CHAPTER 11

Watersheds and problemsheds: A strategic perspective on the water/food/trade nexus in Southern Africa

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Abstract

Conventional wisdom maintains that water scarcity may lead to conflict and war between states. The riparian states of the Okavango basin are all under varying degrees of water stress, necessitating the joint management of transboundary water in the region. The fact that disputes over water very rarely lead to conflict between states has much to do with the role of water in the modern economic landscape. There is no correlation between economic development and water resources in a country, as some of the poorest nations on earth have vast reserves of fresh water. The factor more important to ensure continued economic development is the level of social adaptive capacity, including aspects such as wealth, the level of education among the population and the sophistication of the economy. The small water reserves available can be used in the sector of the economy where they generate the most income and cheap staple foods can be imported with the profit, analogous to the import of virtual water. Subsidisation of irrigated agriculture by the state can be used as a tool to encourage rural development. It is argued in this chapter that this is highly ineffective, as water is not the ultimate limiting factor to agricultural development in arid countries. Low prices for staple foods, caused by overproduction and agricultural protectionism, pose the largest threat to local agriculture. The obstacles to agricultural development, as well as the solutions to overcoming water scarcity are located not within the watershed, but on international trade markets. The Permanent Okavango River Basin Water Commission (OKACOM), as the organisation managing the Okavango River, is in a prime position to implement policies leading to such a positive outcome.

Introduction

Agriculture is central to any food security policy as it accounts for all food grown on land. Self-evident as this may be, it is important to remember that the size of land is finite and, more importantly, available water that is suited to the production of food is even more so. The big question is deciding where and how this food should be produced. In the past, food self-sufficiency, achieved by meeting all food needs through domestic supplies, was a policy objective of many countries. It had the effect of keeping foreign exchange in the country, where it could be used to import products not locally produced. Yet, in the early 1990s, nearly 80% of malnourished children lived in developing countries that produced food surpluses (FAO 2000a). The current trend is to move toward a policy of national food security, relying on other sectors of the economy to generate capital to be used to import various food products not produced locally. The theory of comparative advantage would dictate that countries tend to focus on manufacturing products in which they have a comparative advantage in the factors of production.

In the arid regions of the world, such as the Okavango basin, water is perceived as the factor of production in short supply. It also happens to be a relatively mobile natural resource, compared to factors such as soil and sunlight. Great water transfer schemes have ensured the security of supply for various water-short civilisations for centuries. These transfers imply dependence upon foreign sources and have political, economic, as well as environmental repercussions. The juxtaposition of security and dependency in the context of shared watercourses has prompted the prediction that the wars of the 21st century will be waged over water. There is much evidence to the contrary, especially in the Middle East, which ran out of water in the 1970s. Although the region is by no means stable today, there is no evidence that disputes over water resources have fuelled tensions between states. If anything, the reverse is true, with several examples of states on politically stressful terms with one another actually cooperating in water resource management. Although in a de facto state of war with each other, Israel and Jordan cooperated in the management of the Jordan River basin long before the Oslo peace accord of 1994 (Wolf 1993; Allan 1999; Jagerskog 2001).

Political will, regime creation, natural resource endowments and socioeconomic development levels all play a role in determining how countries respond to water scarcity. Just as Adam Smith put forward his illustrative device of the ‘invisible hand of the market’ to explain economic theory, so too can the concept of ‘virtual water’ give insight into the interplay between water resources, food security and international trade. The aim of this chapter is to shift the focus of thinking and debate within the region away from the river basin, with finite water resources in it, to that of a ‘problemshed’, with a variety of options available to ensure continued economic development. The concept of virtual water will illustrate the ability of an economy to overcome problems of water resource scarcity and ensure continued economic development in the face of aridity. This approach has implications for conflict mitigation and allows riparian states to arrive at trade-off situations with a positive sum result. Angola, Namibia and Botswana have indicated a readiness to move away from sharing the waters of the Okavango River towards sharing the benefits of the river. Additionally, it will be proposed that water is not the limiting factor to agricultural expansion in developing arid nations. Agricultural trade protectionism in the world’s largest markets limits local production of staple crops and has a tangible effect on the food security policies of developing countries.

Implications of water resource scarcity

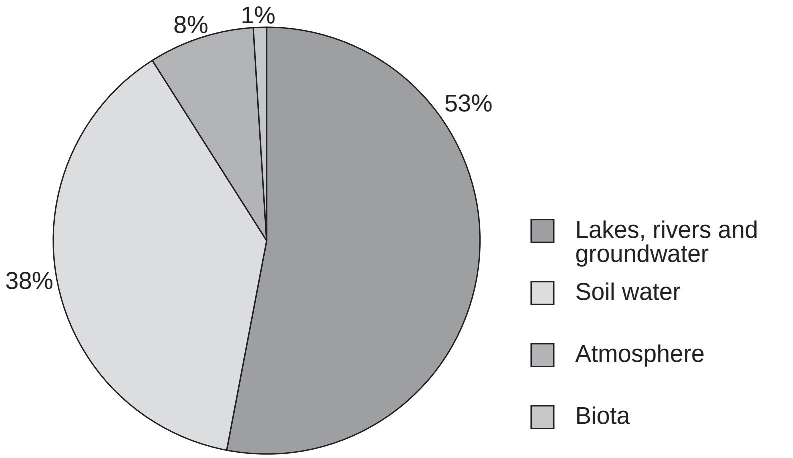
There is some debate over what constitutes water scarcity in a country. On a per capita basis, Namibia – with 10,211 m^3 per person annually – has three times more water than France – with 3,439 m^3 per person annually (FAO Aquastat 2002). This fact is routinely ignored in water scarcity assessments and highlights the limitations of quantitative indices. In the above example the fact is that much of the water counted as being part of the Namibian supply lies in rivers on its borders. This water has to be shared with its neighbours, yet water assessments frequently fall prey to this double counting, including the full flow of the river in both the neighbouring countries’ supplies. There is also the factor of evaporation, accounting for 98% of Namibia’s rainfall. A qualitative assessment of water resources in a country differentiates between the types of water available (Falkenmark 1989). A water scarcity index gauges the level of renewable surface and exploitable groundwater reserves in a country, generated both locally and externally (FAO Aquastat 2002). The majority of the world’s food is not grown using the above water, but rather soil water trapped between particles in the soil horizons. Irrigated agriculture accounts for 43% of world grain production, with soil water supplying the moisture needs of the remainder (Berkoff 2001). Soil water comprises about 38% of the fresh water available on earth (see figure 1).

