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**CHANGING UNSUSTAINABLE PATTERNS  
OF CONSUMPTION AND PRODUCTION**

**HUMAN SETTLEMENTS AND WATER**

Submitted by:  
United Nations Department of Economic and Social Affairs  
Division for Sustainable Development

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**BACKGROUND PAPER NO.4**

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## INTRODUCTION

1. The Johannesburg Summit noted that fundamental changes in the way societies produce and consume are indispensable for achieving global sustainable development. It agreed that all countries should promote sustainable consumption and production patterns, with the developed countries taking the lead and with all countries benefiting from the process. For this purpose, the Johannesburg Plan of Implementation (JPOI) called for the development of a 10-year framework of programmes in support of national and regional initiatives to accelerate the shift towards sustainable consumption and production to promote social and economic development.<sup>1</sup>
2. The CSD, in its post-Johannesburg programme of work, identified changing unsustainable patterns of consumption and production as a cross-cutting issue to be considered in the context of the themes for each of its sessions. The Commission also decided to include the 10-year framework of programmes on sustainable consumption and production as part of the thematic cluster for detailed consideration during the 2012/2013 cycle.
3. As part of the implementation of the JPOI, an International Expert Meeting on the 10-Year Framework of Programmes for Sustainable Consumption and Production was organized in Marrakech, Morocco, 16-19 June 2003. In view of the themes to be discussed at CSD-12 and 13, the meeting requested the United Nations Department of Economic and Social Affairs, together with UN-HABITAT, and in collaboration with UNEP and other relevant organizations, to prepare a report on the actions needed at the international level to support national action in the waste, transportation, construction, and water and sanitation sectors, relating to sustainable consumption and production.<sup>2</sup>
4. A Background Paper was submitted to CSD-12 reviewing efforts in various countries toward making consumption and production patterns more sustainable with respect to the 2004-2005 thematic cluster, in particular human settlements and water.<sup>3</sup>
5. The present paper, building on the initiatives taken by countries, identifies a number of policy options and actions that have proven effective in making consumption and production patterns more sustainable and that could be used by other countries.
6. The present paper is intended to complement the reports of the Secretary-General on human settlements, water and sanitation,<sup>4</sup> focusing on aspects of those themes related to sustainable consumption and production. While the reports of the Secretary-General focus primarily on the poverty-related aspects of human settlements, water and sanitation, particularly on slum improvement and expanding access to safe drinking water and sanitation, the present paper focuses on changing unsustainable patterns of consumption and production, primarily due to over-consumption by those with significant disposable income. However, in considering policies and actions for changing unsustainable patterns of consumption and production, consideration should also be given to the impacts of those policies and actions on poverty as well on the environment and long-term economic development.

7. The policies and actions considered here do not constitute a comprehensive survey of the field, but are intended to highlight some of the successful approaches and practices to changing unsustainable patterns of consumption and production. They are also selected taking into account their potential applicability to other countries or regions. The paper is intended to stimulate international cooperation and exchange of experience and information. The policies and actions considered are accompanied by references to sources of further information.

8. The paper does not generally cover sanitation issues, other than wastewater treatment, as those issues are covered in the SG report on sanitation. On the issue of water, the paper focuses on water consumption and water efficiency in the household and industrial sector, as water consumption and efficiency in agriculture are covered in the SG report on water.

9. As the 2006-2007 sessions of the Commission (CSD-14 and 15) will focus on energy for sustainable development, industrial development, air pollution/atmosphere, and climate change, those issues are not addressed in this paper.

## **I. HUMAN SETTLEMENTS**

### **1. Urban planning**

10. Cities with high population densities use substantially less land, energy and water per person than low-density cities or suburban areas with large and widely spaced individual houses. The spatial development of cities, whether compact and high-density or sprawling and low-density, depends on long-term urban planning and on fiscal structures and economic incentives. Zoning regulations govern housing density and mixes of residences, shops, offices, factories, schools and hospitals. Government tax incentives and subsidized mortgages for house building and home ownership promote the development of suburbs with separate private homes. Rental apartments in high-density urban areas, although generally more sustainable, are rarely given economic incentives. Zoning that separates residential areas from commercial areas, rather than mixing the two, also promotes the use of cars, rather than walking or cycling, and increases average trip length. Public spending on transportation infrastructure that goes disproportionately to road building also promotes and subsidizes the use of cars.

11. Improving urban planning to make cities more sustainable, and increasing the quality of urban life generally, requires integrated urban planning and management, involving cooperation among agencies responsible for land use, environment and transportation. Such agencies, however, have different and often conflicting priorities. Transportation policies, for example, commonly contradict environmental policies, for example by promoting the use of cars. In addition, many metropolitan areas consist of a number of independent towns with their own planning processes and priorities, and central cities and suburbs often have conflicting interests. National spatial planning agencies can help in setting integrated national standards and policies,

as illustrated by the Netherlands Ministry of Spatial Planning, Housing and the Environment; and the Danish Spatial Planning Department within the Ministry of the Environment.

12. Some large cities that consist of a number of municipalities with separate political and financial structures have established metropolitan agencies to coordinate roads, transportation systems, land use planning, schools and water supply for the metropolitan area, as illustrated by Toronto, Canada, and Portland, Oregon, United States.

13. In some countries, such as France and the United States, the political difficulties of creating a new level of policy-making authority have led national governments to use incentives to promote larger-scale integrated planning, such as making central government financial support for local authorities dependent on regional coordination. In some cases, a strong political leader can push local sectoral agencies into coordinating their efforts, as demonstrated by Mayors Jaime Lerner in Curitiba and Enrique Peñalosa in Bogotá.<sup>5</sup>

14. Some cities, notably in Brazil, have introduced “participatory budgeting,” with public debates on municipal programmes and priorities, to help ensure that urban planning meets the needs of all. Porto Alegre, Brazil, in the 1990s, organized public discussions on five themes: transportation; education, leisure and culture; health and social welfare; economic welfare and taxation; and city organization and urban development. As part of each annual budget process, discussions on these themes are organized in each of 16 districts of the city, and priorities are developed, with higher priority given to under-serviced areas. These priorities are then reflected in the city budget. This process has contributed to urban development, including expanding access to water services from 80% of households in 1989 to 98% 1996, expanding coverage of the sewage system from 46% to 85%, doubling the number of children in public schools, and substantially increasing public tax revenues by increasing the willingness of citizens to pay. Public participation in the process has steadily expanded, and the urban political culture has changed from one of dispute and protest to one of dialogue and negotiation. Participatory budgeting has subsequently spread more than 100 other communities in Brazil.<sup>6</sup>

## **2. Urban transportation**

15. The economics of urban transportation depends to a large extent on population density. In large low-density sprawling cities, public transit may not be cost-effective, and distances are too large for walking or cycling for most people. Research in Australia indicates that public transit is financially viable only with a population density greater than about 30 people per hectare. Many European cities have about 50, while many cities in the United States average about 14 people per hectare.<sup>7</sup> In some low-density cities in the United States, 95% of people commute to work in private cars. In many European cities, on the other hand, with higher population densities, efficient and attractive public transit, and arrangements for convenient and safe walking and cycling, a majority of people commute to work by public transit or non-motorized transport. In Tokyo, nearly 92% of commuters to the downtown area travel by rail. In some major cities in

middle-income countries, such as Bangkok and Kuala Lumpur, the majority of people commute to work in private cars despite the financial cost, due to the lack of attractive alternatives.<sup>8</sup>

16. Provision of free or highly subsidized parking by employers promotes the use of private cars. If such benefits are assessed at their market value and taxed as income, then workers will have an incentive to use other means of transportation. Alternatively, public policy can allow employers to provide comparable tax-free compensation for use of public transport, as has been introduced in the United States for example.

