Harvesting smaller rains

Droughts are not new, we have known about the flood and drought cycle for years and the storage capacity of our dams per person far exceeds most other countries. Global warming and the increase in our population and the expansion of our irrigation which put extra pressure on our water resources are not abrupt changes, they are trends which have been going on for years and will continue.

In **community action on water** we saw that we are only harvesting the larger rains but the volume of water falling in smaller rains is more than adequate to meet our needs. However the problem is to harvest these smaller rains and to avoiding loosing them again by evaporation.

When these smaller rains fall on soil they are absorbed and quickly evaporate. There are three solutions - capture water that falls on hard surfaces, working the soil to funnel the water into percolation holes and anticipatory scheduling.

Tank water

Catching the water from the rooves of our houses in water tanks is the simplest way. Over the years water tanks have not met with much enthusiasm from authorities, in fact in many areas they were banned. **(See water and social values).**

Even today there are spurious augments from the authorities on the cost and purity of the water. The fact is that water tanks are highly cost effective and the quality of the water can be very high if a few simple precautions are taken. The water authorities that deride water tanks are at pains not to disclose that the water they supply has originated from run off and is initially contaminated by an array of animal droppings. It is basically processed cow shit. May be well processed cow shit but still cow shit.

Rain water falling on the rooves in most areas has a far higher standard of purity, contaminations comes mainly from leaves in the guttering and some bird droppings. With a simple bit of care and using a simple first flush system these are resolved. For those wanting a second layer of protection household filters are available which provide a far higher level of filtration than used in commercial water systems.

There is no doubt that tank water can be made safe and is generally of a far higher quality than the processed dam water we are accustomed to drink.

The only problem with tank water is that there is not enough of it for all our needs, it is fine for normal household use drinking, cooking, washing, the toilet etc but there is no where near enough water for food production or to create the green environment that most people aspire to.

Roads and hard surfaces

The area of hard surfaces particularly in an urban area is simply huge and enough water lands on these surfaces to meet all our needs.

Road water is a complete opposite of roof water, which is high quality but limited in volume. There is lot of road water but it is probably about the dirtiest source of water available. It is not just the animal dropping, dogs, birds cats etc there is all the street rubbish and on top of that there is all the oil, exhaust particulates, brake lining dust etc from the traffic. It wins at least the bronze gong for yukky water. But it is available in large quantities.

And this is where one of the holy cows of the water supply industry comes in to play - and that is the resistance to segregation. Traditionally all water delivered through our public system has to be potable water. The concept of a twin pipe system is regularly thrown around and rejected largely because of cost because it is thought wrongly that this second pipe system this has to be a duplication of our existing premium water reticulation system.

The arguments for segregation are just overwhelming. We use a very small volume of high quality water to drinking standards, and very large volumes of water where some level of contamination is acceptable or in some cases desirable - for example adding nutrients to irrigation water. So why the resistance? This is discussed in **water and social values**.

The point is that to segregate water supplies we do not have to duplicate the existing infra structure.

Instead we capture roadside run off using percolation holes. In the simplest case this is just a question of boring holes through the existing drainage pipes to allow the water to enter the sub soil. Where it goes to after that will depend on the local hydrology but the water will either enter a local aquifer or will emerge lower down the slope as a wet spot.

The water can then be captured by building a local dam or lake, which can become a community asset or a bore hole can be sunk to fill a local header tank on demand.

Water can then be fed from these dams or tanks and fed under gravity to provide utility water to the local residence. The water will be cleaned up to a large extent by filtering through the ground, it will certainly not be drinking standard but will be perfectly adequate for irrigation and general yard duties such as cleaning cars etc. and can be distributed locally using low cost poly pipes.

Catching water in vegetated lands

It is still possible to use percolation holes in vegetated areas, this applies not just to catchment areas but to any land area. The section on **water in arid** contrasts Australia looks at water supplies in other arid regions and shows that most other areas rely on water harvested in mountain regions while Australia has few serious mountains but a lot of land. We have to accept that some land will have to be used for water catchment, not just by conventional dams which only harvest large rains but by catching and storing the water in the ground.