France and other temperate-zone countries are grain exporters due to their large reserves of soil water, freely available to them as rainfall. Levels of soil water are negatively affected by high rates of evapotranspiration. Therefore, although Johannesburg and London receive similar volumes of rainfall annually (just more than 600 mm), the former has much lower volumes of soil water than the latter. The temporal and geographic variability of rainfall experienced by many arid parts of the world, combined with high levels of evapotranspiration typical in these areas, preclude much of the earth’s surface from being suitable for growing rainfed or irrigated grain (see map 1).

Areas with low levels of soil water can augment their supplies through water transfers and grow crops under irrigation. The high rates of evapotranspiration – in excess of 3,700 mm annually in parts of Botswana and Namibia, compared with a world average of 1,200 mm – pose the risk of salinisation of soil in arid regions (FAO Aquastat 2002). Whole tracts of land can be rendered sterile through the accumulation of salts left behind as residues from evaporated irrigation water. From Sumeria to California there are many examples of the devastation caused by the injudicious use of irrigation water in arid regions (Postel 1999). Coupled with the potential dangers of overirrigation is the fact that a positive rate of return on irrigated grain production can prove difficult to achieve (Berkoff 2001). Capital outlay costs per hectare on irrigation schemes in Southern Africa are typically US $1,250-2,900, depending on the system used (FAO 1998). This amount includes only direct costs of ‘in-field’ works and excludes large storage dams and roads, although these would also have secondary uses. At the present grain price of around US $120 per tonne, a hectare of

Figure 1

Exploitable freshwater reserves

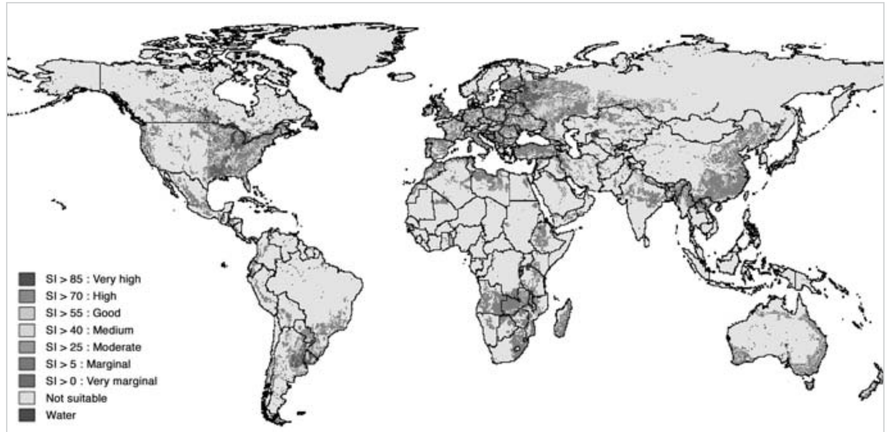


Note: Figures exclude deep groundwater and icecaps.
Source: After Miller 1998.

Southern African soil would realise a return of US $600, assuming a five tonne yield (World Bank 2002). Once other costs have been deducted, such as the operation and maintenance of the irrigation system, fertilisers, labour and machinery, very little is left to cover the initial capital investment in the irrigation system. Water consumed in the production of five tonnes of wheat, excluding runoff, would total about 6,500 m^3, as the production of a tonne of wheat requires about 1,300 m^3 of water (Krieth 1991). The value added to every cubic metre of water used to produce wheat or other grain crops works out to about US $0.09. Roughly 10 times more value can be added to a cubic metre of water used to produce oranges, as these need about 400 m^3 of water per tonne of production. A tonne of aluminium refined from ore adds about US $307 to every cubic metre of water consumed, or 3,411 more than wheat. Typically, domestic use in a country will account for roughly 15% of water consumed, with industry adding perhaps another 30%, depending on the level of economic development. Agriculture frequently uses more than 50% of the water available, yet rarely contributes more than 10% to gross domestic product (GDP) in developing countries. The average water use value for grains, including millet, sorghum, maize, wheat and rice, is about 1,000 m^3 of water for every tonne of mass.

Map 1

World areas suitable for rainfed and irrigated wheat



Source: IIASA 2000.

What emerges is a picture of water resources scarcity suited to a particular economic activity. A shortage of soil water indicates that the production of staple grain crops will not be economically viable (see figure 2). Yet, there are other options open to countries that would allow them to develop their economies within the limits imposed by their water resources.

