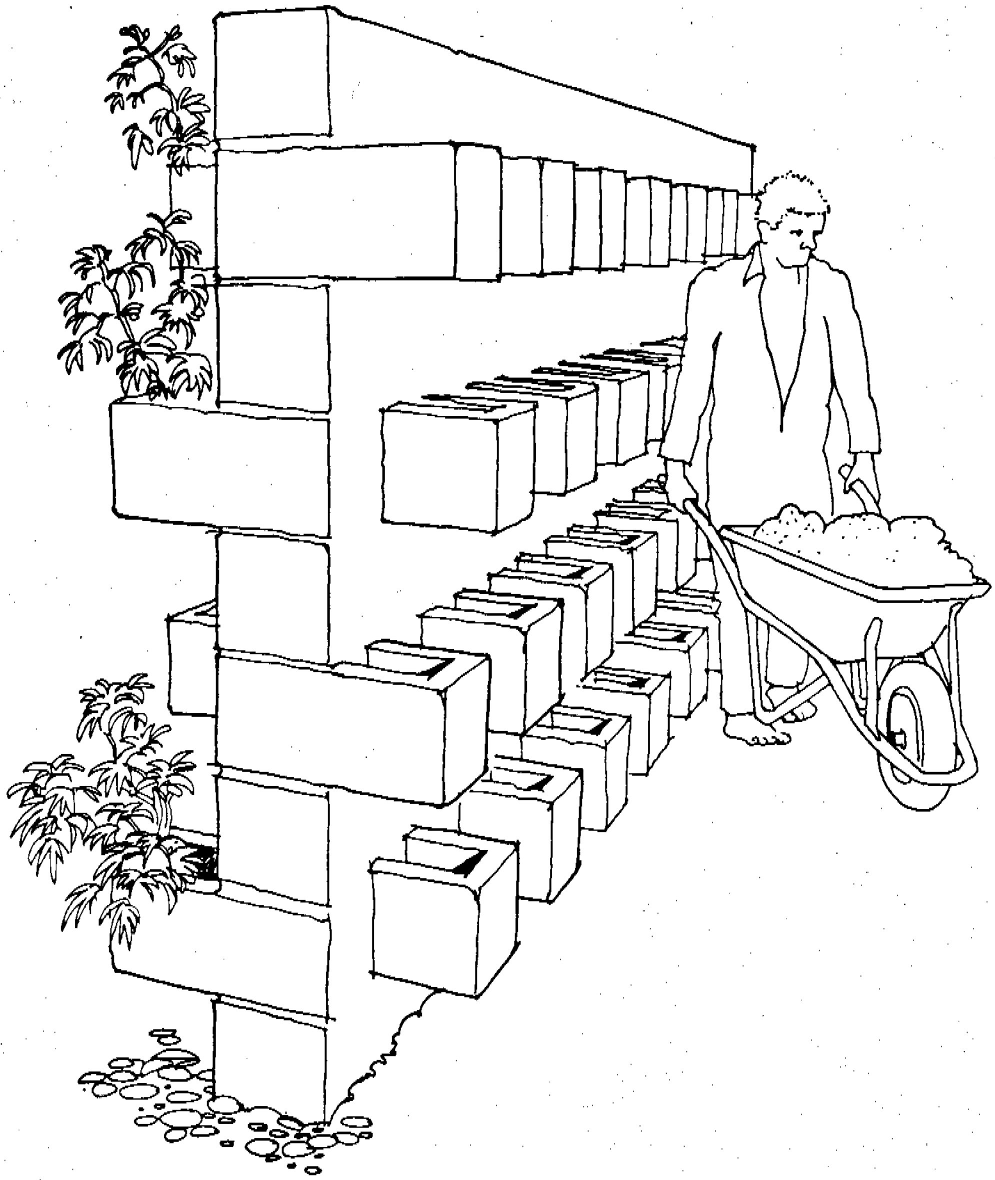

THE PRODUCTIVE HOMESTEAD

- report of a study tour

February 1992

Uno Winblad

PREFACE

Dr Gösta (Gus) Nilsson has lived in Botswana for more than twenty years. He is a man of many ideas but is also a doer with an impressive ability to carry out full-scale tests and demonstrations.

At SIDA we felt that the achievements of Gösta Nilsson deserved further study. As his work touches on a number of topics and disciplines we asked one of our most experienced multidisciplinary consultants to carry out a rapid assessment of Nilsson's work. The purpose of the assessment would be to document Nilsson's practical achievements with special reference to what might be relevant to SIDA funded programmes in other countries.

In this concise and authoritative report our consultant, Mr Uno Winblad, presents the findings of his six-day study tour to Botswana. His conclusion is that Dr Nilsson's experimental activities at Sanitas over the past 20 years have produced results of great relevance to SIDA funded programmes, particularly in areas such as food production, wasteland development, refugee resettlement, housing and urban development, water conservation and income generation. Nilsson's achievements are particularly relevant to programmes aimed at small-scale, labour intensive, cost-effective and sustainable production in arid and semi-arid areas.

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CONTENTS

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INTRODUCTION

Dr Gösta Nilsson is a Swedish horticulturist living and working in Botswana since 1967. Over the years he has put forward, and in many cases tested, non-conventional ideas on food production, dry-land farming, water conservation, ground water protection, pest control, solar heating, housing and self-employment. The scope of his activities range from utopian visions of how to reorganize society to the actual implementation of horticultural and technical innovations.

Gösta Nilsson is the director of Sanitas (Botswana) (Pty) Ltd, a family enterprise consisting of plant nursery, vegetable production, garden shop and experimental station. Sanitas is also providing landscaping services. Sanitas has a site of 8 ha close to the Gaborone dam. Three members of the Nilsson family are working there together with a local staff of 80 persons. The enterprise, including its research and development activities, is self-financing. The annual turnover is well above P 1 million.

The purpose of this study is to describe Nilsson's concept of "the productive homestead" and discuss its potential significance for poverty-oriented development assistance programmes. It is based on a six-day study visit to Botswana in October 1991. The study was financed by SIDA.

THE PRODUCTIVE HOMESTEAD

The cornerstones of Nilsson's "productive homestead" concept are private ownership, decentralization, water conservation and long-term, fixed interest loans:

private ownership of the "minimum needs of production" to encourage savings, long-term investments and gradual improvements; small plots of land to be sold to the landless; (Gösta Nilsson is frequently using the phrase "capitalism for all";)

decentralization of food production to the homes to create self-employment and food security, reduce transport, package and storage cost and provide a fresher produce; small scale production of valuable cash crops and food crops; selfhelp construction;

water conservation based on rainwater harvesting, purification and reuse of all household water, water saving horticultural methods and ground water protection;

long-term loans at fixed, relatively low interest rate rather than outright grants, using part of the proceeds from the sale of homestead produce for repayments. (Gösta Nilsson claims that a productive homestead on a 1,000 m^2 plot can feed a family and pay for the building of the home over a 20-year period.)

