In this module we deal with management of the four resources: nutrients, water, energy and human resources to manage the natural resources.

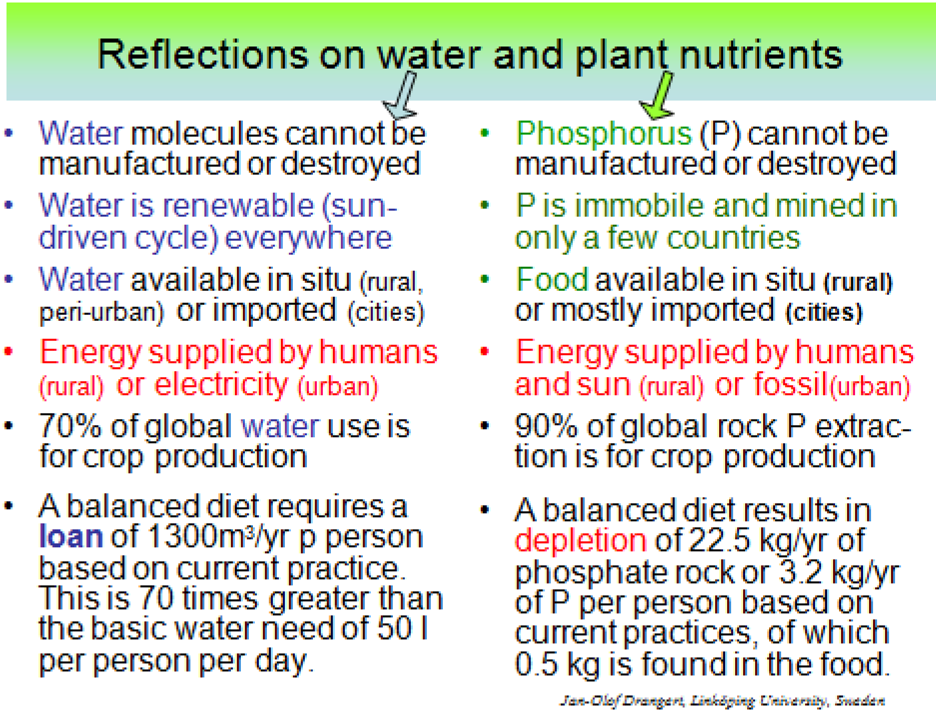
For long, people have been mostly busy raising incomes and consumption levels, rather than worrying about depletion of natural resources. However, with more people on earth who are increasingly living in dense areas, more focus is on materials flowing through our communities. Looming serious challenges concern how the once used products (water, nutrients, chemicals, etc.) may be used again without too costly treatment measures and transports. The intended use of the output from our societies, be it agriculture, industry or nature, defines what quality criteria should be aimed for.

Present sanitation arrangements produce polluted water and mixed solid ‘wastes’ and also energy dependency. It has been calculated that 20 per cent of the energy used in the state of California is used for supplying and treating water. By mixing fewer flows of materials, ideally no mixing, the content of each flow becomes easier to treat and to recover for renewed use in production. This is a leading principle for achieving improved sustainability in the sanitation sector (slide 1.3-24).

Of particular interest are plant nutrients, here represented by phosphorus (P), since they cannot be manufactured nor replaced by substitutes in plant production. The mining of phosphate rock and converting it to plant–available phosphorus is in itself a polluting and energy-consuming activity. Moreover, P is being mined in only few countries in the world and requires long transport. This oligopoly market may become a weapon on the geopolitical scene. P is also a serious polluter of our water bodies. This account shows that phosphorus belongs to soil, not water. Means to re-circulate nutrients from the food chain back to the soil and food production is thus imperative for a sustainable future.

The module deals with understanding the potential in combining sanitary improvements with resource recovery in securing food for future generations.

1.2 - 2



Both water and phosphorus are sturdy molecules that are extremely costly to manufacture. They are significantly different, however, in that water is renewable through the water cycle whereas phosphorus is immobile.

Household water is mostly drawn from available groundwater and/or rainwater in rural areas, while it is mostly imported to urban settlements from distant rivers and conveyed by pumps. Food is produced in situ in rural areas and requires farm work, while food is mostly imported to towns from rural areas and requires transport work.
The energy needed to supply water and food is provided by humans in rural areas, while for city dwellers, water is pumped by electric pumps and food is transported on diesel-driven vehicles.

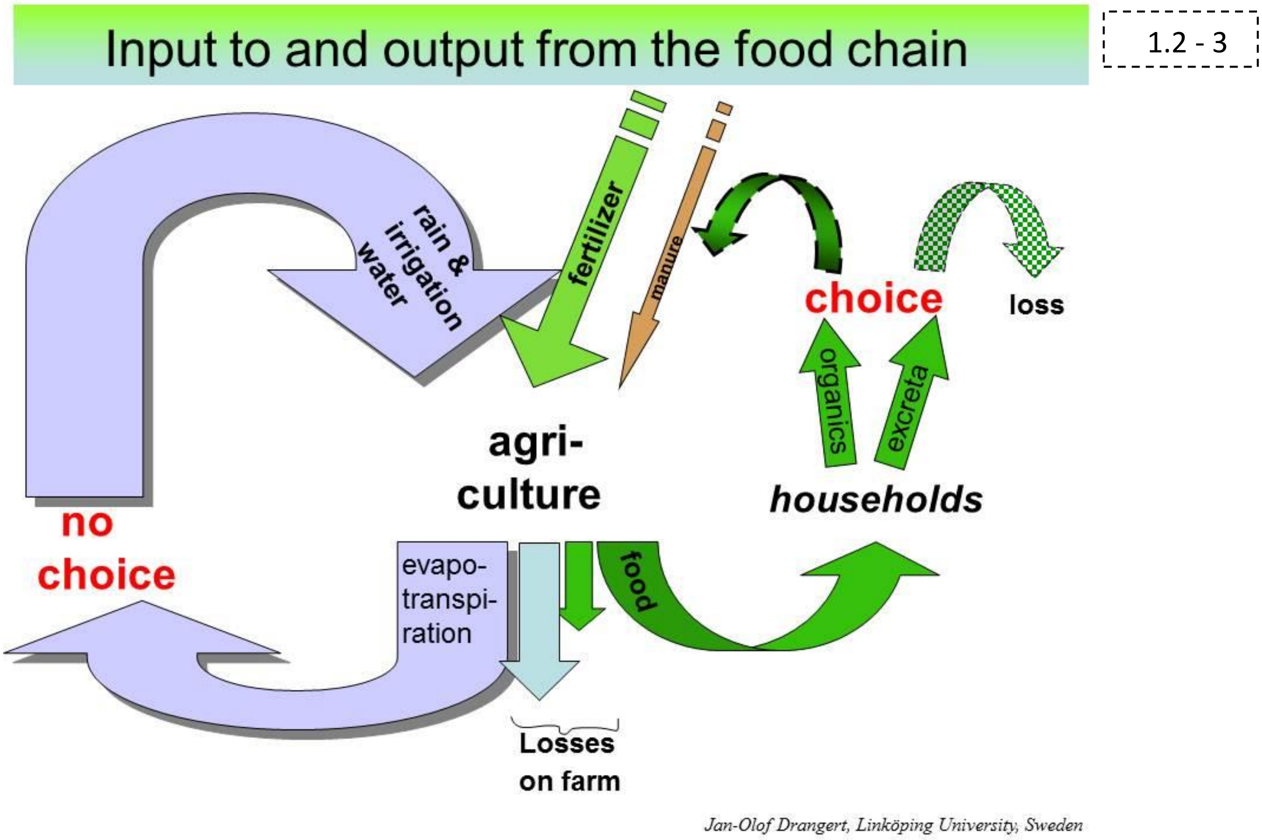
The world´s exploited water and nutrient (nitrogen, phosphorus, sulphur and potash) sources are mainly used for crop production, especially phosphorus.

