A re-assessment of indicators of national water scarcity

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The indicator of naturally available water resources per capita has become the standard index for measuring the degree to which a country is facing water scarcity and is often used to show a growing global water crisis. By simultaneously analysing the national development related data provided by the UNDP, and the water resources related data provided by the FAO it is possible to test the validity of this index, its definitions of water scarcity, and the correlation of water scarcity with national development. This analysis suggests that the naturally available water resources of a country do not have a significant effect on the ability of that country to meet the basic needs of its population.

Key words:
Water scarcity, water poverty, indicators, indices, neo-Malthusian, development

Introduction: water and water requirements

Water is essential for life and for most activities of human society. Both economic and social development, and the maintenance of human health are completely dependent upon ready access to adequate water supplies. All societies require water both for basic survival and for economic development.

Problems satisfying water resource needs or demands are affecting a growing proportion of the world, primarily in arid and semi-arid regions where population pressures are considerable and demand for water is currently rising faster than at any time previously (Rodda, 2001). As a result, an increasing number of nations are struggling to find ways to cope and satisfy their needs as their populations grow and economies develop.

Even though population growth rates are declining, human numbers will still increase significantly before stabilisation occurs (United Nations Population Division, 2003). Estimates of future global population growth therefore suggest continuing rising demand for water resources, and thus growing scarcity. However, the common sense definition of water scarcity being a state of insufficient water to satisfy normal requirements is of little use to policy makers as it fails to acknowledge degrees of water scarcity and how different societies adapt to this scarcity. It also fails to acknowledge the difference between water for domestic uses, and for economic activities such as agriculture or industrial production.

Sustainability indicators are used to determine the direction of systems at the macro level and assist in policy formulation at this level while simultaneously informing decision making at the micro level where action has greater impact (Rutherford, 1997). An indicator of water scarcity is a specific sustainability indicator useful for directing policy formation and resource allocation in the water sector within the overall context of sustainable development.

This paper reviews existing indicators of water scarcity before examining statistically how effective are the most commonly used water scarcity indicators at measuring the ability of individual countries to satisfy their basic water requirements.

Defining national water scarcity

Neo-Malthusian indicators

The issue of water scarcity is widely discussed in the literature relating to global water resources development. Scarcity is a function of demand and availability, with the traditional neo-Malthusian view being that resources are essentially fixed while demand will increase with population (Meadows *et al.*, 1992). This neo-Malthusian standpoint underlies the most widely used indicator of water scarcity, an indicator which is based upon renewable water resources per capita.

Falkenmark (1986) while focusing upon sub-Saharan Africa and the amount of water required for food self-sufficiency proposed an indicator based upon water resources per capita. According to Falkenmark’s definition a country faces water stress when per capita water resources fall below 1667 cubic metres per capita[1]; water scarcity threatening economic development and human health and well-being occurs when there is less than 1000 cubic metres per capita, and absolute water scarcity when water resources are less than 500 cubic metres per capita (Falkenmark, 1986). A country with existing water scarcity and a growing population will inevitably face worsening scarcity as demand for water is expected to grow as a function of population growth.

This indicator has been criticised because it does not allow for differences in water use patterns between countries, nor multiple in-stream uses (Raskin *et al.*, 1997). More fundamentally, authors such as Ohlsson (1999) note that it does not consider the ability of a nation to adapt to reduced per capita water availability. As Allan (2001) has shown, across much of the Middle East, declining per capita water resources in many countries have been compensated for by grain imports, which he terms “virtual water”. In many arid Middle Eastern countries of modest income, such grain imports have effectively been used to satisfy food needs for many years, suggesting that the link between water resources availability and food security is no longer valid in many cases due to the presence of a global food market in which most countries of the world now participate to a greater or lesser extent. Yang *et al.* (2003) point out that below approximately 1500 cubic metres per capita demand for cereal imports increases exponentially with decreasing water resources. Even Least Developed Countries are now connected to the global food market; for example, in 2002 imports made up 20 percent of the grain supply across sub-Saharan Africa, the region with the lowest average per capita incomes, and looking individually, some of the poorest countries in this region managed to import a significant proportion of their grain supply (FAO, 2004b).

Rather than assessing the sufficiency of water at the national level for food self-sufficiency, it makes more sense to evaluate the sufficiency of water for food production needs at a global rather national level (Allan, 2001). Given that per capita global food production has risen significantly during the last thirty years and the proportion of undernourished people has more than halved (FAO, 2001), it suggests that global food production and thus the water resources for this food production remain sufficient for meeting human needs. (It is the unequal distribution of food resources within individual countries and between countries that is the major cause for continuing under nourishment in some communities.) Systematically assessing the global adequacy of water resources for food production is, however, methodologically problematic and beyond the scope of this paper.

