LECTURE

Catastrophic loss of the Aral Sea

Summary of one part of the lecture to the Society on Saturday 14th December 2002, by Dr Tony Waltham of Nottingham Trent University.

The Aral Sea lies in a sparsely populated desert split between the new republics of central Asia. The desert has less than 90 mm, but the Aral is fed by two great rivers - the Syrdarya draining the Tien Shan into the northern end, and the Amudarya draining the Pamirs into the southern end (Fig. 1). As a closed body, the level and extent of the Aral Sea has always fluctuated in response to the flows of these input rivers, both of which are dominated by huge spring flows of meltwater from the snowfields and glaciers of their headwater mountains. But the Aral naturally stabilised with a mean level at about 53 m (a.s.l.) and an area of about 67,000 km^2 (Glantz, 1999).

On the open sea, fleets of 500-tonne trawlers harvested over 40,000 tonnes of fish every year. Huge ferries took all day to cross the 400 km between Moynaq and Aralsk, the two main fishing ports, which were also beach holiday resorts. The Amudarya delta was a splendid wetland with reed beds and beautiful lakes rich in wildlife. But all this is in the past, because mankind has virtually destroyed the Aral Sea.

The shrinking sea

Life in the desert depends on water that has always been taken come from the two big rivers - and this included water for farmland irrigation. In 1900 there was 20,000 km^2 of irrigated land in the Aral Sea basin, and by 1960 this had crept up to a sustainable 40,000 km^2. But then soviet central planning in Moscow decided to create a massive cotton industry in the region - which was then a part of Russia. By 1980 irrigated land had exploded to over 70,000 km^2. All the flatlands became wall-to-wall cotton fields. The largest single soviet creation was the Karakum Canal, which extends for 1370 km and takes 12.9 km^3 of water per year to irrigate 9000 km^2 of cotton fields in the Turkmenistan desert (Fig. 1).

Around 90 km^3/year are now extracted from the Amudarya and the Syrdarya - about 75% of their total flows. With natural evaporation losses in the desert, both rivers can now run dry, and there is often no water left to flow into the Aral Sea. The result is the steady shrinkage of the Aral Sea - entirely due to man's interference with a naturally balanced ecosystem. Moscow's politicians and planners carried on expanding the cotton fields until they lost control around 1985. They ignored the Aral Sea's demise, because they were relying on eventual remedy to be provided by diverting water from Siberia's rivers into the Aral basin instead of the Arctic Ocean. Plans for this even greater environmental bombshell were only abandoned in