In one of his unpublished documents Nilsson states that "Economic independence of a country is not the same as economic freedom of its citizens . . . Food security of a country is not the same as food security of the families of that country. Food production in the homes should therefore be encouraged by the use of mini-farming without mechanization, an inflation free system . . ." In the same document he states that "The lack of ownership of means of production is the basic cause of poverty in Africa".

A "productive homestead" might consist of a plot of 500-1,000 m^2, a house with "growing walls", freestanding "growing walls", sand-filled "growing benches", tanks for rainwater collection and a combination of mechanical and biological filters for grey and black water purification. For fruit growing in combination with vegetable production the plot must be larger, 2,000 - 10,000 m^2. If production is based on dryland farming using the "permanent strip method" a plot of 5 - 8 hectares is required.

Nilsson envisages "crop production villages" consisting of 50 productive homesteads.

THE GREEN BELT

One of Gösta Nilsson's contentions is that there is no shortage of water in Botswana. The average annual rainfall over the country is equivalent to 200,000 m^3 per person. Rivers from neighbouring countries are providing another 20,000 m^3 per person.. The water required per person for food production and other uses is only about 0.1% of what is potentially available. Dr Nilsson has in various unpublished papers, lectures and private conversations put forward a profusion of ideas on how to harvest, store, transport, use and reuse the water required for national self-sufficiency in food production.

One of his ideas is to concentrate development in 1 km wide "green belts" along the major roads. The green belts contain productive homesteads, agro-industries and service centres, see fig 1. The various activities are linked to major water sources through "aquaducts", see fig 8 and 9.

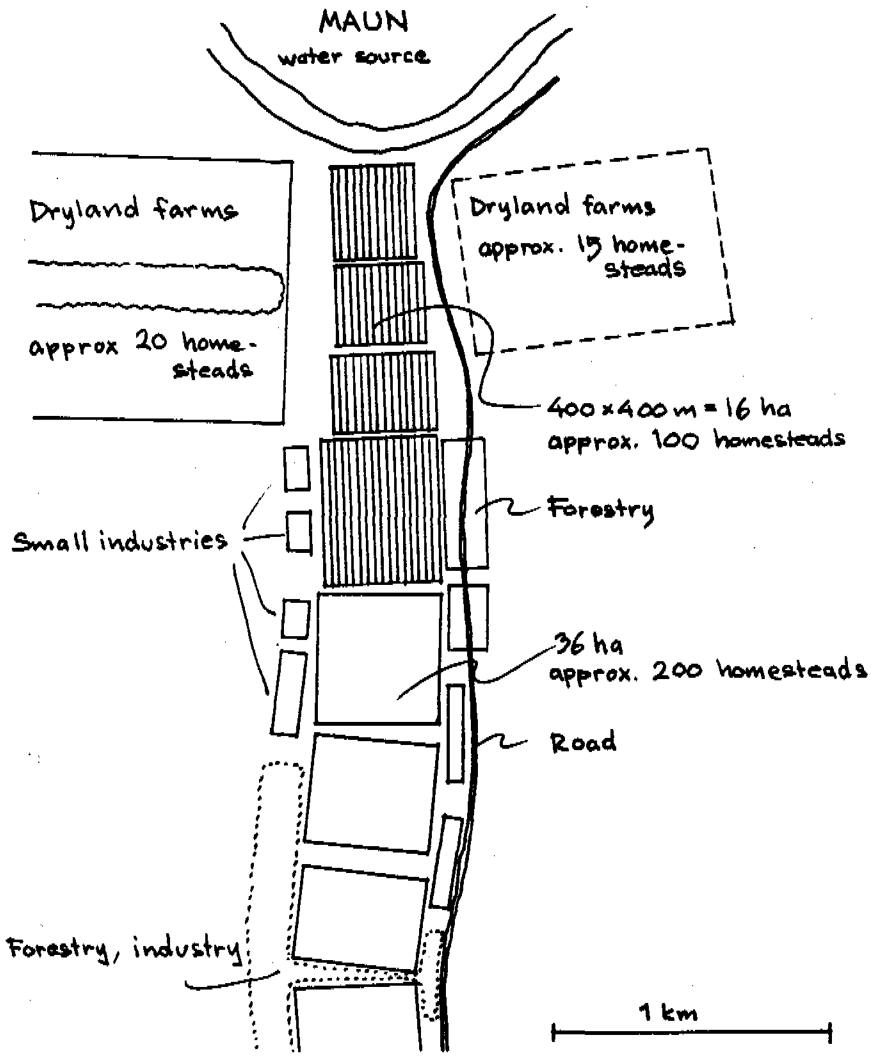

Fig 1: A green belt development in Botswana as envisaged by Dr Nilsson. Productive homesteads are connected to water pipelines in the shape of aquaducts (see page 10) and are grouped into crop production villages. The green belt development includes small industry, forestry and service centres.

THE HOUSE

The house at the experimental productive homestead at Sanitas is a conventional, relatively high-cost bungalow of about 60 m^2 surrounded by growing walls, see fig 2.

Rainwater is collected in two underground tanks. There is also a circular tank above ground in front of the house.

Highly innovative, "in-house" excreta and wastewater reuse/re-circulation systems are under construction. The systems cannot be described in this report as Nilsson is planning to patent them.