As a result of the realisation that water availability and food security is no longer directly linked, the focus of the water discourse in recent years has shifted away from water for food self-sufficiency towards access to water for domestic use as a human rights issue. However, while the issue of access to water at a domestic level is central to the water and development discourse, access data alone provide no indication of the difficulty faced by a country in achieving universal access and say little about water scarcity within a country.

A range of alternative indicators to the water resources per capita (Falkenmark) index for assessing the adequacy of a nation’s water resources have been put forward. Seckler *et al.* (1999) proposed a water scarcity index whereby countries are categorised according to whether they face absolute water scarcity, meaning that they physically do not have enough water to meet expected reasonable per capita water needs by 2025, or economic water scarcity, meaning countries which have sufficient potential water needs to projected requirements for 2025 but will require significant investment in their water sectors to meet the requirements resulting from population growth. Like the Falkenmark index, this index does not give due emphasis to the varying ability of countries to effectively manage their water resources and adapt their economies to changing circumstances; it is also a neo-Malthusian indicator that will inevitably show a worsening situation over time in line with population growth.

Raskin *et al.* (1997) proposed a use per resource indicator, based upon the percentage of water resources withdrawn for different uses. Thus according to this indicator where a country is using most or all of its available natural water resources it will be water stressed, with levels of water stress rising as a rising proportion of available water resources are used. Like the Falkenmark and Seckler indices, this index fails to consider the varying ability of a country to effectively manage its water resources as circumstances change, and thus it is also a neo-Malthusian indicator that will inevitably show a worsening situation over time.

Weighted indicators of water scarcity

Ohlsson (1999) proposes a composite index that he called a social water scarcity index based upon a combination of the water scarcity index and the Human Development Index. The Human Development Index is itself is a composite index that annually assesses human development on a national basis by measuring life expectancy at birth, the adult literacy rate, the gross enrolment ratio, and the adjusted per capita income in purchasing power parity in US dollars (UNDP, 2004). While Ohlsson’s index considers adaptive capacity and thus the ability of a society to adapt to increasing natural scarcity, it depends upon proxies rather than a causal connection for measuring the ability of a country to deal adequately with water scarcity. The index lacks a direct means of measuring the ability of a country to deal effectively with water scarcity through technological processes and infrastructural investment, or social adaptation. It also fails to address water quality issues.

Sullivan (2000) advances an alternative index relating to water scarcity which she termed a water poverty index. This index is based upon a combination of indices which measure water availability, access to water resources and sanitation, and the time and effort required to access adequate water for domestic use. Lawrence *et al.* (2003) further develop this index, specifying each of its individual components and how to measure them, producing an index consisting of 17 different variables, some of which are in themselves composite variables. Like other composite quality of life indices, this index suffers from the problem that it is no better than its weightings, and thus by extension no better than the opinions of those who determine these. It is very difficult to develop a weighted index based upon a scientifically defensible weighting, that is not amenable to manipulation or sensitive to the values of those that participate in the weighting exercise (Dahl, 1997).

Economic indicators of water scarcity

An alternative approach for aggregating data in order to assess the adequacy of a nation’s water resources is offered by Feitelson and Chenoweth (2002). The index they suggest is based upon an assessment of the cost of supplying all segments of a nation’s population with an adequate supply of clean sustainable water and sanitation services, and comparing this cost with national income.

According to this economic based index of water scarcity, rich arid nations (such as certain Gulf oil-producing states) will not suffer from water poverty as their high water supply costs are more than matched by their high ability to pay. Similarly, in poorer humid countries low national incomes will generally be sufficient to meet low water supply costs. Where the cost of providing sustainable clean water to all people at all times is high while national income is low, and thus water supply costs will consume a disproportionate percentage of a nation's resources, that nation faces water poverty.

Feitelson and Chenoweth's index is essentially an affordability index of water supply, and as such is appropriately called an index of structural water poverty. However, it suffers from the problem that for most countries data on the full cost of sustainably supplying water to all segments of the population is not, at present, readily available at the national level. Thus, widespread use of this index would require a significant new data gathering exercise on the part of an international development organisation.

A standard measure of water scarcity

Despite its shortcomings, the water resources per capita indicator with the scarcity definitions proposed by Falkenmark (1986) is frequently used for measuring the degree to which a country is facing water scarcity. Seckler *et al.* (1998) refer to this indicator as the standard indicator of water scarcity and the FAO (2000) notes that this indicator is now almost universally recounted. Indeed, examples of its use include Rodda (2001), Rosegrant (1997), Rosegrant and Perez (1997), Stikker (1998), and Gardner-Outlaw and Engelman (1997) to list but a few.