Each person uses an average of 1,300 m^3/yr of water to produce her food, called virtual water, and little is directly used in the household. She also uses 3.2 kg of mined phosphate rock to fertilize her crops, while only 0.5 kg of phosphorus reaches the food she eats. The important difference is that used water always returns to the water cycle (**renewable**) whereas phosphorus is usually immobilised in the sediments of rivers and lakes or in landfills.

These fundamental differences between water and phosphorus molecules call for different strategies for sustainable use of the two. The following commonly found perceptions about water, nutrients and sanitation face serious challenges today:

H_2O supply perception: Conveyer pipes from lakes and rivers, and/or wells will do the trick to supply water to urban areas. Challenge: Lack of virgin water bodies, sinking groundwater levels and degraded water quality makes this approach unsustainable, as does the related huge energy requirements for conveyance and treatment.

Nutrient perception: The Green Revolution will continue to do the trick in combination with subsidies for chemical fertilisers. Challenge: Looming scarcity of easy to reach sources of phosphate, potash and land suitable for irrigation.
Sanitation perception: Flush toilets will do the trick in combination with sludge application on farmland. Challenge: Poor recovery of nutrients and the quality of sludge is deteriorating as more chemicals are entering the market place. Sludge is often unfit for land application.



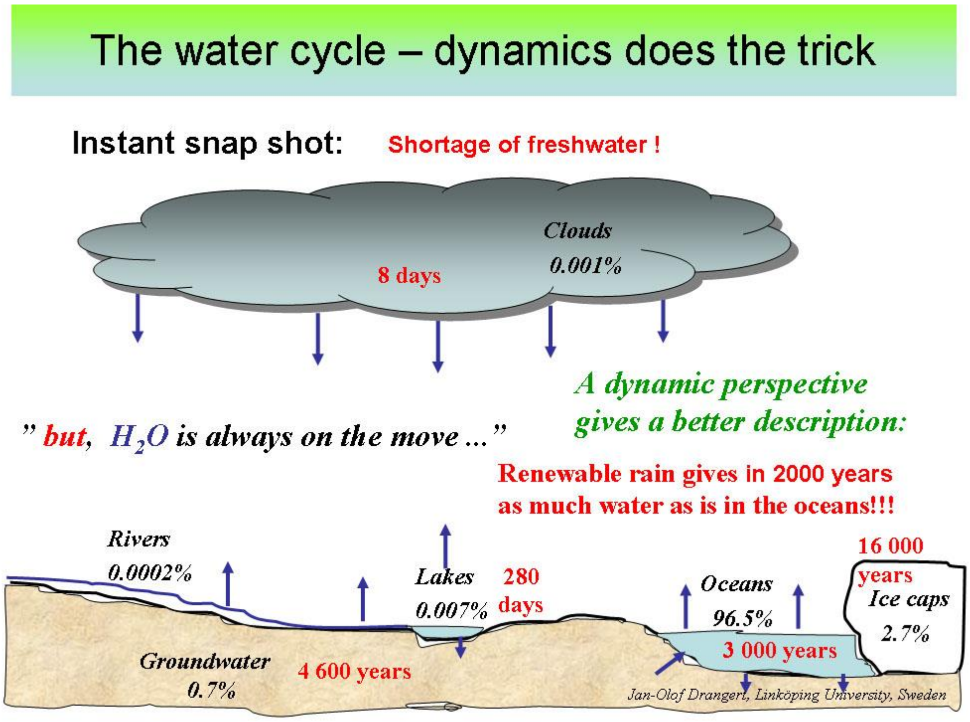
Plants require water, nutrients and solar energy to grow. The two large-scale nutrient and water flows in the picture are centred on agriculture and food production. Part of the water flow, evapotranspiration, is **outside of human control** and a necessary process of plant growth and is not considered a loss. Nutrient inputs, on the other hand, are controlled by man, and we do **have a choice** what to do with them after they leave the household.

Today, poor management of irrigation water and over-application of plant nutrients result in large losses on the farm (picture). Sustainable food production requires that such inputs and production losses are kept at a minimum. A report from Stockholm Environment Institute (SEI, 2005) estimates the present water use to 4,500 km^3/year (2005) and that another 2,200 km^3/year will be needed in 2015 to meet the hunger Goal target, everything else unchanged. The good news is that the agricultural sector can save 350 km^3/year through ”*more crop per drop*” and another 1,000 km^3/year can be captured from local rain on current land. A different kind of water saving measure is to select crops with low water demand, and to compose water-saving diets.

