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POLLUTION AND WASTE PRODUCTION IN HOME-BASED ENTERPRISES IN DEVELOPING COUNTRIES: PERCEPTIONS AND REALITIES

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Abstract

Using mainly qualitative data from a four country case study, this paper describes the nature of home-based enterprises (HBEs) and the wastes that they produce. It finds that most only generate material similar to domestic wastes, but in greater quantities. While some are undoubtedly generating dangerous wastes, they are only a small proportion of all HBEs and tend to be aware of at least some of the problem and take mitigating steps. The paper argues that the encouragement of clean processes should replace the usual negative views about HBEs that are held by policy makers.

Key words: *developing countries, home-based enterprises, pollution, waste production, Bolivia, India, Indonesia, South Africa*

Introduction

There are good reasons for us to fear the untreated outputs of industries in the developing world. Environmental pollution and land degradation are now recognised as having severe (if indirect) and long-term impacts on the efficiency of cities as pivots of national economic growth. Although large scale industrial concerns are responsible for the majority of the pollution load and risk, attention has also been focused on small scale, informal sector concerns as polluters of the environment (Frijns and Van Vliet, 1999). There is no doubt that small-scale industries contribute to water and land pollution. Some commentators are particularly critical of the way they generate liquid effluents and solid wastes, and pollute the air.

> "Combined, the large number of small-scale industries has a substantial environmental impact. As most small-scale industries are situated within or in close proximity to residential areas, their impact on the environment is all the worse. They cause local pollution and nuisance from the release of smoke, foul smells, and toxic contaminants to the air, soil, surface and ground-water, such as chrome from tanneries and oil from car garages" (Frijns and Van Vliet, 1999).

Environmentalists are concerned about whether the scattering of small-scale enterprises leads to more environmental damage and less control the same industry concentrated in a purpose-built estate; and how far the extreme proximity of industrial and commercial activities to homes increases the effects of pollution, waste disposal problems and other nuisances.

Studies have shown that the informal sector can have positive and negative effects on pollution control and waste management. The positive contribution lies in its, still under-acknowledged (Perera and Amin, 1996), reducing of the amount of garbage collected and in urban waste management and recycling. Some with pessimistic views (e.g., Prey, 1992), however, argue that the informal recycling of garbage spreads health and safety hazards.

The negative effects, such as environmental pollution and health hazards, are frequently cited as reasons to stamp out the informal sector and home-based enterprises (Perera and Amin, 1996). Omuta (1986) and Sethuraman and Ahmed (1992) argue, and Perera and Amin's (1996) demonstrate, that the informal sector has very little polluting impact. Indeed, by using the home, enterprises can avoid hazardous conditions in what Sethuraman (1981) calls ramshackle, hazardous and visually intrusive sheds set up on spare land that are occupied by so many informal enterprises.

Although most countries have policies to control pollution, uncontrolled waste dumping, etc., the effectiveness of their control measures are probably too low to achieve good quality environments. Hameed and Raemaekers (1999) identify a range of reasons, taking in unmanageably high rates of industrialisation; very concentrated industry and urban populations; incomplete legislation; and unco-ordinated planning and pollution control agencies. When violators can 'get away with it' because of their political and financial influence, it can be little surprise if pollution from small-scale enterprises goes uncontrolled.

Pallen (2001) reports that small scale industries generate 60 to 65 per cent of total industrial pollution in India. Data from an Urban Management Programme survey in the early 1990s on small-scale and cottage industries in India, Mexico, Peru and Zimbabwe show that, in relation to large-scale industry:

- "Small-scale industries are generally not the major polluters in their respective industrial sector, due to their small percentage of total output;
- Small-scale industries pollute more per unit of output due to their inefficient production, inferior equipment, poor housekeeping and inability to adopt treatment technologies;
- Small-scale industries are not responsible for the bulk of organic water pollution and air pollution. The problem is toxic waste from specific enterprises; and

- Small-scale industries cause local nuisance (including occupational health problems) due to their dispersed and residential location." (Bartone and Benavides, 1993 cited by Frijns and Van Vliet, 1999).

In development control planners' nightmares, home-based enterprises (HBEs) indiscriminately use hazardous and inflammable substances, such as dyes, disinfectants and detergents, turning benign residential areas into unpleasant places replete with dangers and shedding pollution into the urban environment. In the context of a study focusing on spatial impacts of HBEs, this paper examines to what extent the reality supports the idea that HBEs are seriously harmful to residential environments. It uses mainly qualitative data from a four country study to examine the realities of pollution arising from a particular fraction of small and micro enterprises in the informal sector; home-based enterprises (HBEs). First, published sources are used to set out the types of pollution which arise in industries, including craft work. Second, the planning measures controlling HBEs in the countries studied are examined. Third, the types of HBEs that occur in the study areas and how they are reused are considered. Notice is taken of the different perceptions of what constitute wastes between the study area. Fourth, means of mitigating pollution while enabling the economic activity represented by HBEs are discussed.

Health impact of pollutants

A nuisance emanating from a manufacturer may affect the neighbours but it probably has a much worse effect on the operatives within the enterprise. Informal sector workers, including those in HBEs, often lack appropriate equipment to protect them against hazards. Furthermore, when trouble arises, they tend not to have the funds to pay for treatment in the private sector medical centres, nor are they likely to pay for insurance or to have access to public or company assistance (Werna, 1997). The type of problems that can arise from pollutants used in many industries are listed in table 1.

Table 1. Pollutants and hazardous residues from small-scale industries in developing countries

Industry/process	Hazardous residues
bricks	chromium, fluoride, sulphur dioxide
textile dyeing and finishing	cyanide dyes, oils, resins, sodium hypochlorite, caustic soda, sodium carbonate, polyphosphates
canning	alkalis, bleach, solvents, wax
glass and ceramics	arsenic, barium, manganese, selenium
dry cleaning	solvents, bleach
dye formulations	tin, zinc
metal mechanics and metal finishing	caustic soda, sulphuric acid, iron oxide, zinc, solvents
metal plating	polyphosphates, cyanides, caustic soda, chromium, zinc, carbonates, detergents
automotive services and machine shops	burnt oil, oil absorbents, solvents
pickling	acids, metal salts
battery recovery	lead, cadmium, chromium, copper, nickel, acids, mercury
paper recycling	methanol, mercury, titanium, zinc, wax
pesticide formulation	zinc, copper, fluoride, organic phosphorus, phenol
tanning	chromium, arsenic, sulphates, bicarbonates, formaldehyde
photography	cyanide, silver, phenols, mercury, alkalis

Source: Benavides (1992) and Hamza (1991) in Werna (1997).

