



**A PRAGMATIC INQUIRY INTO THE NEXT WORLD  
SUMMIT OF SUSTAINABLE DEVELOPMENT  
TARGETING OPTIONS RELATED TO SANITATION AND  
POVERTY REDUCTION**

**ID 013**

**Manfred FEHR**

Federal University at Uberlândia, Uberlândia, MG, BRAZIL  
[prosec22@yahoo.com](mailto:prosec22@yahoo.com)

Paper ID 013 presented at

*The 8th International Conference on Waste Management, Environmental Geotechnology and Global Sustainable Development, August 28.-30. 2007, Ljubljana, SLOVENIA.*

**ABSTRACT**

The World Summit on Sustainable Development of 2002 quantified targets and fixed time frames for many topics relevant to sustainable urban development. The present study addresses the question asked by local administrators on what exactly has to be achieved every year to reach the targets. There are flow problems and storage problems. This study singles out one example of each for analysis. Urban sanitation, of which waste management is an integral part, is representative of flow problems, which are those that can be solved quite rapidly with appropriate technology and financial support. Poverty eradication is representative of storage problems, which are those that require depletion of an existing stock. The directive was to halve, by 2015, the proportion of the World's people who live on less than one dollar per day and have no access to basic sanitation. The resource arithmetic presented here moves beyond the year of 2015 and evaluates the targeting options of the next Summit. It is concluded that both the flow and the storage problem may be solved within approximately 13 years after the 2012 Summit if presently valid annual sanitation service expansion factors and annual poverty contraction factors were maintained. For shorter time allowances, significantly sharper targets would have to be set by the next Summit.

**Key words:** municipal planning, poverty eradication, resource arithmetic, sanitation, waste management, World Summits.

**INTRODUCTION**

This study tries to provide the missing link between directives emitted by World Summits and local courses of action aimed at putting the directives into practice, with regard to poverty and sanitation. Ultimately, local administrations are the parties responsible for implementing the targets passed down by the Summits, and they are left with many questions and uncertainties. The document originating from the World Summit of 1992 in

Rio de Janeiro, Agenda 21, has 40 chapters, each of which referring to a definite problem to be solved at the local level. In fact, countries, provinces and cities started to prepare their own Agendas 21. Most of them are as general and uncommitted as the Summit Agenda 21. There are exceptions, of course, but ten years later, at the World Summit of 2002 in Johannesburg, it was admitted that the progress during the last ten years remained below expectations. Consequently, it was decided to quantify the targets in order to be able to claim and measure results. The following numbers were put forward: By the year 2015, halve the proportion of the World's people who do not have access to basic sanitation, and who live on less than one dollar per day. At a first glance, that quantification appeared to make the difference. After all, numbers can be impressive. Upon scrutinizing the Johannesburg directives, however, many more queries arose to local administrators. A few examples will illustrate.

If the directive is to halve, by the year 2015, the proportion of people not served by means of subsistence and sanitation, the unsuspecting local administrator is left with the need to define his or her own point of departure and point of arrival. The first measure to be taken is a diagnosis. Once this is done, the factor of relativity comes into play. A city that in 2002 offers sanitary service to 20% of urban residents will have to reach  $20 + 80 / 2 = 60\%$  by 2015, an increase of 200%. A city that starts with service in place for 70% of urban residents will have to reach  $70 + 30 / 2 = 85\%$ , an increase of 21%. The required efforts are quite disparate, and many cities will simply not be able to cope. The directive did not state how to reach the target. Would it be admissible that some cities advance more and others advance less such that on the average the desired 50% reduction may be reported to the World? Could the directive be interpreted to mean that what is to be reduced by 50% is the number of cities without sanitary infrastructure?

Clearly, the correct problem statement is the most important starting point for defining the course of action.

