Water in Food

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The terms virtual water and food security are increasingly used to enable us to focus on the need to conserve resources that pertain to the growing and eating of food. By understanding what water is required for food after the growing process, the complete role of water in food is revealed. That there is a looming crisis in the availability of food to many consumers is not denied. But as world famous economist Amartya Sen has written, there is sufficient food in the world today to feed everyone, and the problem is in the inequalities of distribution.

What is a real crisis is the loss of arable land to industry, housing and the agribusinesses that produce profit but not the nutritious food that we need to remain healthy.

Slopes cleared of trees and undergrowth for these purposes become a channel for erosion and the cause of destructive flooding when heavy rainfalls. The bitumening of roads prevents rainfall from entering the soil where it will nurture vegetation and trees and provide food for the animals we eat. Intense city conurbations such as London frustrate rainfall from being absorbed and used in the production of food, yet they create increasingly unsustainable demands for domestic and drinking water. Many of the industries operating within cities also use large quantities of water. Gardens, historically a source of food for families, are either non-existent, minute or devoted, as public parks are, to aesthetically pleasing trees, shrubs and flowers. Rainwater tanks to harvest rain from roofs are rare and only found on allotments, where a very small but increasing number of people are growing their own food.

Another growing crisis is the wasteful use of water in the food chain. We can see this crisis in action when we examine the food available to most consumers in the Anglo-Saxon world.

While we profess to be enamoured of "ethnic" food, we have not yet understood that it is based on fresh, largely untreated fruit and vegetables available from daily markets or domestic small holdings. The meat, from animals fed on pasture and grain in stubble, is sold the same day. Much of the ethnic food that 87 % of people

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buy and consume from supermarkets is not "fresh" and is only a pale shadow of the real thing. It is also deficient in nutrition compared to fresh food, eaten raw or cooked daily in the home.

In spite of manufactured food becoming available in cities within the so-called developing world, the majority of the population still demands and eats food cooked from fresh meat and vegetables grown sufficiently close enough to town and city markets to avoid the deterioration that lowers nutrition.

This is, of course, a generalisation. Some food does come from animals force fed in feedlots and industrial sheds—a system that has been heavily promoted in many developing countries by development agencies—and by the agribusinesses, based on plastic tunnels, chemical stimulation and control of pests by pesticides. These are used to produce vegetables mainly for export to supermarkets in the West.

The determination of Western style supermarkets to expand into countries such as India poses a threat also to the way food is grown and sold to the consumer in Asia, many Arab countries, Turkey and the Southern Mediterranean. Such an invasion, if achieved, would result in food coming by and large from manufactured products requiring much larger quantities of water than the current food chain that consumers rely on. This is fresh food, grown under rainfall or managed irrigation using water stored in domestic tanks or large reserves, and in some cases direct from rivers. Fresh food grown in domestic plots, and on small farms, is a remarkably economical use of water to produce food. Water that supplements rainfall is stored and used for dry periods. When the food chain from farm to consumer is direct and daily, it cuts out the manufacturing process that transforms fresh food into product.

1 The Food Chain

If we take a plate of typical food from Anglo-Saxon sources, we will see that much of it is grown in other countries, processed and distributed through a long and complicated food chain.

If we take a plate of typical food from the countries named above, we will see that much of it is grown very close to where the consumer lives, which is largely bought and consumed daily.

If we follow the operations needed to transform food from plant and animal into consumer product, we can see how much water is used over and above that required to grow the food to its natural maturity.

Meat provides a good example of this.

Meat from animals fed on grain, sometimes grown as a fodder crop under irrigation and concentrates manufactured in factories, will consume much more water before it reaches our tables than animals fed on pasture in summer and hay and silage during winter. The demands of water for irrigated wheat grown for fodder, the processing of concentrates, the packing, transport, and other operations required to place meat on supermarket shelves all consume water as they take their

place in the meat food chain. The hormones administered to animals on this regime to stimulate growth require water in their manufacture as do the antibiotics and other prophylactics used widely to protect animals from illnesses common to intensive production.

To turn the animal into meat from this source, it is necessary to first slaughter and prioritise parts of the carcase. Some of this meat is turned into processed meat sold in supermarkets and acquired by many commercial food catering outlets. Much of it is used in the precooked "instant" meals packs that have become so ubiquitous over the last 30 or 40 years. During the processing operation of this product, much water is used—some of it injected into the carcase to cause the meat to swell and appear larger than it is thus increasing the profit to the eventual retailer. When this meat is cut into small portions, and some of it is minced for hamburgers, more water is consumed. The factory processes required to turn meat into profitable product are water intensive, the packaging for the display of this meat in shops requires water in its production, and the need for strict date stamping due to the perishability of meat leads to waste as consumers reject some packages that the retailer must then discard or are kept too long in the household refrigerator or freezer and must be discarded for fear of food poisoning. Refrigerators and freezers necessary for the storage of meat products also require water to build and function—thus making yet another demand on the water resource.

Animals fed on pasture and silage only consume water that comes from rainfall. The major use of water for these animals occurs during the abattoir process. They are not fed hormones and only need antibiotics occasionally for specific maladies and rare infections.

