

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

WORKING PAPER

THE POTENTIAL ROLE OF INDIGENOUS RESOURCES IN
THE ECONOMIC DEVELOPMENT OF THE ARID
ENVIRONMENTS IN SUB-SAHARAN AFRICA

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Working Paper AEE 9/88

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¹ Arid environments are broadly defined to include all those areas where moisture limits dryland cropping. In most of East and Southern Africa this includes all areas with less than 700 mm of rain per annum.

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³ The views expressed in this paper are those of the author and do not necessarily express those of the Department, the University or any other institution

Introduction

In many of the arid and semi-arid environments which are marginal for cropping, conventional agricultural commodities and technologies are not able to increase incomes reliably or to sufficient levels to attract smallholder interest. Population pressure increasingly prevents the use of such areas for low-productivity, large-scale ranching. Often, smallholders can exist in such environments only by seriously depleting the biological capital. There is much which can and ought to be done to improve conventional agriculture in marginal lands but unless we are able to increase the value of the output significantly, it is unlikely that we will reduce poverty. It has become imperative to test the hypothesis that a more intensive production system is possible on a sustainable basis in marginal lands if we include unconventional indigenous flora and fauna in the production systems.

Comprehensive inventories of the resources must be compiled; species for which local or international demand could be developed must be isolated and the potential for developing these promising species or systems for widespread exploitation must be investigated. It is only after considerable research has been carried out by social, natural and technical scientists, that we can afford to discard the hypothesis as invalid. The situation in Africa is too critical to ignore potentially valuable and untapped resources.

This paper explores some of the theoretical and empirical evidence which supports the hypothesis with respect to wildlife⁴ exploitation on private land. The findings have highlighted the importance of isolating an exceptionally high-value output, or an output which does not compete with conventional commodities or services, when establishing a new production system. It also supports the increasing evidence from conventional agriculture that in marginally productive environments a multiple-use approach is likely to produce greater returns in the long-term than would be derived from the economies of size achieved with monocultures.

The Importance of Increasing the Value and Sustainability of Arid-Land Production

African agricultural growth continues to lag seriously behind population growth despite the fact that between 70 and 90 percent of the population earns its income from agriculture. Per capita incomes are extremely low in Africa (23 countries had a per

⁴Wildlife is narrowly defined in the American tradition to include only wild mammals and the larger mammals in particular.

capita income of less than US\$400 per annum in 1983) and the poorest people in these countries are farmers so that any drop in per capita production means even lower returns to labour in agriculture.

The increases in agricultural productivity in North America, Europe and Asia have been achieved by the introduction of capital-intensive farming methods. Some success from the green revolution is technically feasible in much but not all of Africa. However, it is only in specific areas that it is economically viable. For example, Bremen and Uithol note that the physical structure of the soil and lack of nitrogen and phosphorus limit development even where water is available. Furthermore, their research has shown that whilst leguminous plants could increase nitrogen, they would require the application of phosphates which would cost five times more than the value of the yield increases (World Resources Inst).

The limitations of increasing incomes through conventional agriculture in Africa are ecological, infrastructural and social. Whilst institutions, pricing policies and even ideologies and cultural practices can be altered, the necessary changes to the environment and infrastructure would require capital investments which are only viable in specific areas. Even where such investments are viable, many countries do not have the capital, skilled manpower or foreign currency necessary for these developments. Thus the options for the intensification of conventional agriculture in much of Africa are limited. This is particularly true for the low-rainfall, or marginal areas which characterise the Sahel and much of East and Southern Africa.

In development circles and amongst policy-makers, aid agencies and research organizations, including agricultural economists, there has been a strong drive to encourage local food self-sufficiency with little or no cognisance given to comparative advantage or demand. Thus, for example, much emphasis is placed on people in arid zones growing millets with little regard to the demand for these millets. These food-first strategies have, at best, addressed the starvation issue and can only be viewed as an interim measure. Reducing poverty is the only effective long-term strategy. Only very limited increases to wealth are possible without specialisation so that increasing the value of output from marginal areas is a priority. Developing new institutions to ensure that the wealth gains remain in the areas with the local inhabitants is the other major challenge.

