INSTITUTE FOR DEVELOPMENT STUDIES

UNIVERSITY COLLEGE, NAIROBI

Discussion Paper No. 87

FORECASTS OF RETURNS TO KAJIADO COUNTY COUNCIL FROM THE MASAI AMBOSELI GAME RESERVE, 1970 - 2000

BY

FRANK MITCHELL

November, 1969

Summary of Main Points

1. Expanding Amboseli's thirty square mile cattle-free area to two hundred square miles and installing the infrastructure necessary to support intensive tourism will enable the Kajiado County Council to earn profits from Amboseli of over £500,000 annually by the end of this century. The most intensive development of the thirty square miles is unlikely to yield half this much.

2. It is technically feasible and economically profitable to relocate the herds of cattle now using Amboseli in dry seasons to areas where the forage available is sufficient to permit an increase in the size of these herds. The single requirement is to provide water in the new areas. This can be done at a capital cost of £ 15,000 - or rather less than one third of the profit which the Kajiado County Council will draw from Amboseli this year.

3. The future profitability of Amboseli requires that the lands in the wet season dispersal areas (which cover around 300 square miles) be managed in ways consistent with the survival of the wildlife. This does not preclude controlled cropping by either or both of sport hunters and commercial firms/ranchers.

4. Even on very conservative assumptions about demand, the capacity of Amboseli to accommodate visitor increases will have been exhausted by the end of this century. It is therefore important that the tourist potential of other parts of Masailand be surveyed, and that the profitability of tourism be considered in the preparation of land use plans for them. The particular areas involved include, at a minimum, the Nguruman Escarpment, Kimana Swamp, the Kitengela Game Conservation Area and Namalog Swamp.

5. In order to make decisions which maximize the returns from the range resources of southern Masailand, policy-makers must have access to more and more reliable information than is presently available. This is particularly important in view of :-

a. the large range of possibilities which exist for the development of the area,

b. the extremely limited present knowledge of several important aspects of the region's ecology, and

c. the interrelatedness of different land uses at widely separated geographical points.

Information costs money. However, research on the possibilities for development could pay large dividends.

6. The complexity of the problems, and the wide geographical extent of the interactions among different land uses, pose administrative questions as well. For example:

a. What is the administrative framework which is most likely to result in optimal plans being made for the area?

b. What set of institutions is most likely to be able successfully to implement those plans?

c. What are the minimum geographical areas which must be planned as units? Administered as units?

This paper makes no recommendations on these issues. It is fair to point out, however, that there is a wide range of alternative answers to each of them, and that selection of the best alternatives requires extensive discussion between several central government ministries, local governments, and most importantly, the individuals living in the particular areas concerned.

FORECASTS OF RETURNS TO KAJIADO COUNTY COUNCIL FROM THE MASAI AMBOSELI GAME RESERVE, 1970 -- 2000*

INTRODUCTION

1. This paper has two very limited objectives:

   a. to list the factors which will determine the future size of what is even now the largest single source of revenues to the Kajiado County Council - profits from the Masai Amboseli Game Reserve; and

   b. to make forecasts of those profits for the different policy options confronting the County Council for developing the reserve.

This paper does not attempt to deal systematically with all of the cultural, political, ecological and economic factors which must be resolved if the range resources of southern Masailand are to be managed optimally in terms of some objective function.[1] Since tourism is and will continue to be one of the major economic activities in southern Masailand, examining its potential is a worthwhile task. Since the main decision-making body for Amboseli is the Kajiado County Council, it is appropriate to calculate the costs and gains of different development options to it rather than to, say, the economy of Kenya. The detailed assumptions underlying the forecasts are set out in the Appendix.

DEMAND

2. Amboseli lies in the middle of the three centres from which most non-resident visitors for the foreseeable future will begin their tours of East Africa - Nairobi, Arusha (after the completion of the Kilimanjaro International Airport in 1971), and the Coast. Demand for visits to Amboseli can therefore be expected to grow in proportion with numbers of tourists to the region. It is assumed here, somewhat conservatively, that demand by non-residents for visits to Amboseli will rise at a compound annual rate of 15%. and by residents, at 5%.

---

* I am grateful to Mr. Daniel Sindiyo, Warden, Masai Amboseli Game Reserve, for providing the visitor and accounting data which act as a basis for the forecasts made, and to the Ministry of Local Government for providing information on the accounts of the Kajiado County Council. This paper draws heavily upon the knowledge of Amboseli's natural and human ecology accumulated by David Western in the course of his research, an early summary of which appeared in David Western, Land Use in Masai Amboseli Game Reserve, A Case Study for Inter-disciplinary Discussions, Social Science Division, Institute for Development Studies, University College, Nairobi, Staff Paper No. 40, April, 1969. Discussions with T.J. Aldington, R.K. Davis, A. Jacobs, D. Leonard, E. Rado and D.J. Western, some in connection with earlier drafts of this paper, were valuable for putting the issues into perspective and clarifying the exposition of points made. Apart from the assumptions about viewing capacity of the Amboseli basin, which secured the approval of Messrs. Aldington, Davis and Western, I accept full responsibility for sins of omission and commission.

1. Some of these factors have been outlined in papers by Western, ibid., A. Jacobs, "Comments on David Western's Paper Land Use in Masai Amboseli Game Reserve", Cultural Division, Institute for Development Studies, University College, Nairobi, April, 1969, and by the same author, The Pastoral Masai of Kenya, A Report of Anthropological field Research, submitted to Ministry of Overseas Development, Eland House, Stag Place, Victoria, London SW1, 1967 - especially pages 60 -67. For general statements of the issues involved see the pages by T. Riney, R.K. Davis, D.J. Pratt, L. Berry, P.H. Pearse, and F. Mitchell in the Proceedings of the Symposium on Wildlife Management and Land Use, E. Afr. agric. for J., Vol. XXX-III Special Issue, June, 1969.

CAPACITY

3. Whether visits to Amboseli will grow in line with East African tourism depends upon whether the facilities are in place to handle the demand increases.

4. The binding constraint on the growth of tourism in Amboseli is the capacity of the reserve to accomodate at an acceptable level of amenity all of the visitors who want to go there. The 200 square miles of maximum attractiveness, which coincides with the dry season concentration area of the wildlife, cannot itself be expanded. However, the tourist capacity of the 200 square miles can be expanded in several ways. In particular, this capacity will be larger, other things being equal,

a. the more game there is in the basin. (i) Wild animals will be more numerous, the fewer the cattle in the basin. At present, with only 30 square miles of cattle-free area, cattle constitute 70% of the biomass in Amboseli.[1] Reduction in cattle numbers through expanding the cattle-free area can be expected to result in an increase in game numbers. With, say, double the amount of wildlife, (2 prides of lion for every one now, etc.), the numbers of visitors can also double without any significant increase in congestion.

(ii) The amount of game in the 200 square miles in dry seasons (which coincide with peak visitor demands) is also contingent upon unhindered access by the wildlife to, and security within, the wet season dispersal areas which cover an additional 300 square miles (see map on p.3). Maintaining Amboseli's wildlife stocks does not preclude controlled cropping in the dispersal areas, so long as due attention is paid to the effects of cropping on the size and composition by age and species of the herds which attract visitors in the dry seasons. Uncontrolled cropping, or outright elimination of large animals in the dispersal areas, on the other hand, would be disastrous. In brief, the tourist appeal of Amboseli depends crucially upon the land use practices followed in surrounding areas.

b. The more dispersed the game is. If the game is concentrated in a very small area, fewer visitor parties can be accommodated for a given level of amenity than if the game is dispersed over a larger area. Optimal dispersal will require removal of bomas which presently frighten wildlife away from large areas with good viewing potential, and research-based management practices to foster a variety of habitats within the park.

c. The more natural cover there is. Increased bush and forest in some parts of the reserve will not only enable more animals of some species to spend the dry season in the basin; it will also tend to conceal tourist parties from each other, thus permitting more vehicles to be in the park at once for a given standard of amenity.

