Economic Inequality and the Urban Environment: The Case of Water and Sanitation

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ECONOMIC INEQUALITY AND THE URBAN ENVIRONMENT: THE CASE OF WATER AND SANITATION

Nick Johnstone

ABSTRACT

This paper looks at the relationship between economic inequality and urban environmental quality in developing countries, with specific reference to the provision of water and sanitation services. The paper explores the consequences of "dual" systems, in which a proportion of a city's residents are served by subsidised "town" water and sanitation facilities, whilst another section of the city has been forced to develop a variety of "on-site" strategies through their own efforts. A number of conclusions are reached: firstly, it is argued that poorer households are generally more adversely affected by low levels of provision and that standard project evaluation techniques perpetuate this bias; secondly, the cost structure of service provision implies that equal access to a standardised system is more efficient than the differentiated levels of access and treatment which prevail; and, thirdly, it is argued that access to water and sanitation and the means by which such systems are financed can be one of the most significant and effective means of distributing resources in the urban context.

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I. Introduction

This paper looks at the relationship between economic inequality and urban environmental quality. The cases of water and sanitation services have been chosen since they are significant determinants of environmental quality in urban areas. Moreover, by examining water and sanitation provision, the close relationship between access to environmental goods (*ie*, clean water for drinking, cooking and bathing) and exposure to environmental bads (*ie*, various water pollutants, solid waste, and even airborne faecal dust) can be explored. However, many of the conceptual issues addressed here will also be true of other important determinants of urban environmental quality, such as the provision of transport infrastructure and household/industrial solid waste collection and disposal.

The case of water and sanitation also illustrates the bias which presently exists in respect to the provision and financing of environment-related infrastructure in many of the urban areas within developing countries. In a large number of cities "dual" systems have developed, in which a proportion of the city's residents are served by subsidised "town" sewage collection and treatment facilities and potable water systems, whilst another section of the city is not incorporated into the "town" system and has instead developed a variety of "on-site" collective, or individual strategies through their own efforts.

The paper is not primarily concerned with the relative "unfairness" of such a system and the extent to which service access varies with relative economic wealth.[1] While important, considerable work has been already been devoted to this question, as well as the more general issues related to relative income levels and exposure to environmental hazards. (See Meuser and Szasz 1996 for a recent bibliography on the "environmental justice" literature.) Instead, this paper is concerned with the effect that economic inequality has on the overall level of service provision (and thus urban environmental quality) and the effect that unequal service provision has on the efficiency of the system as a whole.

The arguments presented in the paper have a number of policy implications. Firstly, it is argued that poorer households are generally more adversely affected by low levels of provision and that standard project evaluation techniques tend to perpetuate this bias. Secondly, the simultaneous existence of economies of scale in the extent of service provision but rising marginal costs in the quality of service implies that equal access to a standardised system is more efficient than differentiated levels of access and treatment. Thirdly, it is argued that access to water and sanitation and the means by which such systems are

[1] In general it appears the integrated "town" system tends to serve richer neighbourhoods to a much greater extent than poorer neighbourhoods. (See Serageldin 1994 and Choguill and Choguill 1996 for discussions and some evidence on the relative extent of the two systems in different cities). UNICEF/WHO (1993) reports that 95% of "high income" households have access (defined variously by different countries) to safe water and sanitation facilities, while the figures for low-income households are 64% and 45% respectively. Unfortunately relative access to services is considered to be one of the criteria for the definition of "high income" and "low income" households so these figures are not particularly helpful. While it is certainly true that in some cases this bias is a reflection of the fact that some of the poorer neighbourhoods are informal squatter communities, wherein the possibility of integration may be restricted by legal (*ie*, absence of property rights) and/or technological (*ie*, situated on steep slopes) factors, this is by no means the primary factor since this bias in provision also seems to be reflected across communities which are formally incorporated.

financed can be one of the most significant means of distributing resources. In comparison with the actual situation in many urban areas in developing countries, this implies that a rather significant change in the nature and financing of urban water and sanitation facilities is desirable on grounds of both equity and efficiency.

Section I comprises the introduction.

Section II places the issue in the context of the broader discussions of the poverty-environment relationship.

Section III discusses the “public” nature of urban environmental quality, the relative income-inelasticity of demand for environment-related urban services, and the consequences that these two factors have for the relationship between equity and efficiency in service provision.

Section IV discusses the collective nature of the provision of water and sanitation services and the effects that unequal access of service provision has on relative economic welfare and efficiency.

Section V ties the arguments of the preceding two sections together by examining the potential for a more efficient allocation of resources devoted to water and sanitation than that which presently exists.

Section VI looks at some of the policy implications. There is also an annex which discusses the empirical evidence on relationship between economic inequality and environmental quality.

II. Poverty and the Environment

An examination of the relationship between economic inequality and the provision of water and sanitation services needs to be understood in the broader context of the relationship between poverty and the environment. There is a considerable body of literature concerned with the relationship between poverty and environmental quality.[2] The most widely-held view is that expressed in the Bruntland Report (WCED 1987), which asserts that poverty tends to generate various forms of environmental degradation:

> "Those who are poor and hungry will often destroy their immediate environment in order to survive: They will cut down forests; their livestock will overgraze grasslands; they will overuse marginal land; and in growing numbers they will crowd into congested cities." (WCED 1987, p. 28)

This view was also expressed in the *Human Development Report (1990)* which describes poverty as "one of the greatest threats to the environment." (UNDP 1990, p7).

Within this framework it is also further argued that causality runs in both directions, with environmental degradation contributing to poverty. Since livelihoods are (directly and indirectly) based upon the use and management of environmental resources, their degradation will lead to poverty by undermining the basis of the economy. As such, the goals of economic development and environmental conservation are held to be largely complementary, mitigating the likelihood of falling into a downward spiral of economic underdevelopment and environmental degradation. (See Durning 1989.) On the one hand, by allowing individuals, households and communities to look beyond the immediate future, economic development will tend to relieve pressures on the environment. Whilst on the other hand, the preservation of environmental quality and natural resource endowments will improve prospects for long-term economic development.