17. While most public funding for transportation in most countries goes to roads, in some, such as the United States, the share of funding going to public transit has increased in recent years, including funding for environmental measures such as low-emissions buses, alternative-fuel fuelling facilities, service facilities for clean-fuel vehicles, and use of bio-diesel fuel (from vegetable oil).<sup>9</sup>

18. While cars offer convenient, flexible and rapid transport in rural areas and smaller cities, for the growing number of megacities, travel by car is commonly slow, expensive and unhealthy, due to congestion, the costs of car ownership and parking, and air pollution. Rush hour speeds in the core areas of cities such as Bangkok, Manila and Jakarta are 6 to 8 km/hr, not much faster than a brisk walk. In many large cities of the developing world, less than 10% of the land is devoted to roads, less than half of the share in most European and North American cities, leading to greater congestion despite the smaller number of cars relative to population in the developing countries. The megacities of the developing world thus need efficient mass transit systems and other alternatives to cars even more than cities of the developed world.<sup>10</sup>

19. Some cities in developing countries have developed innovative urban rapid transit systems based on dedicated bus lanes along radial routes from the city centre. To speed loading, passengers pay their fares in advance in shelters at the stops, as pioneered in Curitiba, Brazil, in the 1970s and 1980s. Similar systems have subsequently been developed in Bogotá and Jakarta.<sup>11</sup> Such systems can provide efficient rapid transit on main routes for less than 1% of what a subway would cost. Such systems can be public-private partnerships, with private bus operators providing much of the investment. During the planning process, the city can purchase land along the planned routes to build affordable high-density housing for low-income households.

20. The “finger plan” approach to urban development can help promote public transit and reduce the need for cars. High-density housing combined with retail stores are concentrated on a few axes (fingers) extending out from the centre of the city, and these axes are well served with rapid transit systems, whether subways, light rail or dedicated bus lanes. The land in between the fingers can be used for parks or other low-density uses. Land along rivers in cities can be used as park land with foot and bicycle paths, providing flood protection as well. This approach has been very successful in reducing vehicle traffic and improving the quality of urban life in such cities as Copenhagen and Curitiba, Brazil.<sup>12</sup>

21. In some cities, municipal authorities have consulted with environmental groups, alternative transportation organizations and others to develop plans for more sustainable transportation systems that meet the needs of all. The municipal authorities of Santiago, Chile, for example, invited the Ciudad Viva organization of community groups concerned with urban development, community participation, transportation and waste management to participate in an urban reform task force. The views of the organization, which was originally formed to protest a proposed toll highway through the downtown area, have also influenced the establishment of dedicated bus lanes and limiting the largest streets to public transit on high pollution days. One of the results of this collaboration has been a considerable increase in public transit use.<sup>13</sup> More recently, the organization was consulted in the development of a project funded by the Global Environment Fund (GEF) to improve transportation and reduce air pollution in Santiago.<sup>14</sup>

22. Some cities have effectively reduced congestion and pollution through efforts to promote public rapid transit together with walking and cycling through improved sidewalks and bicycle paths, pedestrian streets, bicycle parking facilities, reduced car-parking space, and promoting high-density residential and commercial development around transit stations. In Bogotá, Colombia, such measures have cut rush-hour commuting times in half and reduced pollution levels. Bogotá has also been experimenting with selectively banning cars from some streets at certain times, and the experiments have proven popular.<sup>15</sup> In the United States, such measures have enabled Portland, Oregon, to enjoy economic and population growth while reducing property taxes, commuting time, energy consumption and air pollution, and improving the perceived quality of life.<sup>16</sup>

23. Some cities have used road tolls that depend on the time of day and traffic conditions to optimise traffic flow while encouraging use of bus and light rail mass transit systems, an approach pioneered by Singapore in the 1980s. Charges can be automatically deducted at toll points from an electronic card in the vehicle, so there are no toll booths to slow traffic. Singapore also limits the overall number of cars in the city through auctions for a limited number of license plates. As a result, Singapore achieves average rush hour speeds of 45-65 kph on expressways and 20-30 kph on city roads.<sup>17</sup>

24. Similarly, a “congestion charge” can be used to discourage the use of private cars in congested urban areas. London, for example, introduced in early 2003 a charge of \$9 for cars entering central London between 7am and 6:30pm, using monitoring cameras with automatic license number recognition. As a result, many commuters switched to public transit, traffic delays were reduced by one-third, average speeds have increased by 40%, and bus delays are down. Central city congestion charges have also been used successfully for years in Trondheim, Norway, and have recently been introduced in Toronto, Canada, and Melbourne, Australia. Zermatt, Switzerland, bans cars entirely from the central urban area, using its car-free status as a tourist attraction.<sup>18</sup>

25. In most large cities of the developing world, public municipal transport systems have not kept up with rapid urban growth, and informal transport services have grown rapidly to meet the growing needs and to respond to emerging demands for services not provided by the formal

system. The informal transportation sector thus provides essential transport services, especially for informal settlements and poor people. Pedicabs, mopeds, motorized tricycles and motorcycles are often the only vehicles that can penetrate the narrow alleys in informal settlements. Privately-owned vans, such as Manila's Jeepneys, Mexico's collectivos, Nairobi's matatus and Jakarta's mikrolets, serve larger streets for longer trips. This informal transport often complements municipal services, serving areas not served by municipal services and providing feeder services to the large buses on main routes, or to subway or rail services. Late at night, informal services may be the only means of transport for people who cannot afford cars or taxis.<sup>19</sup>

26. The informal transport sector provides up to 15% of urban employment – with sales and services providing additional employment - and is a particularly important source of employment for recent migrants to the city. In some cases, the “informal” services are actually regulated private transport services, while in other cases they are strictly informal and officially illegal but unofficially tolerated. The informal transport sector is often highly organized through route associations, informal codes of conduct, and even vehicle dispatchers.

27. The rapid growth of informal transport, while meeting essential needs and contributing to economic growth and poverty reduction, has also posed major challenges to sustainable urban development, in part because of lack of regulation. The vehicles are often old, highly polluting and unsafe, and operators usually have no insurance to cover injuries or damage. In many cases, informal transport vehicles are old used buses, vans or cars imported from developed countries. Because there are no official and protected stopping places for informal vehicles, they often load and unload passengers in the middle of traffic, usually in the busiest locations. Intense competition in the unregulated market may cause aggressive driving, and competition with formal public transit may reduce revenues for the formal system. Some cities are addressing these problems by licensing and regulating the informal sector, setting vehicle standards and insurance requirements, excluding pedicabs or other small, slow vehicles from major streets, limiting the number of vehicles, and establishing waiting and loading points off the busiest streets.<sup>20</sup>

28. Older vehicles are a disproportionate source of air pollution due to lower standards when they were built and deterioration of performance over the years, sometimes due to poor maintenance. Some countries, mostly developed countries, require periodic inspection of vehicles to eliminate those that do not meet standards. The old, polluting vehicles that cannot be used in those countries are sometimes exported to developing countries that do not have standards or inspection systems. To address environmental and safety issues arising from old cars, some developing countries restrict imports of used cars beyond a certain age. Bangladesh and Jamaica, for example, ban imports of used cars over four years old, while in Peru the limit is five years, and in Nigeria, eight years. While such restrictions are not as effective as standards applied to all old cars, they are much easier to administer. It should also be noted that restrictions that apply to imports but not to cars within the country raise issues of trade protectionism.<sup>21</sup>