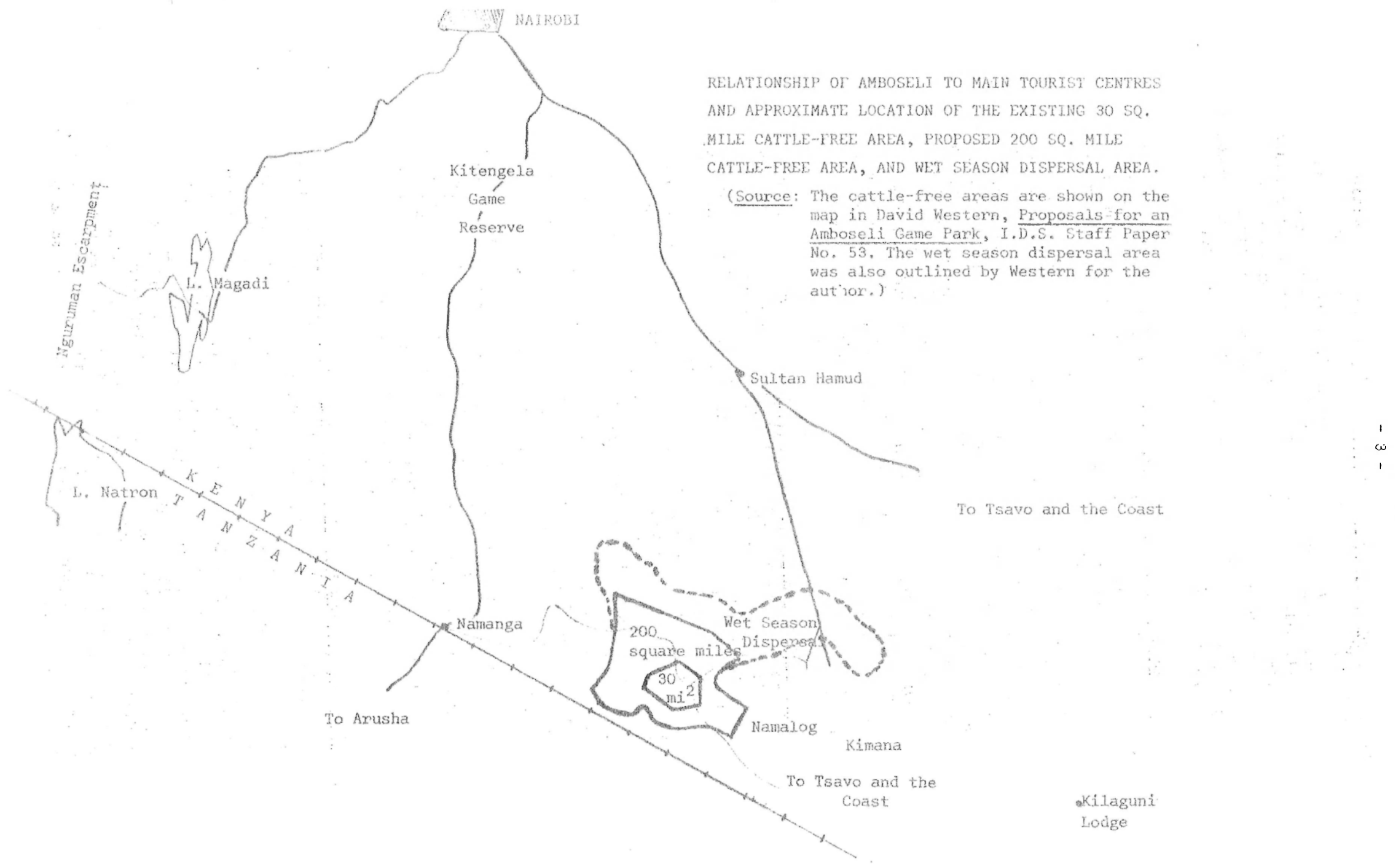
d. The more miles of viewing track there are. The more miles of viewing track along which vehicles can be spread, the more vehicles - and visitors - can be accommodated.

e. The more skillfully the viewing tracks are laid out. It is possible, through careful assessment of traffic flows, planning of intersecting and non-intersecting circuits, culs-de-sac, etc., so to locate viewing tracks that a given number of miles of track can accommodate a larger number of vehicles (for a given standard of amenity) than if such planning were not done.

f. The higher the construction standard of viewing tracks. Dust is a serious problem at Amboseli, and can be expected substantially to reduce the attractiveness of the area unless road surfaces are improved as numbers of vehicles increase.

---

1. Western, op. cit., p. 9.



RELATIONSHIP OF AMBOSELI TO MAIN TOURIST CENTRES AND APPROXIMATE LOCATION OF THE EXISTING 30 SQ. MILE CATTLE-FREE AREA, PROPOSED 200 SQ. MILE CATTLE-FREE AREA, AND WET SEASON DISPERSAL AREA.

(Source: The cattle-free areas are shown on the map in David Western, Proposals for an Amboseli Game Park, I.D.S. Staff Paper No. 53. The wet season dispersal area was also outlined by Western for the author.)

g. the larger the number of stopping points. The construction of hides, viewing platforms, and nature walks (viz. Arusha National Park, Nairobi National Park Hippo Pools, Mzima Springs in Tsavo National Park) will immobilize some proportion of tourists allowing the area to handle larger numbers of vehicles at once for a given standard of amenity. The existence of one "model manyatta" could also be a useful attraction. There is no compelling reason for it to be located within the 200 square miles - indeed, quite the reverse if viewing capacity of the reserve is to be maximised.

h. the larger the number of visitors per vehicle. Since the amenity of the park is affected by the number of vehicles, rather than the number of visitors, the visitor capacity of the park will be larger, the more visitors there are in each vehicle. From the point of view of visitors, larger vehicles would have the advantages of greater comfort, and of making it cheaper to have articulate and well-informed guides to accompany them. On the other hand, larger vehicles are more noticeable to other parties in the park, and also reduce the amount of individual choice over which attractions are seen. Numbers of visitors per vehicle can be affected by pricing policy (raising the vehicle entry fee as contrasted with the visitor entry fee). Since most visitors will travel to the reserve in vehicles which they are also using to see other attractions, the extent to which pricing policy in Amboseli alone can influence the size of vehicles used by visitors is limited. As all of East Africa's Parks become more crowded, however, the average size of vehicle used will probably rise.

i. the better trained are ranger guides. There are several ways in which ranger guides, through their actions, can increase the capacity of the park. First and simplest, rangers can direct their parties into the less densely crowded circuits on any particular morning or afternoon. Establishment of regular routings and scheduled departures may also help to reduce congestion on a given road network. Second, the better informed are the rangers about the ecology of each part of the park and the behaviour of different animals and birds, and the more skillful they are in communicating this information in an interesting way to visitors in the visitors' own languages the more time will tourist parties be willing to spend near "non-big 5" attractions. The preparation of good guide-books on the park, and the establishment of a small museum which would include exhibits on the culture of the Masai as well as natural history would also do much to raise the level of visitor sophistication. Perhaps the maximum gains in capacity to be secured under this head will come from inducing tourists to take a larger interest in the rich bird life of the area. Birds are much more widely distributed than animals, and hence provide many more local attractions near which tourists will wish to stop. The more time visitor parties remain stationary, the more parties can the park accommodate at busy times.

j. the more accommodations there are in or near the park. Many visitors going to Amboseli will fly there on one day outings. (Approximately 2,000 of the 31,500 visitors in 1968 flew to the park, although many of these stayed overnight there.) However, a majority of visitors will wish to spend one night there. (In 1968, there were 0.83 visitor nights spent in Amboseli per visitor entry. Additional nights were spent in Tsavo and at Namanga River by persons going to Amboseli.) If beds are not available in or near Amboseli, potential visitors will go elsewhere. The capacity to build more bed-spaces in Amboseli without reducing the areas suitable for wildlife viewing is strictly limited. Careful planning of the location of new lodges will be necessary to ensure that they use up no more viewing space than is necessary. Even with such planning, however, accommodating visitors will increasingly require beds to be located outside the park.

5. It is easy to list the potential ways in which the capacity of the reserve to handle visitors (and earn revenues and profitsfor the county council)can be increased. It is much harder to carry them out in practice. Maximum development of the reserve will require increased development and recurrent expenditures on:

a. research on the ecology of the area and on tourist preferences to illuminate the possibilities for intensive development;

b. economic and physical planning to decide which of the alternatives shown to be feasible by research will maximize the returns of the reserve, and to make detailed plans; and

c. administration to implement plans, build tourist capacity-raising infrastructure, train staff, and maintain a much larger plant (especially roads) than is in place now.

6. Amboseli, with the Magadi soda factory, and the meat and cement plants at Athi River, is one of the big four businesses in Kajiado District. Its contribution to education, health, road and other producer services financed by the County Council is larger than those of the other three combined. Yet its budget for research, planning, administration and mainenance of plant is probably less than one-tenth of the operating budget of any one of the others. It would be foolish to expect the profits from Amboseli to increase very much unless a much heavier commitment of resources is made to it, just as the other big businesses would soon run down if they were similarly starved of funds.