At a conceptual level the poverty-environmental degradation hypothesis has come under criticism. It is argued that while in particular contexts and for particular resources there may be a causal relationship between poverty and environmental degradation this is by no means universally true. Indeed, in some cases the poor may be effective guardians of the environmental resources which are the basis of their livelihood. (See Broad 1994.) Moreover, poverty itself may act as a brake on the use of environmental resources since in many cases degradation arises from the consumption and use of the very economic assets which define wealth. (See Leach and Mearns 1995.) In this vein, a distinction has been made between the "merely poor" and the "very poor," with the latter having fewer disincentives to degrade the environment in a desperate effort to secure their own survival, while the former are more likely to be in a position to avoid having to do so.

It is beyond the scope of this paper to review the case study evidence of the relationship between poverty and the environment. However, at the aggregate level the empirical

[2] It should be emphasised that most of this literature deals with rural poverty and natural resource over-exploitation.

evidence on the relationship between various indicators of environmental quality and income is ambiguous, although the posited positive relationship seems to be more evident at relatively higher levels of income rather than at very low income levels. (See Lucas *et al* 1992, Shafik 1994, Grossman and Krueger 1995, Holtz-Eakin and Selden 1995 and Selden and Song 1994.) [3] More specifically, the studies have tended to find that a sub-set of indicators of environmental quality deteriorate with growth at lower levels of income, but after a certain point begin to improve. Thus, although there may be a positive relationship between some indicators of environmental quality and economic development, this does not appear to be true at very low levels of economic development.

Moreover, it is significant that the results vary widely across measures of environmental quality, with those effects which are most localised and immediate (*ie,* local air and water pollution) tending to exhibit the most evident inverted-U relationship, and others with effects which are more diffuse and distant in time (*ie,* global pollution) not exhibiting such a relationship at all. Thus, the positive effects of income levels on environmental quality tend to be weaker the more "public" is the environmental good. Conversely, some of the most important sources of environmental degradation at the urban level (*ie,* suspended particulate matter, faecal coliform concentrations, etc....) do appear to decline beyond a certain level of income. Indeed, those indicators which are most pertinent to this study (*ie,* dissolved oxygen levels in water courses, lack of access to sanitation facilities, lack of access to drinking water, etc....) decline monotonically with income levels.[4]

As noted above, rather than further contribute to the general body of literature related to the poverty-environment relationship, this paper will instead focus upon two particular aspects of the relationship which have been disregarded to a great extent. The first is related to the paper's focus on urban environmental degradation. Indeed, an examination of recent surveys on the poverty-environment relationship (*ie,* Dasgupta and Maler 1994 and Duraiappah 1996), reveals the almost exclusive focus on rural issues in the economics literature. This is significant, since there is good reason to believe that the role of poverty in encouraging environmental degradation is even weaker in the urban context. (See the chapter on "The Urban Challenge" in the Bruntland Report (WCED 1987) for an early discussion of these issues.) The second issue is related to the paper's focus on the role of relative poverty (or economic inequality), rather than absolute poverty. This is also significant since decisions about environmental quality are taken (explicitly or implicitly)

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[3] While there are rather fewer studies of resource use, Shafik (1994) includes deforestation rates and forest cover in his study.

[4] The environmental significance of the inverted-U curve (even for those indicators for which it appears to exist) should be clarified. Firstly, since the "turning-points" for some of the indicators are well in excess of actual income levels in most countries it would appear that the environment-intensity of production will continue to rise for quite some time. (Rothman 1996). Secondly, given the pervasiveness of irreversibilities in processes of environmental degradation it may be the case that economic growth will eventually bring about falls in environment-intensity of output once the 'hump' of the U-curve has been passed but in the interim the resource base upon which the economy depends may have been irreversibly degraded. (Opschoor 1995). And finally, it appears that trade patterns plays an important role in bringing about changes in the aggregate pollution-intensity of production, by allowing from changes in the sectoral composition of output at the national level. Thus, even if the relationship for particular pollutants holds for a broad group of countries over a period of time, this may not be true indefinitely in aggregate. (Saint-Paul 1994.)

collectively, and as such the relationship between individuals within a given society may be more important than the characteristics of individuals themselves.

III. Equity and Efficiency in the Provision of Urban Environmental Services

This section will examine the relationship between equity and efficiency in the provision of urban environmental services. In the first instance the "public" nature of urban water and sanitation provision will be discussed. Following this the relative income-inelasticity of demand for urban environment-related services will be explored. And finally, the consequences that these characteristics have for the relationship between equity and efficiency will be examined.

The Public Nature of Urban Environmental Quality

The urban environment is "public" in the sense that residents of an urban area share, to one extent or another, the same environmental system. As such, residents will be exposed to some of the same environmental "bads." For instance, although there is likely to be some (and in many cases considerable) differentiation between levels of pollution in different parts of the same urban area, it is generally true that residents will tend to share exposure to the same environmental bads. Thus, while uncollected and/or untreated sewage effluent may result in pollution concentrations which differ, depending upon the location of neighbourhoods, air flow patterns, and the course of surface waters and groundwaters, residents in one area of a city are likely to be affected by degradation in other areas to some extent.

Analogously, the environment is "public" in the sense that all residents share the benefits from the preservation of its quality. This follows directly from the previous point since access to some environmental goods (*ie,* clean surface waters, groundwaters and air sheds) is merely the absence of exposure to environmental bads (*ie,* solid waste and air and water pollution). Thus, the externalities arising from inadequate water and sanitation facilities include a variety of adverse health effects. (See Cairncross 1990 for an excellent discussion.) The estimated potential reductions in morbidity from diseases such as cholera (80-100%), typhoid (80-100%), conjunctivitis (60%-70%), amoebic dysentery (40%-50%), and diarrhoeal diseases (40%-50%) due to improvements in water supply and sanitation are considerable. (WHO 1992). To the extent that the community at large benefits from improved health of individuals (*ie*, reduced exposure to communicable diseases, increased economic productivity, satisfaction of "moral" values, etc....), some of these benefits are external.

Thus, the level of provision of sewage systems in one part of the city will to some extent determine the level of exposure to environmental bads and the degree of access to environmental goods in other parts of the city. Even if all households are connected to a centralised drinking water distribution system, the quality of water provided (or the costs of its provision) will depend upon the degree of collection and treatment of household sewage. Access to safe drinking water – whether from the public distribution system, private wells or surface waters – is a function of the quality of the public environment. As such, while water and sanitation services are not "pure" public goods in the sense that a large proportion of the benefits are internal to the household, they do possess characteristics which distinguish them from private goods.

