose potential environmental contamination threats of various degrees.

### 2.4.2 Site operation and disposal site practice

Even having a well managed and properly constructed waste site does not guarantee proper functioning. Waste needs to be kept covered to prevent human or animal contact and the wind from spreading litter. Respondents were therefore asked at what frequency waste was covered. It is significant that, while a mere 2% follow the most desirable practice of covering their waste directly after each dumping, 60% do so only at irregular intervals. Of even more concern, however, are the remaining 38%, who openly confessed that they never cover their waste at all, leaving it exposed to the elements. It would therefore be reason-

able to assume that more than half of all waste in the rural area under study is constantly exposed and therefore poses a threat to the health of human beings, animals and the environment in general.

Upon enquiry as to the number of waste sites operated on each property over time, an additional problem emerged. One-third of properties have only ever operated one site, while 36% have operated two and three sites per property, and a full 30% have operated more, in two cases as many as 20 sites. This means that many properties are pockmarked by numerous old dump-sites that may be as badly managed as the current ones and that may be slowly leaking their undetected and undesirable environmental loads.

### 2.4.3 The suitability of disposal site locations

The competence of rural landowners to take responsibility for their own waste disposal was judged by the extent to which waste sites complied with site selection criteria. Using a set of criteria gleaned from the DWAF (1994a) Waste Management series: Minimum Requirements, respondents were required to rate, on a scale from 1 (unimportant) to 5 (extremely important) the importance of each criterion in their selection of waste site location. The results are listed in Table 3. Close scrutiny of these figures reveals that owners generally seem to regard the natural (especially water-related) environmental criteria as more important than others. Rather inconsistently, criteria dealing with site drainage, terrain slope and soil permeability were not highly rated, casting some doubt on the owners' ability to grasp the significance of all the criteria. Visibility criteria were adjudged of almost equal importance — perhaps a case of "out-of-sight-out-of-mind"? Unfortunately it was not possible to judge objectively whether respondents' own sites complied with these criteria as an indication of the extent to which sites may exhibit "fatal flaws" advanced by the minimum requirements.

Table 3: Importance rating of criteria for the location of waste sites

| Criterion | Frequency in each rating class (%) | | | | | *n* |
|---|---|---|---|---|---|---|
| (Row percentages) | 1 | 2 | 3 | 4 | 5 | |
| Level of groundwater table | 5.1 | 4.1 | 6.1 | 15.3 | 69.4 | 98 |
| Non-permeability of soil | 8.9 | 8.9 | 22.2 | 28.9 | 31.1 | 90 |
| Level terrain | 26.4 | 14.3 | 27.5 | 16.5 | 15.4 | 91 |
| Natural vegetation at the site | 17.3 | 14.3 | 21.4 | 14.3 | 32.7 | 98 |
| Invisibility from housing | 3.0 | 4.0 | 13.1 | 25.3 | 54.5 | 99 |
| Invisibility from hiking trails | 8.0 | 3.0 | 7.0 | 15.0 | 67.0 | 100 |
| Invisibility from main and farm roads | 6.9 | 3.0 | 13.9 | 16.8 | 59.4 | 101 |
| Distance from neighbouring properties | 7.4 | 10.5 | 23.2 | 16.8 | 42.1 | 95 |
| Distance from surface water bodies | 5.4 | 1.1 | 13.0 | 12.0 | 68.5 | 92 |

### 2.4.4 Site evaluation

The logistic impossibility of inspecting and evaluating each individual waste site prompted the researchers to rely on the owners' own evaluation of site suitability on a numerical scale from 1 (not suitable) to 5 (highly suitable). The results indicate that one-third of the respondents regarded their sites as unsuitable (scores 1 and 2), 30% were ambivalent and equal numbers totalling 37% judged their sites as suitable (scores 4 and 5). Less than one-fifth were highly satisfied, while the same number were personally of the opinion that their sites were highly unsuitable. One can therefore safely deduce that the majority of landowners are aware that their waste management practices were inadequate. Judging by the generalised suitability rating scores of practices listed in Table 2, owners who take greater care in constructing proper dump sites also seem to be more critical of their own facilities, while some bad practices are actually rated quite highly by others.