THREE DEVELOPMENT OPTIONS FOR AMBOSELI

7. There are essentially three options which can be followed with respect to the future development of Amboseli.

8. The first option is to continue with the present 30 square mile cattle-free area, and to spend no more in the future than in the past on developing and administering this area for wildlife viewing. It will be impossible even in the short run (over the next few years) to maintain the existing standard of amenity in Amboseli with present levels of recurrent expenditure. The administration of the area requires the employment of personnel with the leadership and political ability to maintain good relations with the local residents and to ensure that ranger staff perform their proper functions adequately. Personnel must also understand ecology, be able to direct the attention of researchers to the most important questions whose answers are required for sound management, and be capable of making use of research results in day-to-day running of the reserve. These skills and abilities do not come cheap. Without them, the attractiveness of Amboseli can be expected to decrease. Relaxed control over visitor behaviour would, for even present numbers of vehicles, result in a marked deterioration of habitat. Poaching would increase. It is also unlikely that the cattle-free status of the 30 square miles could continue inviolate. Under these conditions, no prudent investor would build more lodge beds to accommodate visitors to the area. While, for a few years, the County Council might get slightly larger profits from the reserve, it is most unlikely that it would for long receive more than it will in 1969 (£ 50,000-70,000). It is more likely that profits would decline as visitors shifted to spending more time in the Kenya and Tanzania National Parks which had maintained their natural attractiveness.[1]

---

1. Nothing in the above paragraph should be taken to imply criticism of the present Warden. On the contrary, it is due solely to his efforts that the deterioration in the attractiveness of Amboseli has been arrested since 1967. However, his skills were only secured on concessionary terms due to a very special set of circumstances. The point being made is that if Amboseli is to be run as an important and continuing business - as important to the people of Kajiado as the cement, soda and meat factories together - it must have sufficient resources devoted to its operation to ensure its profitability over the long run. Among other things, this means that to continue to secure the requisite quality of direction and leadership, the County Council must remunerate management at a level similar to that obtaining for posts of comparable responsibility elsewhere in the economy.

(Footnote 1 cont. on page 6.)

9. The second option is to continue with the present 30 square mile cattle-free area, and to increase the viewing potential of this area through more intensive and more scientific administration, road construction, etc.

10. The third option is to expand the cattle-free area to the whole 200 square mile dry season concentration area, to provide dry-season sources of water outisde the 200 square miles for cattle currently using the water from the swamps, and to install the infrastructure necessary to support intensive tourism.

FORECASTS OF RETURNS TO AMBOSELI

11. Before going on to the detailed comparison of these options, it is necessary to describe what magnitudes are being compared, and the likely biases in the calculations.

12. The forecasts are of financial returns, to the County Council only. They do not include estimates of central government revenues from taxes on lodge profits or from purchases of commodities subject to indirect taxation. (Petrol tax revenues generated in the reserve would alone rise to around £ 60,000 in 1990 if the reserve were intensively developed.) They do not include estimates of sales to tourists of curios and permissions to take photographs by the people of Amboseli itself. Nor do they include forecasts of the employment which will be generated by tourist expansion. For this reason, the returns to the people of Amboseli, of Kajiado District, and of Kenya as a whole can be expected to be much larger - say three or four times larger - than the figures given here.

13. The forecast county Council profits are conservative rather than optimistic, for four main reasons. First the revenue assumptions provide a receipts forecast for 1969 of £ 70,867 as compared with an estimate of £ 85-90,000 for 1969 based on actual receipts so far this year. The reason for the discrepancy is that petrol station and shop receipts are ignored in the revenue forecast for the sake of simplifying calculations.

14. Second, no allowance is made for increasing entry fees over time, or for rises in numbers of visitors per vehicle. Both changes can be expected to raise the actual future revenues and profits from Amboseli above the amounts forecasted here.

15. Third, the forecast compound annual visitor growth rates (12-13% from 1969 to 1975, 1985 and 1990) are much lower than those experienced in recent years (22% from 1964 to estimated 1969 visitor entries). (See the Appendix for details.)

16. Fourth, it is assumed that the 200 square mile option must be chosen in 1970, or not at all, and that the choice of this option raises costs over those of the 30 square mile option from that year. That is, it is assumed that the 200 and 30 square mile options are mutually exclusive from 1970. This assumption, obviously, is extremely arbitary. At present, the major factors affecting the feasibility of extending the cattle-free area from 30 to 200 square miles are social and political, rather than technical or economic. In future, when rights to exclusive use of the lands surrounding Amboseli have been legally defined, and allocated to specific individuals and groups, and when new ranching practices have been introduced, it is possible that conflicts will arise between wildlife and cattle in the wet season dispersal areas, and in the corridors leading to them from Amboseli. At that point, the feasibility of expansion will be affected by technical and economic considerations as well as political ones. Conflicts will exist

---

Footnote 1 (cont. footnote of Page 5)

For statements on the deleterious effects of insufficient funds to manage wildlife resources, see the remarks of Mr. D.W.J. Brown, ex-chief game-warden of Kenya, contained in the Proceedings of the Symposium on Wildlife Management and Land Use, op. cit., pp. 110-1, and 199. The second statement refers explicitly to the situation in Amboseli before the present warden went there.

whether the wildlife spends the dry seasons in the 30 or the 200 square miles. However, the 200 square miles will support much larger herds than the 30 square miles, and so the conflicts are likely to be more acute for the 200 square mile option. The cost of resolving these (potential) conflicts will be lower, the earlier their likelihood is recognized, and the more time there is for developing improved ranching practices which are consistent with wildlife survival. If the decision to expand the cattle-free area is delayed until after group ranches have been demarcated and are in operation, changes to accommodate wildlife may require not only expensive adjustments in ranch operating procedures, but perhaps compensation as well. Therefore, while it is probably overly pessimistic to assume that the choice of the 200 square mile over the 30 square mile option requires higher expenditures from 1970, it would equally be overly optimistic to assume that the decision could be delayed very long without substantial increases in the cost of implementing the expansion.

17. No provision has been made in these forecasts for grants which might be secured from external sources for the development of Amboseli. It is assumed that all development expenses are raised by the County Council either out of reserve profits, or from loans at 10% interest for periods of 10 years. If, as is likely, external grants were available for the development of the 200 square mile option, but not the others, these would increase the relative attractiveness of this option.

Forecast profits from developing the "30 square miles"

18. Just to maintain the present level of amenity in Amboseli will require larger expenditures in the future than in the past for reasons explained in paragraph 8. The amount by which expenditures will have to increase will depend upon whether Central Government continues to accept financial responsibility for construction and maintenance of the main entrance roads. Profits have been calculated under the alternative assumption that it does, and that it does not.

19. There are presently 60 miles of track exclusively for wildlife viewing in the neighbourhood of the 30 square mile cattle-free area. 10 of the 90 miles of entrance road are also used for wildlife viewing. If we assume that the present network of viewing tracks is capable of simultaneously handling one vehicle per mile at busy periods without reducing the level of park amenity to the point at which visitor numbers would cease growing, the capacity of the 30 square miles will come to around 17,400 vehicle entries per year, or a little over twice the estimated vehicle entries for 1969. (See Appendix for the detailed assumptions underlying this conclusion.)

20. This capacity will be reached, on the demand forecast, in 1976. It may be possible to increase the viewing capacity of the area further by improving the standard of track, building more tourist infrastructure, and intensifying administration of the reserve. The implications of doing so are discussed in paragraph 22. However, it would be impossible to build more accommodation within the 30 square miles. Even to handle the occupants of the 17,400 vehicles will require between 329 and 396 beds in the reserve (depending upon whether the annual occupancy rates achieved are 60% or 50% respectively). Both of these figures are more than double the existing 150 bed spaces available (including those in campsites), and any more beds would undoubtedly cut severely into viewing capacity of the 30 square miles.

21. The annual profits to the County Council under this option will rise up to 1976, in which year and following years they will come to £ 114,000 (if the maintenance of entrance roads is a charge on reserve revenues) and to £127,000 (if it isn't). (See Cols. (3) and (4) of text Table I and the Appendix for details.)

22. Improving the surface of the viewing tracks (tarmacing, gravelling, cement stabilization, tarring, depending upon the location of the road and frequency of use), and increasing the numbers of hides and look-out points may permit the viewing capacity of the 30 square miles to be doubled. This will require increased administrative and development expenditures. However, it will also permit the reserve to accommodate forecast visitor increases up to 1981/2, and will result, after 10 years 10% interest road improvement loans have been repaid in 1992, in annual profits to the County Council of between £180,000 and £198,000 depending upon who undertakes the

responsibility for maintaining and improving the entrance roads. (The profit forecasts for the intensive development of the 30 square miles are shown in Cols. (3a) and (4a) of Table I.)