The Income-Elasticity of Demand for Urban Environmental Services

In the past it has often been argued that preferences for environmental quality are income-elastic (see, for example, Baumol and Oates 1988). However, there is increasing reason to believe that this is not the case across a wide spectrum of indicators.[5] This is even more likely to be true of those aspects of environmental quality which are more closely identified with basic needs rather than luxury goods. Potable water and sanitation facilities clearly fall into the former category. Holding all other factors constant (*ie,* access to infrastructure, relative prices, etc....) the proportion of income spent on water and sewage facilities tends to fall as income rises.

There is some empirical evidence to support this hypothesis. Thus, in a study of particular neighbourhoods in Khartoum (Cairncross and Kinnear 1992) it was found that the income-elasticity of demand for water appeared to be approximately zero, implying that increased income did not generate any significant increase in the demand for water.[6] Bahl and Linn (1992) review a number of studies of water demand which find estimated income elasticities ranging from 0.0 to 0.4 for a number of different countries. And finally, cross-sectional evidence from a number of different countries indicates that the income-elasticity of water consumption is in the region of 0.3. (Anderson and Cavendish 1993). Thus, it is quite likely that water demand rises less than proportionately with income.

Unfortunately, there is no evidence of the income-elasticity of demand for sanitation facilities. This would in any case be closely related to the level of household water use, but may also be a function of demand for surface water quality. Given the reliance of poorer households on the latter for many basic needs such as cooking and washing, it is quite likely that this is also income-inelastic. Thus there is good reason to believe that lower-income groups are willing to pay − or rather are required to pay − a higher proportion of their incomes for water and sanitation services than higher income groups.[7]

[5] In a review (Kristrom and Riera 1996) of empirical studies of a variety of environmental indicators (wetlands, forests, water quality, etc....) it was found that preferences for public environmental quality declined as a proportion of income with increased income levels.

[6] The study did not use standard statistical techniques and as such does not distinguish income effects from other factors such as household size, relative prices, and access to facilities.

[7] In a related vein, it has been found that the *price* elasticity of demand for water differs with income levels, with elasticities being much lower for poorer households. (See Anderson and Cavendish 1993 and Bahl and Linn 1992). However, it should be emphasised that if the nature of the service provided by the good changes with income then the demand function may exhibit rising income-elasticity. For instance, households in which a significant proportion of water is used for recreation (*ie,* swimming pools) and aesthetic purposes (*ie,* car washing)

In light of this it can be argued that a redistribution of income will – holding other factors constant – tend to result in an increase in aggregate demand for those services. Assume that there are two sets of households in the city and one group is considerably wealthier than the other. Given the discussion above, a transfer of income from the richer households to the poorer households will result in a relatively smaller decrease in demand for environmental services for the rich than the increase in demand for environmental services for the poor. This implies that a relatively unequal (relatively equal) distribution of income will result in less (more) demand for environment-related services in aggregate.[8]

More importantly, the relative income inelasticity of demand for water and sanitation services and the public nature of their provision implies that low levels of provision will tend to hurt the poor relatively more than the rich even if there is no income-bias in its provision. Even if both groups of households have equal access to environmental services irrespective of income levels, the existence of significant environmental degradation (due to insufficient investment in infrastructure which mitigates such damages) will tend to have more adverse effects on poor households than rich households since water and sanitation services are a much more important part of their total welfare. Although they are affected equally in absolute terms if there is no bias in provision, poorer households will still be more adversely affected since they attach greater relative importance to the provision of environmental services than richer households.

Equity and Efficiency in the Provision of Urban Environmental Services

Moreover, the "public" nature of urban environmental goods and bads and the relative income-inelasticity of demand for urban environmental services has important consequences for the relationship between distribution and efficiency. To understand why this is so it is useful to compare the public good case with the private good case. In the private good case, buyers and sellers will trade goods and services until the point at which the marginal rate of substitution between the different goods and services are equal – *ie,* the marginal cost and marginal benefit of each good and service will be equal for all participants in the market. This maximises utility, at least in so far as it is reflected in the consumption of marketed goods. However, the level of consumption for each good and service and for each individual will differ, depending upon the distribution of economic assets (and consumption preferences). A change in the distribution of economic assets will generate a different outcome, but it will not affect the relative economic efficiency of the outcome.

In the case of public goods, the issues of distribution and efficiency can not be separated. This arises from the fact that for public goods an efficient level of provision requires that all residents freely choose to consume the same level. If, however, preferences for public

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may have highly income-responsive demand. This will, however, represent a very small proportion of total demand in most developing countries.

8 See Annex for a review of the empirical evidence on the relationship between economic inequality and the extent of provision of urban environmental services.

goods differ systematically with income levels such an outcome is not feasible. The marginal benefits of its provision will not be equal to the marginal costs for each and every resident, unless an additional policy instrument is introduced. Thus, in cases where preferences differ systematically with incomes, distributional issues will play an important role in determining whether or not the level of provision of public goods is efficient. Decisions related to the level of provision of a public good become ethical questions. One group will necessarily be favoured over another – *ie,* one group will receive benefits in excess of its costs and *vice versa* for the other group.[9]

While neither sanitation service provision nor water service provision are "pure" public goods in the sense that a large proportion of the benefits derived from them are internal to the household, there is a sufficient degree of publicness for this to be relevant (*ie,* all households suffer from insufficient investment even if they have access themselves). As such these issues have important consequences for the evaluation of projects related to water and sanitation. Ideally, when evaluating such a project planners try to ensure that it is efficient.[10] However, since there are likely to be net gainers and net losers in all projects, such criteria are not always helpful. Given this, the "compensation" principles are applied, whereby a project is deemed to be worth undertaking if aggregate social welfare rises, and thus if compensation between affected households allows for a situation in which all households will be better off. (See Maler 1985 and Johansson 1993 for discussions related to general environmental projects.) However, the compensation assumed in project evaluation is usually hypothetical. This has been justified either by asserting that over a cross-section of projects distributional issues will tend to be counterbalancing or by asserting that a separate agency (*ie,* the central government) already addresses distributional issues by other means. (See Maler 1985 for a discussion.)