Sometimes, ‘craft industries’ are approved, especially if they have tourist potential, with the implication that they are less polluting. However, table 2. shows that craft industries can generate pollution with serious health implications.

Table 2. Craft Industry Hazards

Craft Materials or Discipline	Associated Hazardous Materials	Possible Risk
Biological materials Plants, feathers, bone, shells, ivory	Poisonous Plants. Plants exposed to toxic pesticides, Toxic glues, lacquers, paints, varnishes, dyes, solvents Untreated animal material	Respiratory irritation, intoxication, damage to vital organs, allergic reactions, bacterial disease
Ceramics, clay, glaze firing	Many dry clays contain silica. Glazes containing lead cadmium, chrome, zinc, asbestos silica, uranium oxides. Deadly gases and metal fumes released during kiln firing especially in salt glazing	Chronic lung disease, skin irritations, allergic reactions, metal poisoning
Enamelling	Corrosive acids. Some enamels contain silica, nitrobenzene. Silver solder containing cadmium	Acid burns, chronic lung disease, metal poisoning
Glass, Stained glass, Glassblowing	Highly toxic materials and gases. Corrosive acids	Heat stress, eye damage. Acid, thermal and infrared burns. Carbon monoxide and metal poisoning
Leather	Toxic dyes and glues. Chromium poisoning. Improperly-cured and stored hides	Irritation, intoxication. Damage to vital organs. Allergic reactions Bacterial disease
Metal, Soldering, Casting, Welding, Forging	Solders containing lead, zinc borax and fluorides produce toxic gases. Cadmium solder produces deadly fumes. Metal moulds of silica and asbestos	Damage to nervous system. Fire, explosion, heat stress. Electrical shock, burns and cuts. Chronic lung disease
Painting	Pigments containing heavy metals. Toxic solvents. Asbestos (pastels, gouache)	Irritation, Intoxication. Damage to vital organs. Metal poisoning Chronic lung disease. Some pigments are suspected carcinogens

Plastic, rubber	Toxic vapours from mixing and heating processes. Monomers containing toxic and volatile materials	Irritation, intoxication. Damage to vital organs. Allergic skin reactions
Print-Making	Pigments containing toxic cadmium, lead compounds, cobalt, zinc, asbestos. Toxic and inflammable solvents	Irritation, intoxication. Damage to vital organs. Metal poisoning. Some pigments are suspected carcinogens
Sculptural Media, Clay, plaster, Stone, Wax, (see also metal, plastic, wood)	Oil based modelling clay is potentially poisonous. Stone containing asbestos or silica, inflammable waxes release toxic fumes when heated, poisonous solvents	Irritation, Intoxication. Chronic damage to vital organs. Lung disease.
Textiles, Fibre dyes, Batik	Vegetable moulds, poisonous solvents, toxic mordents. Corrosive vat and acid dyes, direct dyes (azo, coaltar, aniline) are often poisonous, waxes	Allergic reactions, chronic lung and other diseases. Some dyes are suspected carcinogens
Wood	Toxic glues, paints, strippers, finishes and solvents	Irritation, Intoxication. Damage to vital organs, allergic reactions, possible hearing impairment

Source: Ontario Crafts Council (1980: table 4.1).

It is obvious that many industrial processes generate extremely toxic waste products and, in so far as these occur in or near the home, there are potential dangers to workers, household members and neighbours. Environmental measures in place are often inappropriate for the small-scale sector and this can be compounded by problems of implementation. Small-scale entrepreneurs generally lack skill and knowledge about how to deal with pollution; they have little access to suitable environmentally-sound technologies. Their small space and lack of capital tend to prevent the installation and operation of pollution control equipment.[1] In addition, small enterprises are averse to risking their viability by adding even modest amounts to their costs (Frijns and Van Vliet, 1999).

There is a sense in which poverty is a polluter; environmental problems tend to be negatively related to income (Pargal et al., 1997). People living in poverty have access to few conventional services. For example, where solid waste is not collected, many people will burn it releasing noxious gases into the neighbourhood environment that would otherwise be controlled either at a central incinerator or not generated through disposal of the waste at a dumping point.

Unless the basic needs of people living in poverty are addressed and poverty reduced in a determined and decisive manner,[2] they will continue to abuse the environment by default. As Pargal et al (1997) argue, better incomes allow households to mediate the polluting and polluted environment within and close to their private spaces, and to move out of very dirty or badly serviced neighbourhoods. In this context, insofar as HBEs reduce poverty, they may contribute to a cleaner environment for the households (especially women and children) and neighbours. If the HBE can also improve the households' economic circumstances to the extent that they can afford cleaner fuels, then there should be a reduction in pollution.

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[1] In one example, operators of small lead-smelting units in Calcutta, India, installed inappropriate, costly and ineffective pollution control equipment when they were required to reduce emissions (Dasgupta, 1997).

[2] This includes genuine access to housing and business opportunities which enable people living in poverty to break free.

Methodology

In the study, funded by DFID,[3] HBEs are defined as enterprises operated from within or adjacent to the home. The study does not include enterprises that have taken over the home so that domestic space has been squeezed out altogether. Neither are homes included which are only used for catching up on paperwork for a business in a shop or works elsewhere, nor where goods are only stored (unless in a storage business) or vehicles (such as hand-carts, rickshaws, auto-rickshaws, or taxis) are only parked when not in use. Renting is not included in the study as, although it is a valid HBE, it involves no change of use from residential and so does not present the challenge to planning orthodoxy posed by, say, steel fabricating or pig keeping.

The four samples are taken from neighbourhoods in Cochabamba, Bolivia; New Delhi, India; Surabaya, Indonesia; and Pretoria, South Africa.[4] The cities selected are all major urban centres (capitals or major industrial centres) and places where good partners could carry out the field work. Within the cities, neighbourhoods with a wide range of HBEs representative of activities in that city were chosen as the main purpose of the study was to assess the impact of as wide a range of HBEs as possible on the domestic and neighbourhood environments.