Table 1 : Annual profits accruing to Kajiado County Council on different development strategies for Masai Amboseli Game Reserve, and Present values of Development Options

£ '000

Year	No Development w/o entry road b/	Development options: 30 square miles w. entry road a/ Extensive	30 square miles w. entry road a/ Intensive c/	30 square miles w/o entry road b/ Extensive	30 square miles w/o entry road b/ Intensive c/	200 square miles w. entry road a/	200 square miles w/o entry road b/
(1)	(2)	(3)	(3a)	(4)	(4a)	(5)	(6)
1969 d/	48	48	48	48	48	48	48
1970	50	41	41	54	54	26	39
1972	50	62	62	75	75	55	68
1974	50	90	90	102	102	76	89
1976	50	114	104	127	118	103	115
1978	50	114	104	127	122	135	153
1980	50	114	97	127	128	167	198
1985	50	114	60	127	130	205	280
1990	50	114	125	127	182	257	325
1995	50	114	180	127	198	329	357
2000	50	114	180	127	198	511	540
Present (1970) Value e/ of Options at Interest Rate of :-							
10%	521	968	902	1,099	1,177	1,373	1,674
20%	299	484	(N.C.)	559	566	534	655

N.C. not calculated, since this figure will be less than that of col(3).

a/ The improvement and maintenance of entry roads are the financial responsibility of the game reserve.

b/ The improvement and maintenance of entry roads are not undertaken by the game reserve.

c/ Assumes that it is possible to double the viewing capacity of the 30 square miles by investment in road improvements and higher administrative costs.

d/ This is the 1969 profit using the estimation procedure followed for making the profit forecasts. For reasons explained in text paragraphs 13-15 this procedure underestimates "actual" profit for 1969 and following years.

e/ The time horizon used is the year 2000. The reason for this choice is that 2000 is the first year in which there are no more repayments on the road development loans in the 200 square mile development option. Source see Appendix tables VII (a) and VIII.

Forecast Profits from developing the "200 square miles"

23. The first requirement for developing the 200 square mile basin as a cattle-free area will be to provide sources of water for the cattle which presently drink at the Amboseli Swamps in dry seasons. This can be provided at a capital cost of £ 15,000, and a recurrent cost (including a small provision for replacement of machinery) of £ 2,000. While it would undoubtedly be more "economic" to relocate the cattle herds over the next several years, it is assumed here that relocation - and the £15,000 investment in it - is undertaken in 1970.

24. If the whole 200 square miles of the Amboseli basin is made a cattle-free area, it will be possible to increase the track suitable for wildlife viewing to 300 miles. Of this, 140 miles will be suitable for intensive viewing (one vehicle per mile at slightly improved road standards at busy times), another 80 miles for viewing intensities of 1 vehicle per 2 miles of track, and 80 miles of boundary road capable of handling one vehicle per 4 miles of track. The visitor forecast indicates that this capacity will be fully utilized in 1983.

25. Assuming that road and other infrastructural improvements can double the 1983 capacity of the 200 square miles, the basin would be capable of handling 400 vehicles at busy times, or rather over 99,000 vehicle entries per year. This capacity limit would be reached in 1990 on the forecast.

26. Such intensive development of the reserve will require much higher research, administrative and maintenance expense than the alternative of developing the 30 square miles. It is assumed that these expenses are higher for the 200 square mile option than the 30 square mile option from 1971, and rise more rapidly until park capacity is reached. It also involves a road construction programme costing in excess of £ 1.6 million over the next 20 years (including £ 320,000 to raise the standard of existing entry roads).

27. Table 1 shows the profit forecasts for the three main options. It is assumed for the "no development" option that the County Council is not responsible for improvement and maintenance of entry roads. The returns under the other options are calculated under both assumptions about the allocation of this responsibility. The last two rows of the Table show the present values of the three options, calculated at interest rates of 10% and 20%.[2]

---

1. See D. Western, Proposals for an Amboseli Game Park, Social Science Division, Institute for Development Studies Staff Paper No. 53, for the location of the boreholes and pumping installations necessary.

2. The present value of a stream of profits is the amount of money which, if invested today (1970 in our example) at the interest rate used for calculating the present value, could just yield that profit stream over time. For example, ignoring taxation, if an investor wished to buy Amboseli from the County Council, and if he believed the profit forecasts made here are correct, and if he required a 20% return on his money, he would be willing to pay £ 655,000 for the right to secure the profits on the 200 square mile option (when entry roads are maintained by central government), and £ 566,000 to secure the profits on the 30 square mile option.

The rate of interest which equates the present value of the 200 square mile option and the extensive 30 square mile option is around 30%.[1] Chart one summarizes the visitor and profit forecasts for the extensive 30 square mile option, and the 200 square mile option.

THE ROLE OF LIVESTOCK

28. Livestock has been mentioned in the above paragraphs mainly as an impediment to tourist development. This it is - within the 200 square miles. However, there is no reason for cattle and tourism to be in conflict over the whole of southern Kajiado in the near future. Aldington[2] has shown that if water is provided, more cattle could be supported in areas immediately outside the 200 square miles during dry seasons than are presently supported within them. (The expense of providing this water supply was included in the costs of the 200 square mile development option above.) The fact that provision of water would permit the Masai presently using Amboseli to have more cattle than they do now means that no compensation need be paid for relocation on grounds of income maintenance. However, in so far as seasonal residents of the basin own traditional rights to the land there, it may well be that they should receive some of the returns accruing to that land on legal, moral or social grounds. Further analysis of this issue lies outside the scope of this paper.

29. It was stated in Paragraph 4a above that maximum development of Amboseli for tourism will depend upon wildlife having access to 300 square miles of wet season range. At present, there is no conflict between cattle and wildlife in the area. The drying-out of water holes and pans forces both cattle and wildlife to migrate away from it before most forage has been consumed. In future, there are plans for dividing this area into group ranches with water provided, and hence eliminating the necessity for out-migration of cattle. Given the large seasonal variation in nutritional content of most grasses in the wet season area, such ranches may not be viable. If they are, there may be a future conflict between cattle on the one hand, and Amboseli tourism on the other. Research is called for, both to establish the technical feasibility of alternative schemes for range management in the area, and to illuminate the ways in which returns from cattle and tourism can be jointly maximized.

DISCUSSION OF THE FORECASTS AND CONCLUSIONS

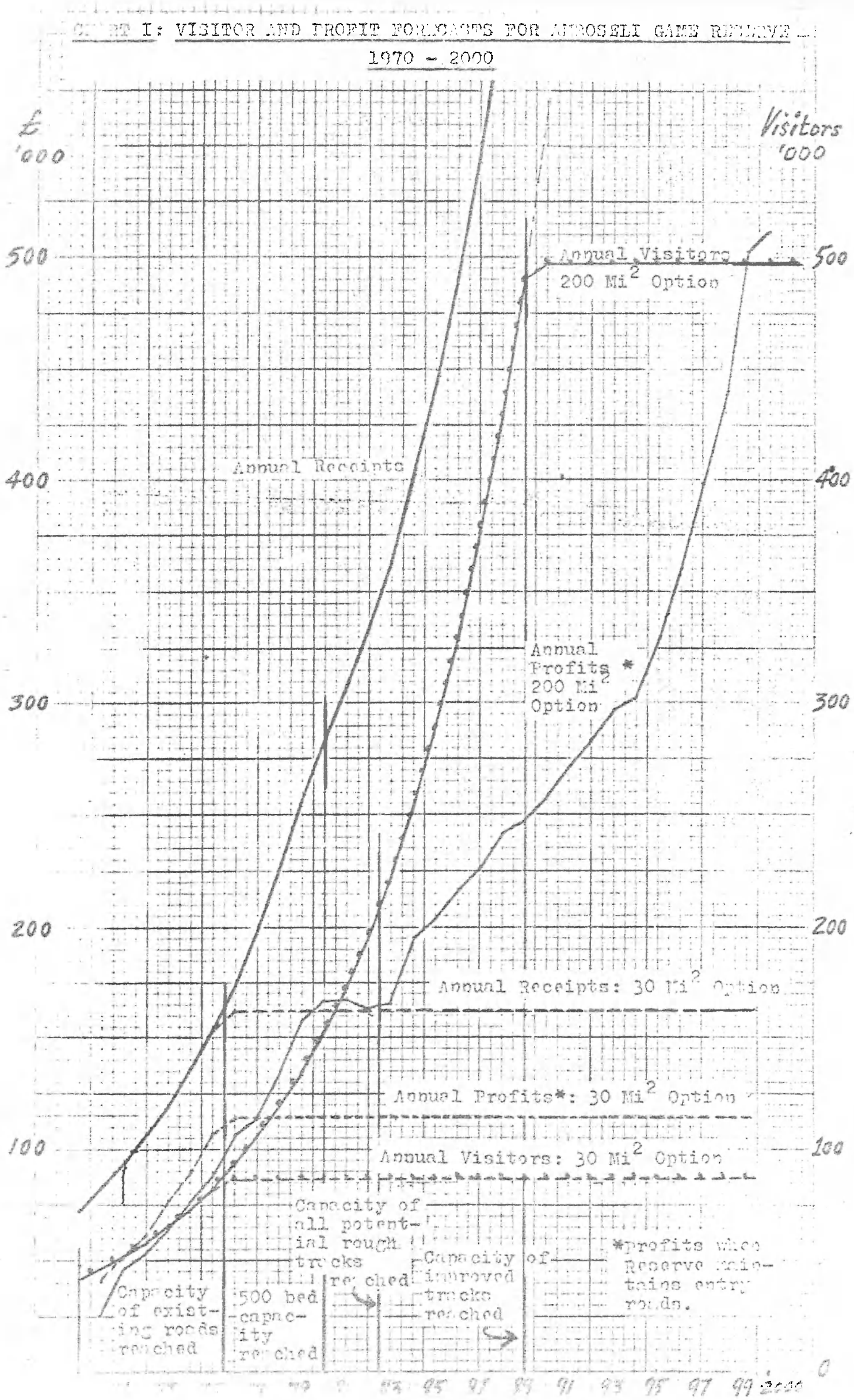
30. The above forecasts of tourist returns indicate that the most profitable - for the County Council - option for the development of Amboseli is to convert the 200 square miles into a tourist attraction (unless the County Council uses discount rates in excess of 30% in evaluating investment projects).