A further indication of site suitability is obtained from an analysis of the problems respondents experienced with their sites. Table 4 lists the questionnaire results for reported problems with specific environmental elements emanating from waste sites. The results of the unsound practice of not covering waste, discussed earlier, are prominent here, with wind-blown litter occurring fairly generally and odour problems and scavenging also being experienced. Most of these problems are prevalent

at unsuitably constructed dumpsites. Water quality problems are worse than reported, simply because there are likely to be chemical manifestations that can only be measured by laboratory testing, whereas only visible contamination is likely to be reported. The mere fact that some health problems in animals and human beings are indeed reported, albeit it at a low frequency, gives rise to concern, since owners are likely to conceal such occurrences and one would be safe to assume higher frequencies than reported. It is also significant that all these problems were reported from properties with less suitable waste sites.

Table 4: Confirmed environmental problems with waste sites

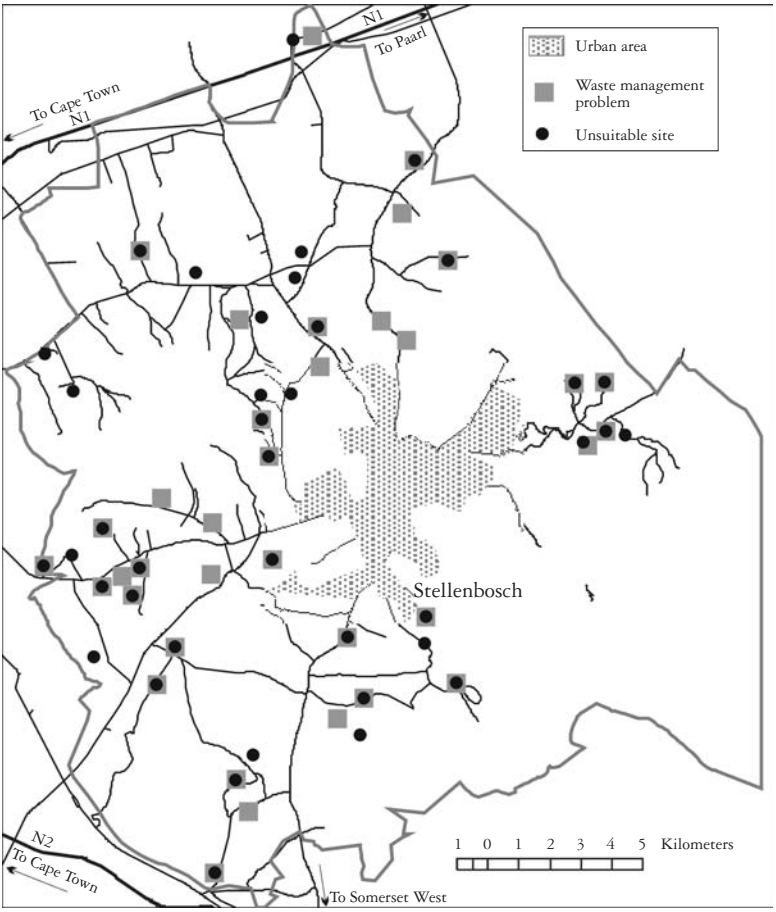
| Problem | % | n |
|---|---|---|
| Scavenging by animals | 27.6 | 105 |
| Scavenging by human beings | 13.3 | 105 |
| Health problems for animals | 4.8 | 104 |
| Health problems for human beings | 7.6 | 105 |
| Wind-blown littering | 55.8 | 104 |
| Water quality deterioration | 10.5 | 105 |
| Bad odours | 23.3 | 103 |

Utilising a combination of field work observation and the questionnaire results from cases where unsuitable waste sites occurred, as well as where problems with waste management were reported, and mapping these in Figure 3, the spatial spread of potential "waste hotspots" becomes evident.

From this map it is clear that environmental problems related to unsatisfactory waste management are omnipresent in the rural area studied. Yet less than 10% of the respondents admitted to having received complaints about their waste sites, while 34% listed complaints about others in their vicinity — clearly an indication that all is often not well! As may be expected, owners operating unsuitable sites or practising surface dumping received complaints.

In the light of these observations one is left with the conclusion that waste management in this rural region often leaves much to be desired. If it is thus decided at this juncture that something needs to

Figure 3: Location of poor disposal practices in rural Stellenbosch



be done about the situation, the planner is immediately confronted by the question: To what extent would respondents be willing to accept and contribute to rectification of the situation?

## 3. Waste management: future possibilities

Working on the assumption that centralised waste removal and disposal service delivery by the local authority is probably the only efficient way to ensure compliance with waste management regulations, the question arises whether such a service would be acceptable to rural landowners and what their anticipated service needs would be. Moreover, this solution may be feasible since the reasons advanced for the current non-usage of local authority service were mainly because the majority (51%) were unaware of its existence, 21% simply preferred their own existing facilities, and only 10% regarded it as too expensive.

