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Research in Japan #1

sustainability of urban areas

tokyo, japan

1. Introduction

The term sustainability in general is open for many different definitions and interpretations, depending on the particular context under consideration. The context of this report is the city, the built environment of urban areas.

“A sustainable city is a city where achievements in social, economic, and physical development are made to last. It has a lasting supply of the environmental resources on which its development depends, using them only at a level of sustainable yield.

A sustainable city maintains a lasting security from environmental hazards that have the potential to threaten development achievements, allowing only for acceptable risk.”⁴

Even so it is understood that social and economical conditions are of major importance, the main focus of this report will be on the physical conditions of urban areas. As one example I have chosen the urban area of Tokyo, Japan.

2. Current status of the city

It has been widely accepted that our cities nowadays are not sustainable. But what are the crisis issues, that we need to focus our attention on? In the definition given above, two

major conditions account for a sustainable city,

- (1) “a lasting supply of the environmental resources“, and
- (2) “a lasting security from environmental hazards“.

So the crisis issues could be defined as

- (A) lack of environmental resources and
- (B) lack of security from environmental hazards.

In the Environmental White Paper 2006 the Tokyo Metropolitan Government (TMG) describes the two crisis issues similarly as (A) Crisis that endangers the sustainability of cities and the earth, and (B) Direct crisis that threatens the health of the residents of Tokyo and the safety of their lives.²

Let's focus on the issue of resources, as stated in (1) and (A). One popular way to measure the value of necessary environmental resources is the so called ecological footprint, a term coined by Mathis Wackernagel and William Rees in 1992.³ It basically is used to compare the demands of any kind of human activity with planet earth's regenerating capacity and behind it lies the idea of local responsibility. It is measured in global hectares (gha) of required land area, thus the term footprint on planet earth.

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According to The Ecological Footprint Atlas 2008, the available biocapacity per person on planet earth equals 2.1 gha.⁴ In contrast, the per-person ecological footprint of Japan exceeds this value already 2.4 times with 4.89 gha.⁵

The inner city of Tokyo is one of the densest inhabited urban areas in the world.⁶ When calculating the ecological footprint of Tokyo, the results are becoming even more astonishing. The name “Tokyo“ is rather ambiguous and depending on the administrative and geographical boundary chosen, different footprints can be calculated (see table 1).

achieve true sustainability of cities, which might be impossible. It rather proves a simple fact as Kano (2000) points out, the fact that cities have, and will continue to have their resource base outside their boundaries. It underlines the axiom, that without this base, there can be no city and that a city cannot sustain by itself.¹⁶

3. Possible solutions

Even so the numbers of this resource based approach are impressive, the least we should do is give up in our efforts to trim the development of cities towards the path of sustainability. As the ecological

Tokyo [September 1, 2007]	Land area	Population	Density	Ecological Footprint
City of Tokyo (東京市), which existed independently until 1943 and are now the 23 special wards or “inner city“ of Tokyo ⁷	621 km ² (62,100 ha) ⁸	8,650,000 ⁹	13,929 / km ²	42,298,500 gha (exceeding 681 times)
Tokyo nowadays, officially Metropolis of Tokyo (東京都), including Tama area, 23 special wards and islands ¹⁰	2,187 km ² (218,700 ha) ¹¹	12,790,000 ¹²	5,848 / km ²	62,543,100 gha (exceeding 286 times)

Table 1

If compared with the land area of Japan, which is 377,923 km² (37,792,300 ha)¹³, it becomes apparent that the footprint of Tokyo alone exceeds the land area of whole Japan, in the case of the 23 special wards 1.1 times and in the case of the metropolitan Tokyo 1.6 times, which could be called way beyond ANY notion of sustainability with regard to the ecological footprint. This makes the crisis as formulated in (A) obvious and illustrates how much a city nowadays depends on the bearing capacity of the hinterland, which is in the case of Tokyo also highly populated and adds to the urgency of the problem. In this light all efforts of Factor 4¹⁴ or even Factor 10¹⁵ seem to fall short if we want to