---

1. 31% when entry roads are improved and maintained by central government, 27% when they are maintained by County Council. The present value of the profits stream of the former at a discount rate of 30% is £ 374,000, and at 31% will be a little lower. (Tables with discount factors for 31% were not available.) The estimates of the rates at which present values of different options would be equated were made by interpolating the PV's of the flows in col. (4) in Appendix Table VIII plotted against the different interest rates at which the PV's were calculated.

2. T.J. Aldington, "Livestock Aspects in the Development of Amboseli", IDS Staff Paper., forthcoming. See also Western, op. cit., p.4.

CHART I: VISITOR AND PROFIT FORECASTS FOR AMBOSELI GAME RESERVE — 1970 – 2000



31. It must be emphasized that this option will require considerable resources to be devoted to research and planning. Research and planning activities must cover more than the area of Amboseli itself, for several reasons. First, the capacity of Amboseli to accommodate overnight visitors is strictly limited. The intensive tourist development of the 200 square miles will create a demand for around 2,000 beds in the area. If Amboseli can absorb 500, it is clear a large number will have to be built outside. Providing pleasant accommodations on this scale, properly served with facilities such as water, will require that planning be done to ensure that hotel sites are available when required.

32. Second, we have noted the necessity for more research on the ecology and ranching potential of the wet season dispersal areas. Proper management practices in those areas are essential to the success of Amboseli.

33. Third, the visitor forecasts indicate that the potential of Amboseli to accommodate visitor increases will have been exhausted well before the end of the century. This means that there will be a rising demand for visits to neighbouring areas with wildlife attractions. Indeed, it may be profitable to open up alternative sites before making the enormous investments necessary to bring Amboseli up to maximum capacity. The areas involved are the Kimana Swamp, Namalog Swamp, Nguruman Escarpment, and Kitengela Game Conservation Area. An overall survey of the development potential of Southern Masailand could indicate the desirability of developing these attractions for tourism in the near future. Certainly, careful studies should be carried out if there is any chance that these areas will be developed in ways which render impossible their subsequent development for wildlife-based tourism.

34. The size of the gains to be secured from proper management of the natural resources of southern Kajiado (and Narok), the importance of research in determining what proper management is, and the interrelatedness of developments over large parts of the District, are clear. What is not so clear is the appropriate institutional means for ensuring that the undoubted potential of the area is exploited to the benefit of the Masai resident there, all Masai in Kajiado and Narok and the people of Kenya as a whole. Alternatives such as continuation of the present institutions, the formation of a "Southern Masai Land Development Corporation", or the formation of new bodies for co-ordinating the work of existing agencies all warrant discussion.

APPENDIX: DETAILED ASSUMPTIONS UNDERLYING THE AMBOSELI FORECASTS

Demand

Table I shows entries of visitors and vehicles to Amboseli for the years 1964 to 1969(est). It also shows the numbers of hotel bednights occupied in the "Southern Game Area" of Kenya for the years 1965 to 1969 (est.).

It will be noted that visits to Amboseli have been increasing more or less in line with hotel bed-nights occupied in the larger area.

The assumptions used for the forecasts - 15% compound annual growth of non-resident visitors, 5% growth of residents, yielding 12-13% growth rates for all visitors and vehicles - are decidedly conservative compared with recent trends.

Cols. (2) to (5) of Table II show the visitor and vehicle forecasts based on the above assumptions to the end of the century. The other columns in the Table are explained later.

Capacity

Wildlife Viewing Capacity: Demand

It is the standard of amenity provided by the park at busy times which is important for determining how many visitors are willing to go on an annual basis, and how much they are willing to pay for the privilege.

Perhaps as many as one half of the visitors to the park are there at "busy" times. For example, 4,139 road visitors entered the park in August, 1968, 3,670 in February, and 3,555 in January, for a total of 11,364 or 38% of annual visitors in only ¼ of the year. (The analogous figures for vehicle entries were 921, 815 and 735, for a total of 2,471 or 36% of vehicle entries.) Within these months - and in others - there are some days which are much busier than daily averages for the above months would indicate.

On any particular day, the number of vehicles spending time in the reserve exceeds the vehicles entering the reserve by the number of vehicles which have remained over from the previous day. In 1968, visitors spent 26,102 nights in the reserve, or an average of 0.83 nights per visitor entry into the park. Assuming that visitors who stayed in the park overnight travelled in the same sized parties as visitors who did not, there were 1.83 vehicle days in the park per vehicle entry in 1968. At "busy" times, the ratio was lower, since accommodation capacity was less than viewing capacity. (That is, given existing prices and attractiveness of the park, more people would like to stay in the lodge than can be accommodated, and so they have to take day trips to the park and stay elsewhere.) Thus, for the first 21 days of August, 1969, for which good information is available upon lengths of stay of vehicles in the park, it was found that vehicles were in the park for 1.3 days on average. (Vehicle entries averaged 40 per day and vehicles in the park averaged 52.2 per day. On some days within the period, entries rose to 50, and vehicles in the park to 70.) This exercise assumes that for busy days, the ratio of vehicle days to vehicle entries is 1.3, as in the first 21 days of August, 1969.

The number of vehicles in the park on a particular day overestimates the demand for viewing capacity, if we measure capacity by the number of vehicles which can be simultaneously accommodated on the wildlife circuits without "excessive" congestion. Some vehicles in the park on a particular day leave before others arrive, and others are parked at the lodge rather than being driven on the viewing tracks. For purposes of forecasting, it is assumed that 2/3 of the vehicles in the park on busy days are simultaneously on the wildlife circuits at peak viewing times (3 morning, and 3 late afternoon hours).

The above assumptions imply that capacity demanded at busy times (measured in numbers of vehicles which can be accommodated on viewing tracks without "excessive" congestion) will be 1.3X2/3 of entries, or 0.867 times average entries per day. For the first 21 days of August, 1969, this yields a demand for capacity of 0.867X40= 34.7 vehicles. Alternatively, each unit of capacity in the park can accommodate 1.154 entries at peak times.

Table I: Visitors and Vehicles Entering Amboseli, and Bed-nights spent by Non-residents and Residents of East Africa in "Southern Game Area" of Kenya, 1964-1969 (est).

Year	Entries to Amboseli		Bednights spent in Southern Game Area ('000 bed-nights)		
	Visitors	Vehicles	non-Residents of E.A.	Residents of E.A.	Total
1964	15,459*	3,000*	n.a.	n.a.	n.a.
1965	17,714*	3,528*	27.9	23.5	51.4
1966	20,834*	5,507*	48.7	21.8	70.5
1967	23,859	6,037	57.7	21.3	79.0
1968	31,497	6,819	72.6	26.4	99.0
1969 (est.) **	41,545	8,592	82.9	31.0	113.9
Compound annual growth 1965-69	23.7%	25.0%	31.2%	7.2%	22.1%

n.a. not available

* These figures are not entirely reliable, and may be lower than the "true" numbers.

** First two columns estimated on the basis of visitors for the first four months of 1969, and August and September 1969 compared with the same months for the previous year. Estimates of bed-nights are based on the increase in the first one half of 1969 compared with the same period a year earlier.