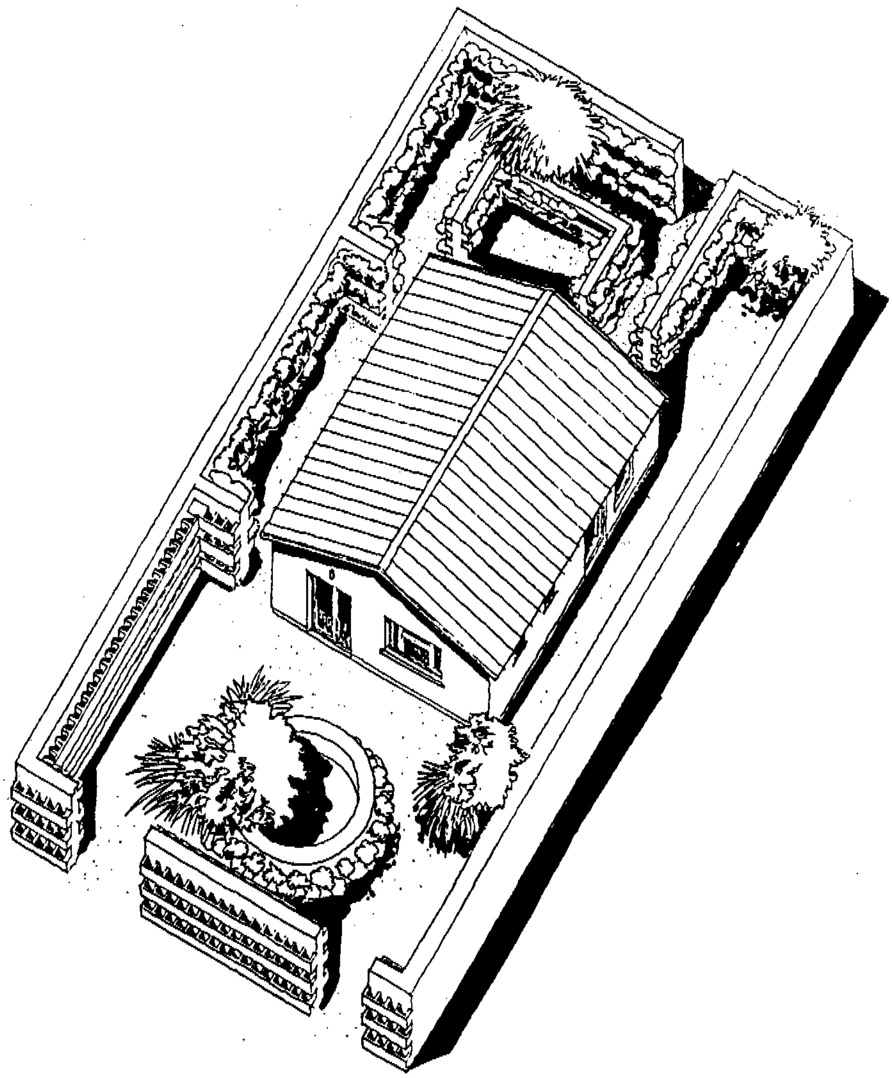

Fig 2: A bird's eye view of the prototype productive homestead under construction at the Sanitas farm. Behind the enclosed garden (outside the picture) is an area with growing benches.

THE GROWING WALL

Gösta Nilsson has developed a container gardening system based on walls with built-in growth boxes made of hollow concrete blocks. The blocks are made at Sanitas using a simple, hand operated block making machine.

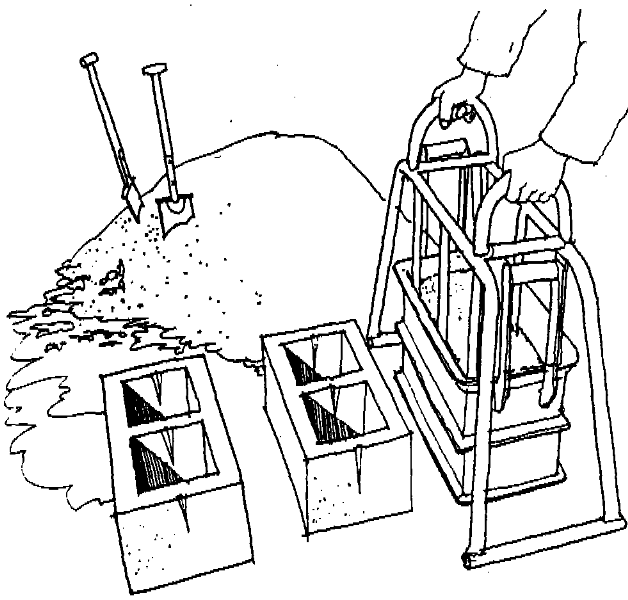

Fig 3: Making concrete blocks with a hand operated block making machine.

With such a machine two persons can make 100 blocks per day. The cost per block (with a mix of 1 part cement and 4 parts sand) at Sanitas is P1. (The current price of such a block is P2 in Gaborone.)

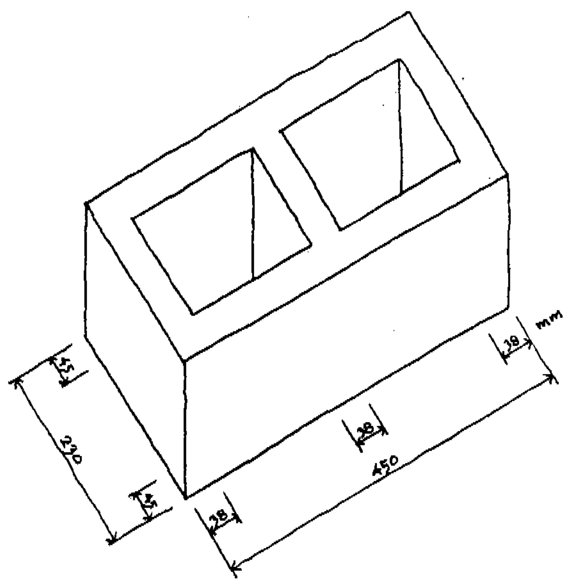

Fig 4: Dimensions of concrete blocks made at Sanitas.

When building the wall some of the blocks are turned 90 degrees and the protruding hollow part is provided with a floor and a hole for drainage, see fig 5. The core of the wall is filled with a weak concrete mixture. The protruding containers are filled with sand on top of a layer of fertilizer (dried chicken manure or farm yard manure). The containers are then ready for planting.

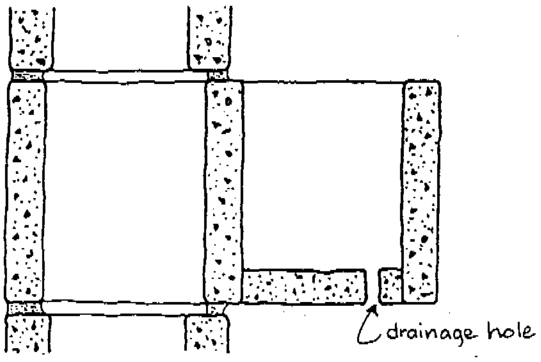

Fig 5: Section through a concrete block container. A floor with a drainage hole is added to the container part of the block.

The containers can be arranged in various patterns and the wall can be provided with containers on one or two sides.

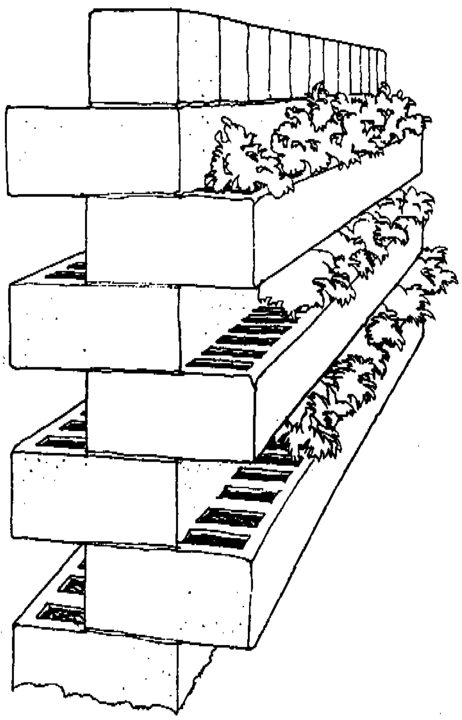

Fig 6: Double sided growing wall.

