Comment

Comment on *"Water Demand and Population Growth"* by CF Schutte and WA Pretorius (*Water SA* 23 (2))

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Abstract

In "Water Demand and Population Growth" published in *Water SA* **23** (2), an attempt is made to estimate the direct and indirect consumption requirements in 2015 of the estimated one million net population increase in 1995.

The estimate of **direct** requirements is essentially sensible in both approach and results, and criticisms are of a relatively minor nature.

Estimating **indirect** water use is far more complicated and it is suggested that the approach taken in this study is flawed. Firstly, it would be a major undertaking to include even a representative sample of the goods and services consumed by a "typical" household and the water required for their production. The calculations in the study under review are too simplistic. Secondly, imports and exports must be allowed for and this has not been done. Thirdly, the study calculates water requirements for both production and consumption, which involves double-counting.

The net result of the study is a serious underestimation of indirect water requirements. It is suggested that a more sensible approach would be one that focuses on the water required in production to fully integrate the one million people into the economy.

Introduction

The report "Water Demand and Population Growth" published in *Water SA* **23** (2) can be reviewed at two levels. Firstly the details of the estimates can be evaluated, and secondly the conceptual approach can be considered. Comments will be made at both these levels, but for **indirect** water use the emphasis will be on the conceptual approach as this is considered to be fundamental. In a nutshell, estimating indirect water use from general household consumption requirements is virtually impossible in an open economy, while calculating both consumption and "job creation" requirements involves double-counting. The range of goods and services available and their many stages of processing further complicate the matter.

Comments are made below on the specifics of the assumptions and calculations before the conceptual issues are addressed. A suggested approach to the calculation of indirect consumption is then outlined.

Comments on the details of the calculations for direct use

The method used to calculate the direct water needs of the additional 1 m. households in twenty years' time would appear to be sensible. A few comments on the specifics are, however, in order:

- The statement that "Current levels of direct water use vary from 25 ℓ/c·d...to higher than ..." (p127) is incorrect. Large numbers of people, particularly in rural areas, currently use significantly less than this.
- The assumption that *per capita* water consumption in "low" and "moderate" consumption groups will increase is sensible. However, rising living standards (assumed to mean rising disposable incomes) are only one reason for this. A more immediate one for the "low" group would be the increased availability and convenience of potable water (on the assumption that this "low" group includes the previously referred to "very low" and "rural/subsistence" consumers). Water consumption tends to be greater if it is available at a nearby communal tap than if it needs to be fetched from a source a fair distance away; and more again is used if a tap is provided on-site or in-house.
- Whether "low" and even "moderate" consumption groups will be using washing machines and particularly dishwashers in twenty years' time is open to question. This statement implies a great deal about relative rates of economic and population growth, given the currently very low levels of income of large sections of the population. Although it does not materially affect the calculations, it does not instil confidence in the analysis.
- The assumption of reduced water requirements for flushing is valid, but the range given (2 to 8 ℓ) is very wide. It would be useful to know the actual figure(s) used in the calculations.

The total direct water consumption for the million people is calculated to be 121 Mℓ/d (Table 8), which translates into 121 ℓ/c·d. In spite of the above criticisms, this seems to be a fairly sensible figure: in an earlier study (PDG, 1994) it was estimated that the average *per capita* consumption for the metropolitan areas of South Africa in 1991/2 was 166 ℓ/c·d, ranging from 98 ℓ/c·d (Port Elizabeth) to 193 ℓ/c·d (PWV). It stands to reason that the average for all (including rural) consumers in twenty years' time, once savings measures have been introduced, should be somewhat lower than this metropolitan average.

Comments on the details of the calculations for indirect use

A great deal could be said about the specifics of the assumptions and estimates made with regard to indirect water usage if the general methodology were accepted. The comments here will, however, be confined to a few small points on obvious errors and omissions:

- In the calculations of water used per loaf of bread produced, no allowance is made for the baking process.