Throughout the world the volume of water stored in the soil far exceeds all the fresh water stored in dams and natural lakes. While maybe only 10% or so of the soil volume will be available for storing water the shear volume of soil give a total water storage capacity many multiples of our dam infrastructures.

The problem is that most of the rain that fall on this land is simply captured by the surface layer and evaporates away without either running off or penetrating beyond the evaporation and transpiration layers (root zones).

But just take a walk through the bush after rain. If it is a small rain of just a few mm (say under 10mm) all the rain is absorbed in the soil and there is no water on the surface. There seems no way of harvesting these rains other than creating an impervious seal such as a road or a plastic film as used in water harvesting.

With a medium rain (say 10 – 50mm) there will be water lying on the surface in numerous small puddles and depressions. At the lower end of this rainfall band isolated patches of surface water form, but they do not converge together giving any surface flow.

With a bit more rain these isolated patches or water or puddles tend to converge and form not exactly a stream more a tribulette which will fill a local hollow which does not overflow so there is still no contribution to run off.

It is quite common to see some water running of the sloping areas forming a tribulette or baby stream which simply stops flowing when it reaches the flatter areas.

They can be seem just driving along our typical bush roads. Water will run of the hard road into the roadside drain if there is one, typically the water will flow along the roadside until there is some small depression in the ground when it will veer off flow for some distance then simply stop as the water is progressively absorbed by the soil.

Australia is just full of these little ephemeral creeks which start and stop. There is no run off and shortly after the rain stops the water evaporates.

Calculation show that we receive the rain that falls on Australia is almost unbelievable, almost a million litres per person per day. Most of this rain falls as these smaller rains and is simply lost to evaporation. Of course the rainfall distribution or spread of small and larger rains vary greatly across the continent and in the extreme North and South the larger rains make the highest

contribution. In the dry centre there is not much rain anyway and it tend to result from large freak storms, but not many people live there anyway.

But in the coastal fringe where the majority of the population live the bulk of the rain falls in this medium rainfall band. These coastal rain are reliable even falling in drought, and even with global warming are expected to be reliable. Some people argue that with the higher sea temperatures these coastal rains may actually increase, yet we largely waste this valuable asset. Why? This is discusses in **water and social values**.

Micro dams and percolation holes

We can capture a useful amount of this water by using micro dams and percolation holes. The idea of a micro dam is not to store water, they will spend most of the time being dry, they simple catch and hold the water while giving it an opportunity to soak deep into the ground.

There are arguments that using percolation holes and storing water in the soil is stealing water from other users eg that it is using water that would otherwise flow into the rivers for others to use. There is little substance in this argument. Percolating water into the soil is a slow process so in a major rainfall there will still be run off. Percolation holes capture the water from small rains which would otherwise evaporate away.

These negative arguments such as that on depopulating catchments areas to increase run off which is totally false. (**See depopulation of catchments**).

The soil in arid area (most of Australia) forms an insulating crust which protects deeper water from evaporation. This is one mechanism which allows desert plant to survive. This crust has to be wetted out before there is any run off or capture of the water deeper in the soil. This water to wet out the surface is simply lost by evaporation. Percolation holes are simply making use of water that would otherwise be lost.

Wicking Beds

The wicking bed technology started off in a very modest way and it is only now that the full implications are being appreciated.

I was involved with a project in Ethiopia working out how to provide water to grow enough food in that country racked by starvation. Before I left Australia I had impressions that turned out to be totally wrong. Ethiopia is not some dried up desert with people trying to scrape a living out of sand; the climate is not that different to Australia with quite reasonable rainfall and agricultural production adequate on average to support a significant population. It is just like Australia in that it suffers a highly erratic rainfall.

Crops can be growing well and looking fertile then a break in the rainfall at the critical time when the seed head are filling can leave the population without food.

Just a couple of weeks without rainfall at the critical time can cause untold suffering.

The problem is one of short term local storage of water. The original solution was simply to increase the water holding capacity of the soil by creating what is essentially an underground pond. In its earliest version a channel was dug, lined with a plastic film and the soil replaced.

It was soon released that this could be extended to a highly efficient form of subsurface irrigation by laying a pipe along the base of the channel. In Ethiopia flood irrigation is often the only way of irrigating crops but the available flow rate are very low so often much of the water is lost soaking into the ground before the water reaches the end of the channel.