29. Air pollution from traffic can be reduced through the use of clean vehicles and fuels. There has been a steady growth in sales of cars with hybrid gasoline-electric engines since the Toyota

Prius was introduced in 1997. Honda has since introduced cars with hybrid engines, and Ford introduced a hybrid sports utility vehicle in 2004. As of early 2004, consumers have bought almost 200,000 such cars, which consume fuel at about half the rate of comparable cars with conventional internal combustion engines. While these cars are somewhat more expensive than conventional cars, the savings on fuel over the lifetime of the car cover the extra cost. A survey of consumers conducted by the US Consumers Union rated the Toyota Prius and Honda Civic Hybrid as two of the three small cars with the highest customer satisfaction, as well as being highly reliable.<sup>22</sup>

30. Governments, local authorities and large institutions, as major consumers of goods and services, can use their large purchasing power to take a leading role in changing consumption patterns. Public green purchasing is part of a broad traffic programme of the City of Malmö initiated in 1995, including pilot projects such as purchasing electric-powered vehicles. A strategic feature of the programme is technical and policy cooperation between Malmö, its surrounding municipalities, and Stockholm and Göteborg, the two biggest cities in Sweden. The project is intended not only to reduce the environmental impacts of public vehicles, but also to serve as a model for the public, to inform them about the use of such vehicles, to demonstrate their practical use, and to stimulate public demand for such vehicles. Other elements of the programme were a municipal bicycle fleet and a requirement that road construction contractors comply with environmental criteria and have an environmental management system (e.g. EMAS, ISO 14001). By 1999, 23 per cent of the municipal vehicle fleet was powered by electricity, compressed natural gas or bio-diesel, and 75 per cent of municipal buses were powered by natural gas. The coordinated introduction of these policies and programmes in the biggest cities of Sweden facilitated the process and enhanced its impact, and the large number of electric vehicles ordered together increased the interest of suppliers. The municipal programmes have also had an impact on the development of Swedish national legislation and guidelines.<sup>23</sup>

31. New York City has an Alternative Fuels Program, implemented by the City's Department of Transportation since 1993. The main objectives of the programme are reducing air pollution and promoting the use of alternative fuels by both public and private vehicles. Under this programme, public fleets in New York are being replaced with alternative fuel vehicles, currently including over 6000 natural gas, hybrid, E85 (ethanol) and electric vehicles. The main alternative fuel at present is compressed natural gas (CNG). Natural gas buses produce an average of 97% less particulate matter, 84% less carbon monoxide and 58% less nitrogen oxide compared with conventional diesel engines. There are currently 17 CNG fueling sites within New York City, mostly owned and operated by the two New York City utilities, KeySpan and Con Edison, and all offer service to the public. New York also provides financial incentives for taxis that use CNG. At the United States federal level, an Executive Order issued in 2000 requires any federal agency operating 20 or more motor vehicles to reduce petroleum fuel consumption by 20 per cent by 2005 compared to 1999. To meet the objective, agencies are required to acquire alternative fuel vehicles and to increase the average fuel economy of new vehicle operations by 3 miles per gallon (mpg) by 2005 compared to 1999.<sup>24</sup>

32. Bicycles can be an effective means of reducing traffic congestion and air pollution. Four to eight bicycles can use the road space occupied by one car, and 20 bicycles can park in the space occupied by each car. Cycling is also much less expensive than public transit, not to mention private car travel. Lima, Peru, is promoting bicycle use, including through a revolving fund supported by the World Bank providing credit vouchers usable in bicycle shops. In Kenya, a luxury tax on bicycles at the rate of 80% until 1986 was gradually reduced, and finally eliminated in 2002, resulting in a large increase in bicycle sales. Most African countries still tax bicycle imports as luxury items, limiting access by poor people to low-cost and environmentally sound transportation.<sup>25</sup>

33. A major deterrent to cycling as a means of urban transport is concern about safety. Construction of bicycle paths or separate bicycle lanes can be very effective in promoting cycling. Denmark and the Netherlands have extensive systems of bicycle paths and lanes, and many Chinese cities reserve traffic lanes exclusively for bicycles. Mexico City, in February 2004, inaugurated the first 5 km section of a planned 90 km bike-way network. Allowing and facilitating the transport of bicycles in subways and trains and providing safe and convenient bicycle parking at train stations allows a combination of local cycling and longer distance rail travel for trips that are too long for cycling and inconvenient by rail alone. Some cities, however, as vehicle traffic has increased, have discouraged or even banned bicycles from some streets.

### **3. Solid waste management and recycling**

#### **(a) Solid waste collection and disposal**

34. Solid waste is a growing problem in cities all over the world. While developed countries have in recent years reduced the environmental impact of solid waste through sanitary landfills and high-temperature incineration, the volume of waste is steadily growing. In the developing world, few cities have adequate waste collection and disposal systems, and the accumulating waste threatens health, damages the environment, and detracts from the quality of urban life.

35. In OECD countries, municipal waste averages 540 kg per person per year, ranging from 354 kg per person in Norway to about 800 kg per person in the United States. During the 1990s, total waste generation in OECD countries increased by about 14%, about half attributable to population growth and half to an increase in per capita waste generation. Most of the solid waste in OECD countries goes to landfills, but there is a growing trend toward incineration with energy recovery, with large differences between countries due in part to different geographical conditions and population densities.<sup>26</sup>

36. Well-designed sanitary landfills are used in many countries to manage the environmental impacts of solid waste disposal. Such landfills have a thick impermeable layer of clay and several inches of plastic at the base to prevent contaminated liquids (“leachate”) from polluting groundwater and nearby surface water. A drainage system collects the liquid leachate for treatment, and some of the methane generated by decomposition of organic matter is collected

and used as a source of energy, reducing greenhouse gas releases to the atmosphere at the same time. The solid waste deposited in the landfill is covered with soil within hours to reduce odour, vermin and health hazards. Such sanitary landfills are costly and are most cost-effective when large. As a result, a large number of small municipal or local “dumps” have been closed, with waste being transported longer distances to large sanitary landfills serving larger regions. In the United States, for example, which relies on landfills for about 86% of waste disposal, the number of landfills has declined from about 8000 in the late 1980s to about 2500 in the late 1990s, in response to the 1976 Resource Conservation and Recovery Act, while the total capacity has increased.

37. Incinerators that use municipal solid waste substantially reduce the volume of waste and can generate electricity and/or heat when the waste stream contains substantial combustible material. Modern incinerators use high-temperature combustion and emissions control systems to minimize emissions, particularly of dioxins, furans and other toxic gases produced by combustion of plastics and other waste. Incinerators also produce substantial quantities of ash with concentrations of heavy metals and other toxic wastes, which must be handled as toxic waste and disposed of in special toxic waste landfills. In the European Union, pollution emissions from incinerators have been reduced since 1990 through the closing of many old small incinerators, the introduction of emission cleaning systems, and higher temperature incineration.<sup>27</sup>

38. The relative costs and benefits of incineration and landfill for disposal of municipal solid waste depend largely on the combustible contents of the waste and the cost of land for landfill. The choice will also depend on political choices among the aesthetic and environmental impacts of incinerators versus landfills. The United States, with relatively abundant land, relies largely on landfills, whereas a number of European countries, more densely populated, rely more on incineration.<sup>28</sup> The choice of disposal options will also depend on recycling policies, as collection and recycling of paper products and wood will make incineration less economic by reducing the combustibility of the waste.