Perhaps more significantly, the focus on potential (rather than actual) compensation means that particular assumptions need to be made in relation to interpersonal comparison, since planners are not in a position to observe household preferences for public goods and individual utility functions directly. In practise most projects apply unweighted utility functions. (Kanninen and Kristrom 1992). The combined effects of the use of potential compensation and equal weights in project evaluation means that equity and efficiency objectives are assumed to be separable and, more significantly, efficiency objectives are given priority over distributional concerns. As noted above, since demand for urban environmental goods tends to rise with income (although not as a proportion of income), projects which tend to benefit richer households disproportionately will have a greater chance of being approved than those which benefit poorer households.

IV. Economic Efficiency and the Unequal Provision, Quality and Financing of Urban Environmental Services

[9] Assuming a constant cost structure with respect to its provision and a constant distribution of economic endowments.

[10] In the usual economic (Paretian) sense that at least some households are made better off and no household is made worse off by the project.

While the preceding section has been concerned with the effect of economic inequality on the demand for urban environmental quality and public environmental services, this section is concerned with the relationship between unequal provision of those services which are necessary for the preservation of urban environmental quality (both in terms of access to services and in terms of their financing) and the consequences that this has for urban environmental quality.

Economies of Scale and Increasing Treatment Costs in Urban Environmental Services

In addition to the "public" nature of urban environmental quality, the provision of water and sanitation services possess other characteristics which distinguish it from private goods. Most importantly their provision usually involves a collective response and not strictly a response at the level of the individual or household. This arises from the high fixed costs and significant economies of scale which exist in the provision of urban environmental infrastructure. In their purest form such goods are natural monopolies since the marginal costs of their provision by one firm will exceed average costs at the level of provision which is optimal. (See Tirole 1988 for a general discussion of the technological determinants of market power.) The presence of sufficient economies of scale in a particular sector (*ie,* such as water and sanitation services) implies that the market level of provision will be much lower than that which is optimal.

Once again this is an approximation, but in general it appears that there are sufficient economies of scale in environment-related infrastructure for there to be potential for considerable market power. For example, in the case of wastewater treatment costs Fraas and Munley (1984) find scale elasticities of 0.89 with respect to investment costs and 0.79 with respect to operating costs. McConnell *et al* (1988) finds overall scale elasticities of 0.7. Although these studies are derived from plants in OECD countries it is quite likely that scale elasticities are comparable in many LDC countries, since plant specifications are often similar and the proportion of labour costs (which are likely to differ more widely than other factor inputs) quite low.

In addition to the existence of economies of scale in the *level* of provision of water and sanitation services there is evidence to support the view that there are increasing costs with respect to the *quality* of service provision for wastewater treatment. For instance, if the costs of treatment rise more than proportionately with the level of treatment (*ie,* it is progressively more expensive to increase the percentage of pollutants removed before discharge into receiving waters),[11] then for a given level of expenditure average urban environmental quality and public health may be best served by standardised – rather than differentiated – levels of treatment.

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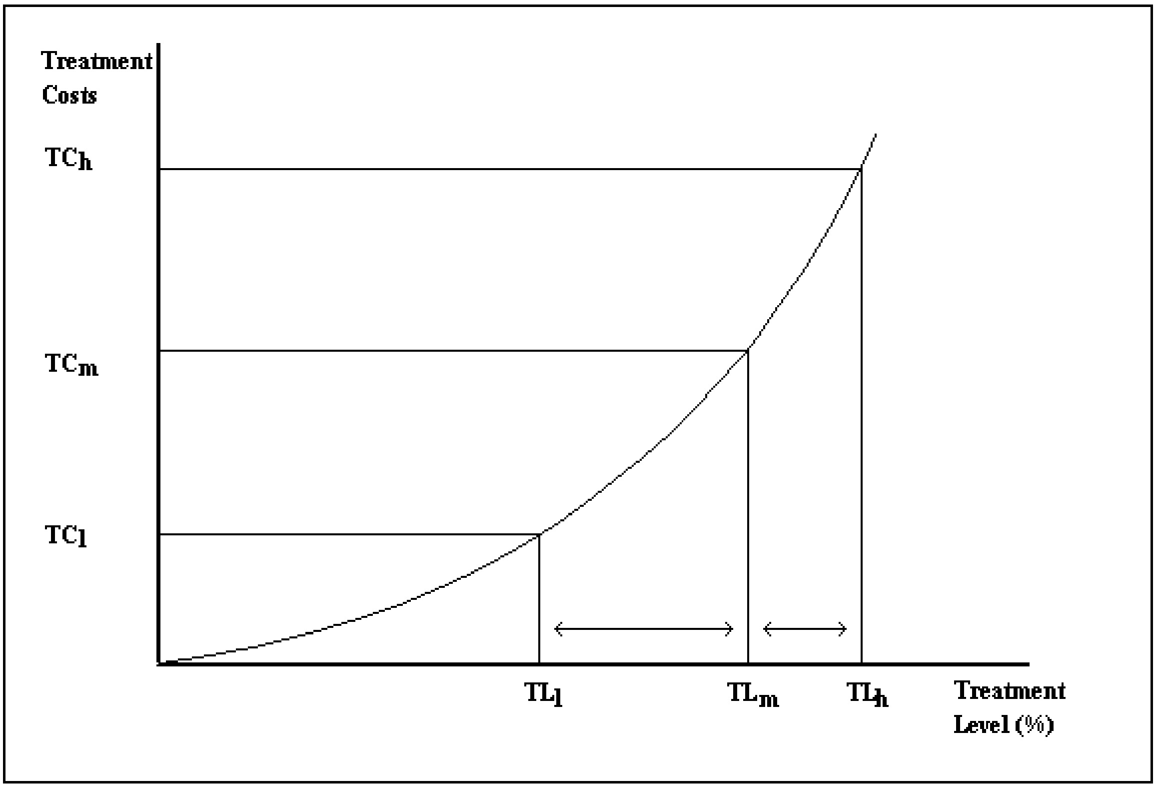
[11] That is to say, if the cost curve is convex. Serageldin (1994), McConnell *et al* (1988) and Anderson and Cavendish (1993) provide evidence to support this claim.

This can be shown in Figure 1. Assume that there are two treatment plants which discharge effluent into a single water course (and that there is full mixing of pollutants in the receiving waters). In this case the concentration of pollutants will be lower for a given level of expenditures if financial resources are transferred from one plant to another (*ie,* $[TC_h - TC_m] = -[TC_m - TC_l]$, but $[TL_m - TL_l] > -[TL_h - TL_m]$). In the case where one part of the city is served by relatively advanced treatment and in another part there is no treatment whatsoever – a situation which exists in many urban areas in LDCs – the same argument would hold true.