In one interesting variation 1/4 of the container block is protruding on each side of the wall. The whole wall is filled with growing medium (sand + fertilizer). This means that the roots have access to a larger volume of growing medium as they can grow into the unturned row of blocks as well. Water can trickle down inside the wall from top to bottom.

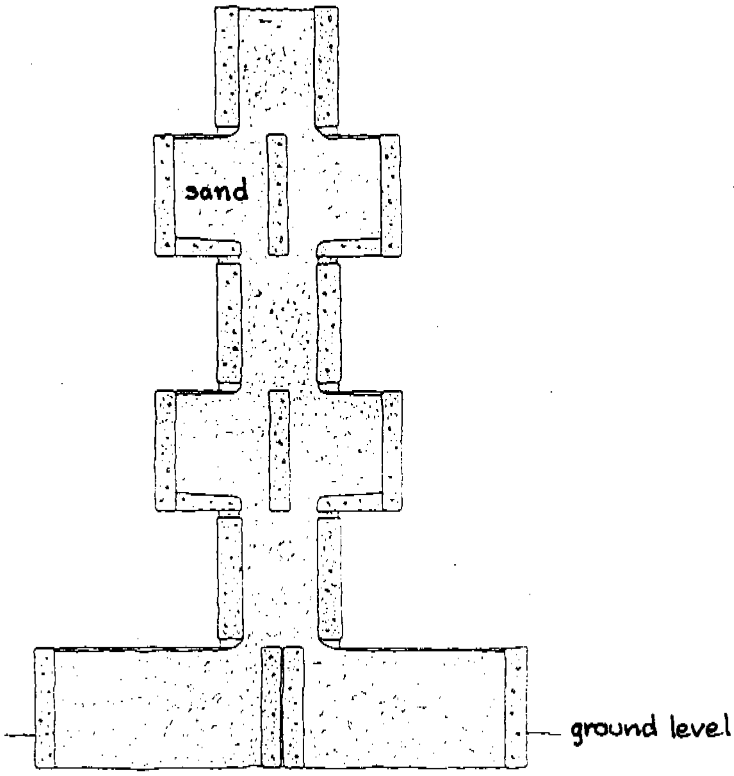

Fig 7: Section through double sided growing wall. In this case all the cavities of the wall are filled with sand.

There are about 2,000 containers on the walls surrounding and within the experimental productive homestead at Sanitas. The containers may face any direction and the walls can be quite closely spaced (1.2-1.5 m).

At Sanitas all growing walls are provided with a drip irrigation system consisting of plastic hosepipes running along the upper layers of the wall. Hand irrigation is also possible and was used during my visit.

There are also examples of special applications: combined solar/growing walls heating water for irrigation and for staff washrooms, and growing walls enclosing various types of water tanks, including the "aquaduct" (see fig 8 and 9).

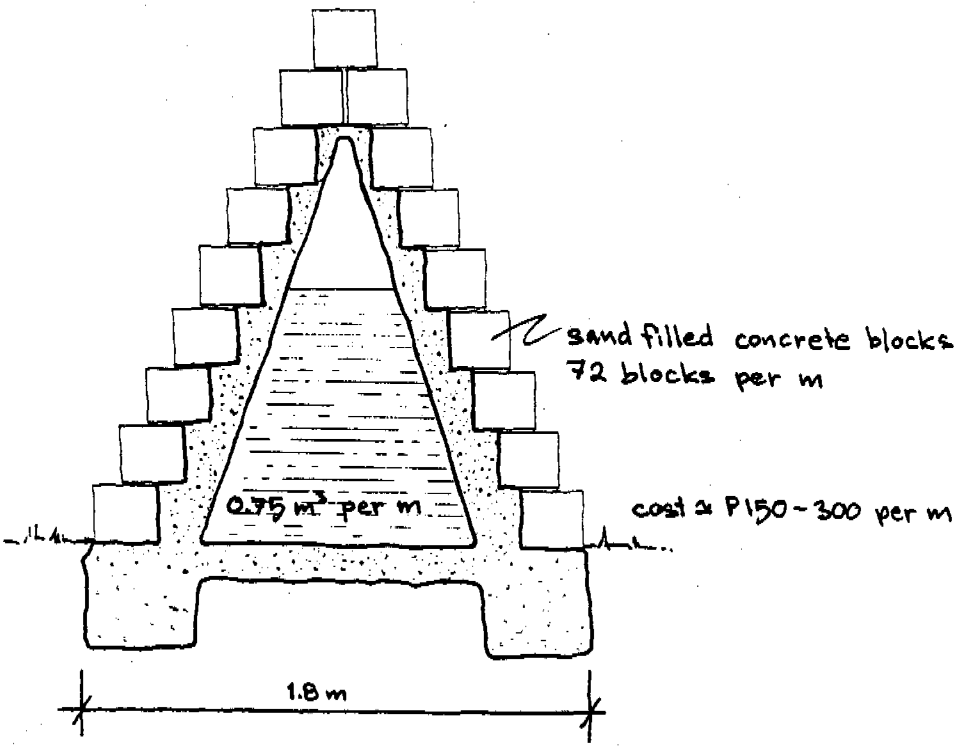

Fig 8: Section through the aquaduct.

