The Okavango Delta and its Future Utilisation: An Attempt at a Synthesis of the Proceedings

KEITH THOMPSON, University of Waikato, New Zealand

This paper is not intended to be an exhaustive analysis of the 32 contributions read or tabled at this Symposium. It is merely one person's attempt to draw together as many as possible of the main conclusions, and to present them, with some comment, as a summary of the proceedings. The author alone has selected that material for this attempted synthesis, and its content should, therefore, not be held to represent, necessarily, the views of the Botswana Society. The paper was written in haste during the two days subsequent to the conference, and an apology is made for any notable omissions. In order to economise on time and space, I have not acknowledged the provenance of the material used herein, and I defend this economy measure by observing that if I have inadvertently misquoted anyone, it is only I who should be blamed.

The aim of the Symposium has been to put down on paper as much information as possible on the Okavango Delta, to hold public discussion on it and to publish it in a form which could be useful to planners and policy-makers. Although I think this aim has been achieved, we must acknowledge that there are considerable gaps in our knowledge about the Delta: there was, for instance, general agreement that we are far from confident about our ability to predict either environmental and ecological or economic effects of even moderate development projects. There is no doubt that more data is still needed, but I believe that the 32 papers of this conference will provide a firm base upon which to build.

Water development

Schemes were proposed for realising some irrigation potential and for increasing water flow down to the Boro River. There are 5-10 000 ha of irrigable land, but poor soils and lack of marketing outlets would restrict, for the present, irrigation to a maximum of 1 000 ha, ie, the regions of Shorobe Nukaneng and Lake Ngami. The advantages of making water available in regions where it can be used for development projects are obvious, but I do not believe that we yet have enough data to be able to predict the full effects of such projects. The effects of the flow-improvement schemes on the natural vegetation would certainly be locally drastic, but the Symposium was not able to predict the scale or the degree of acceptability of such changes. There is also uncertainty regarding changes in sediment distribution and the effects this would have upon continuing maintenance costs. The instability of parts of the Delta also raises the question of whether it will be necessary in the future to maintain flow down the Thaoge or Boro by dredging within the permanent swamp region. It was thought that this might be a possible long-term eventuality, but no attempt could be made to predict the scale, cost or effects of these rather more major modifications.

It would be unfortunate if any channel modifications were to be completed within the near future unless long-term maintenance operations could be considered, with some degree of certainty, both feasible and acceptable, ie, both in ecological and economic terms. An alternative scheme was proposed for piping water directly to Nokaneng from the most feasible part of the Okavango system — the panhandle.
There could be some advantages in this proposal in that it appears on paper, to interfere less with the natural swamp system. However, there are many aspects, such as sediment load and the inaccessibility of interfering directly with the permanent water region, which would need very careful investigation.

One of the great inimicabilities is whether or not the admitted severity in the Delta is a major factor in altering flow distribution. We also do not know the extent to which the Delta is adapted, or would adapt, to climatic changes. Lake Bangweulu rose 2 m between 1936 and 1945, but it has not been established why this occurred or why it did not later fall. The East African lakes rose 2 m in 1962-3, but have not subsequently fallen to their former level. To what extent must we incorporate long-term flexibility in our plans in order to adequately allow for possible effects of future climatic or technical changes? I am afraid we do not yet know the answer to this, but we should make attempts to do so or risk the possibility of considerable future investment in maintenance of hydrological modifications.

Yet another question-mark hangs over the extent to which Angola may wish to exploit the Okavango headwaters in the future. The catchment area is at present very sparsely populated and land utilisation is minimal. In fact, the natural drainage of water into the Cuanza and Cahamba Rivers is now subject to so little interference from man, that the volume of flow into Botswana is much more likely to decrease in the future than to stay at its present level or increase. There is provision for tripartite discussions should any of the three countries sharing river systems decide to develop the resource in any way, but the arrangement probably does not have any legal standing. We are presently unable to predict whether or not Botswana will be receiving the same amount of water in 50 years’ time, or only half of the present amount. I do not need to elaborate upon the implications this holds for large-scale exploitation within Botswana.