- three contiguous neighbourhoods (Cerro Verde, Huayrak'asa and Alta Cochabamba), known in the study as *la zona sur*, clustering on a hill just south of Cochabamba city centre and close to the main market;
- Bhumeeheen Camp, a dense squatter settlement in South New Delhi close to an industrial area and on one of the main roads south;

[3] "Environmental Effects of Home Based Enterprises", DFID Research No. R7138, 1998-2001. The UK Department for International Development (DFID) supports policies, programmes and projects to promote international development. DFID provided funds for this study as part of that objective but the views and opinions expressed are those of the author alone.

[4] The author gratefully acknowledges the assistance of the following in the data collection and analysis for the main study from which this work arises: Justine Coulson, Peter Kellett, Nina Laurie, Maggie Anderson in Cochabamba, Alpana Bose in New Delhi, and teams at CSIR, Pretoria and ITS Surabaya.

- *kampung* Banyu Urip, a large squatter settlement not far south of Surabaya city centre, which has benefited from the world-renowned Kampung Improvement Project; and
- a formal low-income neighbourhood (Extension Five) of serviced plots on which owners can build their dwellings using the government's housing subsidy as capital and an adjoining squatter settlement (Phase Two) on the side of a hill in the Stanza Bopape neighbourhood in the east of Mamelodi, at the extreme east of Pretoria.

Unlike the first three which are all quite close to major centres of industry or commerce within their cities and benefit from sources of demand for their goods and services close by, the Pretoria sample is peripheral to the city and far from alternative employment opportunities, which is reflected in high male unemployment. However, it is close to large concentrations of low-income people living in the Mamelodi (former 'black' township) area in the manner of the *apartheid* city.

The samples each consist of about 150 households with, and 75 without, HBEs for quantitative analysis, and about 25 for in-depth interviews (for qualitative analysis) and drawing a plan of their home with its HBE use. The case studies were selected in consultation with DFID, the sponsor, to include countries from each of the three rapidly-urbanising southern continents. The studies were carried out in 1999-2000.

Prior to sampling, a census was carried out to locate HBEs and form a view of the range of activities present so that the study could cover all main types in the sample. In New Delhi and Surabaya, the samples were chosen by first selecting some routes through the settlements. The surveyor then interviewed all the HBE along those routes. In Pretoria, the whole of the two selected neighbourhoods were surveyed using snowball sampling and a representative range of HBEs were chosen. In Cochabamba, however, activity is so hidden behind high walls and closed doors that HBEs could not be found except through a snowball sample.

Current legislation restricting HBEs in the Case Study areas

The case studies demonstrate two contrasting official approaches to HBEs: the prescriptive and the *laissez-faire*. In Delhi and Pretoria, the approach is one in which

some HBEs are cautiously allowed but there is a weather-eye kept for those that are likely to be polluting or disturbing. Both have rules in place in low-income neighbourhoods. In Delhi, there is a limit of 25 per cent of floor space or 30 square metres. In both, there are lists of approved activities but the difficulty of keeping up a comprehensive list, taking account of newly emerging activities, is seen to be so difficult that the Government of Delhi has proposed to set up a 'Standing Technical Committee' to decide on appropriate uses (Jain, 2001). There is a list of acceptable activities in Durban (Cross et al., 2001), but Pretoria had still to adopt one at the time of the study. In Pretoria's former black townships, occupants are free to run a business from home provided that it is not noxious, does not "interfere with the amenity of the neighbourhood"; and does not generate any

> "disturbance or pollution through noise, smell, dust, radio-activity, gases or vibrations or other offensive condition, which result in inconvenience to the public is permitted" (Act 4 of 1984 of the Township Establishment and Land Use Regulations for Black Communities Development: Part 8.2).

The HBEs reviewed in the study, however, are even less restricted as the 'formal' part of the study area (Extension Five) was established under the Less Formal Township Establishment Act of 1991, which allowed many exceptions to the existing township regulations.

In South Africa, Bolivia and Indonesia, HBEs are acknowledged as desirable for low-income household livelihoods and there is a high degree of acceptance. Cochabamba requires registered businesses to have an environmental impact assessment but is less than strict on this expensive process for informal businesses.

Within low-income housing areas in Indonesia, there is an assumption that there will be mixed uses. Control of nuisance caused by HBEs seems to be on a complaint-only basis. If someone complains to the local authority, action will be taken to mitigate the problem. If no-one complains (and few people do), the authorities appear to remain uninvolved. In squatter settlements that are not fully recognised, side payments are made to police and other officials, which favours those who can afford them against those who cannot.

Most of the businesses in the study areas remain outside the letter of the law. So, despite generally tolerant official stances, many remain illegitimate in the eyes of lenders, police, licensing authorities, tax inspectors and a myriad of people who can make life easier or more difficult for HBE operators.

Table 3. Types of HBE in the samples (percentage frequencies) and the wastes they mentioned in the questionnaire survey

	Cochabamba n=201	New Delhi n=163	Surabaya n=187	Pretoria n=157	Wastes	Wastes recycled
Sale of groceries	29	13	28	16	Waste food Paper, card, plastic cartons, sacks and bags. Plastic and glass containers.	Cartons, containers, sacks and bags reused in the home
Sale of food and drinks	11	8	11	20	Waste food Paper, card, plastic cartons, sacks and bags. Plastic and glass containers.	Cartons, containers, sacks and bags reused in the home
Other sales	2	12	10	11	Waste food Paper, card, plastic cartons, sacks and bags. Plastic and glass containers.	Cartons, containers, sacks and bags reused in the home
Bar/sale of alcoholic drinks	2	0	0	12	Plastic and glass containers.	Cartons, containers, sacks and bags reused in the home
Clothing manufacture	25	18	1	0	Cloth and thread offcuts.	Reused in stuffing or small items
Tailor/seamstress (made to measure and repairs)	3	17	7	6	Cloth and thread offcuts.	Reused in stuffing or small items
Crafts person or artist	4	1	10	0	Wax, cadmium Offcuts and dust of wood, metal, leather, feathers, glass, plastic foam. Paint, thinners and glue containers	Reused by producer Reused in smaller products or burned as fuel

Furniture/ woodwork/ upholstery	1	0	1	2	Offcuts and dust of wood, metal, leather, feathers, glass, plastic foam. Paint, thinners and glue containers	Some containers cleaned and reused
Food/drink processing	2	1	5	17	Waste vegetable matter	
Repairs to cars/ cycles/ machinery/ appliances	4	7	3	7	Used components	Sold for scrap
Hiring equipment and videos	4	0	3	0	None	
Others	14	23	21	11		

NB. These do not precisely represent the distribution in the neighbourhood.