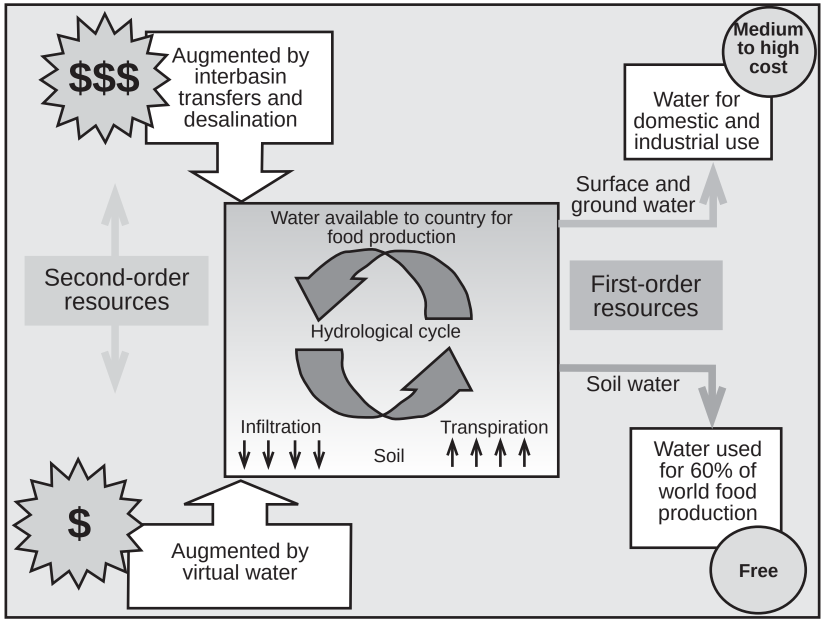
Other options can assist in overcoming a shortage of local water resources for food production, but with a financial cost. The water available for the production of food can be augmented by water transfers, desalination and virtual water. The first two are high-cost options, whereas the last is available at a low cost due to the availability of cheap grain.

It is noted by Berkoff (2001) in a World Bank water strategy paper that:

> "irrigation barely features in such classic texts as those on food policy by Timmer, Falcon and Pearson (1984) or on agricultural development by Eicher and Staatz, ed. (1998). These volumes focus on such issues as the role of agriculture in economic change and development, agricultural technologies, and prices, markets, credit, employment and trade. Irrigated farming systems are considered along with other systems but are not usually given any particular prominence."

Figure 2

Water resources in relation to economic development of 160 randomly selected countries



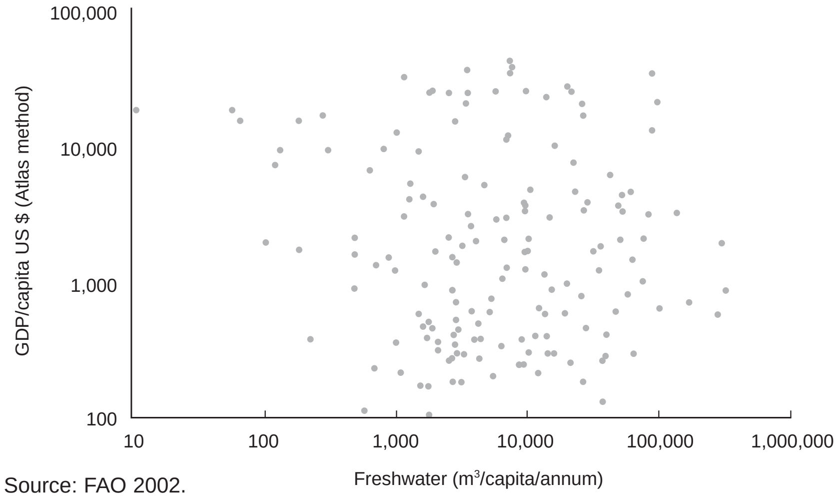
In fact, there is no correlation between a country's level of socioeconomic development and its freshwater reserves (see figure 3).

The mitigatory effect of virtual water

Cyprus, the Bahamas and Bahrain all have very low levels of freshwater resources – less than 1,000 m³ per person annually. All three have high GDP per capita of more than US $12,000. At the other end of the spectrum, Bangladesh, The Gambia and Cambodia have vast freshwater resources, but GDP per capita of less than US $500 (World Bank 2002). Not surprisingly, the former three countries are importers of staple foods. Income generated in other sectors of the economy is used to import virtual water in the form of cheap grain from temperate regions. As the production of a tonne of wheat requires about 1,300 tonnes of water, there is a considerable saving

Figure 3

Water resources in relation to economic development of 160 countries



Source: FAO 2002.

of the local, scarce water supplies. The water available to the country for food production is augmented by imports of virtual water. These imports are considerably cheaper than the other two options of increasing the supply of freshwater. Desalination of seawater and interbasin water transfer schemes are both too costly to be viable as a source of water for food production. Desalinated water currently costs about US $1 per m³, approximately 10 times more than the value added by grain production. Water transfers bring a host of other potential problems, such as the insecurity of relying on an external source for water supplies and potential environmental consequences to the donor basin.

A country facing low levels of a resource, in this case water, can continue to develop as long as it has the necessary social adaptive capacity (Turton 2000; Ohlsson & Turton 1999). If its economy is wealthy, such a country will find ways to overcome its lack of natural resources and to ensure its continued economic development. A good example is Israel, which pursued a policy of food self-sufficiency until the mid-1970s. Since then, water has been diverted to more profitable sectors of the economy at the expense of agriculture (Allan 2000). The foreign exchange earned through the export of manufactured products and tourism is used to import the country's staple foods (see figures 4 and 5).

In 1956, agriculture constituted 20% of Israel's GDP. By 1999, this figure dropped to less than 2% (Allan 2000). The total renewable fresh water available to Israel annually is about 1.7 km3 (FAO Aquastat 2002). As can be seen in figure 5, Israel imports about three million tonnes of grain annually, representing close to 4 km^3 of virtual water, saved locally. Water scarcity would only limit the development of a country if there were very low levels of social adaptive capacity. The small volumes of water available in a country can be used for the activity where they generate the most income, as well as taking care of household needs. In direct consumptive uses, such as water used for drinking and certain manufacturing processes, local water resources are critical. If water is used as an intermediate good (as in the case of agriculture), it forms part of a range of other inputs, which all have an effect on the production of food. Economic issues such as trade preferences and barriers, and development assistance can have a greater impact on food production than water resources, and will be examined in the next section.