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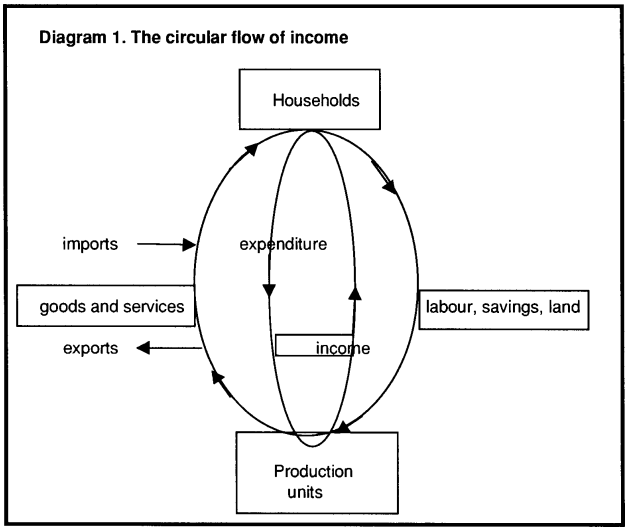
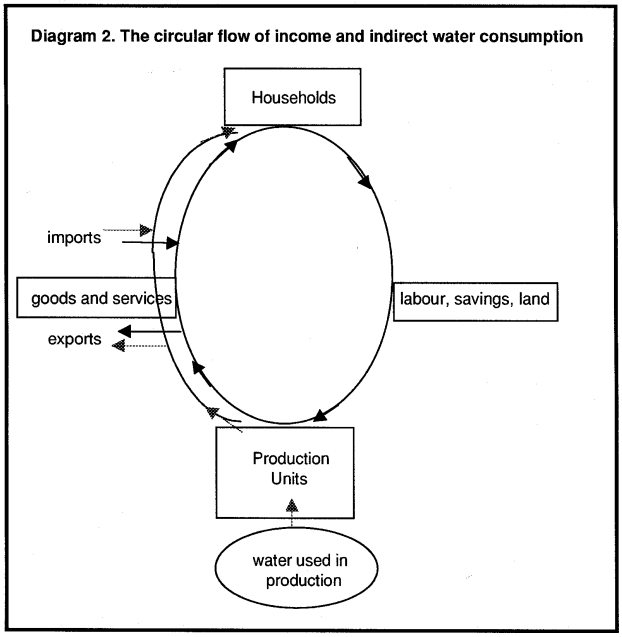




- Although most maize is indeed produced by dry-land farming, producing maize meal certainly requires at least some water. Given the importance of this item in the diets of a large proportion of the population, it should surely be included?
- The estimation of water requirements per job created is problematic:
  - The employment profile of the 1 m. people should most sensibly mirror that of the labour force as a whole: in twenty year's time job opportunities in all sectors will become available as employees leave the workforce (e.g. due to retirement), and any attempt to predict the employment profile of the particular 1 m. people under discussion will be arbitrary. What the employment profile of the total labour force will be is a matter of speculation, and depends on the nature of economic growth over the next twenty years. The division implied in the report is however problematic. Firstly, there is no formal services sector, which is a major employment provider (or is this included under "administrative", in which case the percentage is too low?). Secondly, agriculture is either not included, or included under "self employed other". This is most unsatisfactory, particularly in view of the heavy water requirements of irrigation farming (see Diagram 3). Thirdly, it is highly unlikely that 25% of the labour force will be engaged in "self employed manufacturing".
  - No information is provided on how the estimates of water demand for the administrative and self employment sectors are arrived at.

The conceptualisation of indirect water requirements

The calculation of indirect water requirements from the micro level is no easy task:

- There are far more types of consumer goods than can realistically be accounted for, and many different consumption patterns.
- The production process involves many different activities, and comprehensively tracing the water used to produce final goods and services would require some sort of "input-output" analysis.
- Where an economy is open, water requirements in consumption are not the same as water requirements in production. So what if cigarettes use a great deal of water to produce if most of them are imported?
- The calculation of water requirements for consumption **and** job creation involves double counting.

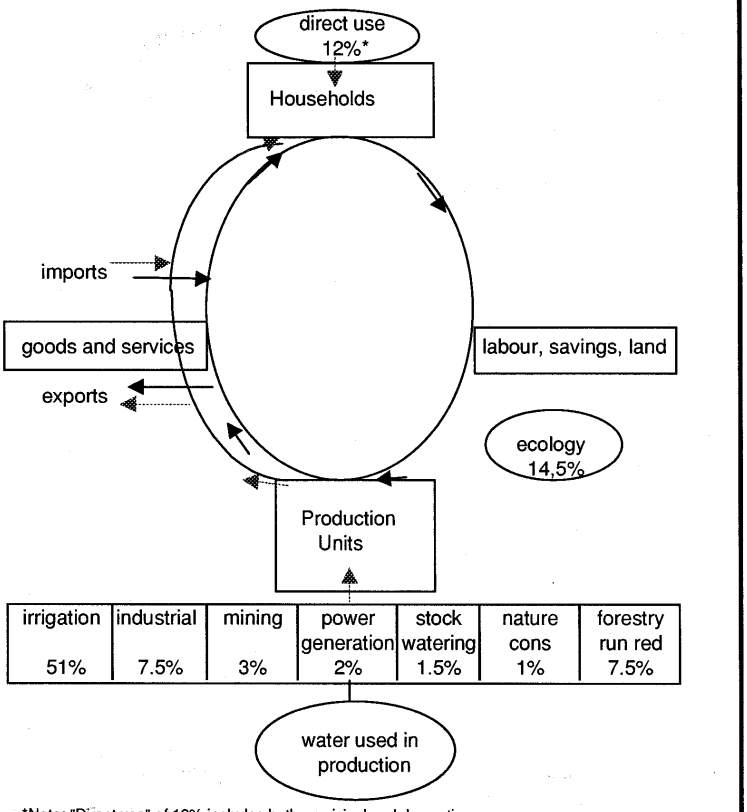
The last two points may be explained by making use of a macroeconomic concept known as the "circular flow of income". As illustrated in Diagram 1, in very simplistic terms an economy may be separated into "households", which provide the factors of production, and "production units" which pay households for their labour etc. (With a bit of licence, for present purposes government bodies may be included in the latter). These "production units" sell goods and services to households who use their income to pay for them. One calculates the total value of output in an economy by adding up either the value of the income stream flowing to households (with due allowance for retained profits etc.) or the value of the goods and services produced (with due allowance for unsold stock). Adding both streams of payment would involve double counting.