Whilst it is true that traditional practices under arid conditions can minimize risks, they cannot, without substantial changes, improve incomes. The new research concentrating on traditional crops is an important step forward but the crop scientists continue to command the largest budget for breeding.

In some countries, sorghums and millets may be preferred commodities but in most they are insurance crops. As such, research should be concentrated on enhancing their drought tolerant properties and at increasing demand.⁵ Greater effort should be concentrated on increasing the value by increasing demand. Technological advances in preparation techniques and commodity development are promising, particularly if millets become an effective wheat substitute.

There is much which can and ought to be done to improve conventional agriculture in marginal lands. It is becoming increasingly recognized that a holistic and multiple use approach may be essential for increasing output from these areas. Monocultivation results in economies of size which have been important for increasing returns in low-stress environments. The increased returns from monocultivation in low-rainfall areas, however, do not appear to be sufficient to overcome the lower yields and higher risks involved. Adaptations and improvements to traditional conservation and production techniques shows some promise (Harrison). There is also some hope that the sophisticated but low input agriculture being developed in the West (in response to high oil prices and environmental costs) may provide a more viable "green revolution" for Africa. However, the management inputs required could limit adoption, unless there is considerable investments in training manpower. In addition "low input" typically refers to "low cost input" which relies on increasing labour costs. In many of these marginal systems labour is a major constraint and labour-saving, stress-reducing and quality-enhancing technologies are the most likely to be adopted (Binswanger).

insert Table 1 here

⁵Experience in Zimbabwe and Tanzania has shown that increased prices result in large unsaleable surpluses (see Muir-Leresche 1984 and Muir 1987)

African land resources are being seriously depleted, (over 80% of rangelands and rainfed croplands are moderately to severely desertified) and if the desertification and degradation is allowed to continue agricultural failure will become the norm (see Table 1). The destruction of our soil, water and tree resources is primarily the result of increased man-land ratios without appropriate increases in environmentally sustainable, technical efficiency. The difficulties of intensifying production in Africa means that population pressure is forcing farmers to cultivate increasingly marginal land, reduce grazing areas and thus increase the overgrazing of rangelands. There has been a positive relationship between declining crop yields and the fall in grazing areas.

Deforestation has serious consequences for rural energy supplies and soil erosion. In some areas, deforestation rates exceed planting rates by a factor of 30:1 (Asibey). Ellwell notes that intensive cultivation even with the best that modern agriculture can achieve, still results in serious soil depletion. He notes that Zimbabwe is "suffering from inappropriate imported technology" and commodities unsuited to our harsh climate where rainfall is concentrated in a few months of the year falling at high intensities (40% at above 2mm per hour, Ellwell p.28). A further complication to the intensification of conventional agriculture is not only the paucity but the variability of the rainfall. Spatially it varies considerably over short distances and temporally it varies both inter- and intra-seasonally. Differences of 100% in rainfall can occur in successive years (Walker).

To support increasing populations in fragile environments we need to develop technologies for the more intensive and sustainable utilization of natural resources. Production processes which promote economic development whilst minimizing adverse environmental consequences must be developed. The difficulties of achieving this through conventional agriculture have been outlined. It is now becoming imperative that we test the hypothesis that unconventional and indigenous flora and fauna can increase incomes and/or reduce environmental pressure in marginal lands.

There is a bias in supply towards the exotic commodities because they have already been developed for production and there is a bias in demand because those are the commodities which are readily available in urban areas. Colonial administrations established infrastructure and institutions to support those commodities which they produced or consumed and only in a few exceptional instances, did this include unconventional indigenous flora or fauna. The hypothesis that Africa has no indigenous resources which could be developed for international utilisation is less convincing than the hypothesis that it has.

As Africa became urbanized, so the local people found it easier to purchase and prepare these exotic commodities and tastes changed.⁶ It is, therefore, essential to determine whether any of the indigenous commodities have nutritional, taste or other properties (aesthetic) which would make them marketable locally or internationally and finally, if demand could exist, is it possible to develop the resources for widespread exploitation? It is important to discover how this will affect existing infrastructure, institutions and incentives and to determine what changes may be necessary and whether they can be made effectively.