Fresh meat sold to consumers daily curtails the food corporation drive for profits. It deprives the packaging, transport and storage industries of markets, although the advertising industry remains untouched. The producer of the meat, the farmer and the farmer's family, receives better prices for their animals, and the consumer benefits from the increased nutrition available in fresh meat grown in concert with nature. Much less water is used in producing food to the consumer and this benefits us all.

As with all matters pertaining to food and farming, it is unwise to draw too many conclusions from broad-based and averaged out statistics. Recent advice to stop eating meat and thus save water is an example of this. The water content quoted appears to have been derived from meat from animals intensively raised—what is commonly known as factory farming. Thus, an animal raised on a factory farm, fed grain and concentrates reliant on irrigation, will certainly require a lot of water. As is shown above, the water waste does not stop there—the food chain required for the marketing of this meat is heavily dependent on water to operate the various processes needed to transform the meat into product for the consumer.

The same factors apply to poultry. Poultry raised in the open air and allowed to graze green fodder that is supplemented with grain, so-called free range, are healthier and less demanding of water than intensive shedding based on industrial feed, growth hormones and antibiotics.

Dairy products from cows fed on pasture and allowed to follow natural cycles will require much less water than factory farmed dairy cows, bred for maximum milk production, to which are added antibiotics and growth compounds.

Thus, meat from a lamb from, say, the Welsh hills or from Australia, where rainfed pasture is the principal source of feed, will utilise much less water than meat from a lamb, grown in sheds or feedlots, fed on grain and concentrates to which are added hormones and prophylactic substances.

It goes without saying that meat sold to the consumer will be more nourishing and healthy if it comes from grazed and healthy animals, and if processing, packaging, storage and transport can be kept to a minimum.

2 Wheat and Barley

Most of the wheat grown in the world is grown on rainfall alone. Wheat, grown under irrigation, costs much more to produce and requires much water to mature and yield a crop.

It will be said that irrigation provides more security against seasonal extremes, but if there is a drought, then irrigation will become problematical. Water in rivers and dams also suffers from drought. Monocultural crops such as wheat and barley are grown in open fields and require a lot of water so drip irrigation is impractical and large centre pivot sprinklers are extravagant in their water use, losing much of it through dehydration before it is available to the plants. The crop will also receive what rainfall there is as the sky cannot be turned off.

Bread and other food obtained from wheat and barley grown under rainfall alone is much less costly in terms of water used than that obtained from irrigated grain.

There is another distinction between wheat grown as a monocultural crop and wheat and barley grown in rotation with self-regenerating pasture such as medicago. Wheat grown without this rotation requires large quantities of nitrogen fertiliser to yield productively, and water is needed in the process of manufacturing this.

A pasture/wheat rotation requires one-fifth of the cultivation needed compared to wheat reliant on nitrogen fertiliser. The water requirements of each passage of the machinery are not insubstantial, if somewhat hidden from the casual observer.

Yet again, milling, processing, packing, storage, etc., all require water over and above the needs of the growing plant.

3 Olives

Olives and olive oil are staple food requirements in the WANA region, and countries in Southern Europe and Turkey.

They grow on rainfall alone and are often overlooked as an important source of food in these regions. Yet they are one of the most water economical foods of all.

Olive trees thrive on hot, dry conditions in summer and low winter rainfall.

The adoption of olive cultivation in Australia, New Zealand and parts of North America has seen the use of additional water applied in irrigation systems to trees in dry summers to induce rapid growth of the young trees and also to encourage higher than traditional yields. This is a commercial decision and not a necessity. The only extra water required for the oil to be available is that used to wash the fruit as it begins the process of oil being extracted. Once the olives have been crushed, the crushed material moves to the oil separation phase which takes place under centrifuge using the olive juice obtained from the crushing process to separate out the oil. Nothing further is added—the only water used at this stage is to wash the containers before the oil is poured into them.

Olive fruit for the table requires only the saline water needed to leach out the bitterness before they are packed in jars and preserved in either oil or salt.

Commercial table olives in some countries are soaked in weak caustic soda solution to remove the bitterness and then must be washed in large amounts of water to remove the caustic soda.

If they are sold in supermarkets, they are usually vacuum packed in plastic pouches or made available in tins. Water to manufacture plastic and tins is necessary for both these forms of preservation. And, again, the exigencies of the large supermarket use even more water.

4 Fruit and Vegetables

Vegetables, in particular, require ample water if they are to produce healthy and nutritious food.

In Southern Europe and parts of the WANA region and Turkey, some vegetable crops are grown on moisture in the soil from the winter rainfall—for example melons and early tomatoes.

There are vegetables that grow and are harvested during various phases in winter such as cabbage, cauliflower, onions and garlic. These do not require irrigation, unless the climate is particularly arid.

In Europe and North America, the summer season for vegetables is relatively short and growth must begin early and be maintained until the plant reaches maturity. Almost daily watering is needed as any short period of dryness will check growth and affect the plant's productivity.