Room renting is excluded.

Processes and wastes in HBEs found in the study

In line with Strassmann (1986), it was found that the HBEs in the sample concentrate in particular types of business but also spread widely with a few enterprises in many categories. The samples were designed to collect information on each major type represented rather than to reflect the distribution of types. Some types are more difficult to find than others, especially the illegal or clandestine HBEs such as drug dealing, some liquor production, and prostitution to which no-one admitted. The surveyor asked open questions about the three most important raw materials supplied to and wastes produced by each HBE. Table 3. shows what the samples claimed to produce as wastes within the 'three most important' rubric.

The most common HBEs in each of the case studies, though not in all the samples, are the small shops selling daily household necessities. They receive fresh bread and other staples, fruit, eggs, packaged food and drinks, soap and soap powders, cigarettes, and other daily shopping items and divide them up for resale. Some enterprises process part or all of their stock, for example, in the tea stalls that prepare and sell drinks and snacks and those where food is made or processed for sale off the premises. As expected from Strassmann (1986) and Cross et al (2001), petty retailing and cooked food production were found to be especially common in the Pretoria sample where access is poorest.

These enterprises together generate used packaging, of many sorts and sizes; plastic, foil and cardboard, aluminium bottle tops and cans, tinplate cans and glass bottles. However, not all of these feature in the 'three most important'. The food sales produce waste or rotted foodstuffs. Some receive, prepare and sell products of fish, meat and other perishable food. The wastes from these are usually disposed of in the same manner as if they were from domestic activities but in larger concentrations.

There is also a range of more specialised shops in the study areas: second-hand clothes, paraffin/kerosene, fish, meat, vegetables, sweets, soft drinks, ice cream (especially in Cochabamba), small cafes and teashops (especially in New Delhi and Surabaya), and beer bars (especially in Pretoria). Although they do not seem to be common in earlier studies (Strassmann, 1986), the samples contained several HBEs

making and selling snack food for consumption on the premises or for sale outside either in the street or at work-places or schools.[5]

Meat sales and processing, which is quite common in the cooked food HBEs, can generate waste fat and other organic substances, either whole or as dirty water. These are more dangerous than vegetable wastes and require more careful disposal if the immediate and wider environment, especially ground water, are not to be harmed.

Cooking, which is common among the HBEs, generates smoke and fumes and increases the use of fossil and other fuels within the home. Where these generate gases such as CO, SO_2, and NO_2 or particulates, irritation of the respiratory tract and other ailments such as asthma may increase. This may also occur in purely domestic activity. Indeed, Songsore and McGranahan's (1996) work in Accra, Ghana, shows how solely residential uses are not necessarily environmentally friendly. Poorer households in Ghana are more likely than better-off to use cooking fuels that generate smoke and particulates (wood, charcoal),[6] to cook in the living rooms or communal outdoor living space, and to be crowded in the rooms. Women (and girls) carry the burden of cleaning and household chores and have more time in the home environment to suffer its smoke, or whatever. Cooking and heating processes may also generate ash which can blow about and impede breathing. The poor ventilation inherent in the design of many of the dwellings, combined with long hours of work in HBEs, exacerbate the domestic problem (Napier et al., 2000).

Production HBEs are dominated by clothing manufacture, but this is only evident in two of the case studies; *la zona sur*, Cochabamba and Bhumeeheen Camp, New Delhi. The business people in Cochabamba buy cloth, thread, zips, buttons, and other haberdashery items, cut, sew and embroider products, and sell them by the bundle.

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[5] Gokhale (1992) found in Pune, India, that street food tended not to be more contaminated than restaurant food because it had usually been prepared in a home. Yasmeen (2001) discusses the growing importance of snack and prepared food for households where all adults are in employment.

[6] Tests for respiratory particulates during cooking showed that wood and charcoal generated significantly more than kerosene, LPG and electricity. Exposure to CO during cooking is also a matter for concern and is much greater for wood and charcoal than for the modern fuels.

The homeworkers in India receive the supplies and pass the finished products back to the suppliers via middlemen. In both Surabaya and Pretoria, the garment industry is not important at all. Typical wastes produced are offcuts of cloth and thread, many of which can be recycled in making smaller products or as stuffing material for quilts, mattresses and soft toys, or else used as fuel in cold times. However, there is also a problem of fine dust (lint) where cloth is handled in machinery, as in *la zona sur*, which is highly inflammable and may be harmful if constantly inhaled. One jeans producer has built on his plot in such a way that the kitchen is not near to the workshop and he keeps his children away from the lint. He and his workers, however, do not wear masks when they work.

There are a wide variety of manufacturers in the four case studies. There are manufacturers of knitwear, shoes, bags, jewellery, and stone monuments in *la zona sur*; makers of paper packages, shuttlecocks, golf-gloves, plastic mouldings and bags, and clusters of TV tuner assemblers, thread cutters[7] and craftspeople of many sorts in Bhumeeheen Camp. Banyu Urip is known throughout Indonesia for its papier-mâché mask makers but there are also clusters of production HBEs manufacturing traditional Javanese furniture, rattan and wooden handicrafts, decorated birdcages for the Japanese market, and shoe uppers for multi-national companies (notably Ecco). All these activities generate offcuts and dust derived from wood, metal, glass, plastic, leather and other materials used. Many use solvents, paints, and other volatile substances and generate empty containers tainted with them. In both Bhumeeheen Camp and Banyu Urip, screen printing and spray painting are found which involve volatile and noxious chemicals. The production activities in the Mamelodi study areas are very strongly concentrated on traditional housekeeping skills; producing a local version of an Indian pickle and brewing traditional beer; there is also some manufacture of local stoves (*mbawula*) and furniture.