Figure 1: Reallocation of Financial Resources and Average Level of Treatment



A similar argument can be made in terms of the *quality* of drinking water distribution. For instance, engineering-based data from WHO/UNICEF (1992) reports a ratio of annualised costs of 2:1 for conventional urban water supply (household connections) relative to intermediate-cost solutions (public standpipes). Similarly, Cairncross (1990) cites a ratio of annualised costs of almost 2:1 for private connections relative to yard taps and over 3:1 for private connections relative to public standposts.[12] Thus, disproportionately high financial burdens are being incurred in order to pipe water directly into the homes of a small minority of households.

Moreover, this would also apply across services. For instance, if the costs of drinking water treatment also rise more than proportionately with the level of treatment, then in some cases it may make sense to transfer financial resources from one service to the other, rather than

[12] Although some of the discrepancy in costs can be attributed to differences in consumption levels.

concentrate resources. Rather than concentrate resources in potable water treatment and discharge the effluent untreated, it may make sense to devote some of the expenditures currently devoted to water treatment on sewage treatment. This is particularly important if some residents rely upon surface waters. And finally, if environmental degradation is subject to threshold conditions and such thresholds are exceeded when pressures are spatially concentrated then differentiated levels of collection and treatment may result in greater overall degradation.

Thus, there are numerous reasons for believing that unequal quality of service provision will lead to decreased average urban environmental quality, both because it increases aggregate pressure on the urban environment and because it increases the negative effects of a given level of pressure.

Financing of Urban Environmental Services

Environmental service provision is not only unequal in terms of access and quality, but it also tends to be unequal in terms of its means of financing. Reviewing a number of World Bank-financed water and sanitation projects, Serageldin (1994) found that “internal cash generation” financed 10% of costs in 1991 – a decline from 34% just three years earlier. Anderson and Cavendish (1993) report that average tariffs for water projects represented 53% of incremental costs between 1966 and 1981, rising to 58% for projects between 1987-1990. Overall in developing countries, WRI (1996) estimated that consumers pay 35% of the costs of water provision. Effectively, the figures imply that those residents who do have access to drinking water and sewer connections are not paying the full costs of its provision.

Conversely, neighbourhoods which are not served by the integrated “town” system are likely to pay for the full costs of the provision of whatever “on-site” system is used. From the perspective of the household these costs can be significant. Table 1 gives data on the ratio of costs per unit of consumption for users who obtain their water from vendors and other sources relative to users of the “public” system with private connections.

Table 1: Ratio of Unit Water Costs for Households With and Without Access to Public Facilities

Source	Ratio	Coverage
Anderson and Cavendish (1993)	2:1-100:1	Cross-Section of Countries
Dillinger (1994)	10:1-12:1	Cross-Section of Countries
Bahl and Linn (1992)	3:1-25:1	Sub-Saharan Africa
Choguill and Choguill (1996)	34:1	Honduras
Whittington *et al* (1991)	35:1-300:1	Nigeria

The study of Onitsha in Nigeria by Whittington *et al* (1991) is the most interesting since it provides details on relative costs by form of provision for unconnected users. They find a ratio of approximately 300 for those who rely upon vendor-distributors (who bring water to the household), 100 for those who rely upon small retail vendors, 75 for households with private boreholes, and 35 for those who rely upon tanker truck vendors (which would require private storage facilities). Moreover, the real differences are to a greater extent reflected in terms of quality of service. Thus, the "costs" of not being connected are not strictly financial. This is not only true of households who rely upon vendors for their water, but also household and community-level responses. While it is clear that a number of small-scale local solutions adopted by communities not integrated into the "town" system have been relatively less costly than the town system itself, [13] this is perhaps more a reflection of differences in service provision rather than relative costs *per se*.

Access to Environmental Services and Economic Inequality

Given these cost differences it is clear that access to water and sanitation services is not only determined in part by relative household economic welfare, but is itself an important contributor to a household's relative economic wealth. Indeed, in their study Leach and Mearns (1995) point out that measures of poverty should include indicators of access to public goods. Choguill and Choguill (1996) point out that investment in infrastructure can be one of the most important means of raising standards of living.

Thus, connection potentially represents one of the most important economic assets that a poor household can possess, and non-connection represents one of the most important determinants of its lower disposable income for other goods and services. For instance, WRI (1996) estimates that poor unconnected households can pay up to 30% of their income on water, while connected rich households pay generally less than 2%. (Okun 1988) Whittington *et al* (1991) find that poorer households (58% of the sample) spent an average of 18% of their income on water, while upper-income households (classification not given) spent 2-3% of their income. Bahl and Linn (1992) cite the case of Kingston, Jamaica where the poorest 30% of the population spend twice as much on water as the richest 10%. Other studies find that the poor (defined variously) can spend as much as 55% (Khartoum, Sudan; Cairncross and Kinnear 1992), 20% (Port-au Prince, Haiti; Fass 1988), and 9% (Addis Ababa, Ethiopia; Bahl and Linn 1992) of their income on water.

[13] Although Dillinger (1994) cites the case of Jakarta in which the costs of the use of septic tanks are approximately 3 times that of the town system.

Moreover, the relative significance of these discrepancies is even greater when it is recognised that costs per unit are usually higher for unconnected users and/or quality of service provision usually lower. Even ignoring external costs and benefits (*ie,* health and environmental), the distributive impact of access to water and sanitation services will not be reflected in either aggregate income or aggregate expenditures. Further incorporating the adverse environmental and health effects of non-connection makes the distributive impact of selective access even greater.

V. "Dual" Water and Sanitation Systems and the Realisation of Distributional Objectives

The combined effects of income-inelastic demand for urban environmental quality and services, the unequal provision and financing of urban environmental infrastructure, the existence of significant economies of scale in its provision, and generally increasing marginal costs of more advanced forms of provision, indicates that there is significant potential for improvement in the allocation of resources within a given city. In this section the scope for such reallocation will be explored.