In the Food and Agriculture Organization's (FAO) report *Review of World Water Resources by Country*, the water resources per capita index is used to identify water scarce countries, with 1000 cubic metres per capita being used as the point at which a country is defined as water scarce (FAO, 2003). The same water resources per capita index of water scarcity is referred to in the report produced by the World Water Assessment Programme's report *Water for People, Water for Life: The United Nations World Water Development Report*. In this report it is stated that "At present many developing countries have difficulty in supplying the minimum annual per capita water requirement of 1,700 cubic metres (m^3) of drinking water necessary for active and healthy life for their people" (World Water Assessment Programme, 2003, p10), with this quotation suggesting confusion between drinking water needs and water requirements for other uses. This report also states that as many as seven billion people in sixty countries may live water scarce lives by 2050, again basing the projection on the Falkenmark index (World Water Assessment Programme, 2003). The United Nations Environment Programme (UNEP) also refers to the Falkenmark index when defining water scarcity and discussing projected water stress in 2025 (UNEP, 2002).

Falkenmark's index of water scarcity is used to show a growing global water crisis whereby an increasingly large percentage of the world face a water scarce future that condemns them to poverty. However, the validity of the index given the global nature of food markets remains untested. The question of whether the economic development and human health and well-being of countries which are classified as suffering from water stress or absolute water scarcity according to this index is impaired compared with countries better endowed with fresh water resources has not been addressed. How useful therefore is the Falkenmark index of water scarcity as an indicator of the state of global water resources and the ability of countries to satisfy the basic needs of their people has not been assessed.

Assessing the validity of the standard water resources per capita indicator of water scarcity

Since 1990 the United Nations Development Programme (UNDP) has produced the *Human Development Report* series which analyse the status of global human development. These reports contain a wealth of data on economic development, human health and well-being which are inter-related and together provide an indication of human development (UNDP, 2004). These data are compiled on a national basis, with data from these reports available from the UNDP website. Data includes life expectancy at birth, adult literacy rate, education ratios, percentage of children underweight, percentage of the population with access to adequate sanitation and water supply, fertility rates, real GDP per capita, debt service rates, nature of imports and exports, level of urbanisation and so on. As such, this data base compiled by the UNDP provides the most comprehensive multi-country survey presently available of human development data.

The Land and Water Development Division of the FAO has developed an extensive database of water resources related data which is also compiled on a national basis. This database contains information on internal renewable water resources per capita, total water resources per capita, water use ratios, percentage of water being used for agriculture, domestic, and industrial uses, the per capita area of crop land, volume of desalinated water produced, extent of irrigation and so on for most countries. By analysing these two databases together it is possible to test the validity of the water resources per capita (Falkenmark) index, its definitions of water scarcity, and the correlation of water scarcity with national economic development and well-being. It is also possible to test the usefulness of the other major water scarcity index in general use, the use-per-resource index proposed by Raskin *et al.* (1997).

Any statistically-based analysis of water resources data conducted on a national basis risks being skewed by a small number of countries which contain relatively massive internal per capita water resources. Six countries (Iceland, Guyana, Suriname, Congo, Papua New Guinea and Gabon) all have renewable water resources per capita exceeding 100,000 cubic metres per capita per annum. Inclusion of these six countries in the dataset increases average national per capita water resources per capita by 63 percent. Two sets of analysis have therefore been carried out, one set with the full database (the combined UNDP and FAO datasets), and a second set with these six outlier countries removed. In total there were 173 countries in the database. However, for some indicators (namely adult literacy, percentage of children under weight for age, percentage of the population using adequate sanitation facilities, and percentage of the population using improved water sources) the dataset was incomplete, as it lacked data for developed countries.

The most obvious relationship to test the extent to which a country's water resources have impacted upon national economic development is the correlation of internal renewable water resources per capita with national GDP (PPP $US) per capita data. Internal renewable water resources refers to the average annual flow of rivers and recharge of groundwater generated from endogenous precipitation (FAO, 2004a). GDP is a measure of the value of wealth generated within the country, adjusted for price differences between countries (United Nations Development Programme, 2004). If increasing water scarcity does impact significantly upon economic development, then there should be some level of correlation between these two data sets. However, these two variables for the year 2000 have a Pearson Correlation of 0.116 using the full database (171 cases), and of -0.066 when the six outlier countries are excluded. Neither correlation is statistically significant or greater than might be expected to occur with a random set of numbers. See Figures 1 and 2 for scatter grams of the relationship.