### 3.1 Service provision required

Proper waste management requires that the client population's societal needs to be understood and properly addressed (cf Barr *et al* 2001; Barr 2002). The crucial question is whether rural landowners would indeed be willing to participate in a waste removal scheme and which types of waste would need to be removed — household, industrial or both? Table 5 indicates that adequate basic support for various types of removal services would indeed be forthcoming — particularly when it is considered that respondents had to express their willingness without being given any detail as to what service would be provided, where and at what cost. The majority would make regular and year-long use of a household waste removal service, with about a quarter refusing participation. The only real difference between the patterns of household and industrial waste service use is the greater seasonality in industrial waste generation, prompting a greater demand for infrequent ("sometimes") service provision. Planning for the service needs to accommodate this subtlety, unique to the generation of the rural waste stream and service demand, by providing some seasonal flexibility in the removal capacity of the system.

Table 5: Willingness to participate in waste removal services provided by the local authority

| Frequency of use foreseen | Household waste | | Industrial waste | |
|---|---|---|---|---|
| | % | *n* | % | *n* |
| Never | 24.5 | 40 | 27.7 | 33 |
| Sometimes | 22.7 | 37 | 41.2 | 49 |
| Whole year | 52.8 | 86 | 31.1 | 37 |
| Total | 100.0 | 163 | 100.0 | 119 |

Probing the reasons why owners indicated that they would "never" use a new service (for either household or industrial waste) reveals that this was the response of one-third of those stating "high cost" as their reason for not using the current service and of almost half of those stating a preference for "own facilities" — clearly denoting a tendency towards self-sufficiency and cost-cutting. That 61% of those indicating a willingness to use a household waste service the "whole year" had been unaware of the existing service is significant. Also, 58% of this group favoured compulsory participation in such a service. This emphasises the need and the potential for success of better and progressive information campaigns to market possible service provision.

A further question yielded the responses that all (38%), only household (34%), only toxic (11%) or only inorganic and industrial (17%) waste removal was regarded as the most urgent target for a removal system. A special need often mentioned was for the removal of toxic pesticide containers, but this type of specialised task is really an industrial problem for which the producer — not the local authority — should find a commercial solution. The removal of toxic substances is an aspect of hazardous waste management, which is a provincial responsibility (DEAT 2000b).

## 3.2 Willingness to participate in services provided

Crucial questions to which a local authority contemplating service provision would require answers are how much money and effort the participants would be willing to expend on the service. This would determine the level of service to be delivered and whether the authority has the capacity to provide what is required. The answers given do not

reflect a great deal of realism — probably because rural residents have little idea of what waste removal services cost. For both industrial and household waste removal, an identical willingness pattern emerged: per property, one third were willing to pay a maximum of R20 per month (the average urban removal cost at the time); a further third up to R50 per month (three times the urban rates) and only 18% more than R100 per month (five times the urban rates). The average monthly amounts which respondents were willing to pay were R95 for household waste and R110 for industrial waste. Converted to a mean amount per household on the property, owners were willing to spend just over R14 per household on household waste and about R22 per household for household and industrial waste combined. Considering the probable lack of realism among owners in calculating these amounts, their expressed willingness to pay is encouraging. Perhaps the most coherent conclusions to be drawn from these results is that there is a willingness to participate and that a reasonably priced service, well motivated and "sold", would be likely to find a ready market.

## 3.3 Logistical service requirements

Selling the concept of a full waste removal service requires the delivery agency to ensure that the logistical demands of service provision can be met and that service delivery parameters will be acceptable and affordable to consumers and provider alike. The first of these is the location at which consumers would expect their waste to be collected: at the property itself or at some central point along a designated access road. A large majority (68%) of respondents would prefer to have waste collected at the gate, while the rest were willing to deliver to a central transfer station. When asked about the possibility of having to deliver to a transfer station, over 80% would be willing to deliver up to 5 kilometres from their properties, with the remainder willing to go even further. The average distance respondents were willing to go to deliver was calculated as 4.5 kilometres from the property gate. As may be expected, those intending to use the service the whole year wanted to travel shorter distances and required a higher removal frequency than those intending to use the service only "sometimes". It is understandable and encouraging that owners of properties generating greater volumes of waste were willing to deliver it over longer distances.