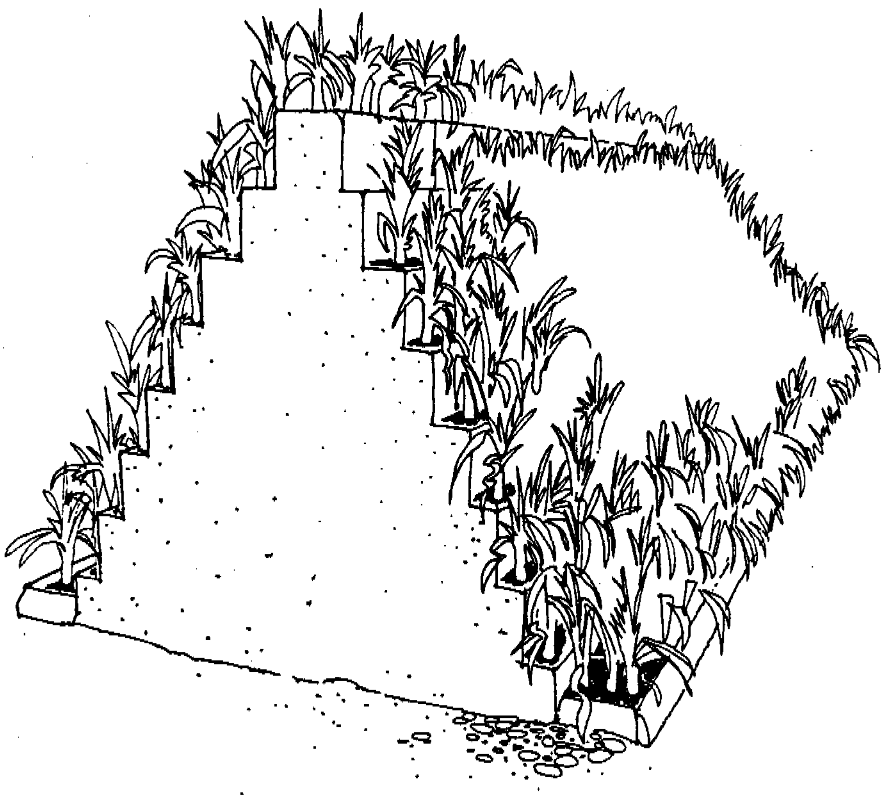

Fig 9: Exterior view of aquaduct with leek growing in the containers.

The solar heated wall, fig 10, is 30 m long and 2 m high. It produces 30 m^3 of warm water per day during winter. It is used for heating walls and benches at night. With ambient temperatures ranging from 0° to 10°C the heated water has a temperature of 30°C in the evening and around 20°C in the morning.

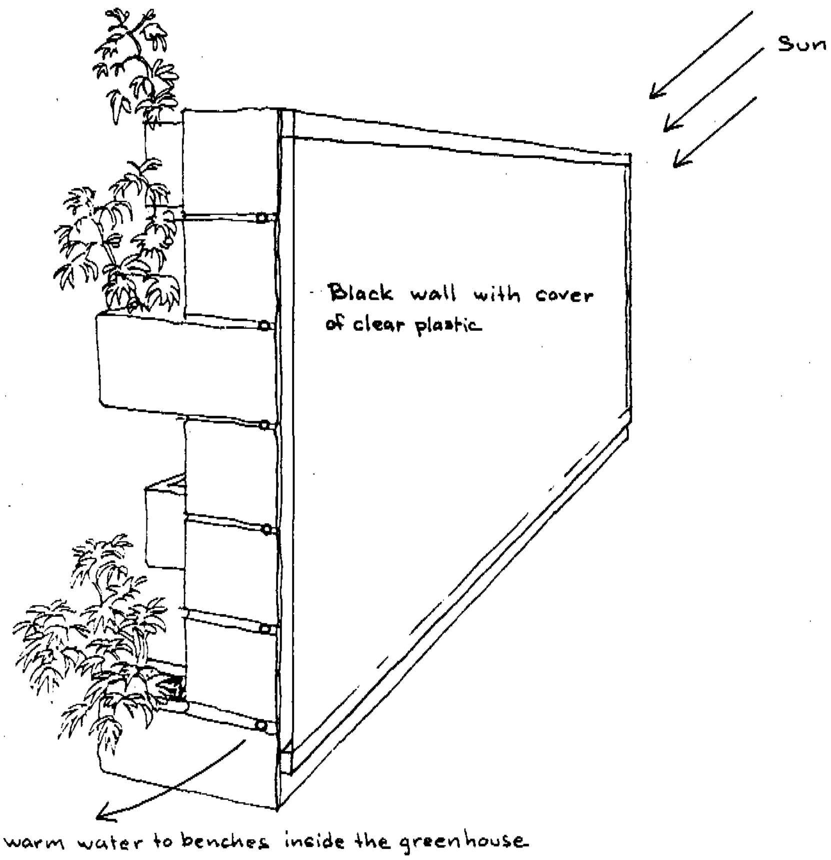

Fig 10: A solar heated wall as part of a greenhouse.

At Sanitas the walls are used for growing a variety of vegetables and ornamentals. Most vegetables can be grown in the containers. During my visit I found spinage, beans, tomatoes, leek, garlic, pepper and a large variety of flowers. According to Nilsson each container can easily produce a profit of P5 per year. Three bunches of spinage grown in one container can be sold at P2. It is possible to produce 2 kg tomatoes per container four times a year. The wall system is particularly suitable for high value crops like spices and medicinal plants.

If Nilsson's figures are correct, a 1 m^2 wall with 8 containers should be able to produce vegetables with a retail price of P40 in a year. This is roughly equivalent to the cost of building 1 m^2 wall.

THE GROWING BENCH

A growing bench can be used for all kinds of vegetables, cereals, fruit trees and ornamentals. The benches used at Sanitas consist of a thin, 1.2 m wide and about 20 m long convex-shaped concrete floor (50 kg cement for each 300 litres of river sand). The floor is surrounded by a 10 or 20 cm high concrete edge with drainage holes.

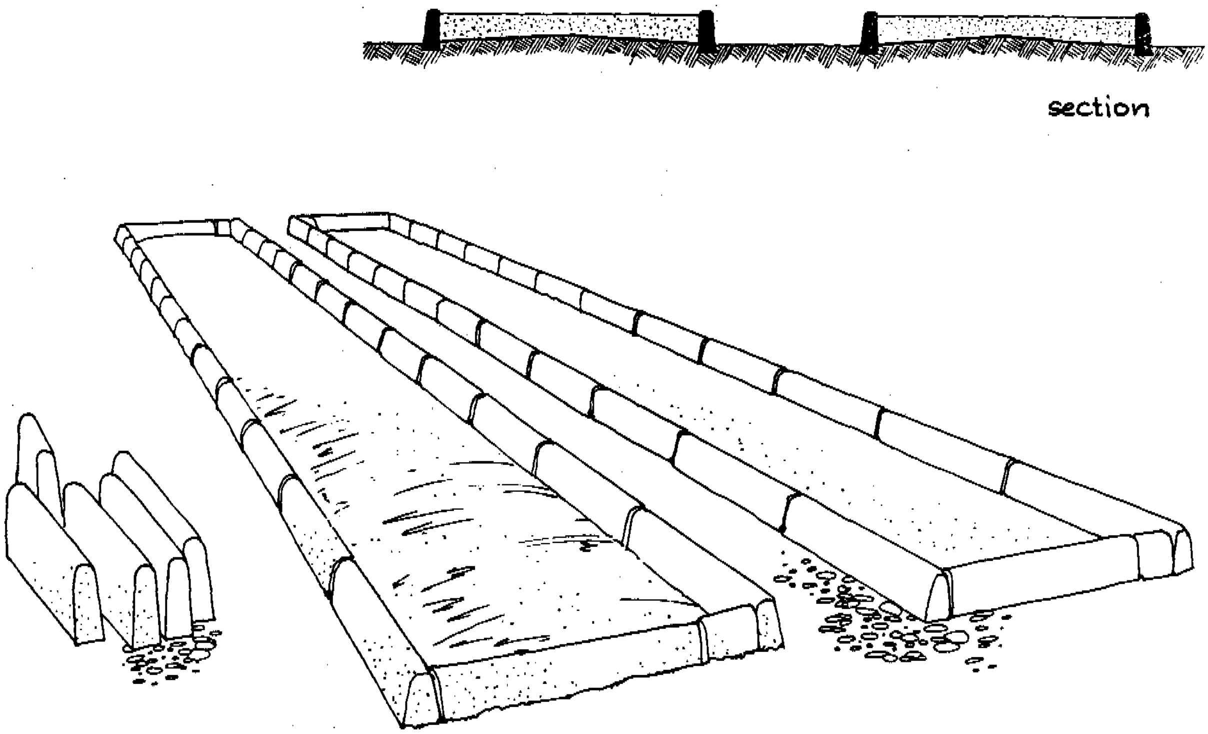

Fig 11: Two sand filled growing benches.