Source: Entries to Amboseli: Warden, Masai Amboseli Game Reserve
Bed-nights: Kenya Statistical Digest, Quarterly Economic Report. September, 1969, Vol. VII- No. 3, p.9.

Table II: Forecoasts of Visitors, Miles of Road Built and Improved

Year	Number of Visitors: non-residents	Number of Visitors: residents	Number of Visitors: Total	Number of Vehicles	Viewing Capacity Demanded (vehic. at peak times)	Miles of Road Built	Cumulative miles of Road	Miles of Road "Improved"
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1969	27697	13848	41545	8592	34.6	-	150	-
1970	31852	14540	46392	9278	37.4	-	150	-
1971	36629	15267	51896	10379	41.8	-	150	-
1972	42124	16030	58154	11631	46.8	-	150	-
1973	48442	16832	65274	13055	52.6	-	150	-
1974	55710	17674	73384	14678	59.1	-	150	-
1975	64066	18558	82624	16525	66.6	5.0	155	-
1976*	68079*	18895*	86895*	17379*	70.0*	n.a*	150*	-
1976	73674	19486	93160	18632	75.0	9.7	164. 7	-
1977	84725	20460	105185	21037	84.7	11.1	175. 8	-
1978	97435	21482	118927	23785	95.8	12.6	188. 4	-
1979	112051	22557	134608	26922	108.4	14.5	202. 9	(20.0)
1980	128858	23684	152542	30508	122.9	16.5	219. 4	(20.0)
1981	148187	24870	173057	34611	139.4	37.8	257. 2	(20.0)
1982*	149824*	5992*	173790*	34750*	140.0*	-	150. 0*	
1982	170414	26112	196526	39305	158.3	44.0	301..2	(20.0)
1983	195976	27418	223394	44679	180.0	78.8	380. 0	5.0
1984	225373	28789	254162	50832	204.7	-	380. 0	28.4
1985	259177	30229	289406	57881	233.1	-	380. 0	32.6
1986	298047	31740	329787	65957	265.7	-	380. 0	37.3
1987	342750	33327	376077	75215	303.0	-	380. 0	48.7
1988	394184	34994	429178	85836	345.7	-	380. 0	128.4
1989	453317	36743	490060	98012	394.8	-	380. 0	19.6
1990*	459797*	36743*	496540*	99308*	400.0*	-	380. 0*	-
1990	521313	38581	559894	111979				
1995	1048525	49239	1097764	219553				
2000	2108960	62842	2171802	434360				

* Numbers corresponding to capacity limits, in 1976 for the extensive 30 square mile option in 1982 for the intensive 30 square mile, and in 1990 for the 200 square mile option.

Explanation of Columns

Col (2): Number of non-residents: It was assumed that two thirds of 1969 visitors were non-residents of Kenya, andthat they increase at 15% per year.

Col (3): Number of Residents: It was assumed they increase at 5% per year.

Col (4): Total Visitors (2) + (3)

Col (5): Number of vehicles. It was assumed that there are five visitors per vehicle. This compares with a rate of 4.6 for 1968, and an estimated 4.8 for 1969.

Col (6): Viewing capacity required is explained in the text.

Col (7): These are miles of track built. The number of miles of viewing track required per vehicle is indicated in Table III, which also shows the total number of miles of each type of track assumed possible.

Col (9): The 80 miles of track improved indicated in brackets are the entry roads (excluding 10 miles which are suitable for viewing). It was arbitrarily assumed that they were reconstructedand regravelled in the four years preceeding the improvement of viewing tracks.

In order to convert forecasted annual entries into demands for capacity, or assumed capacity figures into annual visits permitted by capacity, it is necessary to adjust the above figures for seasonality. Entries in the first 21 days of August, 1969, came to 9.76% of estimated 1969 entries. Assuming these days were "typical" of "busy" days, maximum annual entries per unit of capacity will come to 1.154X21/0.0976 = 248.3. The capacity required by one entry per year comes to 1/248.3 = 0.004. This is the assumption which underlies column (6) of Table II.

Wildlife Viewing Capacity: Supply

Assessing the viewing capacity of Amboseli requires answering the following series of questions. At what level of congestion (given the attractiveness of Northern Tanzania parks and other Kenya parks, and their entry fees) are visitor numbers likely to cease rising due to a decline in the amenity of the park as presently organized? At what cost is it possible to increase the numbers of visitors who can be accommodated at a given level of amenity? And what type of facility must be constructed to permit the increase?

It is assumed here that the basic constraint on wildlife viewing capacity at Amboseli is the miles of viewing road and track in those parts of the basin with substantial numbers of animals. Col (2) of Table III indicates an estimate of the miles of road and track presently used by visitors. Of the total of 150, 70 miles are used by parties viewing animals, and the remaining 80 miles are used only by visitors travelling to or away from the reserve.

If the cattle free area were extended to 200 square miles, and the stock of game increased within the areas presently used primarily by cattle, it is possible that an additional 230 miles of road and track suitable for wildlife viewing could be constructed. (See Col (3)).

Column (4) indicates assumed maximum "acceptable" levels of congestion on each type of track at current or slightly improved construction standards. Clearly, the "acceptable" vehicles per mile ratios will depend upon how many attractions there are at which visitors wish to stop, how many of them duplicate other attractions (e.g. if there are 5prides of lion on view, it will be a rare visitor party which will want to find andspend time beside them all), how long visitors stay beside particular attractions, how far they must travel between them, and the average time spent on a game drive. These things are all affected by policies of the types mentioned in text para. 4. Specification of these policies, their effects, and their costings must await detailed research and formulation of management plans for the park, (It should, however, be emphasized that the cost assumptions made below include substantial sums for preparation of plans and implementation of them.) In favour of the simple congestion assumptionsof this paper is that they secured the acquiescence of several individuals knowledgeable about East African tourism and Amboseli.

Column (5) indicates the maximum annual entries possible for maximum congestion levels for each type of track, given the assumptions about seasonality of demand outlined in the last section of the Appendix.

Finally, it is assumed that improving the standards of track (tarmacing of heavily used tracks, constructing passing points and viewing aprons, realigning sections of track, building more culverts and so on) will double the capacity possible on "rough" tracks. Column (6) indicates the maximum number of annual entries which Amboseli could accommodate on this capacity assumption.

TABLE III: CAPACITY OF TYPES OF ROADS, ACTUAL AND POTENTIAL MILES OF DIFFERENT TYPES OF ROADS AND TRACKS.

Type of Road	existing miles of road in 30 sq. mile of cattle-free area	possible miles of road in 200 sq. mile cattle-free area.	Capacity on busy days for viewing (vehicles per mile of track at busy times)	annual entries possible on rough track all possible miles in place at "rough" standard	annual entries possible with improved track
(1)	(2)	(3)	(4)	(5)	(6)
Entrance Roads (excl. 10 miles suitable for viewing, incl. below)	80	80	-	-	-
Intensive viewing track (incl. 10 mile entrance road)	70	140	1	34,758	69,516
Extensive viewing track	-	80	½	9,931	19,862
Boundary Road	-	80	¼	4,965	9,931
Totals	150	380	-	41,654	99,309

TABLE : NUMBERS OF BEDS REQUIRED IN OR NEAR AMBOSELI TO ACCOMMODATE FORECASTED DEMAND *

Year	Beds required when annual occupancy rate is	
	50%	60%
1970	211	176
1975	376	313
1980	694	578
1985	1,316	1,097
1990	2,258	1,882

* This forecast is based on nights' spent inside Amboseli in 1968. It takes no account of bednights spent in Tsavo or at Namanga River by visitors to Amboseli. Nor does it adjust for the current shortage of beds in Amboseli.

Wildlife Viewing Capacity: Development Forecasts

Column (6) of Table II indicates the amount of wildlife viewing capacity demanded given the vehicle entry forecasts of Col. (5) in that table.

Column (7) indicates the miles of viewing track built in each year to accommodate the following year's increase in demand for capacity under the 200 square mile option.

Column (9) shows the miles of track improved under the 200 square mile option. The figures in parentheses are miles of entrance road improved, which were arbitrarily assumed to be improved in the four years before it was necessary to raise the standard of viewing tracks. For the intensive 30 square mile option, it was assumed that entrance roads were improved in the same years as those shown in the Table. Under this option, viewing track had to be improved from 1975 (since expansion of "rough" tracks was impossible).

To summarise the capacity forecasts: existing capacity will be fully utilized in 1975/6; the doubling of existing capacity which can be secured by improving the existing track network will permit accommodating the demands forecasted up to 1981/2; under the 200 square mile option, the expansion of "rough" tracks will permit accommodation of demands forecasted up to 1983, and maximum capacity (after upgrading of tracks) will be reached in 1990.

