

## Case study: The water problem in south-western USA

The USA is a huge user of water. Over the country as a whole there would not seem to be a water problem. However, the western states of the USA, covering 60 per cent of the land area with 40 per cent of the total population, receive only 25 per cent of the country's mean annual precipitation. Yet each day the west uses as much water as the east. It is the south-west in particular where the water problem is most intense. This is the area of the USA most vulnerable to water shortages.



Figure 9 Desert region in south-western USA

The south-west has prospered due to a huge investment in water transfer schemes. This has benefited agriculture, industry and settlement. Hundreds of aqueducts take water from areas of surplus to areas of shortage. The federal government has paid most of the bill but now the demand for water is greater than the supply. If the west is to continue to expand, a solution to the water problem must be found.

Although much of the south-west is desert or semi-desert, large areas of dry land have been transformed into fertile farms and sprawling cities. It all began with the Reclamation Act of 1902 which allowed the building of canals, dams and hydro-electric power systems in the states that lie, all or in part, west of the 100th meridian. Water supply was to be the key to economic development in general, benefiting not only the west but the USA as a whole.

California has benefited most from this investment in water supply. A great imbalance exists between the distributions of precipitation and population in the state. Seventy per cent of runoff originates in the northern one-third of the state but 80 per cent of the demand for water is in the southern two-thirds. While irrigation is the prime water user, the sprawling urban areas have also greatly increased demand. The 3.5 million hectares of irrigated land in California are situated mainly in the Imperial, Coachella, San Joaquin and lower Sacramento valleys. Figure 10 shows the major component parts of water transfer and storage in the state.





Figure 10 Water management schemes in California

Agriculture uses more than 80 per cent of the state's water, though it accounts for less than a tenth of the economy. Water development, largely financed by the federal government, has been a huge subsidy to California in general and to big water users in particular. However, recently there has been a move to bringing the price mechanism to bear on water resources.

## The Colorado: a river under pressure

The 2333 km long Colorado river is an important source of water in the south-west. Over 30 million people in the region depend on water from the river. The river rises 4250m up in the Rocky Mountains of northern Colorado and flows generally south-west through Colorado, Utah, Arizona and between Nevada and Arizona, and Arizona and California before crossing the border into Mexico. The river drains an area of about 632 000 km<sup>2</sup>.

The Colorado was the first river system in which the concept of multiple use of water was attempted by the US Bureau of Reclamation. In 1922 the Colorado River Compact divided the seven states of the basin into two groups: Upper Basin and Lower Basin. Each group was

allocated 9.25 trillion litres of water annually, while a 1944 treaty guaranteed a further 1.85 trillion litres to Mexico. Completed in 1936, the Hoover Dam and Lake Mead marked the beginning of the era of artificial control of the Colorado. Despite the interstate and international agreements (between the USA and Mexico), major problems over the river's resources have arisen because population has increased along with rising demand from agriculture and industry.

The \$4 billion Central Arizona Project (CAP) is the latest, and probably the last, big money scheme to divert water from this great river (Figure 11). Before CAP, Arizona had taken much less than its legal entitlement from the Colorado. It could not afford to build a water transfer system from the Colorado to its main cities and at the time the federal government did not feel that national funding was justified. Most of the state's water came from aquifers but it was overdrawing this supply by about two million acre-feet a year. If thirsty Phoenix and Tucson were to remain prosperous, something had to be done. The answer was CAP, which the federal government agreed to part-fund. Since CAP was completed in 1992, 1.85 trillion litres of water a year has been distributed to farms, Indian reservations, industries and fast-growing towns and cities



along its 570 km route between Lake Havasu and Tucson. However, providing more water for Arizona has meant that less is available for California. In 1997 the federal government told California that the state would have to learn to live with the 5427 million m<sup>3</sup> of water from the Colorado it is entitled to under the 1922 Compact, instead of taking 6414 million m<sup>3</sup> a year.



Figure 11 Part of the Central Arizona Project

## Resource management strategies

Implementation of the following strategies would conserve considerable quantities of water in the south-west of the USA:

- measures to reduce leakage and evaporation losses – up to 25 per cent of all water moved is currently lost in these ways
- recycling water in industry where, for example, it takes 225 000 litres to make one tonne of steel
- recycling municipal sewage for watering lawns, gardens and golf courses, which could be implemented or extended, as Los Angeles has already shown
- introducing more efficient toilet systems
- charging more realistic prices for irrigation water – many farmers pay well below the true cost of water pumped to them, while the rest is subsidised by the federal government

- extending the use of the most efficient irrigation systems
- changing from highly water-dependent crops such as rice and alfalfa to those needing less water
- requiring both cities and rural areas to identify the source of water to be used before new developments can begin.

## Future options

Several ideas have been put forward for future strategies:

- New groundwater resources could be developed. Although groundwater has been heavily depleted in many areas, in regions of water surplus such as northern California they remain virtually untapped. However, the transfer of even more water from such areas would probably prove politically unacceptable.
- It has been claimed that various techniques of weather modification, especially cloud seeding, can provide water at reasonable cost. However, environmental and political considerations cannot be ignored here.
- In 1991, after several years of drought, the city of Santa Barbara approved the construction of a \$37.4 million desalination plant. Although much too expensive for irrigation water, it is likely that more will be built for urban use.
- The frozen reserves of Antarctic water could be exploited. Serious proposals have been made to find a 100 million tonne iceberg (1.5 km long, 300 m wide, 270 m deep) off Antarctica, wrap it in sailcloth or thick plastic, and tow it to southern California. The critical questions here are cost, evaporation loss, and the environmental effects of anchoring such a huge block of ice off an arid coast. There could also be political implications.
- Offshore aqueducts might be constructed that would run under the ocean from the Columbia river in the north-west of the USA to California.

There is now general agreement that planning for the future water supply of the south-west should embrace all practicable options. Sensible management of this vital resource should rule out no feasible strategy if this important region is to sustain its economic viability and growing population.

### Interesting note

The water level in the Colorado-fed Lake Mead, the USA's largest reservoir, has dropped by more than 30 m since the beginning of the twenty-first century. The basin is now only just over half full!

### Case study analysis

- 1 Describe the imbalance in population and precipitation between the eastern and western parts of the USA.
- 2 Discuss the main uses of water in California.
- 3 Why is the Colorado river under so much pressure?
- 4 Explain the resource management strategies that can be used to try to improve the balance between supply and demand.