Furthermore, hydrological changes, natural or man-induced, result in redistribution of the aquatic vegetation. We do not yet know enough about the factors which control the growth and spread, or the elimination, of aquatic and semi-aquatic plants. Currently, there is also the threat of introduction of the aquatic weed, Salvinia, from the Cuanza system, and we cannot predict with any certainty the effects it would have upon the Okavango regime. Irrigation schemes, water impoundments and canalised rivers are known to be ideal situations for excessive development of aquatic weeds. Since a “weed” is “the wrong plant growing in the wrong place at the wrong time,” the Okavango Delta does not, at present, support any weeds at all. All Okavango aquatics are part of, and are largely responsible for, the swamp system as we know it today. But, under a man-directed regime, even some of the existing aquatic plants could suddenly become weeds.

Lastly, it has been suggested on several occasions that it might not only be easier, but also more profitable in the long run, to sell Okavango water to neighbouring States and use some of the revenue to import all necessary food. I cannot see this possibility as being a likely contender for serious consideration. It would involve massive artificial waterworks, severe ecological damage to the Delta and considerable social problems within the Ngamiland population. In fact, I see the proposal as being quite unacceptable, since it would severely restrict future development options.

Agricultural development

The Symposium concluded that crop production is perhaps the most promising field in which to develop if cash subsidies are available to encourage it. Most of the Delta soils are very poor in quality, and intensive use of them would require large fertiliser applications. Maize production averages, at present, about 400 kg/ha.
evaporation and depresses primary productivity. It often also encourages the spread of unpalatable grass species. Burning, by removing old, unpalatable plant material, increases the availability of palatable species so that grazing animals expend less energy in merely searching for their food. However, if the burning tool is over-used, grass productivity is drastically reduced and may not easily recover.

It is of critical importance that if the tsetse fly can be eradicated, strict control be exercised over stockings densities and burning frequencies. It is even more important that land-use plans should be agreed upon well in advance of tsetse disappearance, so that the expansion of stock grazing areas which would inevitably ensue, can be controlled. Uncontrolled expansion of grazing could drastically affect the swamp communities and damage wildlife stocks. Extension of grazing land is most likely to take place up the saadwalwe tongue, but could penetrate well into the western swamps if control measures are not available and enforced.

Tsetse control activities at present are based on aerial spraying of the insecticide Endosulfan. Investigation of the more direct side-effects of this chemical are still at a very preliminary stage and therefore far from conclusive, but it would appear that effects on birds and mammals are not, at present, giving any cause for concern. The chemical is concentrated in a food chain, so that levels are much higher in the tissues of fish-eating birds and fish, and there is no evidence to date of higher carnivore mortality or population decline. As spraying continues carnivore populations must be carefully monitored in case unpredicted threshold effects eventuate.

The chemical is highly toxic to fish in concentrations of less than 1 part in 10 billion, but spray concentrations are very low and it is hoped that fish stocks are not likely to be greatly affected. The insecticide is many times more toxic to tsetse than it is to the house-fly, so that it is hoped that if tsetse is subsequently less important, many of which are important components of the food chains leading to fish, birds and mammals. There is insufficient data at present to confirm this contention. One of the possible indirect effects of tsetse eradication, viz, livestock expansion at the expense of wildlife, has been discussed above. There may be other indirect effects, and careful monitoring of key aspects of community structure must be continued throughout the spraying programme.

Wildlife development

The wildlife stocks of the Delta are quite well known and most of the habitat requirements of the animals are reasonably well understood. The wildlife of the Okavango Delta is an integral part of the entire Delta ecosystem (ecosystem = the integral assemblage of biological, physical and chemical components which together form a functional unit), and management plans involving them must take into account recommendations regarding the way in which the Delta ecosystem and its other animals should be managed. The wildlife stocks are critically dependent upon the flood regime of the region, and development which affects this must necessitate a reassessment of the wildlife populations.