While internal renewable water resources show the amount of water which a country is securely able to access, total renewable water resources reflect the amount of water available to a country at present since this indicator allows for cross-border water flows. The Pearson Correlation of total renewable water resources per capita and GDP per capita (PPP $US) is 0.080 for the full database (171 cases) and 0.033 when the six outlier countries are excluded. Neither correlation is statistically significant and again the correlation is no stronger than might be expected to occur by chance. See Figures 3 and 4 for scatter grams of the relationship.

When internal renewable water resources or total renewable water resources are correlated with other basic indicators of national development, using the combined UNDP Human Development Index ranking, no statistically significant correlation results with the 172 cases analysed. Similarly, when specific indicators of human development are examined individually, no statistically significant correlation results. In both cases, all correlations are less than 0.15. Perhaps most tellingly, neither internal renewable water resources per capita nor total renewable water resources per capita produce a significant correlation when compared to the percentage of the population using adequate sanitation facilities or the percentage of the population using improved water sources. It would be difficult to argue that access to improved water sources or sanitation did not relate directly to the effectiveness of a country at satisfying the economic development, human health and well-being of its people as referred to in the definition of water scarcity adopted in the water resources per capita (Falkenmark) index. The lack of any significant correlation suggests that the level of available water resources per capita is a relatively insignificant factor compared to other factors in determining the ability of a country to satisfy its most basic water and other human needs.

A stepwise regression analysis of the database with either internal renewable water resources or total renewable water resources used as independent variables and the indicators of human development as dependent variables did not produce a result as the F value for each of the dependent variables is not sufficiently large to produce meaningful regression results.

This analysis of the data suggests that the water resources per capita (Falkenmark) index can tell us little if anything about the ability of a country to satisfy the basic water resource needs of its population, the health of a country’s population, or the ability of the country to develop economically; water resources per capita and level of national development appear to be unrelated. There is no evidence to support the statement of the World Water Assessment Programme (quoted above) that countries require at least 1,700 cubic metres per capita to sustain a healthy and active life for their citizens. No thresholds relating to water resources per capita and national development were revealed. Unsurprisingly perhaps, national development depends on a much more complicated set of factors than the per capita availability of water resources. See Tables 1 and 2 for the correlation results spread sheets.

The full database allows the testing of the validity of the water use ratio index proposed by Raskin *et al.* (1997) as an indicator of the ability of a country to satisfy the basic needs of its citizens. When the water use ratio is compared to either Human Development Index rankings or GDP per capita (PPP $US) the correlations are less than 0.15 (with 150 or 151 cases) and the results are not statistically significant, for both the full database and when the six outlier countries are excluded.

When the water use ratio is compared to other data relating to national development some statistically significant, although weak correlations result. There is a weak but statistically significant correlation (at the 0.05 level) for the water use ratio and the percentage of the population using adequate sanitation facilities: 0.212 for the full database (111 cases) and 0.215 with the six outlier countries excluded. Being a positive correlation, however, this suggests that to a very limited extent the greater the water use ratio of a country the greater proportion of its people that will have access to sanitation services. It does not support the neo-Malthusian contention that a higher water use ratio indicates water stress and therefore a reduced ability to meet the basic needs of the population. There is also a weak but statistically significant (at the 0.05 level) negative correlation between the water use ratio and the infant mortality rate, suggesting that a higher water use ratio might have a very slight positive benefit for the health of a country's population. Both these correlations contradict the neo-Malthusian basis of the water use ratio indicator.

A stepwise regression analysis using the water use ratio index as the independent variable and the national development indicators data as dependent variables produced a regression model using GDP per capita, total fertility rate, life expectancy at birth and combined primary, secondary and tertiary gross enrolment ratio. However, the R Square is 0.292, suggesting only a weak relationship. In this model, because the standardised co-efficients are all positive, a higher GDP per capita, life expectancy and combined education enrolment ratio all suggest a higher water use ratio, again contradicting the neo-Malthusian basis of the water use ratio indicator.

Per capita levels of domestic water use and industrial water use have statistically significant (at the 0.01 level) correlations that are moderate to strong for all the basic indicators of development analysed. (See Tables 1 and 2.) This should be expected, since per capita levels of domestic or industrial water use directly relate to the level of economic development of a country. Conversely, the correlation between domestic water use and internal or total renewable water resources per capita is very weak. It is only 0.188 and 0.140 respectively for the full database (172 cases), and 0.288 and 0.213 respectively when the six outlier countries are excluded.

Similarly, the percentage of a population using adequate sanitation facilities and improved water sources also correlates moderately strongly (and is statistically significant at the 0.01 level) with the basic indicators of national development. However, again, these indicators do not correlate with the internal or total renewable water resources of a country and are not used as indicators of water scarcity but rather national development. Hence it is not surprising that they correlate with other basic indicators of national development.