39. Most developing countries do not have the financial resources to provide municipal solid waste collection services on a house-to-house basis, in particular in low-income neighborhoods where access for large vehicles is limited. There, scavenging and informal recycling have long been the norm, and government policy has begun to focus on how to make such systems work more effectively and safely, recognizing their importance not only to waste collection and recycling of useful materials, but also to employment of the unskilled. The World Bank estimated in 1995 that scavenging employed 7000 workers in Manila, 8000 in Jakarta, and 10,000 in Mexico City. In cities in Egypt, India, Indonesia, and the Philippines, scavengers collect household waste door-to-door with handcarts. Support measures include legalizing scavenging activities, encouraging formation of scavenger cooperatives, awarding contracts for collection of mixed wastes and recyclables, and establishing public-private partnerships between local authorities and scavengers.<sup>29</sup>

40. A problem for individual scavengers is that industry often demands a minimum quantity from suppliers, so scavengers have to sell through middlemen. The middlemen can often take most of the profits as there are few of them and many scavengers. By forming their own cooperatives, scavengers can bypass the middlemen and increase their earnings. In a number of countries in Latin America (Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Peru, Venezuela) and Asia (India, Indonesia, Philippines), scavengers have formed cooperatives and become part of formal solid waste management programmes. Through such programmes, refuse collection has been expanded at relatively low cost, creating jobs and benefiting low-income communities. Instead of being a problem, scavengers can be part of the solution to the problem of solid waste collection and disposal in the cities of low-income countries.<sup>30</sup>

41. Cairo, Egypt, has had for decades a large, well-organized informal system of garbage collection that collects about one-third of the 9000 tons of solid waste generated every day, mostly from the more affluent neighbourhoods. The activity provides employment for about 40,000 people who collect, transport, sort, sell and remanufacture discarded material. About 80% of the waste is either recycled by the collectors or sold to others who reuse or recycle it, probably the highest municipal waste recycling rate in the world. A major problem for the system has been requirements by the city authorities to move the activities out of town in an attempt to clean up the urban neighbourhoods. The system is also now threatened by the new national policy to contract out waste collection to large "modern" waste management systems.<sup>31</sup>

42. In Madras, India, there are almost 1000 civic groups called EXNORAs, each comprising about 70 families, with contributions varying from \$0.02 to \$0.40 per family. The groups hire "street beautifiers" who collect the garbage in the area. The garbage collected is separated and the reusable materials are sold to scrap dealers for recycling, with the income augmenting the street beautifier's salary. The organic waste from several streets is taken to a common collection point for the municipal authorities to transport to the dumping yards, facilitating the collection work of the municipal authorities. Some 18 percent of the garbage of Madras is collected each day through this system, and 1500 jobs have been created.<sup>32</sup>

43. In Dhaka, Bangladesh, the city provides waste collection services from collection points in middle and upper income areas. Household collection occurs in some areas on a small-scale, organized by residents, entrepreneurs or groups organized for other purposes offering waste collection as a public service, in some cases with support from local politicians. Waste collection is sometimes combined with street sweeping. A survey in 2000 identified 250 such local initiatives. One example is a youth club that collects waste from 300 households for \$0.40 per month. Another example is an entrepreneur who has two bicycle rickshaws and six workers to collect waste in a middle-income neighbourhood, with 700 households paying \$0.30 per month for daily waste collection. Some households pay the collectors an extra fee for door-to-door collection. The collectors separate paper, bottles and plastics for resale. A common problem in such arrangements is opposition to the collection of neighbourhood household waste in larger containers for collection by the municipal collection system, which transports it to a disposal site. Households do not want these collections container near them due to the smell.<sup>33</sup>

44. In most urban areas in Africa, there is no public municipal waste collection. In some areas, waste collection is undertaken by neighbourhood organizations or small entrepreneurs. In the Sainte Rita community in Cotonou, Benin, some 2700 households and organizations pay monthly fees to a community programme that trains and employs youths to collect their waste. Recyclable paper and plastic is sold for reprocessing and organic material is composted for the programme's farming operations.<sup>34</sup>

45. In Lusaka, Zambia, in 2000, the Sustainable Lusaka Programme of the Lusaka City Council organized a similar system, providing training and grants to community organizations in low-income neighbourhoods to form household waste collection enterprises serving 200-1300 houses. Trainees were given loans to buy vehicles, boots and safety clothes. Households and shops were informed of the services and fees and invited to subscribe for \$0.20-0.40 per house and \$1 per shop. While many did so, some of the organizations were not well run, had problems collecting fees, could not cover their costs, and the number of subscribers has declined. As in Dhaka, there were problems in transferring waste from the primary neighbourhood collectors to the secondary municipal collectors, which served only the middle- and upper-income neighbourhoods.<sup>35</sup>

46. Dar-es-Salaam, Tanzania, has a population of 2.5 million, 75% of whom live in unplanned settlements. Waste accumulation there had reached a crisis point in 1992, with only about 2% of the waste collected by the municipal collection system, and the rest accumulating in streets and around market places and clogging drainage systems. In 1992, the city organized a consultation on the issue with public, private and community organizations. With international support, the municipal collection system was expanded, with household waste collected by hand-carts. Most of the formal city area is now covered by 20 private companies charging monthly fees of \$3 and employing a total of about 1500 workers. Some 24 community organizations and NGOs employing about 800 workers cover parts of the unplanned settlements, receiving municipal subsidies and charging monthly fees of \$0.30. About 33% of the 2400 tonnes of waste generated is now collected, with about 9% of that being recycled.<sup>36</sup>

#### **(b) Waste reduction and recycling**

47. Governments and other organizations can assist in municipal solid waste management by reducing the quantity of waste they generate, both in their own operations and through the materials they purchase. In Canada, the city of Toronto launched a programme on "Governments Incorporating Procurement Policies to Eliminate Refuse" (G.I.P.P.E.R.) to coordinate efforts by various levels of government to include environmental criteria into public purchasing procedures, with a focus on waste reduction. The programme produced G.I.P.P.E.R.'s Guide to Environmental Procurement, the third edition of which was published in 2002, with guidelines for reducing waste generated by government activities, building markets for recycled materials, and joint purchasing by public agencies to increase their impact.<sup>37</sup>

48. Recycling reduces the amount of solid waste going to landfills or incineration, while also reducing the demand for virgin natural resources and energy. Most developed countries have been promoting recycling by both industry and households. In OECD countries, recycling rates are increasing and now average over 80% for metals, 40-55% for paper and cardboard, and 35-40% for glass.<sup>38</sup> Recycling is most cost-effective for aluminium, other metals and paper, and least cost-effective for plastics and glass. Recycling is generally more cost-effective for waste from industry, which often produces large volumes of uniform waste. Collection of household waste for recycling is less cost-effective because of the high costs of collecting and sorting mixed wastes in relatively low volumes. Demand, and therefore prices, for recycled materials have generally been low, in part because industries are reluctant to invest in systems to process recycled material - which often differ from systems for virgin raw materials (e.g. recycled paper vs virgin wood pulp) – given the uncertainties of volume, price volatility and the variability in the characteristics of recycled waste. Economic analyses of municipal recycling of household waste indicate that it is often more expensive than landfill disposal, particularly where inexpensive land is available.