Services present in the case studies fulfil a range of needs for local people and, sometimes, for a wider clientele. In the samples, there are,

[7] Cutting by hand the long threads left by the machine-stitchers on finished garments.

- carpenters (who use paints and glues), metalworkers and electricians (who may use processes such as welding and soldering);
- repair shops for clothes, cars, household appliances, footballs, shoes and watches (where metal and composite components, glues, paint, dye, glue, thinners and solvents may be used);
- personal services such as child-care, sewing clothes and furnishings to order, hairdressers and beauty parlours (who may use noxious liquids to set, straighten, curl and colour hair), barbers, medical practitioners or traditional healers and dentists (who may produce clinical waste, expired medicines and sharps for which there is no yellow sack service), and photographers (who almost certainly produce small amounts of harmful chemicals);
- rental of videos and party equipment; and
- office services for band bookings, telephones, photocopying and assistance with legal documents.

Waste disposal in HBEs

Generally there appears to be high levels of awareness of potential problems among HBE operators who generate or use noxious substances, and various strategies are employed to minimise dangers and problems (se below).

Figure 1 The batik painter in Bhumeeheen camp, New Delhi, generates cadmium but reuses it.

Wastes

Table 4. Number of wastes mentioned in the questionnaires

	Cochabamba	New Delhi	Surabaya	Pretoria
No of HBEs surveyed	201	163	187	157
All waste products	43	191	275	37
In which hazardous materials are mentioned as follows:				
Chemicals*	-	8	5	1
Needles and blades	-	2	-	-
Glass and potsherds	-	19	3	-
Wastes reused	35	36	53	22

*Includes oil, paint, glue, thinners, dye, acid, and their containers

There are extreme differences in the way wastes are reported across the four country studies. Though efforts were made to achieve some uniformity in the way the questionnaires were administered, largely through long visits by the principal research associate, Dr Justine Coulson, there is probably some interviewer bias in the figures in table 4. However, there are still some very interesting inferences to be drawn from the table and the data behind it. The low density areas (Cochabamba and Pretoria) are much less aware of waste than those where densities are high (New Delhi and Surabaya). In Cochabamba, very few waste products are mentioned and nearly all of them are cloth offcuts. No shops recognised their cartons and bags as waste items. In New Delhi, many more items are recognised as waste, particularly thread and cloth, paper and plastic wrappings, glass, metal and organic matter (hair, feathers, leather), and vegetable matter (mostly food wastes). Of these only about 20 per cent are reused (mainly cloth pieces and plastic bags). The Surabaya sample is particularly aware of wastes with much the highest number of mentions (275) but still only 20 per cent are mentioned as reused. The largest category of waste mentioned is plastic bags but paper bags and cartons, food and thread are also frequently mentioned. There is also the full range of materials (wood, rattan, cloth, metal, plastic) and food. There are

only a few mentions for less straightforward wastes such as chemicals, electrical components, glass and hair which also occasionally occur in the other samples. The Pretoria sample is, perhaps, the least waste-conscious with only 37 mentions of waste products and 22 reuses. Almost all reused items in Surabaya and Pretoria are packaging.

Very few hazardous wastes are mentioned in the questionnaires, but there are individual HBEs that evidently present potentially severe environmental problems but these are few in each of the study areas. In New Delhi there are a few HBE operators who are aware of producing waste glass and a few chemicals and sharps. Others produce wax and traces of cadmium (a batik painter); dilute acid, ink dust, electronic components, chemical powders, coal dust, dye, and oil. Other HBEs present danger from fire where inflammable materials or volatile fumes exist close by electric power sources. A kerosene dealer in Bhumeeheen Camp, who uses no safety measures when selling his highly volatile fuel from an open drum using a scoop and funnel, is the extreme example.

Waste disposal is a problem for some HBEs, especially when they arise in the context of inadequate waste collection services. The disposal of solid wastes in drains can be a major problem in high-density low-income neighbourhoods. While there is sufficient uncollected garbage in Bhumeeheen Camp to produce nauseatingly smelly drains in many places in the neighbourhood, it does not appear to be more serious than in countless residential neighbourhoods in India. There is a sweeper who clears the drains periodically. There are also some smelly drains and a polluted stream in Banyu Urip, and the unserviced part of Mamelodi is strewn with garbage. However, it is important to note that some community residents are aware of the dangers of poorly disposed garbage and take independent action to improve the situation.

The qualitative work and local researchers' observations provide some useful insights into attitudes to waste disposal and management. In Bhumeeheen Camp, many residents understand that the presence of rotting waste is linked to disease. So households work together to clear the drains and paths when the municipal waste collection service fails to perform. Some of the interviewees expressed the opinion that any problem from increase in waste linked to the presence of HBEs would be

mitigated by a more regular, reliable waste collection system. Mr SP, who coaches primary school children, says:

> "… Flies and mosquitoes are common here... Diseases will be common in a slum. … Garbage collection is not regular. We keep the lanes clean. We can't clean the drains daily. We make a complaint but no action is taken. However, we have to live here [with our families]. So after 4-5 days [without the cleaner] all of us together clean the area."

In the South Africa case study area, some individuals are aware of the problems associated with ad hoc dumping but there is no community organisation to regulate the disposal of waste and individual voices go unheeded. Furthermore, waste scavengers, who are attracted to the dumps by the promise of discarded fruit and vegetables, are at risk from exposure to discarded needles. One resident in the squatter settlement known as "Phase Two" explained the problems caused by informal waste disposal,

> "Some go and recycle (the waste fruit and vegetables). Let's say maybe there is a rotten spot on a fresh produce. They remove it and eat it. … the dump is not good at all. I also stay next to it. There is another man there … [who] refused to let them use that area for dumping. So now they cross the road [from the formal area, "Extension Five"] and come here to throw their wastes. …they just dump it even though they hear that it is not acceptable."

Some HBEs are negatively affected by the general waste disposal methods found in the community. This can be especially true for those engaged in the production of food. The operator of the fish frying business in Mamelodi, struggles daily against the randomly dumped rubbish that encroaches on his roadside plot. He even resorts to taking the rubbish to the refuse tip himself.