Soil naturally contains plant nutrients to varying degrees, for instance much of the soils in Africa are deficient in phosphorus. When crops are harvested and taken off a field, also nutrients are taken away and have to be replaced if soil fertility is to remain adequate. Farmers, households, and communities could return most of the nutrients to the soil for plant production. However, today most of the nutrients from urban settlements are going to landfills, incineration or are flushed with water into rivers and lakes. There they cause eutrophication and other environmental damage, and are not available for food production. This is different from much of the animal dung and droppings which are returned to soil and made available for plants.

There are options to secure food provision but it requires new strategies using comprehensive and coordinated approaches for the agricultural, water, and sanitation sectors.

1.2 - 4



People often complain that water is in the wrong place (ice caps, deep groundwater), or is supplied during the wrong time of the year (seasonality), or is of wrong quality (saline). With such a **static view** of the global water sources as stocks, the situation looks grim.

It is true that only a small portion of the water on the globe is freshwater. The reason is that over billions of years rainwater has eroded rocks and brought salts along to the oceans where 96.5% of the water is found (Gleick, 1993). The second largest stock of water is in the ice caps (2.7%), while the rest is found as groundwater (0.7%) and small fractions in clouds (0.001%), lakes (0.007%) and rivers (0.0002%).

The reason we survive is that the water cycle is **dynamic** and water is renewed all the time (picture). Although only 0.001% is found in the atmosphere, the retention time there is only 8 days. A water molecule in the ocean, on the other hand, stays on for 3,000 years on average. The vast ocean area evaporates large quantities of water to the clouds. In ice caps retention time is 16,000 years, and in groundwater some 4,600 years. This means that water in the oceans and ice caps is almost immobile for practical purposes.

During 2000 years the total volume of rain water (renewed fresh water) is the same as all water on earth at any given moment! [0.001% times 50 weeks times 2,000 years which equals 100 %]. The sun runs the water cycle to our advantage by providing a lot of rainwater over vast areas. It provides water for rain-fed agriculture, and replenishes groundwater, rivers and lakes from where industries and households draw their water.

The other important role of the water cycle is that when evaporation and evapotranspiration takes place, most of the dissolved salts in the ocean water remains in the ocean and the cloud water is freshwater that mankind can collect and use without desalination.

Our task is to manage this resource wisely.

1.2 - 5

Annual renewal and use of fresh water

Country	H_2O m³ /person/ year	km³/yr total in country	Rivers from/to countries	Portion being used	Total use per year per person	- by house-holds	- by indu-stry	- by agri-culture
Sweden	21 110	176	+4	2 %	479 m³	36%	55%	9%
Holland	680	10	+80	16 %	1 023 m³	5%	61%	34%
Saudi Ara	160	2	0	164 %	255 m³	45%	8%	47%
Lebanon	1 620	5	-1	16 %	271 m³	11%	4%	85%
India	2 170	1 850	+235	18 %	612 m³	3%	4%	93%
Tanzania	2 780	76	0	1 %	36 m³	21%	5%	74%
Kenya	590	15	0	7 %	48 m³	27%	11%	62%
Egypt	30	2	+56	97 %	1 202 m³	7%	5%	88%
USA	9 940	2 478	0	19 %	2 162 m³	12%	46%	42%
Chile	35 530	468	0	4 %	1 625 m³	6%	5%	89%
China	2 470	2 800	0	16 %	462 m³	6%	7%	87%

Source: P. Gleick, 1993

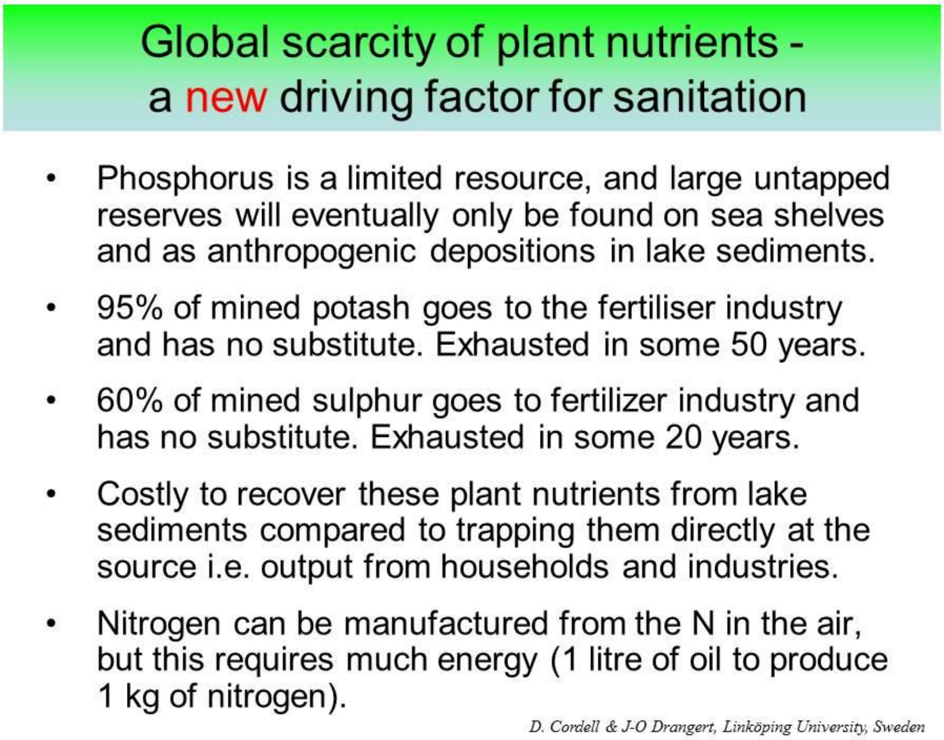
Countries differ in access to water and in amounts actually used. But, it is not sufficient to show one set of figures, because there is not only one reality. If all renewable water (essentially rainwater) is divided with the number of inhabitants (blue column), the variation is enormous. Egypt with 30 m^3 would never survive without the additional water from the river Nile. The benefit to have water in a river is obvious; it is easy to draw the water from it. This is very different from Sweden, where most of the rain falls over vast areas, and only a small portion can be collected from rivers. The 4th (yellow) column reflects this and other factors. Swedes only use 2 % for man-made activities, while other countries may use ten times larger a portion. An extreme case is Saudi Arabia using 164 % of the renewable water source. This is achieved by pumping up fossil groundwater that will not be replenished in thousands of years.