49. To reduce waste generation and promote recycling, Denmark in 1987 introduced a landfill tax, which has gradually increased to 50€ per tonne, roughly doubling the cost of landfill disposal. Somewhat lower taxes are charged on incineration, with incineration with energy recovery taxed at a lower rate than incineration without energy recovery, as incineration with energy recovery is considered the best option for final disposal in Denmark. As a result of this and other measures, reuse and recycling of waste in Denmark increased from 21% in 1985 to 60% in 2000. The Netherlands also has a high landfill tax, which was increased in 2000 to 70€ per tonne.<sup>39</sup>

50. Efforts have also been made to encourage households to reduce waste disposal and increase recycling by charging households per container of non-recycled household waste. In the United States, for example, about 4000 communities have introduced such charges. However, the effectiveness of such programmes is unclear; the number of containers decreases, but the amount of waste in each container increases. Furthermore, such programmes may increase illicit dumping, with substantially greater environmental damage than proper collection and landfill disposal.<sup>40</sup>

51. To increase demand, and therefore prices, for recycled material, and to encourage the introduction of technologies using recycled material as input, some communities have passed laws requiring government offices, and in some cases even private business, to buy products such as paper with a certain proportion of recycled material. These measures, however, have been difficult to administer and enforce. The fact that waste collection and recycling is commonly the responsibility of municipal authorities rather than national governments can make it difficult to develop national policies or build national markets.

52. Packaging makes up a growing share of the waste stream in most countries. Germany, in 1991, began a programme to reduce and recycle packaging waste, including product and transport packaging, through a Packaging Ordinance that requires manufacturers to pay the cost

of recycling the packaging from their products and to achieve a recycling rate of 60-75%, depending on the material. While some companies developed schemes to comply with the Ordinance on their own, many manufacturers joined forces with retail firms and waste collection companies in the German Dual System or Green Dot system in order to reduce costs through economies of scale. Participating manufacturers place a green dot on their packaging and pay the waste collection companies for the green dot packaging they collect for recycling. Packaging recycling in Germany is thus a national rather than a municipal programme as elsewhere. As a result, packaging in Germany declined from about 96 kg per person per year in 1991 to 77 kg in 2002, a reduction of about 20%. Of over 6 million tonnes of packaging waste collected, some 5.3 million tonnes were sent for recycling, an 84% recycling rate.<sup>41</sup>

53. The Green Dot programme has been expanded to the European level in response to the 1994 European Packaging Directive and is now operational in 20 European countries with some 95,000 participating enterprises. Participating waste collection programmes are organized in the Packaging Recovery Organization Europe (PRO-Europe). For goods imported from outside Europe, the European importer is responsible for meeting the requirements.<sup>42</sup>

54. Computers and other electronic equipment, containing toxic elements including lead, barium, chromium, cadmium, beryllium, brominated flame retardants and PVCs, are of growing concern with respect to hazardous waste. In the United States, for example, about 70% of the heavy metals in landfills come from electronic waste, and Silicon Valley in California has become seriously contaminated with toxic waste from electronics production. A large quantity of discarded computers and other electronic products from the United States, Japan and the Republic of Korea is exported to China and other developing countries in Asia for recycling, often under unsafe conditions.<sup>43</sup>

55. To reduce electronic waste going to landfills and incinerators, the European Union in 2003 adopted a Waste Electrical and Electronic Equipment (WEEE) Directive requiring producers, starting in August 2005, to take responsibility for recovering and recycling electronic waste without charge to consumers. On products sold before 2005, the costs of collection and recycling are to be shared by all producers, while later products, producers will be responsible for collecting and recycling their own products. This is intended not only to promote recycling, but also as an incentive to producers to design products to reduce waste and facilitate recycling.<sup>44</sup> In the Netherlands, Norway, Sweden and Switzerland, the purchase price of some electronic items includes an advance disposal fee to fund recycling.

56. The EU also adopted in 2003 a Directive on Restriction of Hazardous Substances (ROHS) in Electrical and Electronic Equipment (ROHS), banning, from July 2006, the use of lead, mercury, cadmium, hexavalent chromium and two brominated flame retardants used in plastics. China is developing regulations banning the same six substances, also beginning in July 2006, thus ensuring that Chinese products meet EU requirements.

57. The EU has also adopted a Directive on End-of-Life Vehicles to reduce waste going to landfills. By 2007, 85% by weight of every new vehicle must be made from recyclable components, up from the 75% metal that is now recyclable.<sup>45</sup>

58. Japan, as part of its Basic Plan for a Recycling Society, has been developing legal requirements for recycling. The 1998 Home Appliance Recycling Law came into effect in 2001. By 2003, collection of used air conditioners, TV sets, refrigerators and washing machines had increased by about 20%, metals were recovered for recycling, and CFCs (greenhouse gases) were recovered for disposal.

59. In 1995, the Danish government entered into an agreement with a number of organizations on a take-back scheme for used tires, with a goal of recycling 80% of scrap tires. Previously most scrap tires ended up in landfills. A consumer charge of about \$1 per tire on purchase is used to subsidize enterprises that collect tires and convert them into rubber granulate. In 1999, the take-back rate reached 87%.<sup>46</sup>

60. Mexico has adopted a National Omnibus Waste Law, which takes effect in January 2006. It requires producers, importers and distributors of products containing hazardous wastes to develop waste management plans for those products. Products currently covered include mercury and NiCad batteries and other products containing mercury, cadmium or lead. Argentina, Brazil and Colombia are also preparing legislation with producer take-back provisions.

61. In the Republic of Korea, following a Volume-based Waste Fee System and a Waste-Deposit Refund System, an Extended Producer Responsibility system was introduced in 2003, covering TVs, refrigerators, air conditioners, tires, lubricating oil, metal cans, glass bottles, paper packaging and plastic packaging material. Responsibility was subsequently expanded to cover fluorescent light bulbs and packaging film, and responsibility for electronic products is planned. Under the system, the Ministry of the Environment sets annual recycling obligations for each product and each producer or importer. The producers and importers than submit annual recycling plans and progress reports, and fines are imposed if the obligations are not met.<sup>47</sup>

#### **4. Sustainable construction, building management and household energy**

62. Concern over sustainability in the building sector has focused on three issues: energy efficiency, construction waste, and indoor air pollution. In recent years, many countries, including most OECD countries, have introduced policy measures to address these issues.<sup>48</sup> Traditional household biomass energy consumption and the resulting indoor air pollution, with a focus on Africa, is considered in detail in a paper prepared for the African regional Expert Meeting on Sustainable Consumption and Production<sup>49</sup> and will not be addressed here.

##### **(a) Energy efficiency in the building sector**

63. Buildings consume about 35-40% of final energy consumption in most OECD countries. In the United States, the share has increased from 30% in 1960 to 36% in 2000, while in Japan the

share has doubled since 1970. Space heating is the largest component of this energy consumption, particularly in residential buildings, where it accounts for 66% of household energy consumption in the European Union and 51% in the United States. Energy is also consumed in buildings for hot water heating, lighting, appliances and equipment. Smaller amounts of energy are used in building construction.

64. Following the oil price shocks of the 1970s, most OECD countries introduced mandatory energy efficiency standards for new buildings to supplement older standards for structural strength and fire safety. In addition, countries have offered tax incentives, subsidies and low-interest loans for buildings that go beyond the regulatory standards, as well as information and technical assistance to encourage builders and buyers to adopt more energy-efficient practices.

65. Promoting the sustainability of buildings and construction is made difficult by the fact that buildings are generally not built by those who live in, use or manage them. Builders therefore have little incentive to reduce operating costs, and even less the impacts of demolition. Studies of consumer choice indicate that buyers of buildings are only prepared to pay extra for energy-efficient buildings if the investment is paid back in a short time, and they have no interest in the impacts of demolition. And energy efficiency measures in buildings are more expensive and difficult if done later. Policies for promoting sustainability have therefore generally targeted builders through regulations, such as construction codes, and to a lesser extent through economic incentives. Another complication is the large numbers of small-scale builders and the diversity of buildings and their elements, where there is little standardization. In the European Union, 93% of enterprises in the construction sector have fewer than 10 employees and have little capacity for keeping up with new or specialized technical innovations. Because every building is different, ensuring compliance with overall building performance standards would require testing of each building, which would be costly and administratively demanding.