One of the characteristics pointed up in the Cochabamba case study is a lack of awareness of solid waste and disposal methods on the part of HBE operators (table 4.). Experience elsewhere suggests that there are many more materials being disposed of in *la zona sur* than claimed. There is also no reason to assume that waste materials from HBEs there are any more or less benign than those found in other areas.

The study suggests that waste products are generally disposed of in the same way as domestic wastes are in the area. Where collection systems are unorganised or ineffective, HBEs will exacerbate the problems. The uncontrolled dumping of rubbish is a community-wide problem rather than one necessarily connected with HBEs. Where community co-operation is strong, as in the Indonesia sample, waste collection can be successfully achieved. In Banyu Urip, as in other areas of urban Indonesia, there is an efficient garbage collection system using bins made from old tyres (figure 2).

Figure 2 Waste bins made from old tyre material are provided for every dwelling in Banyu Urip

Recycling wastes

Around the world, many HBEs are involved in recycling wastes. The most extreme examples of this are dwellings built on refuse dumps where scavengers live on their work and sort garbage in and around the home (Dunford, 2002). One step removed from this are the 27,000-strong Zabaleen community who live from recycling the garbage in and around Cairo. The men and children collect the rubbish in the night and women and teenage girls sort it in the home into piles of plastic, metal, glass and paper for recycling. Rotting food is fed to their 40,000 pigs which live in part of the

dwellings. Conditions are very poor in and around the dwellings, and are not helped by the smoke from the small proportion of rubbish that is burned (Dunford, 2002).

Many such activities are potentially hazardous to the workers and neighbours and may have to be considered as unsuited to HBEs or even within residential neighbourhoods, unless they are dominated by such activities. Dasgupta (1997, quoted in Pallen, 2001) tells of the battery recycling activities in 210 SSEs in Calcutta, some of which are undoubtedly HBEs. The splitting up of the components and subsequent lead-smelting create significant risks to workers and the environment. However, as Dasgupta (1997) suggests, banning these activities may be environmentally advantageous but carries enormous social costs.

Furthermore, recycling is one way in which any disposal problem associated with HBE activities can be minimised. In the case studies, many of the interviewees mentioned ways in which wastes are recycled but only 20 per cent or so of the questionnaire respondents, at best, offered information about product reuse (table 4.). Many of these reuse by wastes in the household (often for burning as fuel), others are sold on to other HBEs or collectors, and others are simply given away. Mrs D, from Banyu Urip, who produces high quality rattan baskets, passes on her waste to her neighbour who makes them into baskets.

The recycling of cloth offcuts is particularly common in all the case study areas for stuffing cushions or mattresses. In *la zona sur*, an agent comes around to the textile workshops to buy up cloth scraps and re-sell them. In Banyu Urip, there are no such agents and, as with much recycling in the area, the offcuts are simply given away to be used by neighbours in toy making.

Food waste may be fed to animals. In the India case study, the operator of a flourmill gives the chaff to the cows that wander through the neighbourhood. Packaging such as sacks and bags are reused for storage. In Bhumeeheen Camp, discarded newspapers and magazines are used to make paper bags, which are then sold to local retail HBEs. In Banyu Urip, paper and card seem to find a ready market in the mask-making industry locally. In *la zona sur*, a home-based carpenter who makes furniture and table-football games collects offcuts to make stools and benches, and sells the sawdust resulting from his business to people who keep pigs. The burning of wood,

cloth, etc., for heating in winter or for cooking adds pollution to the atmosphere but probably little more than would be produced by other solid fuel sources.

Sometimes the waste products are recycled in unexpected ways. Mr C breeds songbirds in the Indonesian sample:

> "I just throw away [domestic waste], but I collect the bird droppings to be used as fertilizer by my friend. ... [Also], there's a type of *Perkutut* bird called the *Bangsawan Mas*, and they do all their droppings in one spot continuously …. those piles of droppings … are used as medicine. Although it hasn't been scientifically tested, a lot of people believe in its powers."

An account by Mr S,, who makes furniture in Banyu Urip, confirms how much recycling takes place and how little waste is eventually produced. He uses a type of foam as padding on chairs:

> "Oh, the excess is very sellable. … those unused foam pieces, I collected them again and sell them. ... It's Rp.3,500 per kilogram. And it's my own friend who buys from me. He uses them as materials for shoe making ... almost nothing is thrown away as worthless rubbish. Sometimes, if we must discard those cans, they don't last long in the rubbish bin. …I don't think there's a problem with the environment, because we don't cause pollution to anything. …when I throw away cloth leftovers from the chairs I repair, even before I throw them away someone comes and asks for them."

Potentially toxic waste can also be recycled. Cadmium, produced by a batik painter in Bhumeeheen Camp, is recycled within the HBE that produces it as he is aware of how dangerous it can be in the environment. A user of sytrofoam in Banyu Urip mixes waste pieces with fuel and makes glue for his own use. Car repair businesses also potentially represent significant producers of waste. However, the owner of the car repair HBE in Mamelodi is careful to keep his waste in the confines of his plot and also sells on scrap metal:

> "My wastes end up in this yard, I don't expose them. We do not dispose of them in the dump. …When they become many, we call a lorry and they take them and give us money so that we can survive. That's how we keep the place clean."

Fumes and dust

HBEs can have a detrimental effect on the community environment through the emission of fumes and dust. A few of the HBEs in the sample generate quantities of fumes or dust:

- The food preparers produce cooking smells and smoke and, in some cases, ash.
- In Mamelodi, several brewers create smells and smoke.
- The spray painters of cars, masks and cages produce unpleasant fumes (tables 1. and 2.).
- The shoe makers and repairers, and furniture makers use glues, paints and solvents that can give off noxious gases (table 2.).
- The screen printers generate fumes from compounds with potentially noxious components (table 2.).
- Metal workers and repairers generate toxic gases (table 2.).
- In Banyu Urip, a feather artist sprays his finished pictures with large amounts of insecticide.
- The hairdressers generate noxious smells from perming and relaxing liquids.
- The flour miller in Bhumeeheen Camp and some garment makers in *la zona sur* generate dust.
- The kerosene sellers generate volatile fumes from their fuel.
- The batik painter generates unpleasant gases in burning wax.