The 5th column shows the variation in actual use per person. In the USA each person uses more than 2,000 m^3 on average, while Tanzanians use 36 m^3. By combining column 5 and 6, we can calculate that Americans use 250 m^3 per person and year, and Tanzanians some 7m^3.

The last green column shows the large proportion for agriculture uses. Major water savings is therefore most likely to happen in the agricultural sector. Huge volumes of water are transformed into vapour during the plant production process. Between 500 and 3,000 litres of water are required to produce one kilogram of grain. Thus, the choice of food becomes crucial.

In 1993, Professor John A. Allan at the School of Oriental and African Studies in London, introduced the “virtual water” concept, which measures how water is embedded in the production and trade of food and consumer products. Behind that morning cup of coffee are 140 litres of water used to grow, produce, package and ship the beans. That is roughly the same amount of water used by an average person daily in England for drinking and all household needs. The ubiquitous hamburger requires an estimated 2,400 litres of virtual water. Per capita, Americans use around 6 800 litres of virtual water every day, over triple that of a Chinese person. A growing number of countries are also facing water stress (Hoekstra et al., 2010).

The water stress is therefore most prominent in agriculture, but is also affecting large cities with a geographically concentrated demand for water (Falkenmark, 2007). This has far reaching social and ecological consequences. Fill in the table with figures from your own country or region, and carry out some analysis of your water situation. You may find the figures in *Water in Crises* (Gleick, 1993) or annual reports from the World Bank.



1.2 - 6

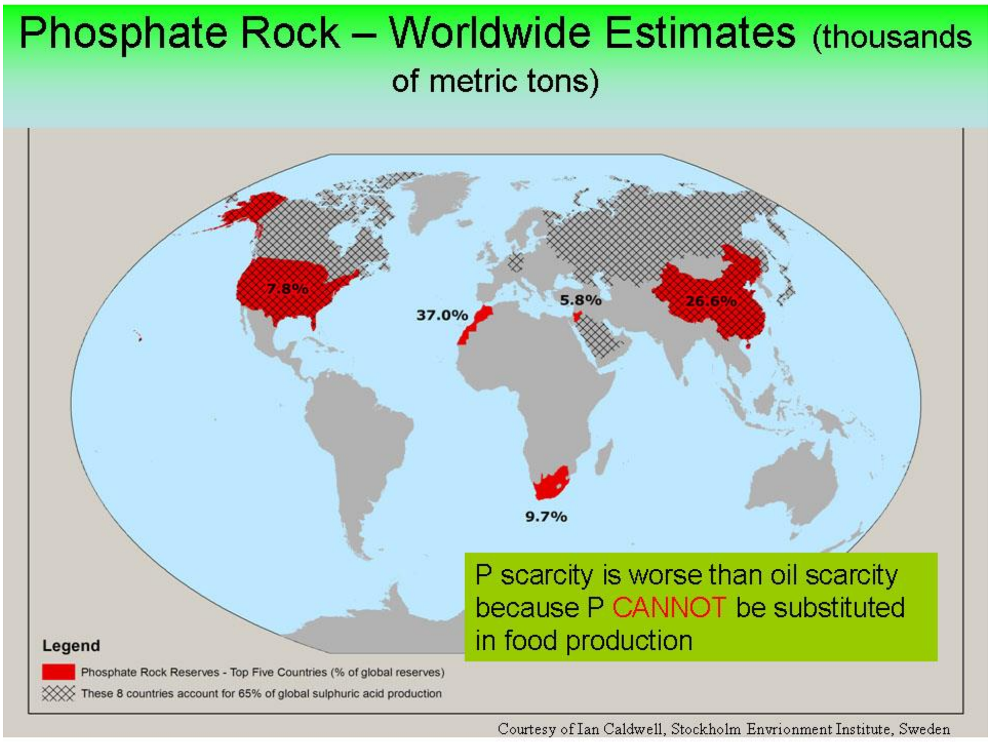
If farmers do not apply fertilisers, yields will decrease over time as the naturally available nutrients in the soil are exhausted. A rule of thumb is to return as much nutrients as was taken off the land during harvest. Today, the required ingredients in fertilisers are mined, treated, mixed and transported over long distances to the fields. Farmers reduce the need for purchased fertilisers by returning as much as possible of the non-edible part of the plants to the soil.

Nutrients in the soil are more or less immobile, but a substantial part can be eroded together with soil particles. Nitrogen is the exception and can easily dissolve in water and percolate or convert to gas and dissipate into the atmosphere. There is a cost to each effort to recover used nutrients, both in money and energy. One kilogram of nitrogen requires one litre of oil to be transformed from a gas in the air to plant available nitrate. There are also nitrogen-fixating plants which use the energy from the sun to do the same work.

The volume of the human-converted nitrogen to reactive forms is larger than the combined effects from all Earth´s terrestrial processes. Much of this reactive nitrogen ends up in the environment, polluting waterways and the coastal zone, accumulating in land systems and adding a number of gases to the atmosphere. Nitrous oxide, for example, is one of the most important non-CO_2 greenhouse gases and thus directly increases radiative forcing (Rockström et al., 2009).

The typical selection of sanitation systems in growing towns and cities is to discharge plant nutrients in food so that they end up in rivers and lakes. When nutrient resources become too expensive to mine, the alternative will be to recover them from lake sediments – at a high cost. Rethinking the system and building short circular flows would facilitate the recovery of the once used plant nutrients at or near the source of use. We will return to this strategic thinking in the following chapters.

In the beginning of the 21st century food prices increased due to changing diets, general population growth but also due to rapidly rising prices on nutrients such as phosphorus. This has triggered a serious mass media interest in world resources and resource use. This may become a springboard for sanitation to be discussed from a resource point of view, not to remain an isolated issue for the sanitation sector alone.