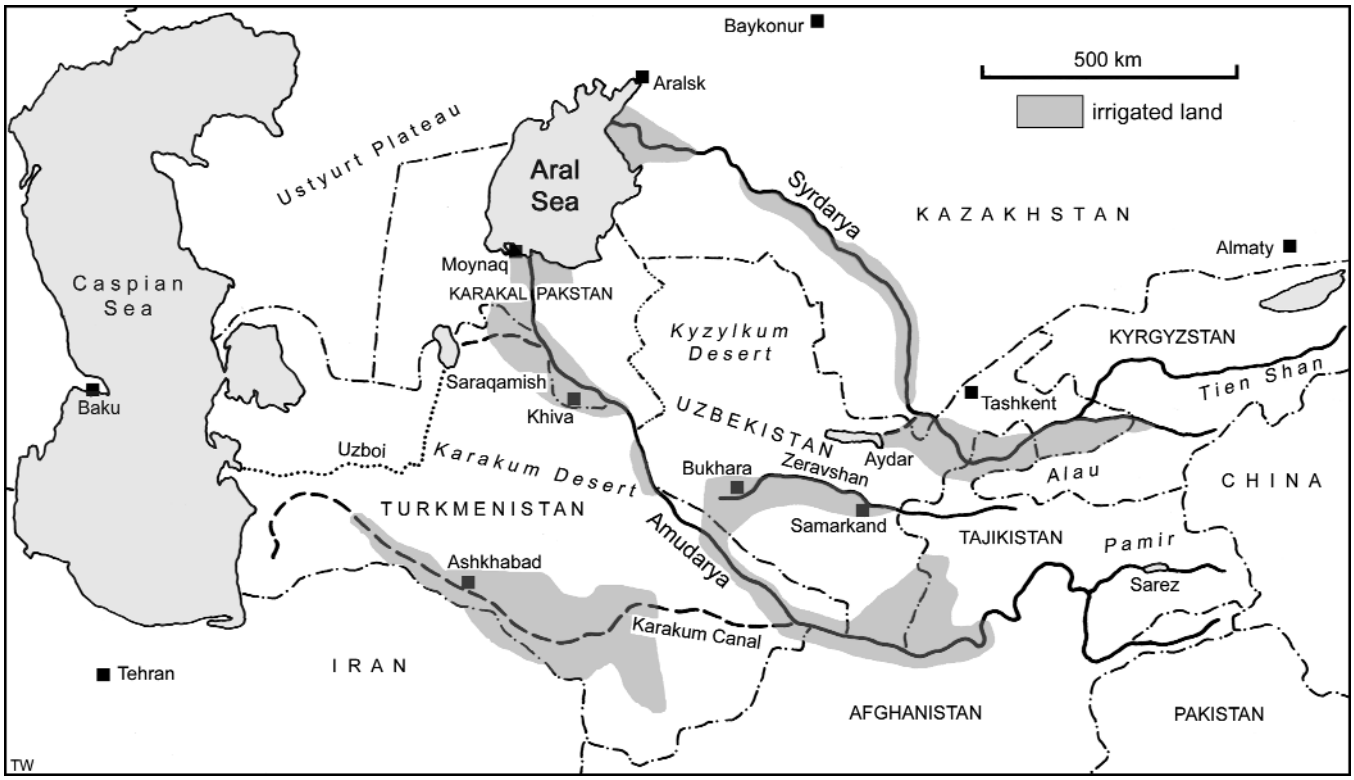

Figure 1. The geography and politics of the Aral Sea basin. The extent of the irrigated lands is as they are today, but the Aral Sea is drawn at the size it was in 1960. Karakalpakstan is a province within Uzbekistan.

the 1980s. But by then the Aral Sea was doomed, and it was already half-dead.

As the irrigation canals were opened up in the 1960s, the flows of the two rivers into the Aral Sea went into major decline. The direct effect was that the Aral Sea went into a matching decline, slowly from 1960, and then more rapidly after 1970 (Fig. 2). In 1960, the two rivers poured 55 km^3 of water into the Aral Sea. In 1982 they contributed none; and modest inputs were achieved in only the wetter of subsequent years.

With its inflow curtailed, the level of the Aral Sea fell by more than 20 m over a period of 40 years, while its volume shrank to just one fifth of its natural state. The most visible impact was the shrinkage of the area of the sea (Fig. 3). Most of the sea was only ever shallow, so the falling level created some massive retreats. Parts of the east coast have receded by 75 km. In 1987 the Aral Sea split into two, as its falling level exposed new dry land. In the north, the Small Aral took most of the remaining flow from the Syrdarya and has continued to decline at lower rates. But the Large Aral in the south loses more to evaporation, and its level continues to fall unabated.

Not only is the Aral Sea shrinking; it has been dying. The Amudarya delta wetlands have dried up, with the loss of the famous reedbeds and the local industry of muskrat hunting. The ferries stopped running in the 1970s with the loss of navigable channels. Fishery catches withered to zero by 1980, and the last indigenous fish species died out around 1985. Perhaps most important, the Aral Sea ceased