However, the way in which the water is applied is important in understanding the amount of water needed. Open-field crops watered with pivotal sprays are extremely wasteful of water. Not only is dehydration most intense in summer temperatures, but it is an extravagant way of applying water to crops. Drip irrigation is much more economical, but it must work efficiently and be applied daily if it is to reach the roots of plants sufficiently.

Drip irrigation, applied through small nozzles, also requires a water supply free of matter such as weeds and seeds. It must run freely if it is to water each plant adequately.

Furrow irrigation is nowadays decried as wasteful, yet it is a very efficient way in which to apply water to vegetable and fruit crops. The furrows are not deep, water is constrained from spreading to unproductive soil nearby, and water application is controlled easily.

Vegetables and fruit need to be consumed as early as possible from the time of harvesting as each minute after harvesting reduces the natural sugar content of the fruit and diminishes the nutritional yield.

Soft fruit such as raspberries and strawberries and freshly picked vegetables will use much more water if they are transported long distances, stored, washed, processed into precooked product and packed for sale in shops and supermarkets.

Fruit trees are grown under rainfall alone in temperate climates. In Australia, commercial fruit such as vines and peaches is irrigated as fruit size and sugar content must be maintained if the fruit is to be nutritious. In the growing period, which occurs in early summer, Southern Australia is mainly rain free and this lack of water will inhibit both yield and quality if trees are left to fend for themselves.

The major call on water in food made from fruit and vegetables is not so much from the growing period (this is a necessity), but during subsequent processing, packaging and storage. The longer fruit and vegetables are subject to these operations, the more the wastage from their natural water and sugars. All fruit and vegetables are best if lightly cooked and maintain their nutritional value if this takes place as soon as possible after harvesting.

5 Conclusion

In assessing the water content of food, we must distinguish between the natural requirements of the crop and the manner in which this food comes to our tables. Industrial processes that transform the natural product into a construct that looks much like the original but is treated with preservatives, chemically based aromas and various other additives such as extra sugar and salt require large amounts of water. Stretching meat into product to make more profit requires extra water.

An example of excessive and wasteful water is apparent in the German export of packets of iced tea to Italy. The ingredients are water and tea. Sugar and lemon flavouring are added for flavour. Italy has its own relatively ample water, buys tea from the same sources as Germany and grows fresh lemons that are exported to Germany, and sugar is an individual taste and better applied in the glass rather than the pack.

Almost every variety of food on sale in large commercial supermarkets requires large quantities of water to get it there. This use of water in wasteful does nothing to add to the natural qualities of the food and increases the price we pay for it.

The growing of food is always a risky business. Drought, hail, early frosts, searing winds and early snow can decimate a crop overnight. Irrigation can help with dry conditions, but we are at the limit of water available for irrigation. In any case, rivers and dams and other types of water storage are equally vulnerable to drought just when needed most.

Rainfall dryland farming sustainable in semi-arid regions has been an orphan in the development industry, yet it is in the semi-arid zone that the potential for increased food is most practical and achievable.

Unnecessary irrigation is wasteful, but the modern supermarket culture has introduced a need for water in food that goes far beyond the natural needs of the plant and animal.

While it is difficult to precisely measure the amount of water used by plants at any given time, it is easy to measure the extravagant use of water involved in industrial processes and food chains that distance farmed food from the consumer.

We need food to nourish ourselves and maintain good health. If we compromise these two values, then we diminish our own human condition and wastefully reduce our most needed resource that of water. As the water resource diminishes, the aim of food security becomes more unobtainable.

Science and technology can produce “cheap food” in abundance, but in the process, water is wasted, nutrition is compromised, and health is threatened.

When we talk about achieving food security, we need to understand what the consequences will be if we achieve this through large agro-industries producing industrial quantities of low-grade food. The alternative is to protect and sustain food that is grown in concert with nature and that reaches our tables while it is still fresh and highly nutritious.

Consumers in most of Asia, the Arab countries, Turkey and Southern Europe manage very well on fresh fruit, vegetables and meat sold direct to the consumer and cooked that day. The food culture in these regions depends on fresh ingredients marketed with little intervention to diminish their food value.

Food security is elusive, but it is better to aim for security in nutrition rather than agribusiness profit.

We in the Anglo-Saxon west have become seduced by the marketing of industrial food. Apart from demands made on the water resource, our food security is now threatened as adulteration, due to handling and storage and additions of unnecessary substances, continues to diminish nutritional quality. Some wealthy countries are now discovering nutritional deficits in children and old people due to this diet.

Agribusiness is designed to make profits. It is supported by technology that transforms produce into food components that can be manipulated for further profit. Transformed food has come to dominate our daily diet, not only in the West but increasingly and invasively in the rest of the world. It is a system that is water hungry, costly to the farmer, costly in terms of health to we the consumers and costly to our environment.

It may not be such a good idea to allow profit and technology to shape the food in which we should be secure. Increasingly, it is not the farming of food that

threatens water supplies, but the processing of food that, it may be argued, makes more demands on water than the farming.

Farmers, farming medium size and small holdings and domestic plots using water efficiently to grow real food, may well prove to be our means of achieving food security after all.

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