Sanitation is understood here as comprising sewage and garbage collection. The next difficulty of interpretation refers to the destination given to sewage and garbage. If I dump sewage into the river and tip garbage at an open dumpsite, have I provided basic sanitation in the sense of the 2002 Summit pretension? A sewage treatment plant for a middle size city may need an investment of 15 to 20 Million dollars, and without it, no treatment target can be reached. Resource economics will have to come into play in order to provide the funds within the established timeframe. There will have to be priorities, technical or financial, as to what to install first: the treatment plant, the sewage collectors, the headers or the pumping stations? The present exercise is on resource arithmetic only. It aims at fixing annual service targets that will lead to the desired situation in 2015. These targets may be interpreted as the number of residences connected to the collection system or the volume of installments of the total cost of the system to be applied, or any other definition the municipal administration sees fit to use.

The topic of poverty reduction is more complicated because it is a storage problem. There is a stock of poor people in 2002 that has to be depleted, but the Summit directive conceded that this might take much longer than 13 years. A 50% reduction was contemplated.

Against this background of diverse interpretations and meanings of the Summit directives, the present study develops resource arithmetic to determine annual local targets in strict compliance with the directive in the areas of poverty and sanitation.

As the cities of the World are quite different from one another, the arithmetic is applied to a fictitious city located somewhere in the Third World called Toribaté. Following the Johannesburg Summit, the city administration undertook the task of establishing its diagnosis for the two topics of this study and valid for the end of 2002 considered year zero.

From the diagnosis, the arithmetic proceeds to develop spreadsheets containing all annual targets to be met if the 2015 situation defined by the Summit is to be reached. At this stage, the Summit directive is neither questioned nor discussed. It is strictly obeyed. So if the Summit directive has no provision for adequate waste destinations, e.g., the arithmetical exercise contents it self with waste collection service. As a result, this study provides a basis for determining what has to be achieved by 2015, what remains to be achieved after 2015, and how long it might take to achieve it. The exercise supplies ample thought for the 2012 World Summit and ponders some of its targeting options

## **WORLD SUMMITS OF 1992 AND 2002**

### **From general pretensions to the birth of resource arithmetic**

The definition of poverty underwent a pragmatic modification between the Summits of 1992 and 2002. The 1992 Summit in chapter 3 of Agenda 21, defined a poor person as one who did not have access to means of subsistence. Consequently, the target of Agenda 21 was to enable *all* people to reach a level of subsistence through adequately remunerated employment. Time is a critical parameter when fixing this type of target. The ten-year-review-summit of 2002 admitted that the 1992 target had not been attained and consequently reduced the ambitions by 50%. The 2002 document requires the proportion of people whose income is less than one USD per day to be halved by the year 2015. Although, strictly speaking, resource arithmetic is able to calculate yearly progress requirements to reach this target, some questions still remain open. They are: Why is the year 2015 targeted, instead of the more probable year for the next summit: 2012? The specific characteristic of a storage problem was not addressed by either Summit document. It remains for resource arithmetic, or in this case for poverty arithmetic, to properly define and solve the storage problem. The arithmetic answers questions like the following: What is the present stock of poor people, how many people have to be removed from that stock every year, and how many poor people will still remain in the stock once the Summit directive has been completely complied with? As the arithmetic presented here strictly attends to Summit directives, its horizon is the year 2015. It does, however, provide results that stimulate thought about how long it would take to reduce the proportion of poor people to 0%, if ever this were considered possible.

In terms of sanitation, the two Summit outcomes were similar. Agenda 21 in chapter 21 cited as objective that by 2005 developing countries adequately treat halve of their sewage and solid waste, and by 2025 treat all of it. Again, the 2002 Summit noted that this was not going to be achieved, and consequently redefined the target to mean that by 2015 the number of people without access to proper sanitation should be halved. The specific requirement to treat the material collected, mentioned in the 1992 documents, is not present in the 2002 documents. The directive could be met by simply collecting it, and experience shows that this is what really happens in many cities up to date. The arithmetic developed strictly meets the 2002 Summit target: provide collection services to such an extent that by 2015 the proportion of people who did not enjoy it in 2002 is halved. The population not included by 2015 is abandoned and will depend on the 2012 Summit for salvation.