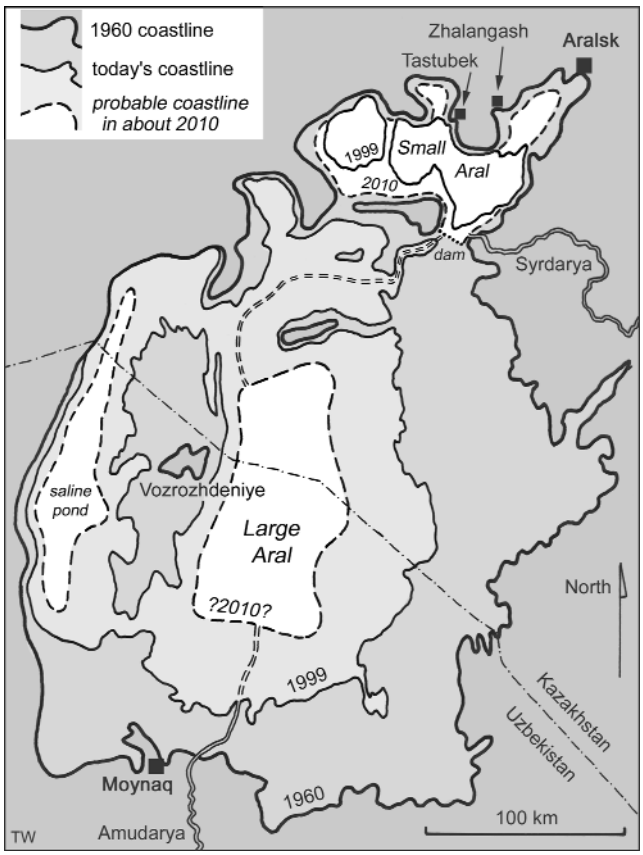

Figure 3. Map of the Aral Sea, with its original (pre-1960) coastline, its present extent (mapped in 1999) and the likely future extent of its three separate seas.

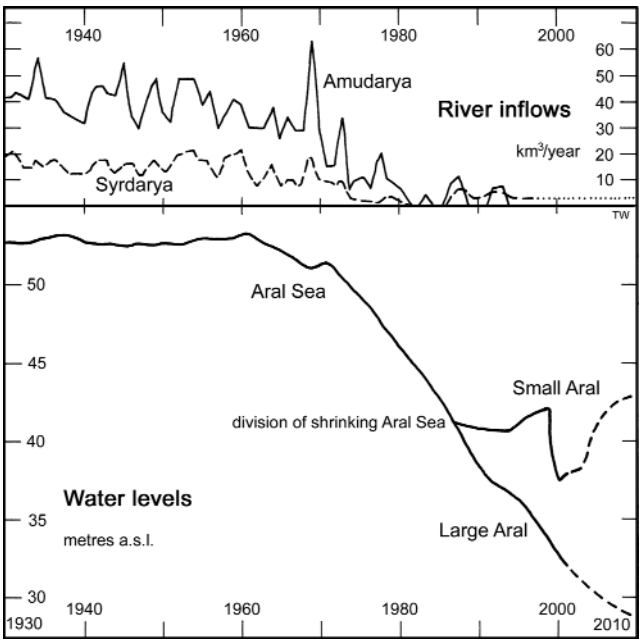

Figure 2. The fall in water level of the Aral Sea correlated with the falling inflows of its two feeder rivers from 1930 until today, with estimates until 2010. The Aral split into two in 1987. Inflows are approximate after 1990.

to be a climatic stabiliser. Its open water had underpinned a stable block of moist air. When this was lost, winds from the north swept across unabated, and the southern deserts became hotter in summer and colder in winter.

Where the salinity of the Aral Sea was once a healthy 1%, it is now an almost uninhabitable 6% in the Large Aral. Over 40,000 km^2 of the original sea floor are now exposed. Most is dry mud flats that any geologist would recognise as a playa floor (Fig. 4). This dry mud is heavy with salt, and is also enriched with a cocktail of chemicals - including DDT and other toxic pesticides that have been washed out of the irrigated soils. Contaminated soil and water have now produced a massive health problem among the people condemned to remain in the dying towns and villages. Two thirds of the people now suffer ill health. Khiva has rampant hepatitis, Moynak is afflicted with birth deformities and Aralsk has an epidemic of tuberculosis. This environmental disaster knows no bounds (Waltham and Sholji, 2001).

The Large Aral today

Though it sits astride the border, the Large Aral is largely the problem of Uzbekistan, who have the

Amudarya that should feed it and also have the populated old delta lands around the southern end. Their problem lies partly in the gross inefficiency of the ageing irrigation schemes, with huge leakages and uncontrolled evaporation losses and no local incentives to repair the disintegrating canals (Hannan, 2000). But it also lies in the cotton, which is among the world's most thirsty crops; it uses twice the amount of water for an equal cash value of wheat or rice, and ten times the amount for potatoes or sugar. Uzbekistan cannot afford to change its main cash crop when there is no practicable means for mass export of perishable food crops - cotton is easier, and the current plans are to expand the cotton fields.