Reallocation of Water and Sanitation Service Provision

A number of commentators have hailed the existence of informal household and neighbourhood responses to water and sanitation provision, and see its gradual integration with the central system as preferable to the more traditional model of centralised development.[14] While on-site solutions are clearly necessary measures undertaken by households and neighbourhoods to protect their local environment and health, it must be emphasised that they are primarily a reflection of policy failure at a higher level and in most cases are not an efficient means of achieving a satisfactory level of service provision and environmental quality. Transferring some of those financial resources which are presently devoted to on-site solutions[15] and requiring users who are presently connected to pay a greater proportion of the cost of the public service they receive,[16] has the potential to significantly improve overall urban environmental service provision (and thus environmental quality) since these transfers can be large.

[14] Indeed, one paper refers to the sale of such systems to the town system as a "windfall gain." (Chogull and Chogull 1996) Considering that development of the town system tends to be subsidised while on-site responses usually receive few external inputs, such a characterisation is grossly misleading.

[15] To the extent that a single integrated system would be more efficient, it would not be necessary to transfer all of actual expenditures in order to improve service provision.

[16] To the extent that water and (particularly) sanitation involve externalities, it would not be efficient for households to bear full costs.

For instance, Whittington *et al* (1991) estimate that in Onitsha, Nigeria the revenues collected by water vendors are 10 times that collected by the public utility at present and would be enough to cover 70% of the total annual costs of a public system serving 80% of the population. Serageldin (1994) estimate that if the money spent on private water systems in Tegucigalpa, Honduras (in-house water storage tanks, booster pumps, private wells) was transferred to the town system, the number of deep wells providing water for the city could be doubled. The subsidy derived from low-cost recovery can be even more significant. For instance, it has been estimated that those residents of Mexico City who are served by municipal systems receive an annual subsidy of approximately 0.6% of GDP. (Serageldin 1994).

Thus, rather than having a relatively advanced public system with limited coverage, in many cases allocation would be more efficient with a basic integrated public service provided to all neighbourhoods, with individual communities having the option to organise the provision of more comprehensive services themselves. For instance, the state (or state-regulated private contractor) could be responsible for provision of water distribution systems to the street. Whether or not the neighbourhood has household connections or public standpipes would be a secondary decision. This would represent a reversal of the existing situation in many cities in which the more advanced service is subsidised for a minority and the majority are left to fend for themselves.

Cross-Subsidy Pricing of Urban Environmental Services

In many cities, there are clearly benefits to be derived from the reallocation of private resources by the poor which are presently expended out of necessity on small-scale systems, as well as increased recovery of funds which are presently borne by the state on behalf of richer connected users. This will, in and of itself, bring about a significant redistribution of economic welfare within a given urban area. However, further distributive impacts could arise through "cross-subsidy" pricing whereby users are differentiated on the basis of particular criteria. For connected users this differentiation may be reflected in development charges, connection fees or user fees. For unconnected users they may be reflected in charges for the use of public standpipes and communal sanitation services.

Cross-subsidy pricing can take a number of forms.[17] Perhaps the most common form is through the use of rising block rates. In its purest form there is a "lifeline" tariff rate which is subsidised up to the point at which most external benefits are likely to be realised. Another common form of cross-subsidy pricing is through the use of differentiated connection fees which are tied to property values or income levels. A third form is one which distinguished neighbourhoods on the basis of socio-economic characteristics. A fourth form is the use of revenues generated by connected users to subsidise the services provided to unconnected users. (See Bahl and Linn 1992 for a discussion.)

[17] This section will only discuss those forms of cross-subsidy pricing which are directly related to urban service provision, and not more indirect forms such as between different services or between regions.

Although all of these have particular deficiencies and in some cases may entail significant administrative costs, there is a strong general case to be made for financial redistribution toward poorer households through charging schemes. In particular, redistribution need not be at odds with principles of economic efficiency due to the external benefits of water and sanitation services at the low levels of provision which poorer households tend to consume. Moreover, since there is a strong (and negative) relationship between the density of development and the cost of provision of water and sanitation services, and a strong (and negative) relationship between relative income levels and density of development, such redistribution may actual be a reflection of cost differences.[18]

The Role of Local Authorities

In order to bring about such an integration of systems and the institution of a more efficient financing system it is clear that the local authorities will have to play an important role. While it is true that the existence of "dual systems" in water and sanitation is in part a reflection of failures of local authorities to develop and manage centralised systems efficiently, much of this is certainly attributable to the role of national governments and international development banks in undermining their capacity to operate efficiently. However, in recent years local authorities have started to reassert their authority and exercise responsibility in the field of urban environmental management. (WRI 1996).

This is supported by the public economics literature, which shows that responsibility for a particular task should rest with the lowest-level authority whose jurisdiction encompasses the majority of beneficiaries. In terms of water and sanitation (as well as transport infrastructure and waste collection and disposal) this is not the individual, household or neighbourhood since many of the benefits will be extra-jurisdictional. Nor is it the state or central government since few of the external benefits extend beyond the individual urban area. (See Dillinger 1994 and Serageldin 1994).

However, the positive experience of many informal solutions which arose as a response to failures in the traditional system makes it clear that participation by non-state local groups is required in order for a system to be effectively managed and in order for the preferences of households to be authentically represented. Similarly, the financial constraints which many local authorities face indicates that the central government may have to play a role as well, if only as a guarantor of provision rather than directly as a manager.

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[18] Conversely, costs of provision to informal urban areas may be high due to topographical conditions.

VI. Conclusion: Policy Implications

Little empirical evidence has been presented in this study and as such practical policy conclusions can not be derived without further research. However, there are a number of general points which can be made:

- The public nature of urban environmental quality and the relative income-inelasticity of demand for the services which are necessary for its preservation means that low levels of service provision (even if it is not income-biased) will tend to have relatively more adverse effects for poorer households.

- The use of potential (rather than actual) compensation and equal weights in the evaluation of public water and sanitation projects results in a perpetuation of this bias over time.

- The provision of urban environmental services can be one of the most significant means of achieving distributional objectives, particularly in countries in which there are relatively few other mechanisms for redistribution available to the state.

- The existence of economies of scale in terms of levels of service provision and rising costs in terms of quality of service provision implies that equal access to a standard system may be more efficient than differentiated access and treatment.

- The existence of insufficient cost recovery in the public system and high costs in the on-site system implies that there is potential for significant expansion of the former if resources are reallocated.