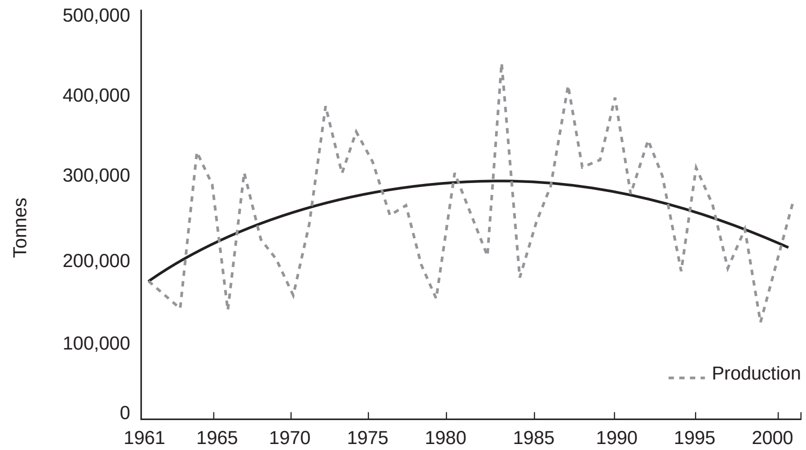
In the case of Israel, virtual water allows the country to continue its economic development, diverting water to the sector of the economy where it generates the greatest yield. This allows the country to implement policies of demand management and sectoral allocative efficiency. The fact that the country is short of water is publicly admitted and supported. There are situations where virtual water can slow efforts to conserve water and implement water demand management. Countries that choose for political reasons not to admit that they are short of water can continue to allow large volumes of water to be consumed by inefficient uses. Egypt was well on its way to becoming a net grain importer in the 1980s. By 1993, it produced almost twice as much grain as what it imported (see figure 6). The trend is continuing, with large new irrigation schemes being planned by the Egyptian government.

It is highly unlikely that Egypt could ever feed its growing population solely from locally produced grain, as imports still form a large portion of consumption. What the importation of virtual water has allowed, however, is for the country to cast itself in the role of an agrarian nation, while ensuring that enough water is available for other sectors of the economy. Publicly the message is that there is no shortage of water in Egypt and therefore no reason to implement demand management. The reason for the above attitude is that Egypt's principal source of water is the Nile, shared with a number of other riparians, which have all indicated that they would like to increase their use of the water flowing through their territories. If negotiations ever start with these riparians, Egypt hopes to argue for a larger share of the water based on the principle of prior use (Allan 2000).

Either local water reserves can be used in the sector of the economy where they generate the most income, like in Israel, or they can be used as a political bargaining tool. In both cases, grain imports will make the specific policy direction possible. Local water ceases to be essential to the food supply of the country and can be used in other activities. This allows countries sharing water resources in arid regions to achieve positive sum outcomes as the volumes of water required to ensure social and

Figure 4

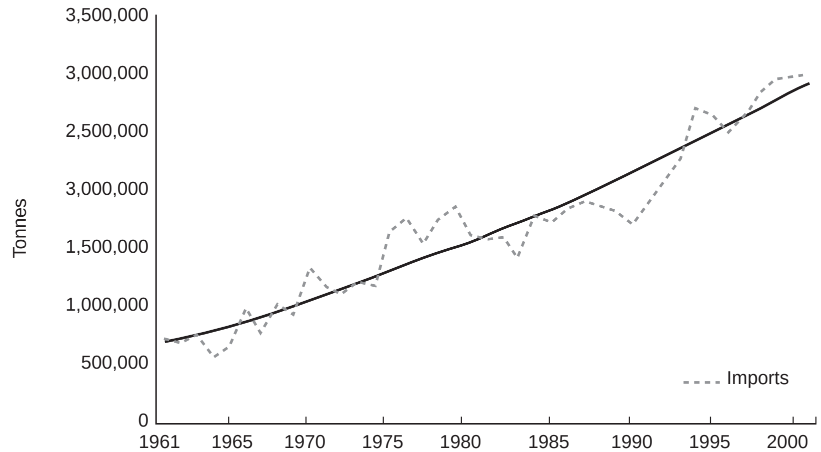
Israeli grain production



Source: FAO 2002.

Figure 5

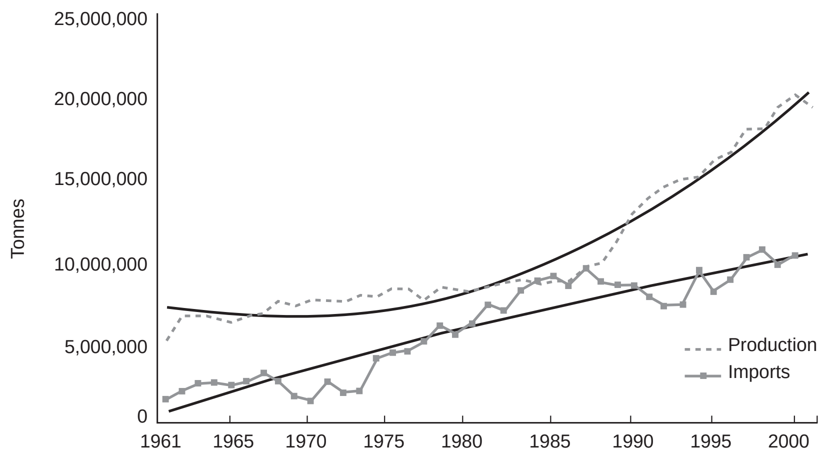
Israeli grain imports



Source: FAO 2002.