66. OECD countries generally began by introducing energy-efficiency standards for each building element, including windows, walls, roofs, and systems for space heating, water heating, ventilation and air conditioning. Some countries have since introduced overall building performance measures, using formulas to calculate the overall performance from the elements. This is more complex to administer and enforce, but encourages innovation, greater cost-effectiveness, and taking into account other factors, such as solar heating from building orientation and design. The integration of these environmental standards into existing systems for monitoring and enforcing safety and health standards reduces the costs of administering the system. Some countries, such as the United Kingdom, have announced a policy of gradually increasing performance standards intended to facilitate and promote planning and innovation by the construction sector. Regular reviewing and updating of building codes and appliance efficiency standards on the basis of current technologies and best practices can ensure a steady and cost-effective strengthening of regulations, as exemplified by California state regulations in the United States.<sup>50</sup>

67. In some countries, governments have encouraged households to undertake low-cost measures to improve energy efficiency. In the United Kingdom, electricity and gas suppliers are

required to assist customers in improving energy efficiency, with a particular focus on low-income households. In a number of countries, including Denmark and the United States, building owners have been provided on request with free energy audits, with recommendations on cost-effective energy efficiency measures. Surveys indicate that the majority of households participating in such programmes have undertaken at least some of the energy conservation measures recommended.

68. In the United States, some states and communities have passed Residential Energy Conservation Ordinances (RECOs) requiring buildings, when sold or renovated, to undertake some basic low-cost energy-efficiency measures such as insulation, weather stripping and caulking. An assessment in San Francisco indicated that some 160,000 homes had been weatherized under RECOs, reducing energy consumption by an average of 15%. Germany, in 2002, began to require energy efficiency measures in existing buildings, including replacement of old boilers, insulation of attics, and insulation of pipes in unheated rooms. As a result of building codes, incentives and general environmental awareness, building insulation in the United States has increased steadily since the 1960s, from 78% to 89% for roof insulation, 44% to 79% for wall insulation, and 37% to 78% for improved windows. An assessment of new building regulations introduced in the United Kingdom in 1995 indicated that they achieved a 25% improvement in energy efficiency.

69. Some countries have introduced incentives for buildings that perform better than regulatory standards. In Canada, for example, the Commercial Buildings Incentive Program offers a subsidy of two-times the projected annual energy cost saving, together with a design support tool. In the United States, tax credits have been used for the same purpose. Analysis of such approaches suggest that such subsidies at the design and construction stage have substantially greater impact on building performance than incentives based on operating costs, such as energy taxes. However, energy taxes, in addition to having a small effect on energy-efficiency, can have a larger effect on building operation and can provide revenue for subsidies for sustainable construction.

70. To encourage a preference for sustainability among buyers of buildings, labeling programmes for energy efficiency or other environmental qualities of buildings and equipment have been established in a number of countries. The United Kingdom, in 2001, introduced a mandatory energy labeling scheme for new housing, requiring the display of energy ratings calculated according to a Standardized Assessment Procedure. Denmark has a mandatory system of energy labeling that also covers existing buildings when they are sold. In the United States, the Energy Star programme labels energy-efficient building elements, including heating and cooling equipment, lighting, insulation and windows, as well as computers and other equipment.

#### **(b) Construction waste**

71. The building sector also accounts for a large amount of waste, mostly concrete and bricks from demolition, accounting for an estimated 10% to 44% of total solid waste in various OECD countries. As it is difficult to reduce the amount of material in buildings without reducing

performance, the potential for waste reduction is mainly from recycling materials. Currently the estimated recycling rate ranges from 5% to 90% in various OECD countries, with much of the waste going to engineering fill or road foundation, where the quality of the material is less important than in the case of building materials. The amount of waste generated by demolition also depends on the lifetimes of buildings before replacement, with average lifetimes of commercial buildings in OECD countries ranging from 31 years in the United States to 62 years in the United Kingdom.

72. To reduce the volume of demolition waste going to landfill or incineration, some OECD countries have imposed mandatory separation of demolition waste and restrictions on the disposal of recyclable construction material to landfills. In some cases, demolition contractors must get disposal plans approved before demolition can begin, which also helps to protect against illegal dumping. These measures are often in addition to general landfill taxes and virgin material taxes (e.g. aggregate taxes), which increase the economic incentive for recycling. In Denmark and the Netherlands, both of which have had, since 1997, strict limitations on the disposal of recyclable demolition waste in landfills, as well as landfill taxes, permission requirements for demolition, and other incentives for recycling, 90% of demolition waste is recycled. In Japan, the Construction Recycling Act came into effect in 2002, requiring the sorting of debris from demolition to facilitate recycling of stone debris for road and building construction, and reuse of lumber for particle board, paper or energy generation.<sup>51</sup>

73. Builders are often hesitant to use recycled building materials due to concerns over quality. Furthermore, due to low levels of recycling, recycled materials are often less conveniently available than virgin material. As part of efforts to address this problem, the United Kingdom, in 1998, established an internet-based Material Information Waste Exchange to allow contractors with unwanted materials or wastes to sell them or give them away.

#### **(c) Indoor air pollution in buildings**

74. Indoor air pollution has been gaining attention in recent years in recognition of the fact that indoor air can be more polluted than outdoor air and that people in OECD countries spend up to 90% of their time indoors. However, the significant pollutants, exposures and health impacts are not well understood. Pollutants include solvents from paints, plywood adhesives, finishes and backing materials, which can cause irritation of the eyes, nose and throat, headaches and dizziness. In recent years, indoor air pollution has been exacerbated by efforts to make buildings more air tight to reduce heat loss and conserve energy. Policies to reduce indoor air pollution have begun with formaldehyde emissions from plywood and other engineered wood products used in construction, with Germany and Denmark having adopted standards for formaldehyde emissions. Consideration is being given to other volatile organic compounds (VOCs).

#### **(d) Comprehensive building sustainability**

75. A number of OECD countries have introduced voluntary labeling schemes for buildings covering broad criteria of sustainability in addition to energy efficiency. In the United Kingdom,

the Building Research Establishment Environmental Assessment Method (BREEAM) was introduced in 1991 and now covers new and existing buildings, houses, schools and supermarkets. The BREEAM scheme includes factors for energy efficiency, building materials, health factors, water efficiency, water pollution, location and transport, land and ecology. There is evidence that the BREEAM scheme has some effect in encouraging buyers to buy sustainable buildings, but a greater effect in encouraging builders to build them. Japan, in 2001, introduced a Housing Performance Indication Scheme, including earthquake resistance, physical durability, energy efficiency, fire safety, indoor air pollution, sound insulation, ease of maintenance, lighting, and elderly-friendliness. The costs of such labeling can be minimized by integrating the sustainability assessment into inspections for mandatory building codes, loans and insurance. However, a survey in Germany indicated that most buyers are substantially more interested in energy efficiency than in other factors.

76. As governments account for a substantial share of construction (40% in the United Kingdom, 44% in Japan), public procurement can have a large impact on sustainable construction, both directly and indirectly. In 2001, the German Federal Government issued "Guidelines for Sustainable Buildings", which all new federal government buildings must comply with. Japan has published Design Guidelines for Green Government Buildings, which are being applied to most new government buildings. In the United Kingdom, all new government building projects should achieve an Excellent rating based on the BREEAM criteria. Swiss authorities require that procurement of all public buildings should take into account full life-cycle energy costs, using energy prices above market levels to take into account externalities.