The greatest threat to the wildlife is the impending eradication of the tsetse fly and the inevitable expansion of domestic grazing stock. Above all, strict land-use planning and control are very pertinent. Contributing directly to the maintenance of the Delta ecosystem, wildlife development is important for licensed hunting and to the tourist industry. The very least one can say about tourism is that it is a source of revenue which is never strictly controlled. In addition, it is a job-provider in remote areas where other forms of cash employment are lacking and in itself generates small-scale industry, like handicrafts, vegetable and chicken farming, etc. Many of the developed nations encourage low-cost, high-density tourism, which is often
damaging to parks and necessitates expensive maintenance operations. It is recommended that Botswana encourages, at least for the foreseeable future, high-cost, low-density tourism, so as to minimise the detrimental effects of large numbers of visitors.

Perhaps one-third of the Delta is burned every year, sometimes by hunters, sometimes by tourists, sometimes accidentally, and occasionally for specific management purposes. As outlined earlier, controlled burning can and does have advantages in making palatable food more available to grazing animals, but we must not ignore the fact that burning also has detrimental effects upon the primary productivity. Inevitably, it increases water loss through evapotranspiration, brings about changes in community structure, and can increase water-flow rates. There cannot be any doubt that burning is more widespread now than it was in the past, but we do not know whether the present ecosystem is adapted to cope with the new burning regime or whether it is still adapting. It is important not only that attempts are made to minimise needle-burning, but that wildlife stocks are carefully monitored in order to detect any trends in stocking densities which could indicate community changes.

There is no doubt that wild animals are more efficient in utilising Delta grazing than are domestic stock. The former have been able to adapt to this type of habitat over millions of years, while cattle are a very recent introduction. Therefore, it is not surprising that high livestock densities are usually much more damaging than to an African ecosystem than are high wildlife densities. It is also most relevant that wildlife is extremely diverse in species, each one with its particular feeding preferences; whereas essential livestock all compete for the same resource. There is little evidence to support the proposal that wildlife and domestic stock could be managed so as to co-exist in the same area; for this reason alone, careful advance land-use planning is certainly required in order to partition the Delta into exclusive wildlife reserves and livestock development zones. It is hoped that some priority can be given to conservation of wildlife stocks, since they alone can maintain the integrity of the Delta. The continuing survival of the Delta ecosystem is essential to the development of its potential for livestock rearing.

In recent years there has been considerable interest elsewhere in Africa in the possibility of raising domesticable game, such as the Eland and Thompson’s Gazelle. Evidence is accumulating which shows that, with suitable management, higher production levels can be achieved than for conventional stock utilising the same area of land. However, it will yet be some time before such a venture can be taken beyond the experimental stage, and even then there will be considerable problems, at the local level, in respect of identification of ownership, land tenure and modification of social custom. Estate ranching may eventually be a more viable proposition. At present, more research should be directed towards establishing levels of sustainable yield of take for certain wildlife species in their natural habitats.

Human development

Man has only been a significant factor in the ecology of the Okavango Delta for about 200 years. Ecosystem changes are often gradual and because integrated scientific study of the Delta is limited only to the last few years, we cannot yet be sure of the extent to which man has changed, or is changing, the system. There is currently due cause for concern over the accelerating drift of the rural Ngamiand population into the main centres of population. Many of the males seek employment in the mines and other industries guaranteeing regular incomes. Although this may be tending to raise the standard of living of those who leave the land, it tends to depress the potential for agricultural, fisheries and livestock development in Ngamiand. It does nothing to raise the standard of living of the majority remaining in rural areas. It was recognised by the Symposium that many of these have a very low subsistence level. Government support is often in the form of grain or fish subsidies or with the introduction of simple agricultural mechanisation, is needed to halt the decline of rural populations. This was seen by the Symposium as being an essential preliminary step to developing resource utilisation. Only when a stable social infrastructure with a balanced pattern of resource utilisation at the local level has been developed in rural Ngamiand, will it be appropriate to evaluate proposals for exploitation of the Okavango at a larger scale. Careful planning and management will be necessary to achieve this growth pattern, and solutions will have to be found to many of the problems which accompany development. For instance, the recent drastic increase in the incidence of bilharzia in Maua area is giving cause for concern.