With a wicking bed it is just like filling an underground bath tub, the water will just trickle along the pipe without soaking away. The high flow rates necessary for efficient flood irrigation are just not needed.

Wicking beds with rain harvesting

Wicking beds can catch water locally, by extending the plastic sheet so that any rainfall is funnelled into the base of the bed – water amplification.

This is more than simply amplifying the rainfall by the increased area. The plastic film will catch even small rainfalls and the water will naturally flow to the bottom of the bed protected from evaporation by the insulating crust. Just as in conventional agriculture any small rains that fall on the bed area itself just wets the surface and are soon lost by evaporation. The amplifying wings of the bed will therefore increase the effect of the rainfall many fold.

At the other extreme a heavy rain in conventional agriculture can simply pass through the soil beyond the root zone and again be lost. A wicking bed will capture much of these larger rains providing water for much longer than would by simply storing water in the soil. With both small and large rains wicking beds make for more effective use of the water.

Obviously any row crop in Australia could use a wicking bed with amplifying wings to grow crops where there is no irrigation or more likely there is limited irrigation water.

Wicking beds with grey water

It must be said that virtually all the wicking beds constructed so far in Australia have still used some form of external water sources, even if it is only for an occasional top up.

In the simplest version the may be connecting the down pipe from a roof directly into the wicking bed eliminating any intermediate storage such as a dam or tank. This obviously has advantages in cases where the space is limited so it is difficult to find room for a tank. The disadvantage of course is there is no control of the irrigation scheduling. Most wicking beds are currently used to grew high value horticultural crops which typically have shallow roots so most wicking beds have some access to an external water source.

The major exception is in the use of grey water which provides a fairly constant supply of water. However the problem with any grey water system is that while the supply of water may be fairly constant the demand from the plants is not. Just relying in grey water would result in an over supply of water in the rainy times.

Avoiding grey water escaping to the general environment is a critical factor in grey water use.

It is therefore much better to have a large enough area of wicking beds with grey water providing a small proportion of the water and additional water being added from an external source as needed. This also leads to a continuous dilution of grey water which is generally alkaline.

Wicking beds with external water source

One of the fascinating features of wicking beds is that generally they give a much higher productivity than conventional beds. This is essentially an experimental observation rather than based on some theory understood before hand. The theoretical challenge is to work out why.

There are a number of possible explanations.

The first is the very nature of the mechanics of wetting, the plant roots system are totally wetted from underneath and then as the water is used air from above is sucked in, giving natural breathing action to the soil. It is essentially a flood and drain system which is widely regarded as the most efficient way of watering.

Another explanation is that each plant needs an ideal ratio of water to air around its roots. The soil at the surface of a wicking bed is dry (apart from the seed germination period) while deeper in the ground the soil is saturated giving a moisture gradient form top to bottom so there is always one region with that ideal moisture to air ratio.

Yet another explanation comes from the mechanics of successfully operating a wicking bed. If for example the bed constructed in heavy clay and this clay is simply loaded back into the bed the chances are that the soil will become water

logged and the plants simply die from the anaerobic action. For this reason the wicking beds are usually partially filled with a layer of waste organic material and preferably an inoculant or starter containing worm capsules with food and a microbe mix which will ensure the soil is maintained open and healthy. This obviously provides excellent growing conditions.

It is probably not one single reason but a combination of these that give the increased productivity.

Large scale use

Originally wicking beds were developed as small scale way of storing extra water; the improvement is irrigation efficiency was just a bonus. At first it was though that their use in Australia would be limited to small scale application, more home and hobby farm use.

It is now becoming clearer that that the improvement in irrigation efficiency by this very simple and cheap way of providing subsurface irrigation may lead to much wider application in commercial agriculture. Although individual beds are usually irrigated separately they can just as easily be linked together. This can either be done by cascading them so water flows from one bed to the next or even better fit each bed with a simple cut off valve so when the current bed being watered is filled that the water is diverted to the next bed, so every bed is watered in sequence.

In hilly country beds have to be aligned along a contour line as they need to be level, but irrigating in cascade by cut off valve makes them particularly suited for regions with some slope. They could well be the way of replacing the huge areas of flood irrigation in Australia.