The same type of logic may be applied to indirect water use. Water is used directly by households, within the "production" sector and for ecological purposes (see Diagram 2). The amount required per person in the course of economic activity (i.e. in the "production" sector) needs to be calculated either as an amount per worker during production, or as an amount per item consumed in the household sector. Calculating indirect consumption requirements **plus** "job creation" requirements means that water requirements are double counted.

Calculating water use by estimating household consumption of goods and services is, however, complicated by two factors. Firstly, and most importantly, between production and consumption comes international trade - imports and exports - so that a country's consumption profile is not the same as its production profile. Some of the water used in production is exported, while some of that indirectly consumed is imported. To be accurate, household consumption of only the domestically produced components of goods and services should be included, and the water requirements of exports then needs to be added.

Secondly, it would be an enormously time-consuming exer-

Diagram 3. The circular flow of income and total water consumption



*Note: "Direct use" of 12% includes both municipal and domestic use.

cise to obtain an even fairly representative picture of "average" consumption patterns for a manageable number of consumer categories, particularly if the domestic and imported components are to be separated out. An inaccurate picture can lead to very large errors in calculated (indirect) water demand, and this seems to have been the case in the report under review.

Total expected water use based on the estimates of *per capita* requirements

The double counting that occurs in the report should lead to an exaggeration of water requirements. The estimation of indirect consumption requirements is, however, so incomplete that the net effect is a serious underestimation of *per capita* requirements. This is illustrated below:

- It was estimated that consumption requirements for the 1 m. additional people would amount to 638 Mℓ/d. This amounts to 232 870 Mℓ/yr.
- Allowing this amount of water for each of the current 38 m. people, total current direct and indirect water demand should amount to roughly 8 850 x 10^6 Mℓ/yr. (This is in fact an overestimate of the scaled-up requirements, because it makes allowance for job creation for the whole population. In fact, only about 40% of the population (or less) are likely to be working at any one time). Actual water use for these purposes is however more in the region of 16 300 x 10^6 Mℓ/yr (DWA, 1986). The calculated consumption scaled up to the full population therefore accounts for less than 55% of actual consumption.

This "lost" water cannot be ascribed to savings in the future, and occurred despite the double counting involved in calculating both consumption and "job creation" requirements. One reason could be an (implicit) assumption that there will be no future expansion of irrigation farming, which may be a reasonable assumption but should be made explicit. A more important reason is however the numerous exclusions in consumption. As previously suggested, it would be an almost impossible task to account for total water use via the consumption route. It is suggested that a more logical method would be to estimate indirect requirements by calculating the amount required per job, in other words during the production process.

A suggested approach to the calculation of indirect water requirements

The principle behind the suggested method for calculating indirect water requirements is that one needs to assess the water required to fully integrate the one million people into the economy.

Estimates of the water required by the different economic sectors are needed on a per job basis. As a starting point the current breakdown of water requirements, as shown in Diagram 3, can be used. From this overall perspective one needs to progress to the requirements per worker in each sector, at as disaggregated a level as possible. Likely future water use can then be considered, making allowance for both trends within each sector and inter-sectoral balance. In order to do this, likely trends in economic growth, international trade and technology would need to be considered.

This approach would have the advantage of explicitly incorporating economic and technological trends, as well as population growth.

References

DEPARTMENT OF WATER AFFAIRS (1986) *Management of the Water Resources of the Republic of South Africa.*

PALMER DEVELOPMENT GROUP (1994) Evaluation of Water Supply to Developing Urban Communities in South Africa. WRC Report No KV 49/94.

Authors' reply

The authors have noted the contents of the review article by Bee Thompson. We have stated in the article that the consumption figures especially for indirect water use have been based on assumptions about factors which vary over extremely wide ranges. Furthermore, in many cases there was no information available and "questionable" figures had to be used.

Our attempt was not to try and establish exact figures, as is stated in the paper but rather to give a "ballpark" feeling of water requirements.

We would encourage the author of the review paper to actually improve on our first attempt in order to have more reliable figures available for planning.