Synthesis of conclusions

Parts of all deltas are inherently unstable. They are formed as rivers enter basins or plains of extremely shallow slope where sediment loads are deposited as the flow rate drops. Usually, sediment deposition is aided by a dense vegetation cover, the rapid growth of which contributes towards the instability. Water flow switches direction from time to time as sediment accumulates, thus raising the bed level. Vegetation communities also change according to individual species tolerances as flow rates, water depths, nutrient levels, etc., are altered. The Okavango system is further complicated by seismic events and by human activities such as clearing and strip farming, by cattle overgrazing and by hunting of grazing species, such as hippo, elephant and buffalo.

In short, deltas are very difficult systems to develop successfully (that is, with long-term success). All too often political or economic expedience overrides common sense and demands development of a resource for immediate gain. Near-sighted planning together with the all-too-common failure to learn from the mistakes of others who have tried in the past to develop similar systems elsewhere, almost always produces serious long-term problems. Such failure to think ahead can be particularly damaging to delta systems. They are complex and they are fragile and many mistakes have been made in the past. The Everglades swamps of Florida still survive, but the corresponding previous errors have cost literally hundreds of millions of dollars. It was mistakenly assumed that, because the resource was so enormous, it would be possible to tap it for large economic gain without significantly affecting it. The developers were wrong.

Most of the huge Huleh Swamps of Israel were removed to establish fish culture ponds; but without the nutrient-laden sediment which the Swamps had previously filtered out, fish production rapidly declined. Furthermore, the sediment now passes through Delta resources on a larger scale. Careful planning and management will be necessary.

Retention of sediment by the Aswan High Dam is causing erosion of the Nile Delta and has presumably destroyed the previously-thriving offshore fishing industry. The developers expected some changes to take place, but the scale on which these have occurred is much greater than they had predicted.

In 1954, the Jonglei Canal was projected to bypass part of the swamps in the huge Sud region of the Upper Nile in southern Sudan. The scheme was geared to release more water downstream and to control the seasonal flood pattern, so as to improve livestock potential and develop irrigated agriculture. The Canal was never built, but:
the idea is currently being revived. However, it is being met with considerable opposition from various international conservation bodies. They are not satisfied that the development engineers, in failing to propose small-scale fishing industries, fully appreciated the ecological implications of such large-scale interference.

One might add that the southern Sudan has similar problems to the Okavango regarding transport and marketing arrangements for exportable produce. There is also very serious doubt about the real cost of continuing maintenance of the Canal scheme.

There is also a price to pay for development of a resource and it is too high if it results, in the long-term, in destruction of that very resource.

The problem with deltas and with many other wetlands is that the natural resource may be extremely large, but the potentially-exploitable component of it, the economic resource, is usually much smaller than people think. The vast quantity of water and the enormous primary productivity (swamp plants have growth rates as high as, or higher than, most crop plants) must be exploitable! Of course it is, but large-scale exploitation is very expensive and man’s technology is, at present, nowhere near good enough to approach the efficiency of a natural swamp ecosystem.

It is an ecological fact that all mature natural ecosystems have evolved towards maximum efficiency in the utilization of sunlight, nutrient, water, etc. A natural community is, therefore, almost always more efficient than anything with which man can replace it. The Okavango Delta has evolved over thousands of years, and can now be said to be a mature natural ecosystem. Parts of it may be unstable, but the unstable parts today are stable: 100 years ago and 100 years from now the instability will have shifted to yet other parts. But this characteristic of shifting instability is the very property that confers stability upon the Okavango Delta as a whole. The Delta ecosystem conserves its resources of water and nutrients more efficiently than could be done by any system with which it could conceivably be replaced. The swamp plants reduce the evaporation rate to below that of an open water surface and, because these plants are all perennial, they recycle within themselves, and within their communities, chemical nutrients and carbon.

When we estimate the efficiency of any system, we express it as:

\[ \text{energy output} \times \text{energy input} \]

The Okavango Swamps will probably average about 1% efficiency. However, the formula for calculating the efficiency of a man-made ecosystem, such as agriculture, is much more complex. The energy input must include quantitative estimates of capital investment, land modification, labour costs and effort, transport costs, marketing costs, etc. The efficiency is always lower than that of the natural system being replaced. Man is usually prepared to accept this fact in order to get what he wants, but there is always a break-even point beyond which development is not justified.