Figure 6

Egyptian grain production and trade



Source: FAO 2002.

economic development are relatively small. As long as the available water resources are utilised in the economically most efficient way within the region, the main thrust of interaction ceases to be the arbitration over the division of water resources. Instead, the issue of debate becomes the manner in which economic gains from the water are distributed within the region.

Trade, development and food security

Throughout this analysis of the interaction between water, food and trade, the focus is on grain. The reason is that grain, including wheat, maize, rice, sorghum, millet and barley, comprises roughly 70% of the daily calorie intake of the poor in developing countries (FAO 2002a). These are the people most at risk of food insecurity. As countries develop and per capita incomes increase, grains form a proportionately smaller component of the household food budget. In the European Union and the United States, only about 20% of the population's calories is provided by grain, while close to 30% is provided by animal products. Animal products form

about 7% of the average calorie intake of a person living in Africa. The grain trade does provide a good proxy for food consumption globally, however, as much of the world's meat products, specifically cattle, are fed on coarse grains. Coarse grains are separate to grains destined for human consumption, but frequently benefit from the same agricultural support and protection measures, which will be discussed later.

In arid developing countries, irrigation schemes can be used as a form of development assistance to farmers. The thinking is that the rural poor can become food self-sufficient and even earn an income from the sale of staple foods as long as they have the necessary water resources. Over the past half a century, innumerable irrigation projects have been implemented by governments, aid organisations, religious groups, the World Bank and farmer cooperatives. In many ways, the support of agricultural development schemes is well suited to countries in the semi-arid tropics, as they have the climatic advantage of increased solar energy. Those in the southern hemisphere have the strategic advantage of being able to supply the northern markets out of season. Water can be put to good use in uplifting the lives of the rural poor, in a manner that a large industrial development would find difficult to achieve. As long as there is water, it is reasoned, a type of agrarian utopia can be achieved, stimulating the economy into higher growth.

Frequently, the reality is very different from the dream. There is evidence that irrigation schemes funded by the World Bank in sub-Saharan Africa and South Asia frequently fail to deliver the expected rates of return on the investment (Berkoff 2001). After completion, yields from irrigation schemes are frequently as high as anywhere else in the world. Yet, some years later, yields and the areas being cultivated often drop, causing production and the ability to cover operation and maintenance costs to decline. As most irrigation schemes operate on some form of operation and maintenance cost-recovery from participating farmers, the scheme frequently runs out of money and falls into a state of disrepair.

Farmers, whether subsistence or commercial, act according to what is economically the most efficient. If they cannot recover the capital invested in a certain input through an increase in overall returns, they will not adopt the input. The majority of the rural population of sub-Saharan Africa are landed peasants practising rainfed agriculture. This has always been a risky business due to the dependence upon unreliable rainfall. In good years, large harvests are possible in many areas, yet droughts and floods are a persistent part of the environment of much of the region. The area should thus be a prime candidate for irrigated farming, with high levels of solar energy and large areas of land available. Yet, this is seldom the case. One of the main obstacles to the profitability of an irrigation scheme, at least by covering the operational and maintenance costs, is the success of world grain production. Although the world population has grown at a high rate over the past century, food production has more than kept pace, with production per capita increasing by 25% from 1961 to 1998. The net result has been a steady decline in world food prices, especially grain, since World War II (Merret 1997). Prices for grain in 2001 were less than half of those for 1960 (see figure 7).

The increase in production of grain stems mainly from efficiency gains on large-scale rainfed farms in developed countries. Various technologies have been used to ‘industrialise’ farming in these countries, with genetic modification technologies, although in their infancy, poised to bring about further gains in productivity. Since the ‘green revolution’ 30 years ago, there has also been increased production in many developing countries, usually aided by irrigation and fertiliser use. The first developing countries to embark on the mass production of irrigated grains – Indonesia, South Korea, Taiwan and China – had a significant advantage over countries currently trying to emulate them. The costs of many inputs to intensive agriculture, such as fertiliser, machinery, labour and land, have either increased or remained stable. These costs have to be incorporated in an irrigation scheme and paid for by sales from a product subjected to a real value decrease of about 50% over the past 40 years.

Rising productivity is not the only reason for increases in the production of grain. Trade barriers and protectionism in the major grain exporting countries depress prices in various ways. Three main methods of providing agricultural assistance are:

- restricting imports, either through taxation or limitation on quotas;
- providing government subsidies for goods and services to farmers; and
- paying export subsidies to local farmers.

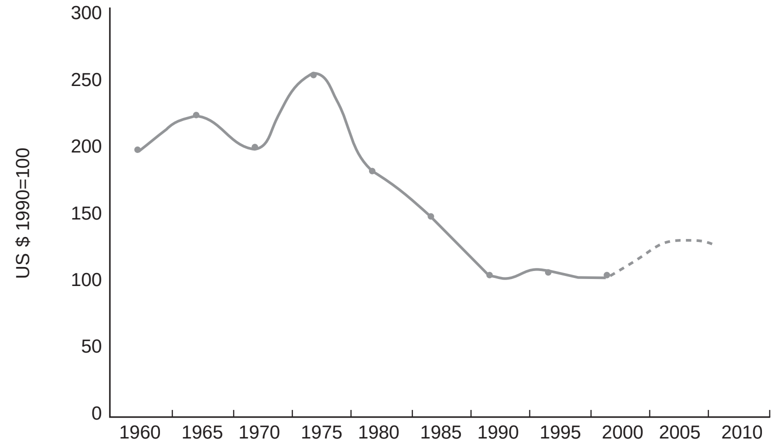
The World Trade Organisation (WTO) Agreement on Agriculture of 1995 sought to reduce the levels of support given to farmers. Developed countries were meant to drop their aggregate measure of support by 36% over six years, and developing countries by 24% over 10 years (Devereux & Maxwell 2001). There are two main problems with the agreement, hindering trade liberalisation. First, the base period during which countries must reduce their levels of support (1986-1988) coincided with the period when support was at its highest (see figure 8). The effect is that any reduction still leaves agriculture heavily supported in these countries.