Conclusion

The relatively comprehensive development indicator database of the UNDP and the water resources database of the FAO provide no support for the notion that the naturally available water resources of a country has a significant effect on the ability of that country to meet the basic needs of its population. It also provides no indication that water shortages hold back the development of nations even though common sense would suggest that in any given country more water should enable a higher GDP because it would permit a greater range of activities to be undertaken and, therefore, at least a weak relationship between water availability and economic development might be expected. In part this counter intuitive finding may be able to be explained by the methodology used for compiling national GDP: where water supply costs are high, the water sector will directly contribute more to a nation's GDP compared to where costs are low because the sector will be more significant economically. A free or nearly free good will contribute little directly to GDP, although its indirect contribution may be significant. It may also be able to be explained by the low economic returns received for many agricultural crops compared to the returns possible from other less water intensive economic activities, and the fact that poor water resources endowment may encourage countries to direct available resources towards non-agricultural development at an earlier stage of their national development process.

The databases suggest that the ability of a country to effectively tap its human ingenuity is far more significant than the natural water resources endowment of a country. It is clearly socio-economic development rather than the natural environment which is the primary determinant of the ability of a country to meet the basic needs of its population; the link between socio-economic development and the natural environment is far from straight forward.

Neo-Malthusian indicators, such as the water resources per capita (Falkenmark) index or the water use ratio index tell us little about the water crisis faced by the world or how to deal with it. According to the World Health Organisation and the United Nations Children's Fund (2000) 1.1 billion people were living without access to improved water supplies and 2.4 billion people lacked access to improved sanitation in 2000. Citing figures, such as the fact that seven billion people living in sixty countries may live water scarce lives by 2050 because they will live countries with less than 1,700 cubic metres of water per capita, as is done by the World Water Assessment Programme (2003, pp10, 13) is highly mis-leading and tells us little about humankind's likely ability to supply water and sanitation or satisfy the other basic human needs of these people.

Despite rapid global population increase during the 1990s, access rates to safe water supply and sanitation services increased slightly from 79% to 82 % for water supply, and 55% to 60% for sanitation services (World Health Organisation & United Nations Children's Fund, 2000). While neo-Malthusian indicators will inevitably show a worsening situation as population increases, fortunately reality is not always so bleak.

This analysis has shown that standard indicator for water scarcity at the national level tells us little if anything about the difficult a country faces in satisfying the basic needs of its people. Water supply and sanitation access data tell us whether the basic needs of a population are currently being met but do not tell us anything about the difficult a country faces in meeting those needs. Thus, despite a wealth of data and potential indicators, it remains difficult to assess the extent to which we face a global water resource crisis or to objectively evaluate where developmental assistance can be most effectively directed so that countries which lack the resources internally to ensure that their basic water and sanitation needs can be met receive the assistance they require.

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Table 1: Pearson Correlations for complete database of countries. (Data sources: FAO 2004, UNDP 2004)

	Internal renewable water resources: cubic metres per capita (2000)	**Total renewable water resources (actual) (cubic m/capita per year) 2000**	**Water use ratio (total water use / total water resources (actual)) 2000**	**Domestic water use (cubic metres per capita) 2000**	**Industrial water use (cubic metres per capita) 2000**	**Agricultural water use (cubic metres per capita) 2000**	**Total water use (cubic metres per capita) 2000**	**Arable & permanent crops per capita (ha) 2000**	**Average precipitation 1961-1990 IPCC (mm/year) (note 6)**	**Population using adequate sanitation facilities (%) 2000**	Population using improved water sources (%) 2000
HDI rank 2002	-0.091	-0.070	-0.139	-.551(**)	-.435(**)	0.006	-.168(*)	-0.127	0.034	-.665(**)	-.694(**)
Life expectancy at birth (years) 2000	0.069	0.049	0.159	.516(**)	.360(**)	0.095	.236(**)	0.04	0.032	.640(**)	.694(**)
Adult literacy rate (% age 15 and above) 2000	0.066	0.083	0.039	.440(**)	.332(**)	.179(*)	.273(**)	0.12	0.076	.581(**)	.523(**)
Combined primary secondary and tertiary gross enrolment ratio (%) 1999	0.104	0.098	0.027	.523(**)	.386(**)	0.113	.261(**)	.242(**)	-0.098	.537(**)	.615(**)
GDP per capita (PPP $US) 2000	0.116	0.080	0.138	.442(**)	.410(**)	-0.124	0.043	0.106	-0.108	.520(**)	.528(**)
Infant mortality rate (per 1000 live births) 2000	-0.049	-0.036	-.164(*)	-.464(**)	-.314(**)	-0.012	-0.14	-0.059	-0.024	-.657(**)	-.725(**)
Children under weight for age (% under age 5) 1995 -2000	-0.049	-0.065	-0.125	-.504(**)	-.342(**)	-0.066	-.194(*)	-.218(*)	0.1	-.607(**)	-.472(**)
Population using adequate sanitation facilities (%) 2000	-0.023	-0.017	.212(*)	.362(**)	.264(**)	.192(*)	.294(**)	0.098	-0.031	1	.705(**)
Population using improved water sources (%) 2000	-0.017	-0.035	0.099	.344(**)	.301(**)	0.12	.243(**)	0.097	-0.012	.705(**)	1
Total fertility rate (per woman) 1995-2000	-0.051	-0.023	-0.008	-.512(**)	-.450(**)	-0.096	-.262(**)	-.160(*)	0.042	-.596(**)	-.685(**)