- The external benefits of water service and sanitation service access and the existence of a proportion of the population which is not in a financial position to pay for full cost recovery implies that some form of cross-price subsidies may be necessary.

In comparison with the actual situation in many urban areas in developing countries, this implies that a rather significant change in the nature and financing of urban water and sanitation facilities is desirable. This would involve a significant reallocation of resources. However, the realisation of such a reallocation is largely dependent upon the reinvigoration of local authorities, and changes in their relationship with local communities, central governments and external support agencies such as development banks.

There are, therefore, two principle avenues for further research. On the one hand it is important that the potential for such a reallocation be assessed. This would necessarily involve case studies of particular cities and would require the determination of the shape of the cost function for treatment and collection, the existence of economies of scale, the degree of cost recovery in the town system, and the relative costs and expenditures for connected and unconnected users. While much of this information exists for some cities, it needs to be brought together in a systematic manner and analysed.

On the other hand, determining the potential benefits (in terms of equity and efficiency) for such a reallocation is not sufficient. Indeed, the most important issues are political – the practical realisation of such a reallocation. Paradoxically the relative weakness of local authorities in recent decades has had two positive consequences. Firstly, the consequences of their weaknesses in terms of the insufficiency and inequity of service provision has brought to light the key role that they will have to play in any reform. Secondly, the role that local communities and neighbourhoods have played in meeting those needs which have gone unmet by local authorities has brought to light the key role that other civil service organisations will have to play. Thus, the second avenue for research is to examine institutional mechanisms whereby the dynamism of local responses can be married with local authority responsibility in a productive manner.

Annex: Empirical Evidence of the Relationship Between Economic Inequality and the Provision of Urban Environmental Services

In a cross-sectional econometric analysis of the determinants of a variety of indicators of environmental quality (*ie,* sulphur dioxide, smoke, heavy particle, dissolved oxygen, and faecal coliform concentrations, as well as potable water and sanitation connections), Torras and Boyce (1994) included an indicator of relative economic inequality (*ie,* the Gini coefficient), as well as a number of other potentially significant economic (*ie,* income levels), natural (*ie,* degree of urbanisation) and social (*ie,* literacy rates and an index of human rights) factors. In general, they found that the indicator of economic inequality was negatively related to environmental quality, although it was statistically significant[19] in less than half of the equations estimated. For no single indicator was it of both the expected (hypothesised) sign and statistically significant for both low-income and high-income countries. As such the evidence provided by the study is, at best, ambiguous.[20]

Further empirical evidence of the hypothesised negative relationship between economic inequality and the provision of urban environmental services can be gleaned from the Society for Development Studies' *India: City Indicators Programme* (1996). Income distribution is measured in terms of household income (in US$) by quintile. These were converted into Gini coefficients, the relative share of the richest quintile and the poorest quintile (Q5/Q1) and the relative share of the richest quintile in total urban wealth (Q5/Total). The environmental indicators included household water connections (%), access to potable water (%)[21] and household sanitation connections (%). The sample size (ten cities)[22] is too small to undertake any regression analysis reliably and as such evidence is only reported on the degree of correlation between the three measures of access to environmental services and the three measures of economic inequality, along with income levels. (See Table 2.)

Table 2: Relationship Between Economic Inequality and Indicators of Urban Environmental Quality in Indian Cities

	Gini	Q5/Total	Q5/Q1	Income
Sanitation (Conn)	0.034	-0.017	-0.003	0.374
DW (Access)	-0.395	-0.405	-0.012	-0.003
DW (Conn)	0.308	0.362	0.419	0.656

In general the results provide only limited support for the hypothesis that access to urban environmental services improves with increased economic equality. Only five of the nine

19 At the 5% level of significance.

20 Moreover, there are two significant methodological problems with the study. Firstly, there is likely to be significant multicollinearity between some of the variables included. Secondly, the Gini coefficients applied were not obtained on the basis of standardised methodologies, although this problem is true of all studies using readily available Gini coefficients.

21 Household connection and/or public standpipe within 200 metres of the dwelling.

22 One of the cities did not report data on household income.

coefficients are of the hypothesised negative sign. Only access to potable drinking water consistently exhibits the hypothesised relationship. Surprisingly, it is also the only indicator which has a negative relationship between income levels and access, although the coefficient is statistically insignificant.

The limited support for the hypothesised relationship between economic inequality and access to urban environmental services can perhaps be explained by the fact that effective demand for such services is primarily reflected in the extent to which households can influence public policy. (See Torras and Boyce 1994). If this capacity differs systematically with income levels then households at different levels of income will have different capacities to convert notional demand into effective demand. Moreover, there are good reasons to believe that such a relationship is likely to be stronger for richer households since the ability to affect public policy is to some extent a function of the ability to bear the high transaction costs associated with doing so – *ie,* the costs of organisation and the costs of exerting influence. (Boyce 1994.) Thus the effect that economic inequality will have on aggregate demand may be rather different than that which is revealed in terms of household preferences. Some of the consequences of this difference have been explored in Section IV above.

References

Anderson, Dennis and William Cavendish (199?) *Efficiency and Substitution in Pollution Abatement*, Washington D.C., World Bank Discussion Paper No. 186.

Bahl, Roy W. and Johannes F. Linn (1992). *Urban Public Finance in Developing Countries* (Oxford: OUP).

Baumol, William J and Wallace E. Oates (1988) *The Theory of Environmental Policy* (Cambridge: CUP).

Boyce, James K. (1994) `Inequality as a Cause of Environmental Degradation' in *Ecological Economics*, Vol. 11, pp. 169-178.

Broad, Robin (1994). `The Poor and the Environment: Friends or Foes?' in *World Development*, Vol. 22, No. 6, pp. 811-822.

Burgess, Joanne *et al* (1991) `Poverty and Environment Linkages' London, London Environmental Economics Centre mimeo.

Burtaw, Dallas and Raymond J. Kopp (1994) `Cost-Benefit Analysis and International Environmental Policy Decision Making: Problems of Income Disparity' Washington DC, Resources for the Future Discussion Paper 94-15.

Cairncross, Sandy (1990) `Water Supply and the Urban Poor' in J. E. Hardoy, S. Cairncross and D. Satterthwaite (eds.) *The Poor Die Young: Housing and Health in Third World Cities* (London: Earthscan).