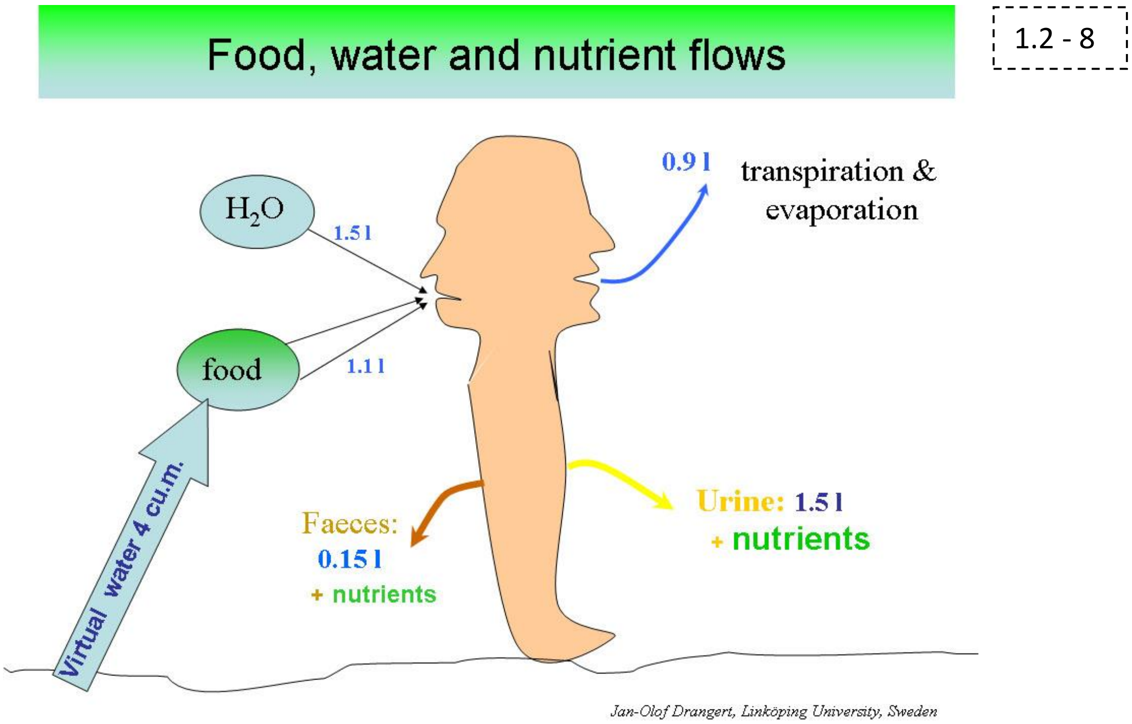
1.2 - 7

The skewed distribution of phosphate rock should worry countries that rely on imports of chemical fertilisers. There is no substitute for plant nutrients such as phosphorus, potash, and sulphur, unlike most other resources we need. For instance, energy from oil can often be replaced by energy from hydropower, biogas, nuclear power, wind power, bio fuels, etc. Yet, the oil industry and political awareness about future price-hikes for oil has resulted in a massive restructuring of investments to reduce oil-dependency. What about phosphorus?

The economically extractable resources of rock phosphate will run out relatively soon, in about a century. Unfortunately, reserves of all other non-renewable resources for food production are also limited. Based on known reserves and world consumption, the static reserve life of sulphur is 27 years, phosphorus 107 years, and oil 40 years (USGS, 1999). We can anticipate a raised awareness of the looming scarcity of plant nutrients in the near future, perhaps initiated by rapid increases in commodity prices. The solution to the scarcity of plant nutrient is improved efficiency in its use and recycling of organic waste, in particular through an improved sanitation system. It may also require that we eat less animal products and more vegetable food (Module 5.1).

Not returning nutrients to the soil has led to a situation where there is an increasing demand for chemical fertilisers in response to the problem of decreasing soil fertility. The relatively inexpensive phosphorus used today will almost certainly cease to exist in the next 50 years; in fact the price tripled between 2008 and 2010. Farmers around the world require an estimated 135 Million tons of fertiliser for their crop annually, while at the same time conventional sanitation systems dump 50 Million tons of fertiliser equivalents into our water bodies - nutrients with a market value of around 15 billion US dollars (Werner, 2004).

If the world does not start recycle plant nutrients back to soil the future food supply will dwindle. However, the present and future scarcity is man-made and man can reverse the trend. In a recent article (Cordell et al., 2009) it is shown that if the looming scarcity is taken seriously, we can manage to return the needed plant nutrients to soil, combining a number of measures: plough back plant remains in the field, collect and compost organic waste as soil conditioner, remain vegetarian or become one, stop over-fertilisation, not buying or preparing more food than will be eaten, return urine and faecal matter to soil after hygienization (Module 5.1)



The Millennium Development Goals, agreed upon by the Millennium Assembly of the United Nations in 2000, seek to halve the number of undernourished people in the world by 2015. This, in itself, is a gigantic task for farmers and the international community. Moreover, this target is to be attained within an environmentally sustainable and socially acceptable framework.