(*) Correlation is significant at the 0.05 level

(**) Correlation is significant at the 0.01 level

Table 2: Pearson Correlations for database with the six outlier countries (having more than 100,000 cubic metre of water per capita) excluded. (Data sources: FAO 2004, UNDP 2004)

	Internal renewable water resources: cubic metres per capita (2000)	**Total renewable water resources (actual) (cubic m/capita per year) 2000**	**Water use ratio (total water use / total water resources (actual)) 2000**	**Domestic water use (cubic metres per capita) 2000**	**Industrial water use (cubic metres per capita) 2000**	**Agricultural water use (cubic metres per capita) 2000**	**Total water use (cubic metres per capita) 2000**	**Arable & permanent crops per capita (ha) 2000**	**Average precipitation 1961-1990 IPCC (mm/year) (note 6)**	**Population using adequate sanitation facilities (%) 2000**	Population using improved water sources (%) 2000
HDI rank 2002	-0.091	-0.081	-0.14	-.538(**)	-.423(**)	0.006	-.167(*)	-0.136	0.012	-.674(**)	-.694(**)
Life expectancy at birth (years) 2000	0.09	0.085	0.16	.506(**)	.349(**)	0.093	.233(**)	0.045	0.055	.640(**)	.692(**)
Adult literacy rate (% age 15 and above) 2000	0.032	0.058	0.042	.442(**)	.336(**)	0.154	.255(**)	0.113	0.075	.587(**)	.522(**)
Combined primary secondary and tertiary gross enrolment ratio (%) 1999	0.105	0.095	0.03	.518(**)	.384(**)	0.112	.262(**)	.250(**)	-0.092	.573(**)	.619(**)
GDP per capita (ppp $US) 2000	0.066	0.033	0.142	.421(**)	.393(**)	-0.114	0.05	0.121	-0.086	.534(**)	.532(**)
Infant mortality rate (per 1000 live births) 2000	-0.041	-0.038	-.164(*)	-.454(**)	-.304(**)	-0.008	-0.136	-0.063	-0.043	-.668(**)	-.726(**)
Children under weight for age (% under age 5) 1995 -2000	-0.125	-0.128	-0.125	-.506(**)	-.343(**)	-0.048	-.186(*)	-.215(*)	0.086	-.617(**)	-.468(**)
Population using adequate sanitation facilities (%) 2000	-0.092	-0.096	.215(*)	.372(**)	.266(**)	0.178	.289(**)	0.103	-0.04	1	.724(**)
Population using improved water sources (%) 2000	-0.034	-0.024	0.098	.335(**)	.301(**)	0.07	.208(*)	0.084	0.011	.724(**)	1
Total fertility rate (per woman) 1995-2000	-0.004	0.003	-0.006	-.507(**)	-.447(**)	-0.072	-.243(**)	-.160(*)	0.034	-.593(**)	-.680(**)