Cairncross, Sandy and Joanne Kinnear (1992) `Elasticity of Demand for Water in Khartoum, Sudan' in *Social Sciences*, Vol. 34, No. 2, pp. 183-189.

Choguill, Charles L. and Marisa B. G. Choguill (1996) 'Towards Sustainable Infrastructure for Low-Income Countries' in C. Pugh (ed.) *Sustainability, the Environment and Urbanisation* (London: Earthscan).

Dasgupta, Partha and Karl-Goran Maler (1994). *Poverty, Institutions and the Environmental Resource Base* (Washington DC: World Bank Environment Paper No. 3).

Dillinger, William (1994). `Decentralisation and its Implications for Urban Service Delivery' (Washington DC, World Bank Urban Management Programme Discussion Paper 16).

Duraiappah, Anantha (1996). `Poverty and Environmental Degradation: A Literature Review and Analysis' IIED, CREED Working Paper No. 6.

Durning, A. B. (1989) `Poverty and the Environment: Reversing the Downward Spiral' *Worldwatch Paper* No. 92, Washington DC.

Fraas, Arthur G. and Vincent G. Munley (1984). 'Municipal Wastewater Treatment Cost' in *Journal of Environmental Economics and Management*, Vol. 11, No. 1, pp. 28-38.

Grossman, G. M. and A. B. Krueger (1995) 'Economic Growth and the Environment' in *Quarterly Journal of Economics*, Vol 110, No. 2 (May), pp. 353-378.

Holtz-Eakin, Douglas and Thomas M. Selden (1995) `Stoking the Fires? CO2 Emissions and Economic Growth' in *Journal of Public Economics*, Vol. 57, pp. 85-101.

Johannson, Per-Olov (1993) *Cost-Benefit Analysis of Environmental Change* (Cambridge: CUP).

Kanninen, Barbara J. and Bengt Kristrom (1992). `Welfare Benefit Estimation and Income Distribution' Stockholm, Beijer Discussion Paper No. 20.

Kristrom, Bengt and Pere Riera (1996). `Is the Income Elasticity of Environmental Improvements Less than One?' in *Environmental and Resource Economics*, Vol 7, No. 1, pp. 45-55.

Leach, Melissa and Robin Mearns (1995) `Poverty and Environment in Developing Countries: An Overview Study' Final Report to the ESRC and ODA.

Lucas, R. E. B., D. Wheeler and H. Hettige (1992) 'Economic Development, Environmental Regulation and International Migration of Toxic Industrial Pollution: 1960-1988' in P. Low (ed) *International Trade and the Environment*, Washington, World Bank Discussion Paper No. 159, pp. 67-86.

Maler, Karl-Goran (1985) `Welfare Economics and the Environment' in A.V. Kneese and J.L. Sweeney (eds.) *Handbook of Natural Resource Economics* (Amsterdam: Elsevier).

McConnell, Virginia D. *et al*. (1988). 'Regional Marginal Costs and Cost Savings from Economies of Scale in Municipal Waste Treatment' in *Growth and Change*, Vol. 19, pp. 1-13.

McGranahan, Gordon *et al*. (1996). `Sustainability, Poverty and Urban Environmental Transitions' in C. Pugh (ed.) *Sustainability, the Environment and Urbanisation* (London: Earthscan).

McGuire, Martin C. and Henry Aaron (1969). `Efficiency and Equity in the Optimal Supply of a Public Good' in *Review of Economics and Statistics*, Vol. 51, No. 1, pp. 31-39.

Meuser, Michael and Andrew Szasz (1996). `Environmental Inequality Bibliography' University of California, Santa Cruz, Sociology Board, mimeo.

Opschoor, J. H. (1995) `Ecospace and the Fall and Rise of Throughput Intensity' in *Ecological Economics*, Vol. 15, pp. 137-140.

Okun, D.A. (1988) 'The Value of Water Supply and Sanitation in Development' in *American Journal of Public Health*, Vol. 78, No. 11, pp. 1463-1467.

Quiggin, John (1993) `Common Property, Equality and Development' in *World Development*, Vol. 21, No. 7, pp. 1123-1138.

Rothman, Dale S. (1996) `Environmental Kuznets Curves – Real Progress or Passing the Buck?', UBC, Sustainable Development Research Institute.

Saint-Paul, G. (1994). 'Trade Patterns and Pollution'. (Milan: Fondazione Eni Enrico Mattei, Working Paper 40.94).

Selden, T. M. and D. Song (1994) 'Environmental Quality and Development: Is There a Kuznets Curve for Air Pollution Emissions?' in *Journal of Environmental Economics and Management*, Vol. 27, No. ?, pp. 147-162.

Serageldin (1994). `Water Supply, Sanitation and Environmental Sustainability' Washington DC, World Bank Directions in Development.

Shafik, Nemat. (1994) 'Economic Development and Environmental Quality' in *Oxford Economic Papers*, Vol. 46, Supplementary Issue (October), pp. 757-773.

Tirole, Jean. (1988). *The Theory of Industrial Organisation* (Cambridge, Mass.: MIT Press).

Torras, Mariano and James K. Boyce (1996) `Income, Inequality, and Environmental Quality: An International Cross-Sectional Analysis' Dept. of Economics, University of Massachusetts, Working Paper 1996-4.

UNDP (1990) *Human Development Report* (New York: UN).

WCED (1987). *Our Common Future* (Oxford: OUP).

Wheeler, David and Paul Martin. (1992) ‘Prices, Policies and the International Diffusion of Clean Technology: The Case of Wood Pulp Production’ in P. Low (ed.) *International Trade and the Environment*, Washington, World Bank Discussion Paper No. 159, pp.197-224.

Whittington, Dale *et al*. (1990) `Estimating the Willingness to Pay for Water Services in Developing Countries: A Case Study of the Use of Contingent Valuation Surveys in Southern Haiti’ in *Economic Development and Cultural Change*, Vol. 328, No. 2, pp. 293-311

Whittington, Dale *et al*. (1991) `A Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria’ in *World Development*, Vol. 19, No. 2/3, pp. 179-198.

WHO (1992). *Our Planet, Our Health: Report of the WHO Commission on Health and the Environment* (Geneva: WHO).

WHO/UNICEF (vrs. yrs.) *Water Supply and Sanitation Sector Monitoring Report* (Geneva: WHO).

World Resources Institute (1996) *World Resources 1996-1997* (Oxford: OUP).