The above is a considerable list of sources of noxious or toxic dust and fumes. However, owing to the small scale of most HBE operations, the quantities generated tend to cause more problems as a health and safety issue for the immediate household, rather than an environmental issue for the wider community.

When asked about air quality, Bhumeeheen Camp residents identified the high-density living conditions and central urban location as the main causes of poor air quality. There are clearly some practices that could be prohibited in order to improve air quality; one respondent faced particular problems from activities in neighbouring areas:

> "Some people burn electrical wires (to sell the metal), some burn tyres; there's also smoke from vehicles - the dirt here and the dirt from the road in the air."

The batik printer in Bhumeeheen Camp has an understanding of the dangers inherent in using volatile chemical dyes.

> "I'm careful about that. If the gas fumes go in through my nose in sufficient quantity, I can have a physical problem. I know that. The dealer I buy the dyes from also warns me to keep distance. I am as careful as I can be when I use that dye."

In Mamelodi, HBEs involved in the cooking of food often cook on open fires or *braais*, which generate smoke. However, not all smoke in the area is generated by HBEs. Charcoal stoves are commonly used there in winter for warmth at night despite the danger of death by carbon monoxide poisoning if used in an enclosed space.

Figure 3 Large manufacturing HBEs like this one in the Indonesia case study may be poorly ventilated

For HBE workers managing noxious substances or dust in small rooms, poor ventilation can sometimes give rise to health problems. Ventilation problems are less likely to occur in the South Africa and Bolivia case study areas, as the climate and the plot size provide people with the option of working outside. The research shows that workers who are affected by fumes generated by the HBE may create their own ventilation systems or wear protective clothing.

In Banyu Urip, the paints used to decorate bird cages and papier-mâché masks are noxious, and can damage the workers' health. In one example, Mr K has made a loft above the ceiling and, when he paints masks with spray paint, he goes up there and removes some roof tiles to eases the passage of the fumes up into the air and away from the neighbourhood. Another mask and toy maker, Mr MJ, uses a facemask when he saws wood, and realises the importance of taking a break and drinking milk if he starts to feel dizzy from the spray paint.

Figure 4 A highly decorated bird cage air-brush painted in Banyu Urip, Indonesia. The plain cage comes from Madura Island

Discussion: to what extent should HBEs be controlled to reduce pollution?

Governments in many countries, either directly or through municipal authorities, have concerned themselves in regulating the use of residential premises for enterprises through "top-down" planning control. They try to balance private benefit and public good, to limit freedom when it would have results beyond the bounds of what a society will tolerate. The challenge to policymakers is to determine where those bounds lie and to enact laws that will deter and punish excesses without inhibiting the people's activities and opportunities within them (Iversen, 1988).

This recognises the contribution of HBEs to improving residents' livelihood strategies. Butler (1988) agrees that planners currently have a difficult balancing role to fulfil. Although they recognise the need to allow or to promote HBEs that meet the needs and demands of residents, they are also called upon to safeguard the residential qualities of a neighbourhood for all the people who live there. However, town planning is changing. In the past, it was enough to know how to control development, to preserve the amenity of an area and to stop "slums"[8] forming. Currently, planning is becoming a more promotional activity, seeking to add governance gains to the physical environmental concerns.

A 'promotional' stance would see HBEs as a valid response to household poverty and would attempt to balance the exigencies of making a living with the need to preserve neighbourhood amenity. It may also be expressed, probably without too much distortion, as favouring the struggle of people in poverty to make ends meet versus the desires of middle and upper income groups to have an attractive and ordered city.

[8] Whatever they are. Indian planners have a definition to work to; most others just attach the word to housing they do not think is acceptable. For the rest of us, the Global Report on Human Settlements for 2003 (UN-Habitat, 2003) has reintroduced the use of the word into the mainstream as shorthand for inadequate housing despite the protestations of some of those who wrote it!

On the other hand, Iversen (1988) points out that a 'protective' view of government would argue that one of its major functions is to protect its citizens from potential harms and maximise equality in the distribution of benefits. In a 'responsible choice' view, government's purpose is seen as safeguarding the right of individual initiative and equality of opportunity by giving individuals full freedom to benefit from their activities as well as to bear the consequences of them. As Iversen (1988) claims, however, on the evidence available, a better case can be made for outlawing cigarette smoking than for prohibiting HBEs.[9]

Working in a developed world context, Iversen (1988) recommends enforcing the wage, hour and child labour laws, and informing entrepreneurs and their workers so that they can judge the lawfulness of their working conditions. This is in line with ILO (1991) in which the Director General suggests that basic rights of employees should be fulfilled while enforcement of the less basic employment conditions could await improvements in the economy, and with the more recent 'decent work' literature (e.g., ILO, 1999; Bescond et al., 2003; Ghai, 2003).

It is quite common to list the uses that are allowed or prohibited, as in New Delhi and Durban, and many local authorities in the USA have a "Home Occupation Ordinance" that typically includes a list of permitted and prohibited home occupations (Butler, 1988).[10] A fixed list may be unhelpful as there is no way of knowing whether those not listed are excluded deliberately or through oversight, and it contributes little to handling new, unprecedented HBEs, some of which may be desirable in a neighbourhood (Butler, 1988). There are other ways of proceeding, however. In Long Beach, California, the local ordinance specifies the standards with which any HBE must comply and then lists those that have been approved and those that have been turned down. This provides a useful model for a flexible set of guidelines for

[9] Of course, in 1988 a ban on smoking was much more unlikely than it might be in 2004 when bans on smoking in public places are well established in the political agenda.

[10] The definition of a home occupation (HBE) in the local home occupation ordinances in the USA may be as simple as any activity carried out for financial gain by a resident conducted as an accessory use in that resident's dwelling.

assessing HBEs. It allows a prospective HBE operator to predict what the city is likely to accept as appropriate home-based work (Butler, 1988). It would be advisable for both New Delhi and Pretoria to look at this way of providing a helpful list rather than the prescriptive catalogue approach towards which they are currently inclining.