(*) Correlation is significant at the 0.05 level

(**) Correlation is significant at the 0.01 level

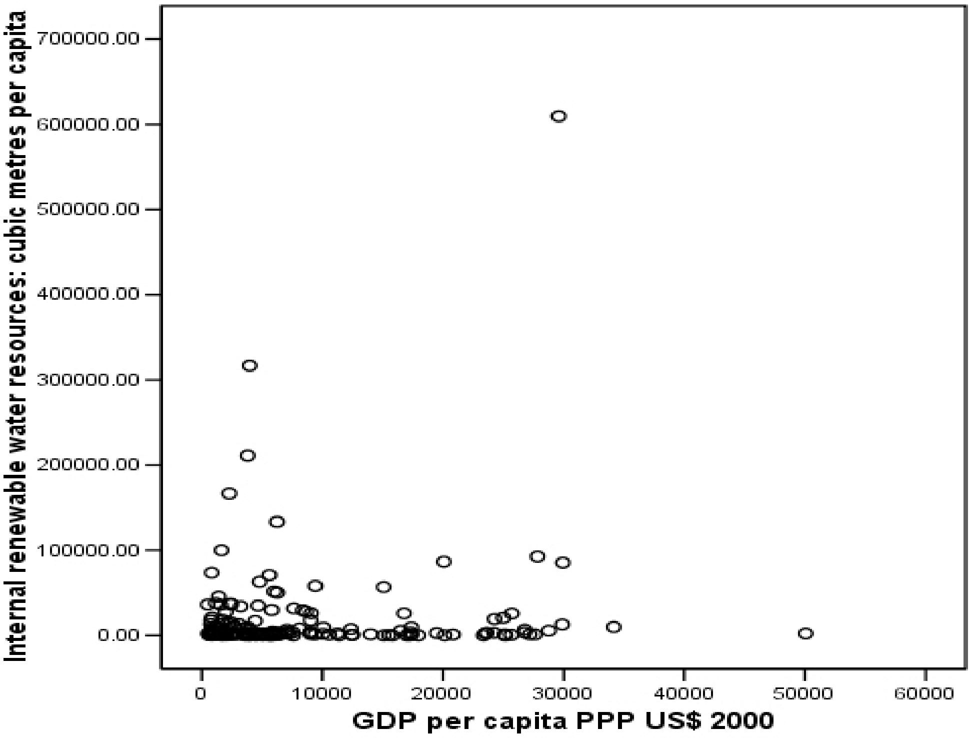

Figure 1: A scatter gram showing the relationship between internal renewable water resources per capita with GDP per capita (PPP US$) for 2000.

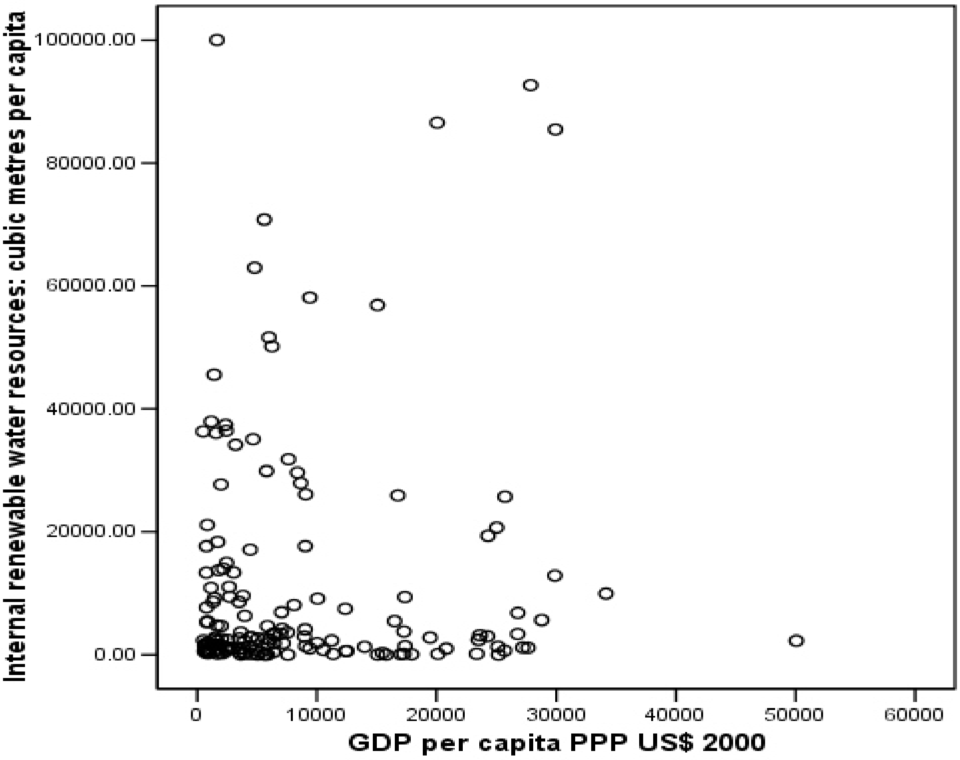

Figure 2: A scatter gram showing the relationship between internal renewable water resources per

capita with GDP per capita (PPP US$) for 2000 with the six outlier countries excluded.