Meanwhile, the largest water user is the Karakum Canal - owned by Turkmenistan, who have no interest in the Aral Sea. Sadly, the political problems run deeper. The Aral Sea wetlands, which are suffering the most, are in Karakalpakstan - a sub-division of Uzbekistan with a different indigenous population. And the controlling Uzbeks have far more concern for their own cotton industry than they have for the entire existence of the Karakalpaks. Signs of positive change are minimal. There is a scheme to clean up the Amudarya delta wetlands (but the wildlife has already disappeared), and another project aims to increase farming and irrigation efficiency in the Khiva basin (but this covers only a tiny part of the basin).

The future is bleak for the Large Aral Sea. A sustainable sea needs an annual inflow of 28 km^3 from the Amudarya, but any hope for this is unreal. An inflow of 11 km^3/year could maintain some form of shrunken sea, but even this is doubtful. Massive reductions of the irrigated areas and major improvements of irrigation technology are just not foreseeable. Turkmenistan's cotton could be maintained with just half the water in the Karakum Canal, and that would put 6 km^3/year back into the Aral Sea. Far more likely is the total failure of the canal, when even more water will then be lost into the Caspian catchment.

Both Tajikistan and Afghanistan are likely to take more water from the Amudarya when their present wars are over and they start to industrialise. The most likely future for the Large Aral is further shrinkage. It will then divide into two again. The eastern sea should become sustainable with modest inflows from the Amudarya and also overflow water from the Small Aral (see below). Meanwhile the western half will continue to shrink, and will ultimately become a saline pond or a salt flat.

The Small Aral today

Lying entirely in Kazakhstan, along with most of its Syrdarya feeder, the Small Aral Sea does avoid some of the political problems of its larger neighbour. But it too has suffered. Aralsk is the old fishing port and coast resort. Once a thriving town served by the Moscow-Almaty railway, it is now a ghostly relic. Where the Aral Sea once stood there is now only desert that produces dust storms on 65 days a year. The holiday beach has no water, commercial fishing stopped in 1980, and fading "seafront" houses look out to the decaying hulks of fishing boats stranded in the new desert. Aralsk is a very sad place, and its inhabitants struggle merely to survive.

The enduring symbols of the Aral Sea disaster are the ships' graveyards, and there is one near Zhalangash - with a scatter of eight ships rusting in a desert that was once a sheltered bay (Fig. 5). The village is awfully depressing. A dusty main street reaches from empty desert to where the Aral Sea is now replaced by more empty desert. Dust has replaced spray. Eagles have replaced seagulls. The men who once worked the trawlers now tend camels, goats and sheep, which struggle for feed on the thin dust-smothered grass. Even more desperate is Tastubek, with less than 30 families eking out an existence on the edge of nowhere. On a section of coast where the seabed was steeper, the Aral Sea has only retreated a kilometre with its falling level, so they survive on subsistence fishing for poor-quality flatfish, but they catch nothing that is worth hauling to distant markets.

When the Aral split into two seas in 1987, much of the remnant Syrdarya flowed into the smaller northern sea. In 1994 an embankment dam of sand was built to divert all the Syrdarya into the Small Aral and also prevent any overflow into the Large

Figure 4. Once a ferry route, now a car track across the old floor of the Aral Sea.

Figure 5. The ships' graveyard near Zhalangash.

Aral. The level of the Small Aral actually rose, until the frail dam succumbed to wave erosion and was broken through in April 1999. The idea of splitting the Aral Sea into sustainable fragments had first been mooted in Moscow in the 1970s. Now it was seen to be feasible. A new dam will be stronger and will be nearly 13 km long. It has a budget of £57M with 75% coming from the World Bank (Williams, 2003). Construction started in spring 2003. After three years to build, and another three to ten years to fill (depending on mountain snowfalls), it will allow the Small Aral to reach a level controlled between 39 m and 42 m, with excess water discharging into the Large Aral.

The new sustainable Small Aral will rely on a maintained inflow of about 3 km^3/year from the Syrdarya. But that is considered achievable, after a modest review of irrigation in the cotton fields up-valley and improved management of flows and storage in some upstream reservoirs. The sea will never again reach Aralsk, but it will reach a stable level, and it should be a lake of almost fresh water with its permanent outflow. Then new coastal settlements and renewed fishing should be possible.

This does offer a glimmer of hope to the people in Aralsk, in Zhalangash, in Tastubek and in the other towns and villages - but only around the new Small Aral. The loss of the larger Aral Sea has been an environmental disaster on a massive scale; sadly, it has occurred entirely due to man's interference.

References

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