**Table 1.:** Nomenclature and 2002 data for Toribaté.

***General symbolism***

c: capita or person

d: day

n: initial letter for all population parameters

p: initial letter for all poverty parameters

s: initial letter for all basic sanitation parameters (sewage and garbage)

USD: United States dollar

y: year count for projection period, varies from  $y = 0$  (2002) to  $y = 13$  (2015)

***Specific definitions and 2002 data***

n: total population  $p(0) = 500000$

nr: annual population growth rate 0.7% or 1.007

nu: number of residential units  $nu(0) = 160000$

p: poor population stock (adults with income  $<1$  USD/d and their children):

$p(0) = 100000$  (20% of n)

pi: annual inflow of poor people by births and migration:

$pi(0) = 500$  with annual expansion of 2% or 1.02

annual outflow of poor people is composed of

pd: by decease  $pd(0) = 400$  with annual contraction of 1% or 0.99

pb: by-pass of stock equal to pi by technical necessity

pt: by transfer to non-poor population, determined every year

pc: annual contraction factor of poor population stock

s: number of residential units served with sewage and garbage collection

$s(0) = 128000$  (80% of nu)

se: annual collection expansion factor

sn: fraction of residential units served by sewage and garbage collection

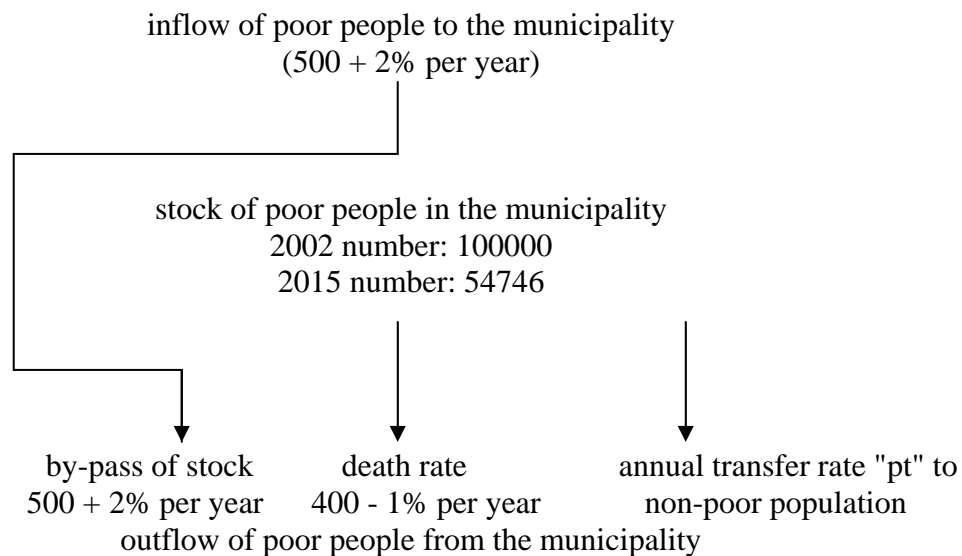
$sn(0) = 0.800$

### Poverty arithmetic

The diagnosis of poverty at the local level is the responsibility of municipal or regional administrations. It provides the input to the exercise of resource arithmetic. What needs to be established is: How do we define a poor person, how many poor persons live in our municipality at present and how many new arrivals fit the definition of a poor person? With those data, resource arithmetic may be developed and applied. It will provide the connection between the diagnosis and political actions aimed at reaching the projected targets. This paper is concerned exclusively with the arithmetic. Consequently, the arguments presented here are based on the hypothetical diagnosis for the fictitious municipality of Toribaté. Any existing municipality may adapt the diagnosis and the arithmetic to its own situation in order to stipulate the pertinent political actions. Furthermore, this exercise is on resource arithmetic, and not on resource economics. The arithmetic presents the annual targets. The expenditures necessary to implement the corresponding political actions and the sources of these expenditures are the subject of exercises in resource economics.