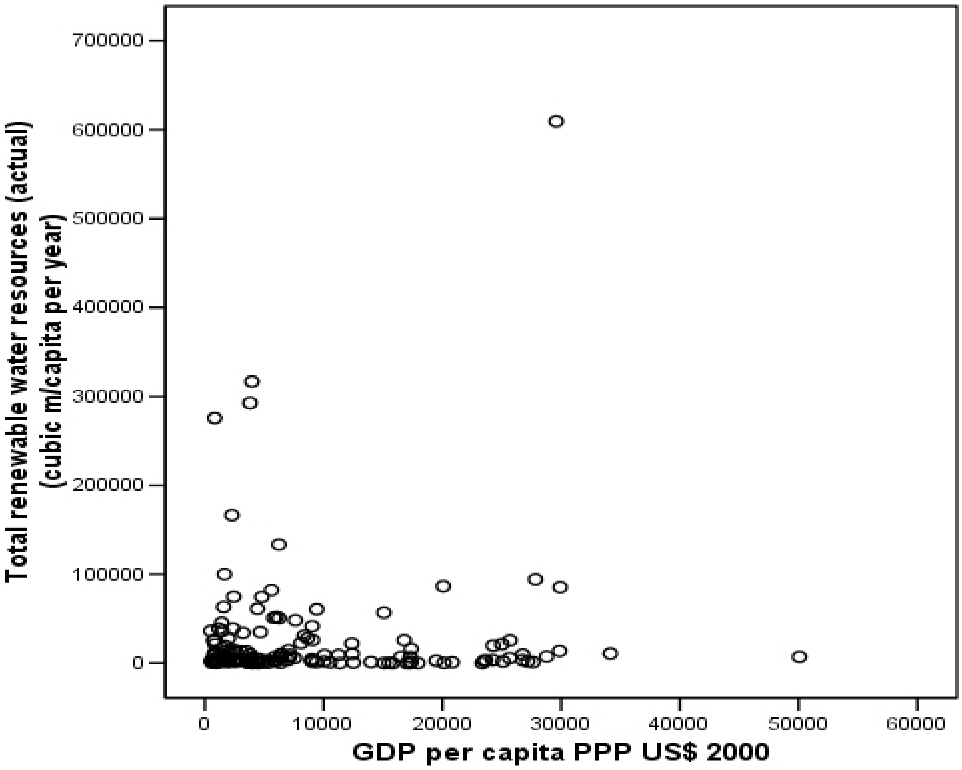

Figure 3: A scatter gram showing the relationship between total renewable water resources per capita with GDP per capita (PPP US$) for 2000.

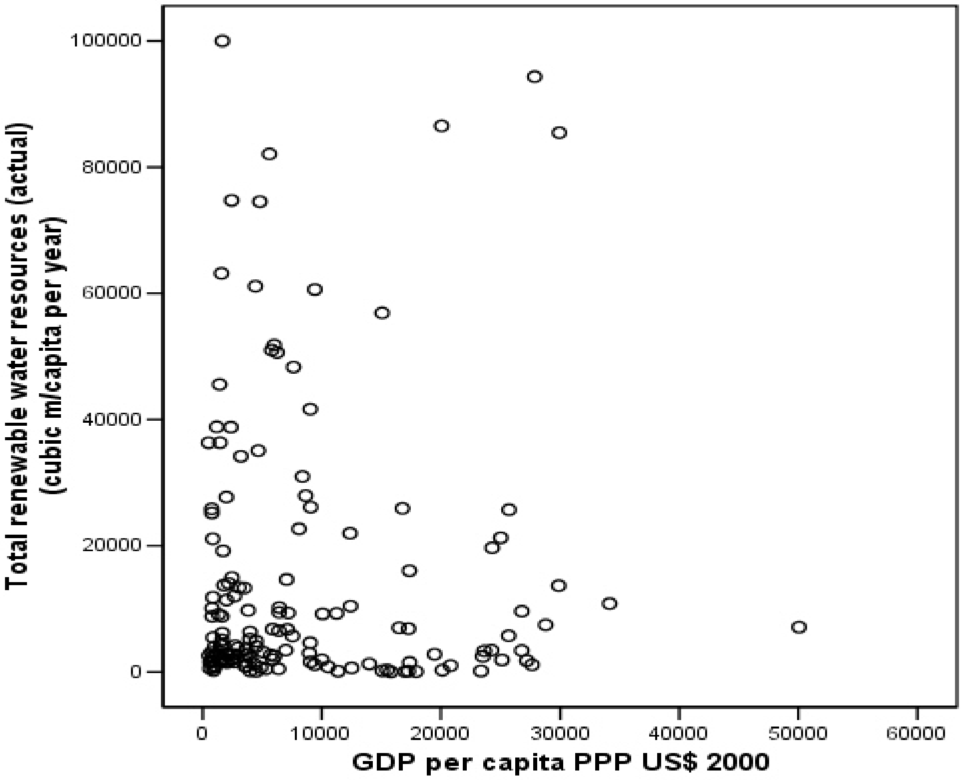

Figure 4: A scatter gram showing the relationship between total renewable water resources per capita with GDP per capita (PPP US$) for 2000 with the six outlier countries excluded.

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[1] This figure is generally rounded off to 1,700 cubic metres per capita.