Accommodating visitors forecast to visit the park beyond 1990 would, on the assumptions used here, require that the ratio of visitors to vehicles increase.

Accommodations Capacity

The capacity of Amboseli to hold more beds, whether in lodges, self-service bandas or campsites, is strictly limited. Already the "urban sprawl" in the neighbourhood of Ol Tukai is using up a substantial amount of prime wildlife viewing area.

There is at present capacity to handle 150 visitors per night in Amboseli (including campsites). For purposes of this exercise, it is assumed that this total can be raised to 500 if the 200 square mile option is chosen. If, on average, there is a demand of 0.83 bed-nights per visitor entry in future, as there was in 1968, the numbers of beds required in or near Amboseli will rapidly exceed this limit. Table IV shows the number of beds which must be in place to handle future visitor demands for selected years under alternative assumptions about annual occupancies. (It might be noted that the basis for projecting demands does not include bed-nights currently taken outside Amboseli at Namanga River Hotel and Tsavo Lodges. Inclusion of these figures would raise the estimates shown.) These forecasts also ignore existing shortages - making them doubly conservative.

Revenue Assumptions

It is assumed that each non-resident visitor pays £1 to the Masai Amboseli Game Reserve, and each resident £$\frac{1}{4}$. It is further assumed that the reserve receives £1 per bed night occupied inside the reserve - but not outside. Bed nights rise to a maximum of 118625 in 1980 on the 200 square mile option, at which point accommodation capacity is reached (500 beds, occupied 65% of the time). Finally, it is assumed that the Reserve receives £1 per vehicle entering (£$\frac{1}{2}$ entry fee, £$\frac{1}{2}$ ranger-guide fee).

These revenue estimates exclude petrol station receipts and receipts from the shop, which in 1969 will add as much as £ 20,000 to the revenue estimate of £70,867 derived on the above assumptions. Thus, the forecast revenues are conservative.

Table V: Revenue Forecasts of Amboseli Game Reserve, 1969-2000.

Year	200 square mile option					30 square mile option	
	Revenues from non-resident visitors	Revenues from resident visitors	Revenues from vehicles	Revenues from visitor nights	Total Revenues	Total Revenues	
						extensive development	intensive development
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1969	27697	3462	8592	31116	70867	70867	70867
1970	31852	3635	9278	38505	83270	83270	83270
1971	36629	3817	10379	43074	93899	93899	93899
1972	42124	4008	11631	48268	106031	106031	106031
1973*	48442	4208	13055	54177	119882	119882	119882
1974	55710	4418	14678	60909	135715	135715	135715
1975	64066	4639	16525	68578	153808	153808	153808
1976	73674	4871	18632	77323	174500	162285*	169300
1977	84725	5115	21037	87304	198181	162285*	183000
1978	97435	5371	23785	98709	225300	162285*	198714
1979	112051	5639	26922	111725	256337	162285*	216735
1980	128859	5921	30508	118625	283913	162285*	237411
1981	148187	6217	34611	118625	307640	162285*	261138
1982	170414	6528	39305	118625	334872	162285*	262697*
1983	195976	6854	44679	118625	366134	162285*	262697*
1984	225373	7197	50832	118625	402027	162285*	262697*
1985	259177	7557	57881	118625	443240	162285*	262697*
1986	298047	7935	65957	118625	490564	162285*	262697*
1987	342750	8331	75915	118625	545621	162285*	262697*
1988	394184	8748	85836	118625	607393	162285*	262697*
1989	453317	9186	98012	118625	679140	162285*	262697*
1990	459797	9186	99308	118625	686916*	162285*	262697*
1991	459797	9186	99308	118625	686916*	162285*	262697*
2000	459797	9186	99308	118625	686916*	162285*	262697*

* The park reaches capacity in 1976 under the extensive 30 square mile option, 1982 under the intensive 30 square mile option. It reaches capacity in 1990 under the 200 square mile option.

Table VI: Annual Maintenance Cost of Different Types of Road (£ per year)

Type of Road (vehicles per day)	Maintenance	Regravelling	Total
	£	£	£
over 300	300	65	365
201-300	250	65	315
101-200	200	60	260
50-100	150	50	200
under 50	100	40	140
M.F.T.	100	30	130
Bitumen (18' carriageway)	150	200 (rescaling)	350

Source: Ministry of Works

Cost Assumptions

Road Maintenance

Increased Expenditures on maintenance of roads will have to be incurred under all "development" options. Table VI indicates the funds allocated by the Ministry of Works to provincial engineers for maintaining roads with various densities of use (1969/70 figures). These funds are intended to cover all overheads associated with road maintenance, as well as direct repair costs, and apply to all areas of Kenya. Since rainfall in Amboseli is much lower than in much of the rest of Kenya it can be expected that maintenance costs there would be lower than for most other parts of the country. On the other hand, in so far as the reserve is unable to reap the full economies of scale possible in road maintenance, the above assumptions are followed, with modifications indicated below.

Entry Roads: The construction and maintenance of the entry roads are presently financed by contracts let by Central Government and grants to the County Council. The cost forecasts of Table VII do include them, however, so as to evaluate the profitability of Amboseli to the County Council if it were to take over responsibility for all road maintenance.

The M.O.W. maintenance and regravelling figures of Table VI are used for estimating the cost of mainteining the entrance roads. In order to arrive at traffic densities, it is assumed that each entering vehicle travels over each mile of entrance road. Thus, vehicles per day can be found by dividing annual entries by 365.

Viewing track: the procedure followed for wildlife viewing track is different. Vehicle days in the park will come to the number of visitor entries + the number of bednights divided by 5. If we assume that each vehicle-day involves 30 miles of travel on wildlife viewing circuits (so that a vehicle which stays in the park overnight and goes on an evening and morning game drive travels a total of 60 miles on the circuits), we can secure density figures by dividing the number of wildlife viewing track miles times 365 into the vehicle miles travelled per year. This procedure never results in more than 50 vehicles per day using the average stretch of viewing road. Some of the intensive viewing circuits will have higher densities than this, however, and it is therefore arbitrarily assumed that maintenance of viewing track costs £ 170 per mile per year. For the early years when there are more miles of road (larger capacity) than are demanded (for the assumed amenity standard), it is assumedthat the demand for capacity measures the miles of road for purposes of this calculation.

Administrative Expense

Total 1969 recurrent expenditure of the reserve is estimated at £ 23,000. Some of this is required for road maintenance. Some consists of petrol for the petrol station, the returns from which are excluded from the forecasts. It is arbitrarily assumed that non-road and non-petrol costs rise to £ 25,000 in 1970 on both "development" options. This increase is probably in the neighbourhood of £ 10,000 over cost of similar items in 1969.

Under the extensive 30 square mile option, these costs are assumed to remain constant. In evaluating the returns from intensifying development of the 30 square miles, it was assumed that administrative expense rose to £ 35,000 in 1976 from £25,000, and rose at 7% p.a. to 1982 (£52.525) when capacity was reached.

Under the 200 square mile option it is assumed that "administrative" costs rise by 10% per annum compound for the first decade, and at 5% per annum from 1980 to 1989 after which they remain at £96020 per year. These expenditure increaseswill permit the finance of research and planning activities, as well as investment in and maintenance of hides, lookout towers, etc.

Water Supply to Cattle

(See text paragraph 23.)

Road Construction

Rough Tracks: It is assumed that rough tracks can be constructed at a cost of £ 200 per mile (or only slightly more than annual maintenance expenditures on viewing track). Both the maintenance and construction expenditures assumed for rough viewing track are generous - given the nil cost of most existing track!

Improved Tracks: Improvement of tracks is assumed to cost the following, per mile:

Entry Roads: £ 4,000 per mile

Intensive viewing tracks: £ 6,000 per mile (some of these will probably have to be paved, at a cost of over £ 10,000 per mile)

Extensive viewing tracks and boundary road: £ 3,000 per mile. This was the cost of the Amboseli end of the Amboseli-Tsavo Road. It was lower than the average for the whole road (£ 3,600) because of the availability of gravel in and near Amboseli.

It is assumed that these costs are financed by 10 year loans at 10% interest.

It is assumed that none of the roads wear out before the end of the century.

Summary Tables and Profits

The cost flows are portrayed in Table VII for the extensive development of the 30 square miles and for the 200 square mile option. Table VII(a) gives the cost and profit flows for the intensive development option for the 30 square miles.

Table VIII shows profits, and the difference between profits accruing on the extensive 30 square mile option and the 200 square mile option.