Research on development of indigenous resources in Africa is essentially non-existent. However, there has been some research into the existing utilization of both flora and fauna. These studies have been poorly documented and where they exist are often to be found in the filing cabinets of various government, parastatal and mission offices. They are usually the work of some enthusiastic, amateur ethno-botanist or zoologist who is not in a position to disseminate the findings. With the exception of some medicinal plants, pyrethrum, tourism, safari hunting and ivory, there has been very little effort to market Africa's indigenous resources internationally. This paper will consider existing evidence with respect to the potential of the larger mammals as an alternative production system in marginal areas. Similar studies are urgently required with respect to other flora and fauna.

Wildlife Utilization in Farming Systems

In order to carry out an economic evaluation of wildlife utilization, it is important to know something about the environmental and technical advantages and disadvantages of such systems. The hypothesis that wildlife⁷ has a beneficial impact on the environment (or at least less harmful than cattle) is based on various theoretical premises with some empirical evidence.

In semi-arid savannas, rainfall is the dominant control factor for primary production but it is seasonal soil moisture which

⁶ For example the growth of potato consumption in Kenya and Zimbabwe and the growth of wheat consumption throughout Africa (Byerlee and Longmire, 1986, CERES Vol 19 no 3)

⁷ This paper will not discuss the issues pertaining to wildlife utilization in protected areas. Except where otherwise indicated, wildlife utilisation refers to the incorporation of large wild mammals in the farming system.

directly influences plant growth. This, in turn, is influenced by the rate of water infiltration and the water holding capacity of the soil. Soil capping appears to reduce infiltration in Central Africa. Soil surfaces covered by litter have been found to have infiltration rates nine times greater than a bare soil surface and the rate through grass tufts is even higher, emphasizing the importance of a high basal cover and the encouragement of perennial grasses (Walker).

The decreases in range productivity in the semi-arid areas has been partially attributed to the increase in both the proportion and number of grazers, together with the development of permanent water points. There is some potential for alleviating the problem by controlled grazing and other techniques but these are only viable on large areas run as single units. Even here it is difficult to increase productivity in ecologically brittle areas (Walker). The control of woody plants significantly increases the production of grass and browsers play an essential role in bush control which is the basis for the hypothesis that wildlife is more suitable than a single species conventional livestock system.⁸

Some empirical work has been carried out in the South-eastern lowveld in Zimbabwe to test the hypotheses that a given unit of land under wildlife production will, a) support a greater animal biomass and, b) be less destructive to the habitat. In 1973, Taylor conducted 80 transects on a 22,000 ha ranch divided into 12,000 ha for cattle and 8,000 ha for game with similar stocking rates of between 50 and 70 kg/ha. The results were indeterminate. Cover abundance, litter cover and grass height were greater on the cattle section, whilst soil capping, shrubs, moribund grass and the extent of soil erosion were lower on the game section. Wild herbivores made more use of the vegetation than cattle at specific sites but domestic cattle utilized the area more evenly. Ecologically, the best form of land use appeared to be an integrated cattle and game ranch with a carefully determined balance of browsing and grazing species (Taylor and Walker).

The study was repeated in 1985 and this time cover abundance, soil capping, litter cover, grass height and erosion also indicated that conditions in the game section were better than in the cattle section. This could be the result of long-term cattle production in these environments. Alternatively, the area suffered a severe, three-year drought (1981, 1982, 1983) and it could reflect the ability of wildlife ranges to recover faster from drought. For a full discussion of these findings see Child and Taylor (forthcoming).

⁸ Similar arguments apply to multi-species conventional livestock systems.

Proponents justify game ranching on the basis of species separation i.e. that multi-species animal communities, make more efficient use of the annually available water and vegetation than any single species. In addition, they stress the adaptation of wild animals to their environment, in particular high temperatures and limited water supplies. The various methods to achieve this include adaptive hyperthermia, dry faeces, lower volumes and higher concentration of urine as well as various behavioral mechanisms. Indigenous mammals also appear to be less susceptible to endemic disease, have higher reproductive potential and better carcass qualities (Talbot and Talbot; Dasmann; Roth; Brown; Mossman and Mossman; Walker; Child and Child).