The bench is filled with coarse sand. Many of the benches at Sanitas have 20 cm high edges with a 15-18 cm layer of sand but Nilsson now prefers the 10 cm edges with a 5-6 cm layer of sand as the thin layer make it easier to control nematodes through solar pasteurization. (In hot climates benches with a thin layer of sand should be shaded.)

Before the bench is filled with sand a layer of fertilizer is spread over the concrete floor. The fertilizer consists of 3 litres of dried chicken manure or 4 litres of dried farm yard manure per m^2 bench area. (This basic fertilizer will last for several years.) After filling sand on top of the manure (about 5 m^3 sand per 25 m^2 bench area) the sand is levelled and provided with a top dressing of about 1 litre of pulverized chicken manure or farm yard manure per m^2. If other fertilizers like 2:3:2, super phosphate and trace elements are required they are applied on top of the sand and slightly raked in.

The benches can be hand irrigated or provided with a drip irrigation system consisting of a hosepipe running along the centre of the bed. The benches are irrigated until water seeps out through the drainage holes. Daily watering is required in summer.

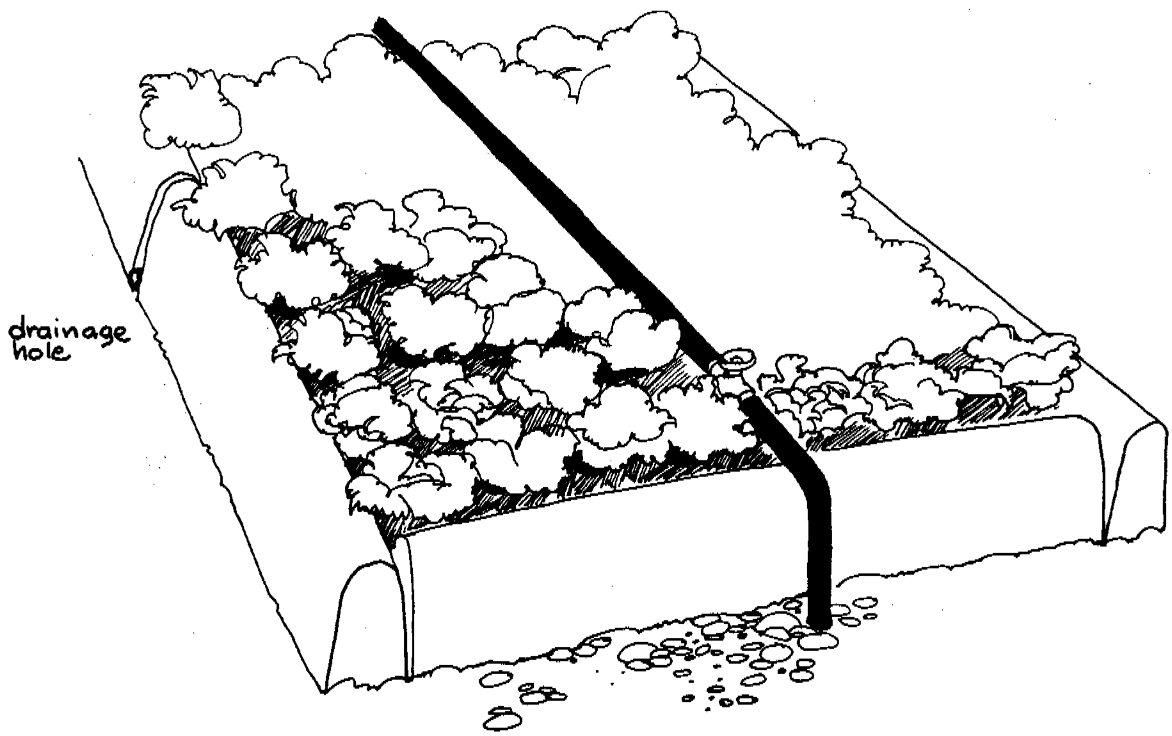

Fig 12: Growing bench with drip irrigation system and drainage hole.

Some of the benches at Sanitas are inside a nethouse. The main purpose of the net is to protect the crop against hailstorms. The net also provides shade and protection against animals, including birds.

The growing bench system has a number of advantages over conventional methods:

- cultivation is possible anywhere, regardless of the quality of the soil (rocky, sandy, salty) as long as water for irrigation is available;

- it requires an average of 3 litres of water per m^2 and day - only 50-70% of the water needed for conventional methods of growing;

- no ploughing, rotavating or digging required - thus no need for expensive machines - the sand is worked with a hand-rake;

- weed control is drastically simplified;

- plants grow faster due to better aeration of the roots;

- productivity per unit area as well as per time unit is higher than for conventional methods;

- if nematodes appear, the thin layer of sand can be pasteurized by solar heating under a plastic cover (55°C for 10 minutes will kill nematodes and their eggs);

- no need for pesticides;

- harvesting plants growing in sand is easy and replanting can be done immediately.

The only disadvantage of the bench system is the initial investment required. The cost of building benches is around P6-P8 per m^2. A bench can, however, be used for growing produce to a retail value of P10-20 per m^2 and year.

THE PERMANENT STRIP METHOD

Dr Nilsson has for many years been advocating a method for dryland farming in permanent strips. This "permanent strip method" can be used for grain production at larger homesteads. Level land is ripped with a special tool, a ripper with 3 shanks, down to a depth of 0.5-0.6 m. The width of the strip is 0.6 m. The interstrip area is shaped and compacted for water collection and weed control.