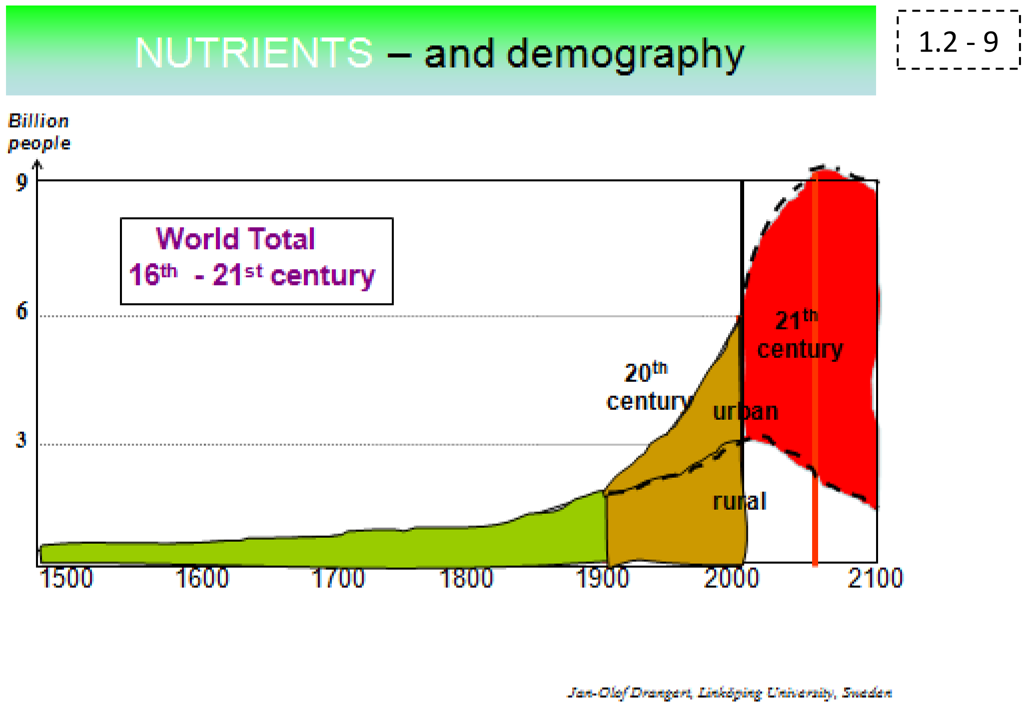
Laudable efforts and accomplishments in global food production have led to a steady increase in the per capita consumption of food, from 145 kilograms of cereals in the year 1961 to 175 kg in 2000. Average global calorie intakes per capita have improved from 2,250 kcal in 1961 to 2,800 kcal in 2000. However, one billion people remain undernourished (2010). At the same time it is estimated that another billion suffer from overweight.

When we move from the ’Big Picture’ of resources to resources for a human body (picture), we can conclude that the body’s demand for water and nutrient is insignificant compared to the demand from growing the person’s food requirement (virtual water and nutrients).

Adults drink 1.5 litres or more liquid every day in the form of ordinary water, soft drinks, tea or coffee, beer, etc. In addition to this amount we also ingest water that is in the solid food, which amounts to more than a litre per day. The fluid is processed in the body and almost a litre leaves when we transpire and breath. All this water ends up in the air and will return as rain. Most of the fluid passes our kidneys and the discharged urine contains both water and nutrients. Most nutrients from the food are in the urine, and the rest are found in the faeces together with some water (0.15 litres per day).

The digested food primarily provides the energy we need, and the body uses only a negligible amount of the eaten food to build cells (slide 4.1-3). Therefore, our excreta comprise the same plant nutrients that are in the food we eat. In rural areas most of the excreta is returned to soil and to plant production. As urban centres grow bigger, excreta are either left in the environment in a pit latrine, or are flushed into rivers and lakes – often without prior treatment. The wasted nutrients create environmental problems. So, the private activity of excreting turns into a public environmental concern.

Human excreta contain high-quality fertiliser with only background-levels of heavy metals and trace elements (Module 4.1). Chemical fertilisers, on the other hand, tend to contain in addition to a few essential nutrients, often too much heavy metals and other impurities.



The population in the world grows ever faster. It took about 50 000 years for humans to reach 1 billion by the year 1800, while only 10 years to go from 6 to 7 billion. Today, we are over 7 billion. In less than a generation we are estimated to be some 9.4 billion (slide). The present rapid increase in the world pushes the case of finding ways to manage short and energy-efficient loops of nutrients from food via the dining table back to plant production.

We may read the diagram of world population in the following way to understand the tremendous impact growth has on the total use of resources:

The vertical distance from the x-axis to the curve could for example represent the amount of urine produced in the world in a single year. The graph tells us that human beings produced three times as much urine in the year 2000 as in 1900, and six times as much as in 1800. In 2050 we will produce 50% more than today (2010).

We may also see how much urine has been produced over a century by measuring the area under the curve. For instance, the total amount of urine produced during the 20th century (brown area) equals the amount for the previous 4 centuries (green area)! In the coming 50 years we will produce almost as much as during the last 100 years. And, more excreta are just a reflection of more food being produced and eaten. This is only possible if we start recycling human-derived plant nutrients back to the fields.

Reuse of urine and faecal matter is often organised differently in urban and rural areas. Most plant nutrients from consumed food in rural areas are returned to productive soil. Where open defecation is practised, excreta are returned to soil, but usually not where it could be taken up directly by food plants. A very short nutrient loop from agriculture back to agriculture takes place where buckets are used and the content is returned to paddy field etc.

The situation is partly very different in urban areas. In poor informal settlements much of the nutrients are sunk into pits in the ground with little value for food production, even if a tree is planted on the abandoned pit. In urban areas served by sewerage the plant nutrients are transported to water bodies, sometimes with some treatment along the route. The nutrient-rich sludge produced when treating wastewater is often returned to agriculture. However, there are many examples where it is not. Untreated wastewater is more and more used for irrigation.