The second problem is that the average reductions are not trade weighted. Simply put, this means that a country can cut the support on a marginally traded item by 57% and the support on a more important item by 15% to achieve an average of 36%. Although export subsidies to farmers have decreased considerably, other forms of protectionism are still at very high levels. Imports are still restricted and local producer subsidies are paid to farmers. The amounts involved are substantial, with the new US Farm Bill officially estimated at a value of US $171.5 billion over 10 years (ABARE 2001a). Most of this will be paid to farmers in the form of direct subsidies and soft loans to compensate for low world prices, effectively insulating them from the market.

These price support mechanisms are countercyclical, with the levels of support high when prices are low, limiting natural responses that create supply and demand equilibrium. The result is higher variability, which affects producers and consumers in other countries. The bulk of world grain exports are from developed countries, with the US by far the largest player (see figure 9). In effect, the US dominates and controls

Figure 7

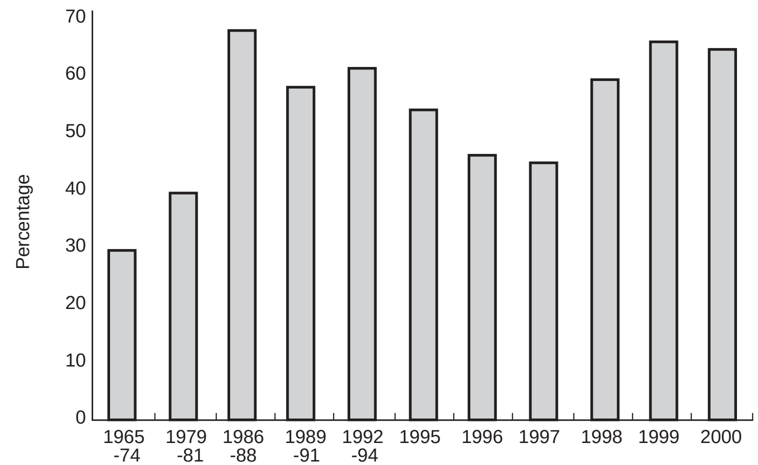
World grain prices per tonne, 2001



Source: World Bank, 2001.

Figure 8

Rates of agricultural assistance in member countries of the Organisation for Economic Co-operation and Development (OECD)



Source: ABARE 2001.

world grain markets due to the extent of its exports. It has been calculated by the Organisation for Economic Co-operation and Development (OECD) using its ADLINK simulation model that, if US wheat production increases by 10% in one year, the world price would fall by about 8% over the same period (ABARE 2001a). While this estimated price decrease is only for the short term, it is clear that US production levels have a pronounced effect on world markets (see figure 10).

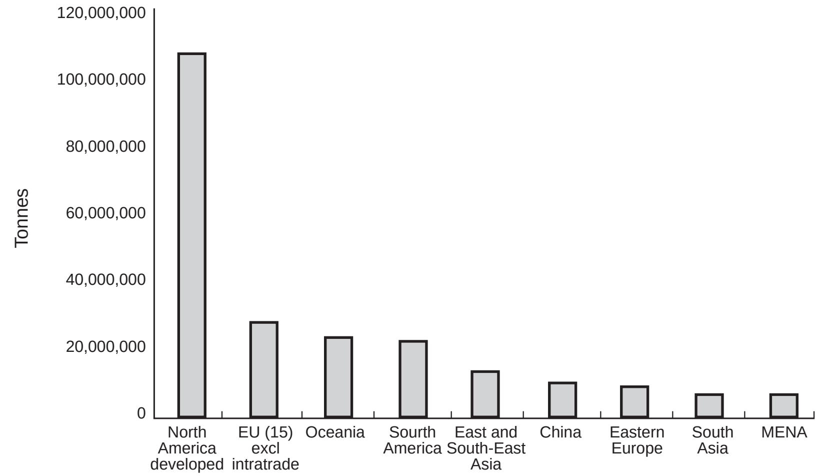
US support for agriculture is concentrated in a few major commodities, called the farm programme crops, which constitute less than one-third of the total agricultural production. These crops include wheat, feedgrains, rice and cotton, and are supported by production subsidies from the government. Although overall agricultural support in the US is relatively low – at about 23% of total agricultural income – it is focused on these crops. Wheat receives support of more than 45%. Sugar and dairy prices are kept artificially high due to import quotas excluding products from other regions, and are therefore subsidised by consumers buying these products. There are strong stakes within the US that ensure the perpetuation of agricultural support measures, even though these are detrimental to the overall economy of the country. In 2000, agriculture contributed 1.12% to GDP, down from 1.7% in 1990 (ABARE 2001c).

The European Union is in a similar situation with regard to agricultural subsidies. These have become entrenched in farm values in the region with prospective landowners calculating the value of subsidies expected on a farm. In 2000, the wealthiest 17% of farms received more than 50% of the aid. These farms all had household incomes higher than the average EU wage of EUR 19,500 (ABARE 2000b). For every dollar a farmer in Europe spends on producing wheat, the EU provides another dollar and a half (ABARE 2000a). To end such subsidies now would be politically stressful, as the farming lobby in both the US and the EU are well organised and highly motivated, placing great pressure on governments to preserve the status quo. There have been attempts to reform the agricultural systems, most notable the Common Agricultural Policy (CAP) of the EU, but with little net effect (see figure 8). "Future negotiations may agree more substantial cuts, but it is reasonable to expect Europe's heartland agricultural products to remain heavily protected well into the twenty-first century" (Devereux & Maxwell 2001).