## **II. URBAN AND INDUSTRIAL WATER CONSERVATION**

### **1. Water conservation**

77. While cities consume less than 10% of the total water used globally, the concentrated nature of that demand poses a heavy burden on limited local water supplies, both in terms of volume of demand and pollution from wastewater discharge. The high costs of collecting, treating and distributing clean drinking water, as well as the costs of wastewater collection and treatment, are a major burden on public budgets and are beyond the capacity of municipal or national governments in most developing countries.

78. In the 1980s and 1990s, with growing demand for municipal water supplies facing the increasing cost and difficulty of developing new supplies of clean water, water agencies and utilities in many countries began to explore demand-side management approaches. This was based on the principle that consumers need effective water services such as showers, toilet flushing, clothes washing and dishwashing, rather than a specific quantity of water. In many cases, it was found to be more cost-effective to meet the growing demand for water services by increasing the efficiency of use of the available water supplies, rather than by increasing the

volume of water delivered. Within households, water efficiency improvements include low-flow showerheads, low-flush toilets, and water-efficient washing machines and dishwashers. For lawns, gardens and landscaping, efficient technologies include perforated “soaker hoses” and soil moisture sensors to avoid wasting water, covering swimming pools in hot weather to reduce evaporation, and limiting water use for car washing. For industrial use, demand-side management approaches include recycling of cooling water and process water and reducing the water consumption of evaporative coolers and boilers. Water audits can be a useful way of identifying cost-effective means of reducing water consumption.<sup>52</sup>

79. In the United States, total water use has declined since 1980 due to reduced use for power plant cooling, other industrial use and agricultural irrigation. Household use and public municipal use, amounting to about 11% of total withdrawals, has increased steadily with population, with per capita use remaining stable at 165 gallons (625 litres) per person per day. The reduction in water use for power plant cooling occurred mainly in the early 1980s as a result of the 1972 and 1977 amendments to the Federal Pollution Control Act, which strengthened water quality standards for wastewater discharge, including water temperature. Since then, power plants have gradually shifted to closed-cycle water cooling or air cooling, reducing water withdrawals from rivers, lakes or groundwater. There has also been a shift toward greater use of seawater for cooling in coastal areas. For agriculture, with irrigated area expanding throughout the period, reduced water use has been primarily due to improvements in irrigation efficiency, including a gradual shift from flood to sprinkler to micro-irrigation, as well as greater irrigation efficiency with each technique and a shift to more water efficient crops.

80. In the United States, household indoor water use averages 262 litres per person per day. Households that have installed a range of water-saving devices and reduced leakage have reduced their water use to 160 litres per person per day. Since 1997, all toilets, faucets and showerheads installed in the United States must meet water efficiency standards established by law in 1992. These efficiency standards can lower indoor household water consumption by about one third, and studies of 16 cities indicate that they will save water utilities about \$200 million in investments over the next 20 years.<sup>53</sup>

81. South Australia, facing increasing water scarcity, in 2003 applied legal restrictions on the outdoor use of water for households and public spaces. Watering of lawns and gardens must be done by hand, by drip irrigation, or in the evening. Paved areas, walls or roofs can only be washed if necessary for health or safety reasons. Cars and boats can only be washed by hand, with a high-pressure low-volume water cleaner, or with a hose with an automatic shut-off nozzle. Construction sites must also use hoses with an automatic shut-off nozzle.<sup>54</sup>

82. In the United Kingdom, the Environment Agency of England and Wales makes an annual Water Efficiency Award to promote water efficiency. In 2003, the major award went to the building company Gusto Homes. Gusto has built houses and offices with automated rainwater harvesting systems which collect rainwater in underground storage tanks and use it for toilet flushing, washing machines and gardening. Houses were also equipped with low-flow toilets, faucets and showers. The collected rainwater provided about 50% of the household water

consumption. As a result of the success of this project, such systems are being installed in other houses, and an Association of Rainwater Harvesting Companies has been established to promote such systems and encourage high standards in their design and installation.<sup>55</sup>

83. Bulawayo, Zimbabwe, is located in a dry, drought-prone region with an average of 460 mm of rainfall per year. As there is limited potential for increasing the water supply to address recurring water shortages, the city has taken a number of water conservation measures, including reducing leakage from the municipal water distribution system, reusing treated but non-potable water from wastewater treatment plants for irrigating trees and lawns, and reusing higher quality water from the largest and most advanced treatment plant for irrigating grain and pasture. An increasing block-tariff pricing structure has reduced average water consumption by 23% while ensuring that basic social needs are met. At times of severe drought, water rationing is applied and the use of watering hoses is banned, reducing water consumption from the normal average of 140 litres per capita per day to 100 litres. These measures have been supported by public information campaigns for water conservation.<sup>56</sup>

84. Improving water efficiency and reducing water pollution from industry is one of the functions of National Cleaner Production Centres (NCPC) established in many developing countries and countries with economies in transition, in many cases with assistance from UNIDO and UNEP. In the Slovak Republic, the NCPC assisted a paper factory to reduce water consumption in the production of cardboard from recycled paper by 48%, or almost 2 million cubic metres per year, with financial benefits of \$313,000 per year. In Costa Rica, the NCPC helped a fruit and vegetable processing plant to reduce its consumption of water for washing produce and equipment by 24%, providing savings of about \$10,000 per year for an investment of \$1000. The NCPC in India assisted an organic chemical factory to reduce water consumption by 22% through internal water recycling, with savings of \$33,000 per year on an investment of \$64,000. In the Republic of Korea, the NCPC helped a fabric dyeing company introduce a new enzymatic process for dyeing cotton, reducing water consumption by 33% and reducing the costs of water, chemicals and energy by \$9000 per year. In a Uganda fish processing plant, cleaner production methods reduced water consumption by 30%, with a savings of \$6000 per year.<sup>57</sup>

85. In Concepción, Chile, fish processing companies that produced fishmeal were a major source of organic water pollution going into the sea. Faced with impending effluent regulations, the Fisheries Association of 16 companies sought technical advice from the University of Concepción, which determined that the fish wastes in the effluent could profitably be recovered, increasing fishmeal production while reducing pollution and water consumption. With financial assistance from UNIDO and the Chilean fund for technological development (FONDEF), the companies bought improved pumps that reduced losses in pumping fish from ship to shore, while substantially reducing water consumption and damage to the fish. Screens were then used to capture fish particles from the effluent and add them into the fish processing system, further reducing losses and pollution. Finally, new fishmeal dryers were installed which used energy more efficiently and improved fishmeal quality, which was particularly important for export markets. The new systems were first tested in one processing plant and then installed in the others when proven effective. The new system reduced organic pollution (chemical oxygen

demand) by 85% while increasing productivity, such that the investment paid for itself within two years.<sup>58</sup>

## **2. Wastewater treatment and reuse**

86. Most cities are located on rivers and are dependent on reuse of water that has been used upstream and discharged into the river, with or without treatment. Paris and its region are provided with water by the Seine River. After serious deterioration of water quality in the Seine in the 1960s due to discharge of untreated municipal wastewater and industrial pollution, municipal and industrial wastewater treatment systems were installed. As a result, dissolved oxygen content has steadily improved, microbial, phosphate, metal and PCB pollution has declined, accidental releases of toxic contaminants are now rare, and aquatic biodiversity is increasing. However, nitrate levels are still increasing and pesticides and other toxic chemicals remain serious problems. About 90% of the population of the river basin is now connected to sewers leading to wastewater treatment plants, and the rest live in rural areas and have their own private sewage disposal systems. Most of the sludge from the treatment plants is used by farmers, although there are concerns over heavy metals in the sludge, largely from industrial effluent. In addition to over 2000 municipal wastewater treatment facilities in the Seine basin, twelve hazardous wastewater treatment plants have been built, reducing the impact of industrial pollution on aquatic environments.