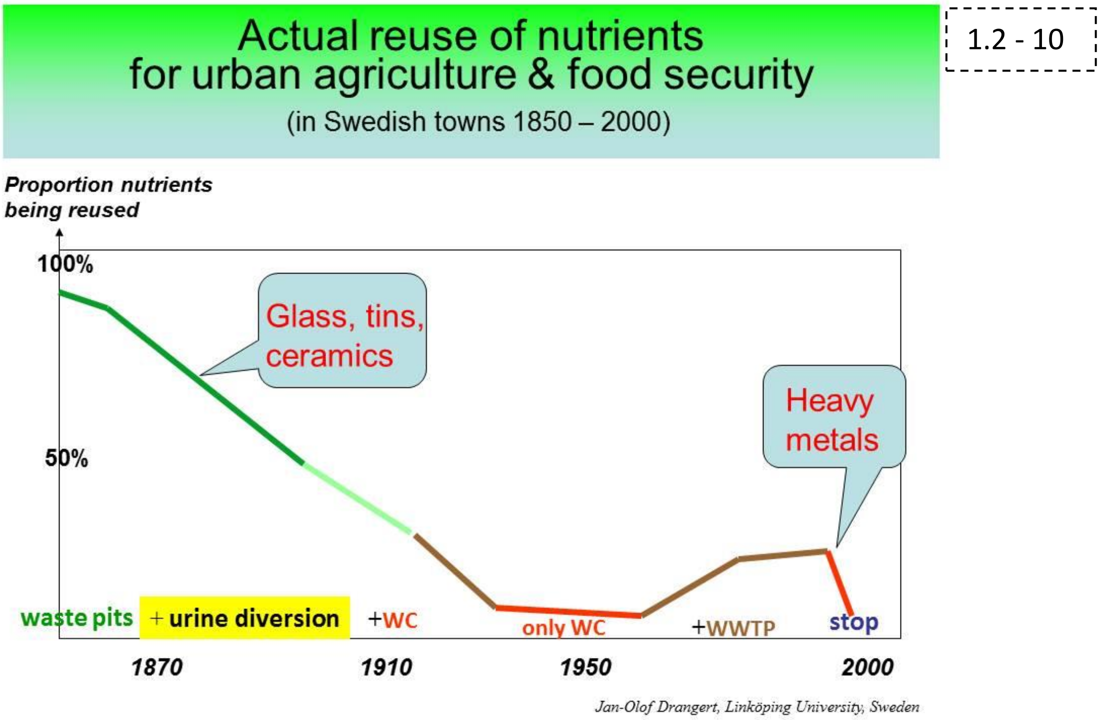
In the 1960s the sludge from Stockholm was loaded on barges and dumped in the Baltic Sea. After ten years of dumping there were signs of ‘dead zones’ with no life on the sea bottom since the oxygen-demanding decomposition of sludge deprived organisms and sea plants of life-sustaining oxygen. The practice was stopped in order to save the fishing industry and out of environmental concerns. Today, the sludge is transported 1,000 km and dumped in an abandoned mine in northern Sweden. In short, there is no meaningful recycling despite a substantial input of energy for the transport.

The new wastewater treatment plant in Buffalo City in South Africa treats the wastewater to a high degree, and discharges the effluent in a pipe reaching a kilometre into the Indian Ocean. The sludge is transported to the beach, loaded on a barge and dumped in the ocean. Again, this represents a costly effort to treat the wastewater without any recycling of its plant nutrients.

Most plant nutrients originating from urban settlements are not being recycled in a meaningful way. In 2008, the area of ‘dead zones’ in the Baltic had increased to the size of Denmark due to large discharges of sewage from a number of countries! This shows the amount of lost nutrients and their negative environmental impact.

We return to the graph to find out the global consequences of not recycling human waste from urban areas. The graph shows the proportion of urban and rural dwellers in the world. It may also be interpreted as volumes of excreta being produced in a specific year or as total amount produced over a certain time period. The red area represents the expected amount to be produced in urban areas during the current century. This amount is much greater than what is being produced in rural areas over the same period. Also, the volume is some 8 times larger than what was produced in urban areas in the 20th century.

We have up to now only seen the tip of an ”excretaberg” of human waste arising when no recycling of plant nutrients is implemented.



The diagram shows the level of use of excreta-derived nutrients in a Swedish urban community over 150 years (Schmid-Neset et al., 2010). The diagram shows the evolution from a short-loop recycling of nutrients towards a linear flow through gradual construction of sewers and water closets.

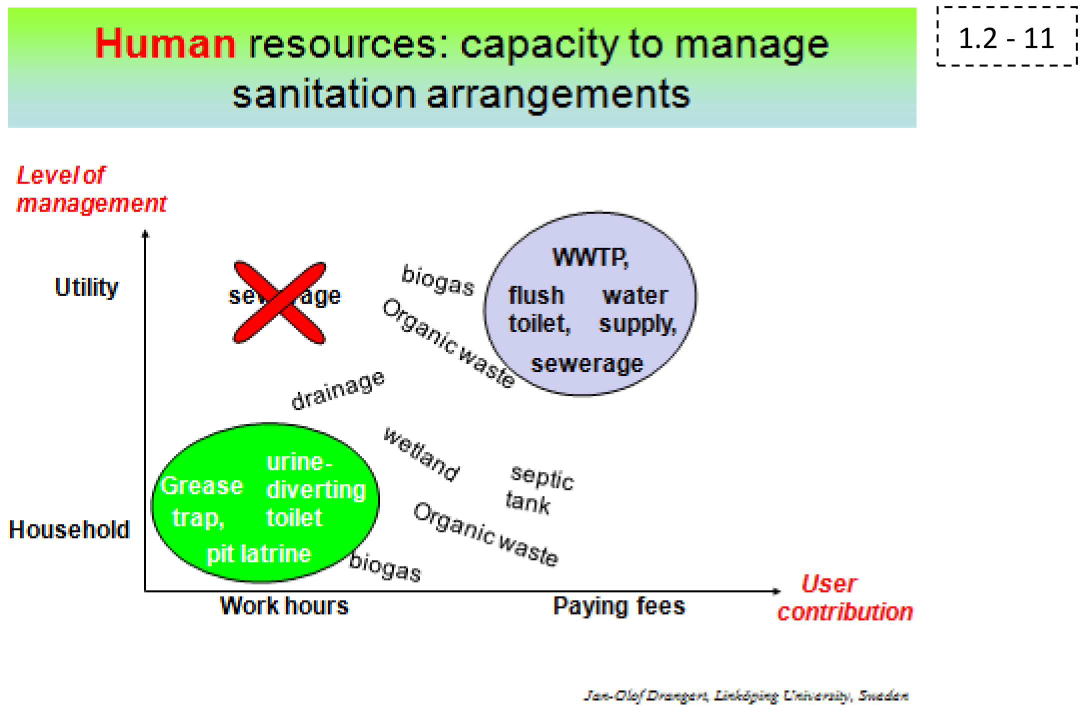
In the early period most human excreta were returned to agriculture by bringing buckets and waste pit (very shallow) content for use in gardens or nearby fields. No flush toilets were around. In 1875 a rudimentary sewer system was built. Towards the end of the century, urine-diverting dry toilets were gradually introduced in towns and the urine was discharged in sewers, while faecal matter was still collected and the content used in gardens. Therefore, an increasing proportion of nutrients in the urine were lost to water bodies. In the mid-world war period (1918-1939), flush toilets were gradually installed and eventually almost all human excreta were discharged in sewers with outlets in rivers and lakes without prior treatment, resulting in a complete loss of nutrients.