It is not only the developed countries that subsidise their agricultural sectors, as many developing countries also seek to protect their local farmers. Generally, the level of assistance given to farmers in developing countries is much less than in developed countries, frequently due to budget constraints. Both India and China support local producers of grains by paying market prices above world prices, but due to the small quantities exported by these countries, there is little effect on international prices. It is argued that, if these governments did not support local farmers, grain imports into these countries would increase, potentially leading to a rise in world grain prices. This is unlikely as the level of subsidies paid to farmers in developing countries is relatively low. For example, the world price for wheat in 1997 was US $112 per tonne, while Indian

Figure 9

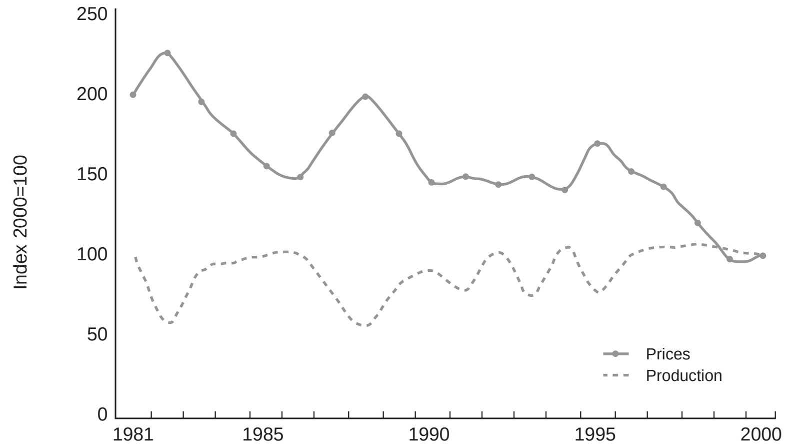
Major grain exporters



Source: FAO 2002

Figure 10

World prices for grain compared to US grain production



Source: After ABARE 2002.

farmers were paid US $120 per tonne. In comparison, farmers in the United Kingdom received US $190 per tonne from their government in the same year (Berkoff 2001).

The removal of trade barriers and other forms of protectionism would have a major impact on the agricultural sector of the international economy – changing prices, stocks, competitiveness and eventually arriving at some kind of equilibrium. The international effects of a reduction in agricultural support levels have been estimated by the Australian Bureau of Agricultural and Resource Economics (ABARE), using its general trade and environment model (GTEM). It included effects such as changes in productive efficiency and intersectoral capital shifts resulting from a drop in tariffs. If a 50% reduction in agricultural support levels was implemented, the model predicted a 0.14% rise in world GDP annually by 2010, relative to the reference case of no support reductions. This represents amounts of US $40 billion for developed countries and US $14 billion for developing countries. Gains in developed countries would stem mainly from cost savings resulting from cutting down on agricultural subsidies. In developing countries, the largest gains would be by countries currently producing and exporting products that receive high levels of support in developed countries (ABARE 2002a). Such a model can only act as a guide to one possible scenario, and not all possible outcomes. What it does show, however, is that there are benefits to both developed and developing nations associated with a decrease in agricultural protection. What it cannot predict is how countries may respond to price changes in commodities. A product not previously profitable in a certain region due to low world prices may be viable under a higher price structure.

The effect of low grain prices

High production levels and agricultural support mechanisms are instrumental in causing a reduction in food prices, due to excess stock being made available on the world market. It could be argued that these low grain prices are beneficial to the poor in both developed and developing nations. Certainly, this may be the case for the urban poor in the developed world and, to a lesser extent, for the urban poor in the developing world. The majority of food insecure people are rural poor living in sub-Saharan Africa and South Asia (UNDP 2002). Impoverished farmers may wish to break out of the cycle of subsistence agriculture, allowing them to invest capital in technology and inputs from the cash generated. Assuming some sort of irrigation scheme has been provided and paid for by outside capital, these farmers would only have to cover the water use and operational and maintenance charges. To attain a higher yield from the land available, they would also need to add fertiliser. Once all these expenses are deducted from the price attained at the market, there is some income left as profit. Increasingly, local markets are flooded with cheap grain imports, often sold at less than the cost of irrigated production. There are years when the price is perhaps high enough to justify irrigated production, but due to the high level of interannual variation in prices, it is difficult for farmers to make long-term plans, as

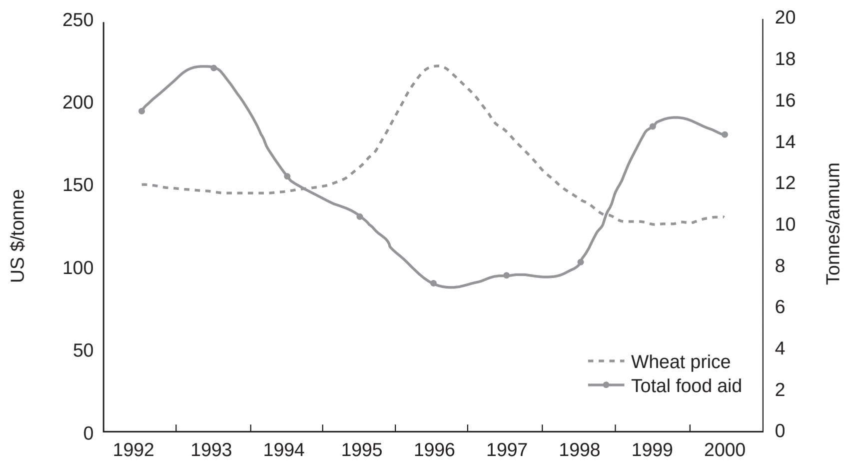
there is no agricultural support or subsidy should the price be low. The rational decision in many cases is not to invest extra capital in farms through irrigation or fertiliser use. Farmers revert to a subsistence lifestyle, relying on rainfall to provide enough moisture for their crops to be sufficient to feed their families. As income cannot be generated through the production of grain on such farms, farmers rely on income derived from off-farm activities. These include finding work in the urban areas or selling their labour on other people's farms. In urban areas, they would benefit from low grain prices, if they have employment. Labourers on farms would benefit from higher producer prices, as this would increase the demand for labour.