To understand the arithmetic it is necessary to realize that the reduction or elimination of poverty is a storage problem and proceeds against the background of a statistical total population growth rate. The challenge is threefold: The existing stock of poor people has to be partially depleted within the given time frame; new arrivals, be they births or migrants, have to by-pass the stock; and natural population growth rates have to be considered.

The simple flow chart of Figure 1 illustrates the movement of poor people required by the 2002 Summit target applied to Toribaté.



**Figure 1.:** Movement of poor people in Toribaté

The yearly targets may be presented in the form of Table 2. Resource arithmetic has sufficiently detailed the annual administrative challenges for easy visualization not only by

the municipal administration, but also by the population at large. The existence of the annual targets makes result reporting transparent. It also explains to the population the local effort required to attend to the 2002 Summit directive. Ultimately, it will tell the 2012 Summit delegates whether that directive was reasonable and to what extent it was possible to attain it.

**Table 2.:** Poverty arithmetic - Projected evolution of poverty reduction in Toribaté.

The poverty reduction targets provided in Table 2 solve a storage problem.

year	y=	n (y)	p (y-1)	pi (y)	pd (y)	pb (y)	pt (y)	p (y)
2002	0	500000	n/a	n/a	n/a	0	0	100000
2003	1	503500	100000	500	400	500	4129	95471
2004	2	507025	95471	510	396	510	3927	91148
2005	3	510574	91148	520	392	520	3736	87020
2006	4	514148	87020	531	388	531	3553	83079
2007	5	517747	83079	541	384	541	3378	79317
2008	6	521371	79317	552	380	552	3212	75725
2009	7	525021	75725	563	377	563	3052	72296
2010	8	528696	72296	574	373	574	2901	69022
2011	9	532397	69022	586	369	586	2757	65896
2012	10	536123	65896	598	365	598	2619	62912
2013	11	539876	62912	609	362	609	2487	60063
2014	12	543655	60063	622	358	622	2362	57343
2015	13	547461	57343	634	355	634	2242	54746

### Sanitation arithmetic

The 2002 Summit pretension was: "Halve, by the year 2015, the proportion of people who do not have access to basic sanitation". There are a few queries about the meaning of this pretension. Does basic sanitation mean that sewage and garbage are collected? Then what about the destinations? If I dump sewage into the river and tip garbage at an open dumpsite, have I provided basic sanitation in the sense of the 2002 Summit pretension? What about the responsibility for services provided to illegally occupied land within the city?

On rephrasing the pretension for a local administrator, it could read: "Halve, by the year 2015, the proportion of authorized residential urban settlements that are not served by sewage and garbage collection".

The sanitation arithmetic can be divided into sewage arithmetic and garbage arithmetic.

Both are similar and are treated as flow problems. To satisfy the 2002 Summit pretension, it is only necessary to expand the collection systems. The numbers provided below can guide the technical and financial procurement operations over the years.

Table 3. shows the local arithmetic required to plan and execute the annual expansion of sewage and garbage collection services required to strictly satisfy the 2002 Summit directive. As may be appreciated, the sanitary service has been extended to an additional 29668 residential units, or from 80% to 90% of existing units during the 13-year period addressed by the summit.

**Table 3.:** Sanitation arithmetic - Projected evolution of sewage and garbage collection service in Toribaté.

The service expansion targets indicated in Table 3 solve a flow problem.

year	y =	nu (y) number of existing residential units	sn (y) fraction of residences served	s (y) number of residential units served
2002	0	160000	0.80000	128000
2003	1	161120	0.80728	130069
2004	2	162248	0.81463	132172
2005	3	163384	0.82204	134309
2006	4	164527	0.82952	136479
2007	5	165679	0.83707	138685
2008	6	166839	0.84469	140927
2009	7	168007	0.85238	143206
2010	8	169183	0.86014	145521
2011	9	170367	0.86797	147873
2012	10	171559	0.87587	150263
2013	11	172760	0.88384	152692
2014	12	173970	0.89188	155160
2015	13	175187	0.90000	157668

### **Principal weaknesses of Summit directives identified by the arithmetical exercise**

For the case of poverty reduction, the following weaknesses may be listed. A poor person was implicitly and arbitrarily defined as one earning less than 1 USD/d, purchasing power parity considered. Nothing was said about exactly what can be acquired with 1 USD/d. The storage logic of poverty reduction was not explicitly contemplated. Annual population growth rates were not considered. The temporal target was arbitrarily fixed as the year 2015. No hope was given to the other halve of the poor population that would not be cared for by 2015. No arithmetic was presented to illustrate the numerical dimension of the directive. Local administrations were left with the task of devising their own diagnoses and annual targets.