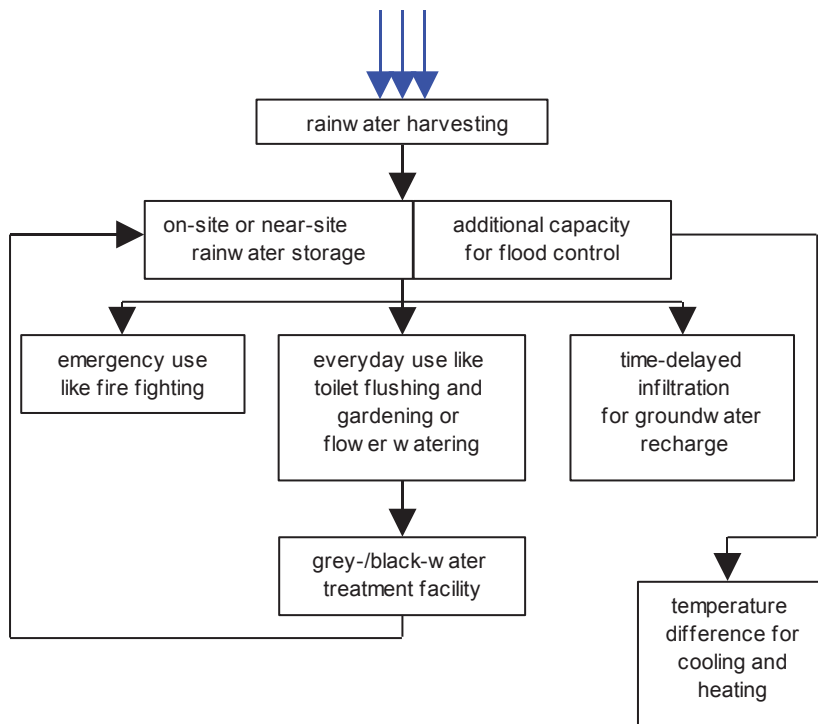
footprint is a rather gross value calculated from global and national data, it doesn't say anything about the real status of one city in particular. Even so the overall sustainability might be difficult to achieve, it should be nevertheless possible for parts of the city's metabolism. When over time more and more parts will have achieved the sustainability goal, we might feel the strong urge to tackle the impossible.

How can we secure or even increase the availability of resources, to avoid a lack of resources, as stated in (1) and (A)? Not all resources are necessarily scarce to begin with. For the last part of this report, let's focus on the resource water, more

precisely water for domestic use. On the one hand, in our current technologically highly developed society we are keeping the luxury of even flushing our toilets with costly treated clean or white water, the same water that we are using for cooking. In Japan this amounts to 28% of the overall household water use.¹⁷ On the contrary the resource rain water is hardly taken into use for this purpose.

When thinking about rainwater harvesting quite a number of different possibilities for its usage can be found. To begin with, the annual precipitation in Japan is 1700mm, so Japan can be called a country with a large amount of precipitation.¹⁸

If the storage tank is large enough, and before the rainy season or a typhoon just slightly filled, it can provide additional capacity for flood control in this area. A time-delayed infiltration of the rainwater into the ground would help in reducing the amount of water that is transported in the sewage system and help in recharging the groundwater levels. Furthermore, the temperature difference of the water in the rainwater storage tank in comparison to the outside air temperature could be used for cooling the indoor environment in summer and heating in winter. One can even think further, depending on the size of the water



Graph 1

However, most of the rain is pouring down in the rainy season and the typhoon. This calls for rainwater storage ideally placed on the site of later use. Furthermore, this water could also be used in case of emergency for fire-fighting purposes.

storage tank, an appropriately sized small-scale water treatment facility could be installed side by side to treat greywater (about 41% of domestic water)¹⁹ or even blackwater for recharging the storage tank in times of little rain.

That such a system can work is not utopian. A wide range of appliances from simple storage tanks for gardeners up to state of the art technology is available. Its implementation on the other hand has just begun and depending on the scale and place of its installation

it is a common task for urban engineers, architects and civil engineers to incorporate it into urban forms like a park or river, into buildings like a stadium or a private house or even into roads as a new form of urban infrastructure.

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