87. While wastewater treatment in France is the responsibility of municipalities, the French national Water Agency, since the 1960s, has used a variety of incentives to encourage municipalities to improve water treatment, including financial support, technical support for operation, assessment and monitoring, pollution charges, and joint programmes. Environmental taxes have been imposed on pesticides and phosphate laundry detergents. In critical regions, higher pollution charges were combined with greater financial assistance. The pollution charges are inducing industry not only to install wastewater treatment facilities, but also to make production processes cleaner, in some cases with support from the Water Agency. Current efforts focus on improving the efficiency of wastewater treatment plants, particularly for nitrates, and developing low-cost, low-tech wastewater treatment systems for rural areas with low population density.<sup>59</sup>

88. In Jordan, municipal wastewater, treated and reused for irrigation, is an important part of the national water supply. Available water from renewable sources was 160 m<sup>3</sup>/capita/year in 1998 and is projected to fall, as a result of high population growth, to 91 m<sup>3</sup>/capita/year by the year 2025, far below the water scarcity threshold of 1000 m<sup>3</sup>/capita/year. The country has 19 wastewater treatment plants serving about two-thirds of the urban population. Treated wastewater amounts to about 10% of available freshwater resources, and plans are to increase the amount to about 30% by 2020. There is little industrial effluent, so pollution by heavy metals or toxic organic chemicals is low. Most of the water from the treatment plants meets WHO guidelines for use of water for restricted agricultural irrigation. Of the treated wastewater used directly for irrigation – including flood, furrow or drip, but not sprinkler irrigation – about half is

used for tree plantations, while most of the rest is used for fodder production and olive orchards. Other treated wastewater is discharged to streams, mixed with streamflow and used further downstream for unrestricted agriculture. A small amount of the treated wastewater is used for cooling in industry. In a few cases, farmers have been found irrigating vegetables with treated wastewater, and the vegetables have been destroyed.<sup>60</sup>

#### **IV. CONCLUSION**

89. These examples of policies for making consumption and production patterns more sustainable, with a focus on human settlements and water, indicate a wide range of initiatives in many countries in all regions. They demonstrate a wide and growing recognition that current patterns of consumption and production are unsustainable and that eco-efficiency can support long-term economic development as well as resource conservation and environmental protection. While the selection of examples for this paper favoured recent work, the review indicated that much of the activity in this field is in fact quite recent, with a rapid growth in the 1990s and since.

90. It could be concluded that Agenda 21, with its chapter 4 on “Changing consumption patterns”, effectively put the issue of unsustainable patterns of consumption and production on the international agenda. The importance of the issue was reaffirmed by the Johannesburg Summit which dedicated chapter III of its Plan of Implementation to “changing unsustainable patterns of consumption and production” and called for “the development of a 10-year framework of programmes in support of regional and national initiatives to accelerate the shift towards sustainable consumption and production.” This has provided a stimulus for greater work in this field, increased exchange of experience and information, and greater international cooperation.

91. In preparing this paper, an effort was made to include examples from all regions and from countries at all levels of development. The review indicated that most activities of the sort described here have taken place in developed countries, but that activities in developing countries have been increasing in recent years. The review also indicated that activities in developing countries often drew on the experience and technology of developed countries. This is in keeping with the call in the Johannesburg Plan of Implementation, reaffirming Agenda 21, for all countries to “promote sustainable consumption and production patterns, with the developed countries taking the lead and with all countries benefiting from the process.”<sup>61</sup>

92. While this paper has focused on achievements in making consumption and production patterns more sustainable, more general analyses of trends in sustainable development indicate that the efforts to change consumption and production patterns have often been outweighed by increases in the volume of consumption and production. The success stories here can serve as a stimulus for efforts to broaden and deepen this work; they cannot be taken as an indication that sustainable consumption and production is being achieved.

93. Nonetheless there has been increasing commitment to changing unsustainable patterns throughout the world, much experience has been gained, and international cooperation and exchange of information and experience are increasing. The Marrakech Process for the development of the 10-year framework of programmes initiated by the Johannesburg Summit is both a response to that trend and an effort to further increase international cooperation toward making consumption and production more sustainable.

## NOTES

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<sup>1</sup> [www.un.org/esa/sustdev/documents/WSSD\\_POI\\_PD/English/POIToc.htm](http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POIToc.htm), chapter III, paras. 14, 15.

<sup>2</sup> [www.un.org/esa/sustdev/sdissues/consumption/Marrakech/MarrakechReport.pdf](http://www.un.org/esa/sustdev/sdissues/consumption/Marrakech/MarrakechReport.pdf)

<sup>3</sup> [www.un.org/esa/sustdev/csd/csd12/Background11.pdf](http://www.un.org/esa/sustdev/csd/csd12/Background11.pdf)

<sup>4</sup> Available at [www.un.org/esa/sustdev/csd/csd13/docs.htm](http://www.un.org/esa/sustdev/csd/csd13/docs.htm)

<sup>5</sup> Molly O'Meara Sheehan, City Limits: Putting the Brakes on Sprawl, WorldWatch Working Paper 156, 2001, pp. 52-53.

<sup>6</sup> Sustainable Development Notes, March 2003, World Bank, [www.worldbank.org/participation/sdn/snd71.pdf](http://www.worldbank.org/participation/sdn/snd71.pdf)

<sup>7</sup> P. Newman & J. Kenworthy, Sustainability and Cities, Island Press, 1999, pp. 55-57.

<sup>8</sup> WorldWatch Institute, State of the World 2004, p. 30; and Molly O'Meara Sheehan, City Limits: Putting the Brakes on Sprawl, WorldWatch Working Paper 156, 2001, pp. 10-11.

<sup>9</sup> US Department of Transportation, [www.fhwa.dot.gov/tea21/factsheets/index.htm](http://www.fhwa.dot.gov/tea21/factsheets/index.htm), 12 April 2004.

<sup>10</sup> Informal Transport in the Developing World, UN-HABITAT, Nairobi, 2000, p. 85.

<sup>11</sup> Institute for Transportation and Development Policy, Sustainable Transport e-update, February 2004, [www.itdp.org](http://www.itdp.org)

<sup>12</sup> Molly O'Meara Sheehan, City Limits: Putting the Brakes on Sprawl, WorldWatch Working Paper 156, 2001, pp. 27, 33.

<sup>13</sup> Pablo Allard, "The Tough Road to Living City", in *ReVista: Harvard Review of Latin America*, Winter 2003, at <http://drclas.fas.harvard.edu/publications/revista/cities/allard.html>

<sup>14</sup> [www.gefweb.org/Documents/Council\\_Documents/GEF\\_C21/CC - Chile - Executive\\_Summary.pdf](http://www.gefweb.org/Documents/Council_Documents/GEF_C21/CC - Chile - Executive_Summary.pdf)

<sup>15</sup> Citynet: The Regional Network of Local Authorities for the Management of Human Settlements, News issue #12, Nov-Dev 2003, [www.citynet-ap.org/en/Activities/SUTP/sutp3.htm](http://www.citynet-ap.org/en/Activities/SUTP/sutp3.htm)

<sup>16</sup> Molly O'Meara Sheehan, City Limits: Putting the Brakes on Sprawl, WorldWatch Working Paper 156, 2001, p. 29.

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<sup>24</sup> New York City Department of Transportation, [www.nyc.gov/html/dot/html/motorist/alternativefuel.html](http://www.nyc.gov/html/dot/html/motorist/alternativefuel.html).

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<sup>43</sup> WorldWatch Institute, State of the World 2004, pp. 44-45.

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