For the case of sanitary services, the principal weakness refers to the destination of collected sewage and garbage. The directive explicitly addresses the provision of service to a certain proportion of people, i.e. residences. Nothing is said about treatment and disposal of collected material. The relativity factor is another case in point. No minimum service

requirement is fixed, but only proportions, read percentages. A municipality may expand its sanitary service from 80% to  $80 + 0.5 * (100 - 80) = 90\%$  or from 20% to  $20 + 0.5 * (100 - 20) = 60\%$  and comply with the directive, although the necessary effort and expenditure as well as the final result are quite disparate.

### Speculative targets beyond 2015

What was the annual service expansion factor for sanitation used to construct Table 3? By dividing the 2015 target situation by the 2002 starting situation, the expansion ratio for 13 years is found from

$$(175187 * 0.9) / (160000 * 0.8) = 1.231784 \quad (\text{equation 1}).$$

Consequently, the annual expansion ratio is

$$1.231784^{1/13} = 1.016165 \quad (\text{equation 2}).$$

One possible management model for the period following 2015 is to maintain this same annual service expansion ratio until all residences are served with sewage and garbage collection. How long would this take?

Starting from 2002, a number of years has to be established to reach equality of the existing number of residences and the number of residences served, as follows

$$160000 * 1.007^a = 128000 * 1.016165^a \quad (\text{equation 3}).$$

The result is  $a=24.628$  years, or in absolute terms year 2026.628 or 2027. With the service expansion factor used to satisfy the 2002 Summit directive, a 2012 Summit directive requiring sanitation service for all residences in Toribaté could be attended to in 2027, which means allowing for a 15-year timeframe from 2012.

What was the annual poverty reduction factor used to construct Table 2? In 2002 there were 100000 poor people in a total population of 500000, or 20%. In 2015 there will be a total population of

$$500000 * 1.007^{13} = 547461 \quad (\text{equation 4}).$$

According to the 2002 Summit directive, only 10% of this total may be poor, or 54746.

Consequently, the required annual poverty contraction factor  $pc$  can be found from

$$pc^{13} = 54746 / 100000 \quad (\text{equation 5}),$$

from which  $pc = 0.954714$ .

Again, one possible management model for the period following 2015 is to maintain this same annual poverty contraction factor until the percentage of poor people reaches desired values. As this is an asymptotic situation, zero poverty can never be reached, nor would it be reasonable to expect it. The time span to reach predetermined poverty levels depends on the initial diagnosis. Table 4 shows the tendency.



**Table 4.:** Poverty evolution expected with the annual contraction factor of 0.954714 that satisfied the 2002 Summit directive in Toribaté

year	y=	total population	poor population if initial value is 20%	poor over total population %	poor population if initial value is 40%	poor over total population %
2002	0	500000	100000	20	200000	40
2015	13	547461	54746	10	109492	20
2025	23	587013	36076	6	72151	12
2038	36	642734	19750	3	39450	6
2058	56	738059	7817	1	15634	2
2078	76	849591	3094	0.4	6188	1

As may be appreciated, the timeframes to reach reasonable poverty reductions with the present contraction factor are similar to those indicated for the sanitation problem, but depend on initial situations. By 2025, or within 13 years running time from 2012, the poverty level in Toribaté would drop to 6% of total population, which is considered a reasonable pretension. For double the initial value, the time span to reach this situation would be twice as long.