The frequency with which such a service would be expected to remove the different types of waste is of similar importance. Full three quarters of respondents expected a weekly service in accordance with the normal urban practice, with only 8% opting for intervals of a month or longer. By contrast, industrial waste removal would be required on a weekly basis by one quarter only while 59% would expect monthly or longer intervals. The survey shows that those intending intermittent use for industrial waste removal expect less frequent service delivery. These indications bode well for the planning of flexible household and industrial service delivery, allowing for efficient and more economical utilisation of existing infrastructure capacities.

About thirty respondents had some "special waste removal needs", for which one third indicated intermittent service need and half required service the whole year. However, these needs were invariably related to the removal of toxic substances or their empty containers — industrial requirements for which a local authority could not normally be expected to cater. Should such a hazardous waste management service (a provincial competence, as mentioned above) be rendered in order to ensure environmentally sound management of a very real problem, it could be subcontracted to private operators for removal on an *ad hoc* basis and the cost be passed on to source.

## 4. Implications for waste management regulation

Acceptance of an altered (probably coerced) waste management policy is crucial. Some indication of the seriousness with which rural owners consider this issue is obtained by gauging their opinion of current waste regulations. As may be expected, lack of knowledge is a problem; 29% were not familiar with any regulations, while only 18% considered them to be adequate. The 53% who were convinced that the regulations were inadequate indicated that stricter regulation and enforcement might indeed be positively received by the majority of rural landowners. The results also show that those admitting to a lack of knowledge about the regulations are less likely to express willingness to participate in a removal scheme. Nearly half the respondents offered advice for improvements to waste regulation in the area, including:

- declaration of environmentally sensitive zones with strictly enforced regulations;
- compulsory recycling;
- stricter policing and regular inspection of waste management practices;
- information campaigns to alert owners to regulations;
- prohibition of all uncontrolled private disposal of waste, and
- provision of a compulsory, paid-for waste removal service.

Significantly, however, respondents were fully ambivalent (48% "yes" versus 52% "no") when asked whether all rural landowners ought to be forced to use a waste removal service. The latter group formed the clear majority (72%) of those indicating that they would "never" use the household waste service, while the former group formed an equally clear majority (80%) of those indicating a willingness to use the service the "whole year". Both percentages increase for industrial waste service use. This underscores some of the problems relating to community acceptance which are likely to be faced by a public service provider contemplating compulsory service provision. The importance of public information campaigns and public participation in planning to advance the acceptance and understanding of the social, economic and environmental desirability of proper waste management programmes (cf Hamburg *et al* 1997; Kuper 1997) cannot be overemphasised, especially since the (Integrated Development Planning (IDP) goals embrace waste service delivery, among other things (DEAT 2000b).

## 5. Conclusions

The study has confirmed a number of suspicions, suppositions and expectations about waste management in rural areas that have significance for future service provision and policies:

- significant amounts, often of environmentally detrimental composition, are produced;
- waste management practices in terms of storage, removal and disposal are often inappropriate;
- disposal sites are generally poorly constructed and operated as well as unsuitably located;

- owners admit to waste management problems and express a variety of needs and requirements for public service delivery, and
- owners are generally willing to participate in and pay for publicly provided waste service delivery.

Community acceptance of waste management policy measures is a complex issue. Joos *et al* (1999) confirm most of the measures considered above, to which they add public participation in the planning process for any new service policy. They further emphasise the importance of such intangible, yet vital, factors as resolution of conflicting interests between individual (private property) and common local and regional environments and quality of life in decision-making on new policy formulation and implementation. In a modern society, at least one governed by a modern South African Constitution containing the environmental provisions of article 24, these principles should become the guidelines driving all aspects of public policy and practice. South Africa cannot afford the GPC International (2002: 6) prediction regarding the Johannesburg Summit to become true for this country:

> Waste management was not a priority area for the Summit and in the absence of targets or deadlines, actions in the field of waste management will follow a "Business-As-Usual" scenario.

As Collins (1997: 26) concludes, waste management

> … has to be seen not only as a local issue but as a regional, national and international problem. More detailed studies are required to provide reliable information and data on which to base the development of sound environmental policy, less influenced by emotion and political expediency.

Issues of environmental justice, as indicated by Heathcote (1996) must also be included. The White Paper's "paradigm shift" (DEAT 1997) towards sound management of the country's waste problem will be served in no better way and may require urgent action in most of South Africa's peri-urban and intensively utilised and densely settled rural agricultural regions.

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