The point may be further illustrated by the following relationship which is based upon sound laws accepted by physical and biological scientists alike:

\[ \frac{\text{Work done to achieve production or Rate of development or Exploitation or cash output, etc.}}{\text{Energy input}} \]

If there is an input of a lot of energy (or work) in order to obtain high productivity, one cannot possibly expect a high efficiency from the system. If you put in very little energy, you will probably have low productivity, but at least will maintain a high efficiency of utilization of the resource inputs. Given the resources available in the Okavango Delta, the natural ecosystem now provides the highest possible energy input, thus maintaining the highest possible efficiency.

The problem can be highlighted by comparing the Everglades agricultural development in the United States or the East Anglian Fen-district agriculture in Britain with man-made ecosystems established on swamp and peat lands in New Zealand. New Zealand has an agricultural base to its entire economy, but because the major export markets are situated thousands of miles away, they must produce goods much more cheaply than the United Kingdom or the USA. New Zealand can afford expensive reclamation and maintenance schemes, but New Zealand cannot do so. The break-even point for energy input occurs much sooner for New Zealand than it does for the USA or for the United Kingdom.

This analogy applies to Botswana. It is agreed that the Okavango Delta must sustain some development, but it has to be acknowledged that grandiose schemes are just not feasible propositions at this stage, and even moderate development proposals must be very carefully studied for their economic viability and detrimental effects before it considers sanctioning them. Economists and politicians must integrate their efforts and in order to fully evaluate proposals, they are suspicious of describing real-life situations with formulae and are dubious of the value of the exercise. Their mistrust is quite justified. Most of the well-studied ecosystems in the world have been described by models of one type or
another. After all, a model is much more concise than a book or a collection of
descriptive reports. Of course, models are only as reliable as the data which is used to
construct them. I admit that some of the best models we could construct today for the
Okavango Delta would not give a very good fit. But the value of the exercise is that a
model often enables us to see the wood through the trees; woolly descriptions are cast
aside to expose bare facts. Then, if the sums do not add up or a parameter appears to
be missing, we know exactly where to direct our data-collecting efforts. In time, and
with more knowledge, the model improves, until it describes sufficiently accurately
the system being investigated, so as to have predictive value. This is precisely what we
want for the Okavango Delta. We want to be able to predict, if possible, the likely
effects of particular development strategies.

On the first day of the Symposium, I proposed that attempts should be made to
model the productivity and chemical nutrient aspects of the Delta so as to establish a
“trophic model,” which may eventually be useful in predicting carrying capacities for
certain communities within the Delta. How useful it would be, for instance, to have
more accurate estimates of the maximum growth potential of the various Delta plant
communities. From this could be deduced the maximum carrying capacity of grazing
animals, and so on. There is already sufficient data to be able to construct a
preliminary ecosystem model. It would not, at this stage, be very reliable as a
predictive model, but at least we would be able to see where we should go next to
collect data to improve the model. One of the most neglected fields appears to be
accurate knowledge of primary productivity. Since directly or indirectly, animals eat
plants, it is important to establish a good base-line before developing management
plans for animals.

Later in the Symposium, we heard about preliminary attempts to construct
hydrological models, and also of research directed towards developing models with
good predictive value in respect of the management of individual game animals. Yet
again we heard of the whole suite of models, ecosystem, hydrological, economic, etc,
developed to assist with the management of the St. Lucia wetland system in Natal.

The Okavango Delta needs an integrated, multi-disciplinary approach towards
research, data collection and development. The Delta needs goal-orientated research
with monitoring of basic ecosystem parameters, so that we can understand the degree
to which they change from season to season and year to year. Some of the resources of
the Delta should be developed now — but only in a small way, so that the effects of
possible interference with the natural system can be detected, measured and used to
predict the effects of possible further development. The Delta should not be pushed to
produce more than it can reasonably be expected to do. By developing gradually and
wisely, most future development options will be kept open. In the future, there will be
more data and new development technologies, but rapid development now may later
inhibit or completely nullify. I repeat an earlier observation: “the Okavango Delta is
a huge natural resource, but its economic potential is not as great as many people
imagine.” It is like a reflection in a mirror: if you try to get at it too quickly, it will
disappear altogether. Botswana will need the Okavango Delta in the distant future as
much as it needs it now.