The rate of return over cost of developing the 200 square miles versus the 30 square miles to extensive standard lies between 27% (when maintenance and improvement of entrance roads are charges on the reserve) and 31% (when they are not). The meaning of this figure is that if the rate of return used by the County Council in evaluating investments (on education, roads, health, etc.) is less than 27% (31%), it will pay to develop the 200 square miles rather than develop the 30 square miles extensively. (The rate of return on the 200 square mile option, over the intensive development option for the 30 square miles, when entry roads are not a charge on the reserve, is a little over 32%. It is uninteresting to do the calculation for intensive development of the 30 square miles when entrance roads are a charge on the reserve, since this option is inferior to extensive development of the 30 square miles even at a discount rate of 10% - see table 1 in the text.)

Note on the Phasing of Investments

It is believed, as pointed out in the text, that the phasing of the investment in boreholes tends to reduce the relative attractiveness of the 200 square mile option versus that of the 30 square mile options more than is necessary.

The phasing of the road investments is determined by the assumption that road capacity is constructed to accommodate the demand forecasts.

The phasing of increases in 'administrative' costs (for which read costs of research, planning, construction of viewing infrastructure other than roads) is arbitrary. It is not felt that the assumptions used tend to favour the 200 square mile option, however, and perhaps the reverse is true.

Inflation

None of the cost estimates takes account of likely inflation. It is appropriate to ignore inflation in these forecasts, since they also assume that prices charged to visitors will not rise. Presumably charges to enter and use the reserve will rise at least in line with inflation of costs in future.

Table VII: Forecasts of Costs of Amboseli Game Reserve, 1970-2000, (£)

Year	Cost of Maintaining viewing tracks @ £170 per mile	Cost of Maintaining entrance roads	Cost of installing and maintaining boreholes/ piping	Administration, research planning	loan repayment on road improvement	construction of rough viewing track @ £ 200 per mile	Total on 200 square mile option incl. entrance roads	Total on 200 square mile option excl. entrance roads	Total on 30 square mile option incl. entrance roads	Total on 30 square mile option excl. entrance roads
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1970	4658	12600	15000	25000	–	–	57258	44658	42258	29658
1971	5406	12600	2000	27500	–	–	47506	34906	43006	30406
1972	6256	12600	2000	30250	–	–	51106	38506	43856	31256
1973	7242	12600	2000	33275	–	–	55117	42517	44842	32242
1974	8347	12600	2000	36603	–	–	59550	46950	45947	33347
1975	9622	12600	2000	40263	–	1000	65485	52885	47222	34622
1976	11050	12600	2000	44290	–	1940	71880	59280	47820	35220
1977	12699	18000	2000	48718	–	2220	83637	65037	47820	35220
1978	14586	18000	2000	53590	–	2520	90696	72696	47820	35220
1979	16728	18000	2000	58947	–	2900	98575	80575	47820	35220
1980	19193	18000	2000	61895	13020	3300	117408	86388	47820	35220
1981	21998	18000	2000	64990	26040	7560	140588	96548	47820	35220
1982	28424	23400	2000	68238	39060	8800	169922	107462	47820	35220
1983	35904	23400	2000	71651	52080	15760	200795	125315	47820	35220
1984	49300	23400	2000	75235	50963	–	200898	131418	47820	35220
1985	49300	23400	2000	78996	84637	–	238333	162853	47820	35220
1986	49300	23400	2000	82945	116471	–	274116	198636	47820	35220
1987	48300	28350	2000	87095	152896	–	319641	239211	47820	35220
1988	49300	28350	2000	91445	194593	–	365688	285258	47820	35220
1989	49300	28350	2000	96020	257284	–	432954	352524	47820	35220
1990	49300	28350	2000	96020	253834	–	429504	362094	47820	35220
1991	49300	28350	2000	96020	240814	–	416484	362094	47820	35220
1992	49300	28350	2000	96020	227794	–	403464	362094	47820	35220
1993	49300	28350	2000	96020	214774	–	390444	362094	47820	35220
1994	49300	28350	2000	96020	209891	–	385561	357211	47820	35220
1995	49300	28350	2000	96020	182217	–	357887	329537	47820	35220
1996	49300	28350	2000	96020	150383	–	326053	297703	47820	35220
1997	49300	28350	2000	96020	113958	–	289628	261278	47820	35220
1998	49300	28350	2000	96020	72261	–	247931	219581	47820	35220
1999	49300	28350	2000	96020	9570	–	185240	156890	47820	35220
2000	49300	28350	2000	96020	–	–	175670	147320	47820	35220

Col. (3) See Table VI for schedule of maintenance costs per mile for different intensities of use. To reach estimates of the intensity of use it was assumed that each entering vehicle travels once over each mile of entry road.

Col. (8) equals (2)+(3)+(4)+(5)+(6)+(7)
Col. (9) equals (8) - (3) - loan repayments on improvement of entrance roads (which begin in 1980 and amount to a maximum of 52080 - see Col. (6)).
Col. (10) = Col. (2) + (3) + £ 25,000.
Col. (11) = Col. (2) + £ 25,000. When capacity is reached in 1976, Col. (2) = 10220.

Table VII(a): Forecasts of Costs and Profits of the Intensive development option for the 30 square miles. (£)

Year	Maint. Viewing Track	Maint. Entry Road	Loan Repayment on Road Improvements	Administration	Total cost, excl. entry road cost	Total cost, incl. entry road cost	Profits excl. entry road cost	Profits incl. entry road cost
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1970-1975: as for extensive development of 30 square miles. (See Table VII)								
1976	11900	12600	4883	35000	51783	64383	117517	104462
1977	11900	18000	14355	37450	63705	81705	119295	101295
1978	11900	18000	25194	40072	77166	95166	121548	103548
1979	11900	18000	37498	42875	92273	110273	124462	106462
1980	11900	18000	64677	45878	109435	140455	127976	96956
1981	11900	18000	93908	49091	128760	172800	132378	88338
1982	11900	18000	109415	52525	132780	189840	129917	72857
1983	11900	18000	120435	52525	132780	202860	129917	59837
1984	11900	18000	120435	52525	132780	202860	129917	59837
1985	11900	18000	120435	52525	132780	202860	129917	59837
1986	11900	18000	115552	52525	127897	197977	134800	64720
1987	11900	18000	106080	52525	118425	188505	144272	74192
1988	11900	18000	95241	52525	107586	177666	155111	85031
1989	11900	18000	82937	52525	95282	165362	167415	97335
1990	11900	18000	55758	52525	81123	138183	181574	124514
1991	11900	18000	20626	52525	65011	109051	197686	153046
1992	11900	18000	13030	52525	64425	95445	198272	167252
1993	11900	18000	-	52525	64425	82425	198272	180272
1994	11900	18000	-	52525	64425	82425	198272	180272
2000	11900	18000	-	52525	64425	82425	198272	180272

Table VIII: Annual Forecast Profits to Amboseli Game Reserve on Different Development Assumptions, 1970-2000(£)

Year	Entrance Roads not the Responsibility of the Reserve			Entrance Roads the Responsibility of the Reserve		
	200 square mile Option	30 extensive square mile Option	Difference (2)-(3)	200 square mile Option	30 extensive square mile Option	Difference (5)-(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1970	38612	53612	-15000	26012	41012	-15000
1971	58993	63493	- 4500	46393	50893	- 4500
1972	67525	74775	- 7250	54925	62175	- 7250
1973	77365	87640	-10275	64765	75040	-10275
1974	88765	102368	-13603	76165	89768	-13603
1975	100923	119186	-18263	88323	106586	-18263
1976	115220	127065	-11845	102620	114465	-11845
1977	132542	127065	5477	114544	114465	79
1978	152604	127065	25539	134604	114465	20139
1979	175762	127065	48697	157762	114465	43297
1980	197525	127065	70460	166505	114465	52040
1981	211092	127065	84027	167052	114465	52587
1982	227410	127065	100345	164950	114465	50485
1983	240819	127065	113754	165339	114465	50874
1984	270609	127065	143544	195129	114465	80664
1985	280387	127065	153322	204907	114465	90442
1986	291928	127065	164863	216448	114465	101983
1987	306410	127065	179345	225980	114465	111515
1988	322135	127065	195070	241705	114465	127240
1989	326616	127065	199551	246186	114465	131721
1990	324722	127065	197657	257412	114465	142947
1991	324722	127065	197657	270432	114465	155967
1992	324722	127065	197657	283452	114465	168987
1993	324722	127065	197657	296472	114465	182007
1994	329705	127065	202640	301355	114465	186890
1995	357379	127065	230314	329029	114465	214564
1996	389213	127065	262148	360863	114465	246398
1997	425638	127065	298573	397288	114465	282833
1998	467335	127065	340270	438985	114465	324520
1999	530026	127065	402961	501676	114465	387211
2000	539596	127065	412531	511246	114465	396781
Internal rate of Return (Discount rate at which PV Col (4), (7) = 0)			31%			27%