### **WORLD SUMMIT 2012 EXPECTATIONS**

The year 2012 is the most likely date for the next World Summit, because the last interval was 10 years, from 1992 to 2002. Why the year 2015 was targeted by all directives is not clear and has not been explained. It is only natural to expect that in 2012 there will be pressure on the United Nations to conduct the next 10-year review process.

The arithmetic has opened two major issues for the next Summit. The first refers to result reporting. Municipalities, provinces and countries will have to produce data on compliance. After the last Summit with its quantified directives, it is no longer admissible to report qualitative generalities. Measurements will be required. The expectation is that the next Summit either expresses its satisfaction with the reported results and moves on to the future, or reformulates the targets and allots additional time to reach them.

The second issue refers to problems related to the specific topics treated in this chapter.

In the case of poverty reduction, Table 2 is a perfect source for data reporting on the first issue, as well as for the identification of remaining problems for the second issue. It could show, e.g., that although the target as stated in 2002 was achieved, there remains a stock of poor people who are still hoping to escape poverty. The exact number in this particular case is 54746. The second issue reserved for the 2012 Summit is exactly this: How to deplete the stock in how much time? The next Summit will be faced with the need to mitigate a chain effect: if issue 1 were not resolved satisfactorily, there would be little or no point in

tackling issue 2. As time will be the single most important factor, much more rigorous targets are expected to be set.

In the case of sanitary services, Table 3 is a possible tool for result reporting on the first issue. It has to be complemented by data on installation of additional sewage collectors and additional equipment and manpower needed to expand the garbage collection. As for the second issue, it is expected that the 2012 Summit clearly introduce requirements on disposal of garbage and sewage in order to make the sanitary services complete.

## CONCLUSIONS

Resource arithmetic related to World Summit directives has been presented and explained. Resource arithmetic provides a link between Summit directives and local policy decisions. Resource arithmetic for the first time translates World Summit directives into precise annual targets at the municipal level.

Results of resource arithmetic relating to poverty and sanitation have been calculated and tabulated.

The tables presented serve as management tools for local administrations.

The local targets specified in the tables are transparent and allow the population at large to understand the World Summit intentions and their local implications.

The difference between storage problems and flow problems has been brought out. Poverty is a storage problems, whereas sanitation is a flow problems.

The arithmetical exercise identified the basic weaknesses of 2002 World Summit directives. The arithmetic presented provides means for quantitative result reporting to the 2012 World Summit.

Resource arithmetic has been applied to a fictitious municipality in order to remain generally useful for the World's cities.

The immediate expectations for the 2012 World Summit created by the arithmetical exercise refer to the elimination of the stock of poor people and to the indication of adequate disposal directives for garbage and sewage.

With sanitation expansion and poverty contraction rates derived from the 2002 Summit directives, an additional 13 years would be needed beyond the 2012 Summit to move both problems to a solution.

## REFERENCES CONSULTED

1. Fehr, M. 2002, *Ideal municipality of Toribaté* (in Spanish), *Água Latinoamérica*, Tucson AZ, 2 (4): 40 - 44. <http://www.agualatinoamerica.com>
2. Fehr, M. 2003, *See you in 2080* (in Portuguese) *Água on-line*, São Paulo, issue 184 ponto de vista, November 14, <http://www.aguaonline.com.br>
3. Fehr, M., Sousa, K. A., Pereira, A.F.N., Pelizer, L.C. 2004, *Proposal of indicators to assess urban sustainability in Brazil*, *Environment, Development and Sustainability*, Dordrecht, 6 (3): 355 - 366, ISSN 1387 585X, <http://www.wkap.nl>
4. <http://www.agenda21.org.br> (2005 11 04)
5. <http://www.johannesburgsummit.org> (2005 11 04)
6. Silva, A., Canozzo, M.A.R., Fehr, M. 2004, *Sewage network management model of the ideal municipality of Toribaté* (in Portuguese) *Caminhos da Geografia*, Uberlândia MG, 5 (13): 221 - 240, ISSN 1678 6343, <http://www.ig.ufu.br/revista/caminhos.html>