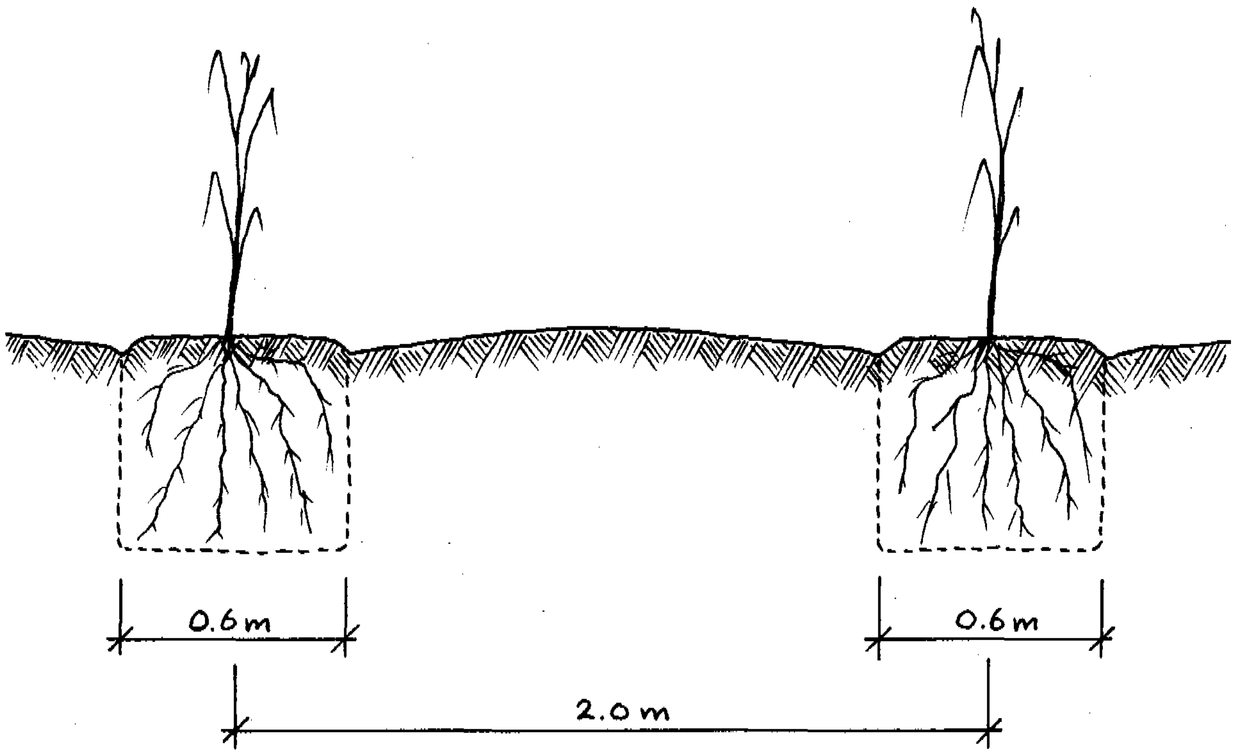

Fig 13: Section through two permanent strips.

The method is characterized by:
- wide spacing between rows and plants;
- 0.5-0.6 m deep ripping of 0.5-0.6 m wide strips;
- rainwater collection and weed control through compaction and shaping of interstrip areas;
- ripping done immediately after the harvest;
- soil left alone until planting after the first rain:
- gradual improvement of soil in the strip by the incorporation of organic matter.

This method provides 360 litres of loose soil per m strip, capable of storing 80-100 litres of water. (Ordinary ploughing provides 200 litres of loose soil per m^2, capable of storing 50 litres of water. This water evaporates faster than the 80-100 litres of the ripped strip.)

The method has been used on a demonstration plot at Sanitas for 17 years. Since 1985 permanent strips are used on four hectares at the Sebele Research Station. The method allows two crops a year with a rainfall of 500 mm. With a rainfall as low as 300 mm it is still possible to have a crop of two tons per ha using the permanent strip method. (Because the permanent strips are so well managed at the Sebele Research Station there are no longer any strip demonstration plots at Sanitas.)

DISCUSSION

The productive homestead concept is part of a blueprint for society evolved by Gösta Nilsson. Some of his ideas are utopian and presuppose major political, social and economic changes. Such changes are indeed necessary if Africa is to survive, but they are beyond the scope of this report. Here I am focusing on some of Nilsson's micro-level, tangible, down-to-earth proposals, particularly those I think are directly relevant to SIDA funded programmes.

For poverty oriented SIDA funded programmes the most promising of Nilsson's accomplishments is the **productive homestead** concept. This concept addresses the issues of poverty and food security at the grassroots level through the introduction of low-cost, sustainable technologies. The productive homestead is intended as a micro-enterprise providing not only food but also a cash income. The concept is well conceived and its technical and horticultural components have been tested and perfected. In Botswana its cost-effectiveness is extremely good. The productive homestead concept has a great potential not only in Botswana but in low-rainfall, drought-prone areas all over the world. It can be applied to rural areas, to urban squatter areas and to the resettlement of refugees.

According to recent FAO estimates almost 1,000 million rural people in developing countries live in households that have too little land to meet the minimum subsistence requirements for food and fuel.[1] This figure excludes China where most farmers even after the land distribution of 1952 had less than one hectare[2]. In Africa and Asia, one-third to one-half of smallholders have to subsist on holdings smaller than one hectare.[3] The man/land ratio in developing countries is expected to fall from 0,9 ha in the mid-1970s to 0,5 ha by 2000.[3] A recent IFAD report states that "a vast majority of the world's rural households have to subsist on landholdings so small that they are hard put to produce the food they require".[4]

Table 1: ***Percentage of rural population in poverty***[2]

Latin America	53.4
Asia	49.8
Near East/North America	32.0
Africa (sub-Saharan)	65.2

The productive homestead concept can be used to increase the productivity of the small farmer, particularly in densely populated rural areas, for instance in Kenya, where high birth rates have resulted in subdivision of arable land through inheritance to a point where plots become uneconomical. In rural areas the productive homestead concept should be particularly useful in the reclamation of ruined land (wasteland development).

The ideas are also highly relevant for urban areas considering the rapid urban growth taking place in the third world. The urban population in Africa is expected to increase from 210 million in 1990 to 766 million in 2020.[5] Many urban dwellers live in poverty in dilapidated houses, on small pieces of land, in squatter areas, with no legal title. In Nairobi for instance, the demand for

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1 Alexandratos, N (ed). World agriculture: toward 2000, FAO, Rome 1988.

2 Lindqvist, S. Kina nu, Förlags AB Marieberg, Stockholm 1980.

3 FAO. Report of the expert consultation on landlessness: dynamics, problems and policies, Rome, October 1985.

4 Alamgir, M and Arora, P. Providing food security for all, IT Publications, London 1991.

5 Tabibzadeh, I, Rossi-Espagnet, A and Maxwell, R. Spotlight on the cities - improving urban health in developing countries, WHO, Geneva 1989.

new housing units is increasing by about 60,000 per year as compared with the current rate of new development of some 20,000 units per year. Informal settlements are growing at an annual rate of up to 12% as compared to the annual growth of Nairobi as a whole of 8%. Currently about 50% of Nairobi residents live in these informal settlements. By the year 2000 more than 2 million people could be living there.[6] For many of these people the application of the productive homestead concept could provide a way of raising the family income. (In existing urban low-income settlements plots are usually much smaller than the 500-1,000 m^2 envisaged by Nilsson. There is a need for further action research on how to apply the productive homestead concept to situations in crowded urban and peri-urban settlements.)