The degradation of lakes and rivers forced authorities to build wastewater treatment plants on a large scale in the 1960s and 70s. A substantial part of the sludge (= nutrients + other unwanted components) was returned to agriculture - again. The use of sludge increased up to the year 1999 when the farmers' union decided to stop using sludge for fear of heavy metals in soils.

Changes in consumption patterns, primarily an increase in meat products, have caused an increase of about 30% in the phosphorus output per capita. Multiplied by population increase over the last 130 years, phosphorus increases about 16-fold in the Swedish city of Linköping.

It is interesting to learn that major changes in the sanitation flow system are guided by changes in the kind of consumer goods available on the market. Accumulation of heavy metals in the sludge led to a stop in using sludge in agriculture. The heavy metals entered the market after the second World when new consumer products gradually conquered the market.

A hundred years earlier, new consumer products such as porcelain plates and metal cutlery, glass, tins replaced wooden plates etc. When broken, these items were thrown in the bucket for faecal matter. Farmers were not prepared to sort it out or to apply the mixed organic waste on their fields or give it to pigs. The municipal authorities failed to commit households to dispose of broken glass and porcelain in the solid waste collection. Again, this time the manufactured goods made the sanitation system unsustainable.



Human capacity to manage sanitation systems can be extended by letting households either spend their own time to carry out sanitation-related tasks, or let them pay fees to finance someone else to do the tasks. In both cases the doer has to be knowledgeable about how to go about the task.

The picture shows how user contributions (work hours or paying fees) and management levels (utility and household) relate to various technologies. A number of sanitation arrangements can be purchased and installed by households or local masons. Other arrangements require specialised knowledge and skills of professionals to install operate and maintain. The picture is intended to encourage discussions about what combinations are feasible in a given local context.

The large sewerage system (pipes, treatment etc.) falls squarely in the upper right corner since only a utility (private or communal) has the capacity to manage the system and the users pay a fee for the service. It is hard to think of household work in this case, except for the very important task to not disposing of chemicals in the sewer. In the opposite corner falls pit latrines, urine-diverting toilets, grease trap for grey water etc. since households can install and operate these and allocate working time to such tasks as emptying pits and buckets. There is a host of arrangements which can be run by either a utility or households, or intermediate organisations. Module 2.1 presents a number of innovative management and technical options.

The choice of technical sophistication should, among other factors, be guided by availability of local management capacity to run the arrangement. Selection criteria for sanitation arrangements are explored in detail in Module 2.5. The crucial need of available funds and administrative capacity to collect user fees and to use them for the operation and maintenance of the system is often underestimated or overlooked (ADB, 2010).

One aspect to consider is that a large complicated system affects many households negatively when it is not operating satisfactorily. If a household-centred arrangement works poorly, the residents in the house are those who suffer.

Good management of a sanitation system has a positive impact on public health, the environment and on conservation of physical resources. Under such good regime there is no scarcity of safe water and nutrients for urban food production. This encouraging point runs through the entire sourcebook.

”Manpower blindness”: driver of new responsibility sharing

1.2 - 12

Our pre-conceived views play a role

- We tend to account only for what is done by governments and projects in water and sanitation
- What is done by residents and small entrepreneurs is rarely appreciated, if at all recognized (blindness)
- Yet, many urbanites survive thanks to such local initiatives
- Here, we pledge that both kinds of activities are needed to solve current sanitation problems

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Discussions during the last few decades have put more verbal emphasis on ”bottom-up”-approaches than on ”top-down”. The focus is to involve users (so called beneficiaries) in planning and implementation, be it a toilet or a well fitted with a hand pump. This could be a reaction to the previously strong tendency to only account for what is done by governments and projects in the water and sanitation sector. Rarely is the kind of activities that residents carry out (often in violation of local by-laws) seen as valid solutions, if at all seen or recognized (blindness). The fact remains that many urbanites survive thanks to local initiatives in the water and sanitation field.

This kind of blindness to local activities could be overcome. More emphasis is required to analyse local solutions from a functional perspective (slide 1.1-12). What driving forces and barriers are the actors facing? An open-ended inquiry would ask questions such as the following. Are existing bye-laws impractical or not allowing for alternatives? How are residents solving the problems today? A test case could be to investigate the sizeable proportion of solid (inorganic) waste management that is operated by the informal sector. What would be required of the sanitation sector for the organic waste to be run by households and the informal sector?

Before routinely considering engaging staff and professionals for an identified task, the first thing to do is to find out what human resources are available in the local community. For instance, how many jobless young men are there who could carry out tasks for a small fee? Are there women groups who can make business by improving their environmental conditions by engaging in sanitation-related activities or recycling plant nutrients to food production?

There are several measures needed to achieve universal sanitation. At the root is *’to make sanitation everybody’s business*’ by introducing societal norms that make citizens responsible and not someone else. Politicians, religious and other leaders can contribute to creating such new societal norm.

The sanitation sector may also learn from the energy sector when it comes to policies and strategies related to conventional water supply and sewerage. When the power supply company in South Africa, ESKOM, failed to supply industries with regular energy the company reduced its supply to households and provided electricity for part of the day only.

This was a wakeup call for awareness that the system is dependent on its parts. Everybody was used to a continuous supply of electricity and took for granted that the company would buy more coal to run the generators to solve the supply problem. However, ESKOM insisted that huge investments would be required to secure future supplies and asked the authorities for a doubling of the tariffs. They also requested households to lower their use by 10% which meant switching off geysers, bulbs, and other appliances when not at home. In a country with many sunny days per year part of the anticipated solution would be to install solar panels.

The demand-management directives from ESKOM met with little resistance, although some newspapers held the view that if households save 10% then ESKOM revenues would decrease by 10% and therefore they would raise the tariffs by another 10%! Interestingly enough, there were few poverty arguments against the propositions claiming that the system would be too costly for the poor.

The water and sanitation sector is different in this respect. Here the prevailing perception is that water is a human right. So, any increase in tariffs or household responsibility will be opposed by strong groups using the argument that the poor will suffer. In South Africa the legislation counteracts this argument by providing each household with a minimum of 200 litres of free water per day.

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