Reverting to rainfed subsistence farming exposes farmers and their dependants to increased risk of drought. Where an irrigation supply can usually be maintained in drought years, the rainfed farmer has little recourse to mitigating strategies. When drought strikes, it can lead to a critical depletion of the food supplies. If most of the rural poor are employed as casual labourers on surrounding farms, they are unlikely to receive enough income, as drought would diminish production in the agricultural industry generally. Therefore, the rural poor, whose subsistence crops have failed, need to buy their food on the markets, potentially driving up local prices. If the economy is not strong enough to provide some income for them, they face the danger of starvation. Obviously, more grain can be imported, at relatively low prices, but this may still be outside the reach of the poor resulting in a small and dispersed local market, which makes it difficult to achieve economies of scale on transport costs. The net result may be that large numbers of people rely on food aid. Generally, food aid shipments tend to be highest when prices are the lowest and world stock the greatest (see figure 11). In times of mass crop failures, when the world price for grain is high, countries receive less aid than at times when the price is low. This situation is caused by producer countries using food aid donations as a way of lowering the quantities of grain on the world market in a bid to bolster low prices. As countries have had to reduce the level of support provided to their domestic farmers, alternative methods of supporting prices are increasingly being used.

In summary, the effect of low grain prices is to remove the incentive for local farmers to invest in technology on their farms. They revert to rainfed subsistence agriculture and other forms of income generation. The risk posed by drought is thus increased and, unless levels of social adaptive capacity are high enough, there is the possibility of reliance on food aid or facing starvation. The argument presupposes that agricultural sustainability is based on profitability. It is possible for governments to fund all capital and operation and maintenance costs involved in irrigated farming, allowing farmers to produce grain and sell it for a profit. Such a policy is not likely, as the trend is for governments to cut back on support spending, both due to obligations under the WTO's Agreement on Agriculture, as well as general budget cuts proposed by the International Monetary Fund (IMF). Even if a country bucked the trend and subsidised its irrigated agricultural sector in order to produce food crops, the high costs associated with providing irrigation in the developing world are

Figure 11

World wheat prices compared to food aid shipments



Source: ABARE 2001b.

prohibitive – up to US $18,000 per hectare if all indirect costs are factored in (FAO 1998). It would be difficult to justify spending such large sums of money on an activity that will remain unprofitable for as long as current trade practices are in place. For this reason, many governments supporting irrigated agriculture choose to focus on the production of high-value cash crops. Such activities can be economically viable, as these products do not only fetch higher market prices than grain, but also consume less water in their production, with fruit and vegetables using less than a third of the volume of water required by wheat (Krieth 1991). Non-food cash crops such as coffee and sugarcane are also water efficient, but frequently face the same unstable world market prices as grain. Quite frequently, the only effect of subsidising irrigation is to transfer production from rainfed farmers to those practising irrigation, without adding significantly to overall production (Berkoff 2001).

Conclusion

What is apparent is that the nexus of water, food and trade is not linked in the intuitively obvious way. Water is not the crucial limiting factor to food production,

food security or economic development. The fact that a country faces a shortage of freshwater resources does not necessarily lead to low economic growth. Second-order or socioeconomic resources can be used to overcome such a water shortage, with virtual water augmenting the local water available for food production.

The issue of crucial importance to any country is that the level of second-order resources should be sufficiently high to overcome a shortage of water, and not the other way around. Water should be used in the sector of the economy where it will generate the highest profit. In the Okavango basin, this often means tourism with valuable foreign income from visitors to natural attractions. The environment becomes the prime user of water to ensure continued ecological functioning. Tourism has the advantage over agriculture of lower levels of protection in the developed world, although there are other types of uncertainties attached to this industry. Mining and manufacturing industries can also be viable water efficient activities, adding a high value to the water consumed.

The approach can shift the emphasis away from water-sharing towards benefit-sharing. Botswana would certainly want the unique ecology of the delta to be kept intact as it is a significant generator of income in the region. This is to be balanced with the desire of the upstream riparian states to use water as a tool for development. At the one extreme is the scenario of all three countries clamouring for as much of the water as they can secure, causing large-scale environmental destruction in the process. The other extreme is Botswana paying the upstream riparians not to develop their sections of the river. Far-fetched as this is, the answer is located between these two extremes.

Agriculture can be a development tool in developing economies wishing to kickstart economic growth. Unless a country is blessed with large resources of soil water, irrigation is needed to produce most crops. Low world prices, brought about by high production and agricultural protectionism, make it difficult to produce food crops profitably, affecting the sustainability of irrigation schemes. Water does not limit continued agricultural expansion, as even water-rich developing countries struggle to become major food producers. The central issue limiting modern agriculture in developing countries is price. Low world prices and their causes need to be factored into any agricultural development policy, whether aimed at food or cash crops. If the terms of trade for a particular product are not in a country's favour, it is highly unlikely that it will ever be able to compete internationally with such a product, no matter what its comparative advantage may be in the factors of production.

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