One of the most important aspects of regulating HBEs through these "Home Occupation Ordinances" is to ensure they remain secondary to the main use of a residence, "that the home occupation tail does not begin to wag the residential dog" (Butler, 1988). To ensure this, there may be restrictions on scale, structural alterations, signs to advertise the business, number of employees, amount of goods stored, scale of sales, and equipment (Butler, 1988); but nothing on level of pollution, presumably because all such uses are unlikely to be approved.

The unwritten rule in enforcement of home occupations for most communities is that, if no-one complains, there is no problem. This is practiced in the Surabaya study area. However, local ordinances that successfully balance the rights of home-based workers with the concerns of neighbourhood residents must be clear in the guidance they give to both zoning regulators and HBE operators (Butler, 1988) as this will limit the exploitation potential inherent in this approach.

In the study areas, the potentially highly polluting HBEs are in the minority. Most HBEs are simply shops or production and service uses that extend household activities such as cooking and sewing into the money-earning realm. Along with Perera and Amin (1996), the study found that HBEs seem to have little polluting effect on their neighbourhood environment. In line with Napier et al (2000), it appears from all the samples that the impact of HBEs on solid waste generation is mainly that of concentrating waste production. More food is thrown away, more paper waste generated, etc., than would be from purely domestic uses. The impact of this concentration, however, is sometimes reduced by the recycling of waste to be used in other businesses. In line with poor neighbourhoods the world over, the case studies have varying degrees of problems with ineffective solid waste disposal. As HBEs increase the quantity of wastes produced, even if they do not affect their nature overmuch, their presence will test out the efficiency of the local disposal system and show up its shortcomings. There is a need for policy-making to improve solid waste disposal in low-income neighbourhoods and to take account of the presence of HBEs

in the expected yields per household or per hectare. Other countries may be able to learn from the organised waste collection in Indonesia through the small, recycled rubber containers.

The reduction of wastes is an obvious focus for attention within the Brown Agenda with respect to all industrial operations, large or small. Many environmental protection strategies seem to be of a command-and-control nature using regulations and economic incentives based on the principle of the polluter pays. Attention is paid to preventing polluting outflows through end-of-pipe equipment. However, a more effective method, and one which is becoming more common in industrialised countries, is a switch to cleaner production methods aimed at preventing the pollution being created (Frijns and Van Vliet, 1999: 973-974). The first steps forward to cleaner production processes can be achieved with only minor adjustments. For example, using less polluting raw materials; adapting production processes to use equipment more efficiently and introducing clean technologies; improving “housekeeping" practices (such as maintaining equipment, reducing spillages, etc., and monitoring and record keeping); and recycling of wastes, either on-site or as a useful by-product (Frijns and Van Vliet, 1999: 975). Such measures can reduce costs, improve working conditions, and generate reductions in pollution. They also tend to be more energy efficient, use fewer resources, and re-use waste materials.

There is a challenge in how to encourage very small enterprises to be involved in such improvements to working conditions arising from pollution beyond their perception of risk. It is obvious from the study that most users of hazardous materials take precautions but they are often rudimentary and intermittent, and unlikely to solve entirely whatever health problems might arise from their operations. To improve working conditions, workers should be provided with protective gear and equipment and trained in health and safety and improved housekeeping to reduce occupational health hazards. Although the introduction of such pollution prevention measures requires changes in attitudes among entrepreneurs and authorities alike, van Berkel (1996) claims that they can be paid for on average in less than one year especially as, if they are healthy and satisfied, workers are likely to work more effectively (Frijns and Van Vliet, 1999: 975).

Pallen (2001) recommends more research and experimentation into how natural systems, such as wetlands, can be managed to absorb and neutralise pollutants. He also recommends clustering HBEs to facilitate, *inter alia*, effective waste treatment but warns that, without waste management in place, clustering could be more harmful through concentrating wastes.

There have been successes in demonstrating how small scale industries can minimise waste, including the DESIRE project ("demonstration in small industries for reducing waste") in India, sponsored by UNIDO and conducted by the National Productivity Council in 1993-94. Many of the measures could be implemented with little cost and resulted in significant economic savings as well as in remarkable environmental improvements (Chandak, 1994, cited in Frijns and Van Vliet, 1999: 975-976).

Frijns and Van Vliet (1999: 976) recommend that small businesses should be given incentives to undertake environmental changes. This may be through a mixture of the "carrot" of information about increased efficiency and cost saving, and the "stick" of environmental legislation effectively enforced. It is desirable to involve HBE operators in the development of such programmes as they will be more likely to adopt improved measures if they have helped to develop them. Trades associations and craft guilds can be helpful in participatory processes and in disseminating information about improved practices (Frijns and Van Vliet, 1999: 975-976).

Conclusions

The survey was not centred on waste generation but it has been possible to garner some information from it to point ways forward for research and practice in HBEs. The most important is that, for the most part, HBEs that generate dangerous fumes and wastes are in a small minority in the study areas. Most HBEs are fairly benign in their environmental effects; they do not pollute sufficiently for environmental considerations to be used as an excuse to harass them or to continue the negative attitude to their operation existing in many regulatory systems. However, there is room for improvement and this should be focused on the actual circumstances of HBEs rather than prejudices. Certainly, an analysis of wastes generated and processes used in particular areas should be a necessary precursor to any policy directed towards improving their environment.

If local authorities invest more in waste collection, and regard low income neighbourhoods as likely to produce more than just domestic waste, many of the problems could be solved at a stroke. The introduction of recycling may assist in covering the cost of the solid waste collection and processing system, but there may be such effective spontaneous recycling that the yield may be fairly low at a central dump.

Some of the HBEs certainly generate dangerously polluting materials and may need to be the subject of prohibition. However, as they represent people's livelihoods and are probably filling a market need, other methods of mitigating the problem should be tried first. These should include the promotion of cleaner processes and involving trade organisations in participatory regulatory systems.

There may still be a case for prohibiting some processes from HBEs. A first list to be made might include metal plating, battery recovery, tanning and dyeing, unless cleaner production methods can be developed and/or adopted. Recycling can be encouraged if there is a market for the material. Where no local market exists for, say, recycled plastics, government should invest in its development before it can expect people to recycle the material.

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