"Discussions with researchers from other African and Asian cities suggest that we may be underestimating the proportion of people in cities who depend on food they grow themselves within or outside the city . . . If an assured, adequate diet now demands access to cultivable land or some non-monetary transaction for a substantial proportion of city dwellers in Africa (and perhaps elsewhere), this has major implications for the urban future."[7]

Some studies indicate that in Nairobi most households grow or produce food themselves.[8] In Lusaka more than half of all households in some low-income areas grow a proportion of their food either on plots next to their houses or on plots elsewhere[9].

The most immediate application of the productive homestead concept might very well be in the resettlement of refugees, displaced persons and demobilized soldiers in countries like Angola, Mozambique, Ethiopia, Eritrea and Somalia.

Gösta Nilsson insists that productive homesteads must be based on

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6 Nairobi City Commission. Naiwasha workshop on improving environmental sanitation in informal settlements, Nairobi, September 1991.

7 Mitlin, D and Satterthwaite, D. Human settlements and sustainable development, UN Habitat, Nairobi 1990.

8 Mazingira Institute, Urban food and fuel study, Nairobi 1987.

9 Rakodi, C. Self reliance or survival: food production in African cities with particular reference to Zambia, paper presented at the Workshop on urban food supplies and peri-urban agriculture, Centre for African Studies, University of London, London 1988.

private ownership of the "minimum needs of production". When his ideas have been tried outside Sanitas it has usually been in donor funded projects where the beneficiaries have been employed. The donors and/or the government have encouraged small projects without clearly defined ownership. Improvement of such schemes, increases in land value etc are not regulated and a person leaving the scheme gets no compensation for the capital gains which result from his/her work. According to Nilsson this is not the way to do it. I think he is right.

A productive homestead can only succeed with an owner-cultivator. There must be security of tenure and the possibility of obtaining bank loans for homestead improvements.

> *Group work is alright for training, but after a few months of intensive training privately owned homes on own land must be the basis for successful production.*
>
> *Gösta Nilsson*

> *Make a man the owner of an acre of desert and he will turn it into a garden - make a man the tenant of a garden and he will turn it into a desert.*
>
> *Arthur Young*

One of Nilsson's proposals is to establish "crop production villages", each based on some 50 productive homesteads. A model for such a village could be the *moshav* in Israel. A moshav is a cooperative village based on individual homesteads[10]. To my knowledge this model has never been tried in Africa where rural development projects tend to adopt either the *kolchos* (state farm) or the *kibbutz* (collective farm) model.

At the regional level Gösta Nilsson has proposed the establishment of **green belts**. In physical planning practice a greenbelt is a means of preventing one town from growing into another. Nilsson's green belt is an urban-rural settlement in a linear shape. Similar regional planning ideas were put forward about 100 years ago by for instance Soria y Mata (the Linear City)[11] and Ebenezer Howard

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[10] Yalan, E (ed). Private and cooperative agricultural settlement - physical planning, International Seminar on Rural Planning, Haifa 1961.

[11] First proposed in 1882. See George R Collins, Linear planning throughout the world, in Journal of the Society of Architectural Historians, Oct 1959.

(the Garden City)[12]. Nilsson's concept differs from these in that his green belt is specifically conceived for third world conditions and based on horticulture rather than industry.

The possible outline of SIDA's involvement in urban issues is currently under discussion[13]. Gösta Nilsson's productive homestead and green belt concepts might be worth considering. They could be used to tackle issues such as rapid urban growth, unemployment, housing, water supply, food production and related environmental issues.

The **house** design at the Sanitas prototype homestead is clearly aimed at a middle class urban household. The most interesting parts of it are the waste-water reuse and excreta disposal systems. At the time of my visit to Gaborone they were still under construction. They were neither fully developed nor tested.

Nilsson's waste-water purification system based on filtration through evapo-transpiration beds is technically simple. It could probably be used for low-income housing if the experiments at Sanitas show that it works. The excreta disposal system, however, is too complex and much too expensive for a majority of third world households. It might be of interest to middle- and high-income households in areas with restricted water availability. Some kind of dry excreta disposal system like the ROEC or the double-vault composting latrine[14] would be more cost-effective.

The cost-effectiveness of the **growing walls** at Sanitas is amazing: full cost recovery after one year only! (See page 11.) Most attempts at building ecologically sound houses have resulted in extremely high-cost prototypes. By using Nilsson's growing walls for the house itself and not only as free-standing structures it might be possible for low-income households to build better houses. (Some research and development is required though. For instance, to what extent would moisture pass through the wall and cause problems?)

The **growing bench** system at Sanitas is simple, environmentally sound, remarkably effective and very flexible. It is well tested and

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[12] Ebenezer Howard. Garden cities of tomorrow, London 1902.

[13] SIDA. SIDA Seminar on Urbanization, Development, Poverty and Development, Stockholm, November 1991.

[14] Winblad, U and Kilama, W. Sanitation without water Mamillan, London 1985.

can be applied right away in a variety of situations, urban as well as rural. Its potential for wasteland development is great. It should be possible to adapt the growing bench system so that it can be operated by disabled persons. Such a system would have a tremendous potential in for instance Angola with its tens of thousands of soldiers and civilians maimed in fighting and by land-mines.

A discussion of the **permanent strip** method is far beyond my field of competence. A proper evaluation would require a series of carefully recorded experiments in various locations over several years.

Nilsson's work provides cost-effective and accessible technologies within the technical reach of low-income households. This is only part of the problem though. Equally important is participatory development, availability of land, security of tenure (in some cases land reform is a prerequisite), access to credit, marketing channels and upgrading of skills in building, horticulture and marketing.

CONCLUSIONS AND RECOMMENDATIONS

Gösta Nilsson's experimental activities at Sanitas in Botswana have produced results of great relevance to SIDA funded programmes concerned with income generation, housing, urban and rural development, wasteland development, horticulture, rainwater harvesting, water conservation and the resettlement of refugees and displaced persons. Nilsson's achievements are particularly relevant to programmes aimed at small-scale, labour intensive, cost-effective and sustainable production.

This report suggests some practical applications of the productive homestead concept. SIDA could play an important role in its dissemination to other donor agencies, NGOs and potential beneficiaries and in its implementation in a number of countries. As a first step I suggest an internal workshop at SIDA. Its purpose would be to discuss this report and possible follow-up actions.