Whilst the evidence does seem to favour these assumptions, further research is required. McDowell questions some of the assumptions and indicates that as the market for game meat is highly specific, there is only limited potential for converting cattle ranches producing beef to game ranches producing venison. However, he did not find negative game/cattle interactions and recommended serious consideration of mixed ranching (McDowell).

The principal advantage of wildlife over conventional livestock systems, however, is related to the multiple and higher value uses for wildlife. Preliminary research by Child 1984, Child and Taylor, and Murindagomo supports this hypothesis.

Combining meat, hide and milk production with safari hunting, tourism and handicraft industries is a radical departure from conventional agricultural production. The scientists, practitioners and policy-makers may prefer to work with more familiar commodities but the chance that it might be possible to increase incomes from marginal lands without increasing biomass, cannot be ignored. It is of major significance to sustainable economic development, particularly in East and Central Africa. The viability and feasibility of incorporating wildlife into the farming systems must be more clearly determined with the advantages and disadvantages of various systems investigated.

Consumptive utilization of secondary production relies on increasing the biomass to increase output. This is not possible in many areas and where it occurs, rapidly depletes the environmental capital. The promotion of the less consumptive uses of wild animals (wherever viable) will not only reduce environmental pressure but will increase incomes. It is also hypothesised that, because much of the value of wildlife is derived from luxury products and services, the international terms of trade will move increasingly in favour of wildlife production. The relative value of beef has declined by almost 2% per annum over the last two decades whilst international tourism is one of the world's fastest growing industries (Child and

Child, 1986). In addition the multiplier effects of wildlife industries are very much greater than those from beef industries.⁹

Sisler (in McDowell) shows that game ranching is less profitable than cattle ranching, even with some favourable assumptions. However, only meat sales were included in the revenue calculations. Child (1984) indicates a similar position in Zimbabwe where revenue from game meat and hides is much lower than from beef. The prices used in Kenya were from the highly-priced, specialized venison market at restaurants and as McDowell points out this is a very limited market. Child's calculations in Zimbabwe were based on the mass meat market with prices for game meat lower than beef. It is unlikely that wild animals could compete with cattle for meat production without considerable investment in developing the marketing systems and appropriate harvesting and quality control techniques. The beef industry has been heavily supported in most countries with marketing infrastructure and taste patterns established over decades and considerable investment in research. Even in our subsistence communities anti-poaching laws have discouraged game-meat consumption. It is, therefore, only in mixed production systems or by making multiple use of the wildlife that it is liable to increase incomes in the short term. This may not be true in West Africa where the tradition for consuming 'bushmeat' is more firmly established and prices are high in village markets despite legal restrictions (Asibey).

The Impact of Utilisation Rights on Wildlife

Individual rights to use wild animals have been eroded by increased State control since the advent of the colonial era. Landholders have been required by law to protect animals and to bear the costs this involves, whilst being denied any major benefits. Thus, wildlife had little or no financial benefits to farmers and there has been widespread overt and covert elimination of wildlife and wildlife habitats, with wildlife being replaced by conventional agricultural commodities. These may be less socially valuable land-use systems but market prices have been seriously distorted by the resource allocation system resulting in the expansion of the more financially rewarding conventional commodities.¹⁰

⁹This may be less true of countries where local industry is not able to supply the furniture, fittings, food and other consumer goods used by tourists).

¹⁰See Child and Child (1987) for a detailed discussion of the impact of institutions on wildlife values.

The hypothesis behind the privatisation of game in Zimbabwe is that if landholders are able to receive financial rewards from wildlife, they will invest in resource protection and development. In Zimbabwe, legislation began to pass some rights to landholders in the 1960s and by 1975 the Parks and Wild Life Act had transferred utilization rights (with the exception of a very few specially protected endangered species) to landholders. However, the black farmers in the communally-owned farming areas were not included and the State continued as custodian of the wildlife on the basis that utilisation of common property resources leads to overexploitation. Since Independence some financial benefits from hunting on tribal lands has been returned to the District Councils¹¹ and some initial research is being carried out on establishing institutions which would relate costs and benefits at grassroots level and involve the local communities in the management of their resources. Legislation, however, continues to prohibit subsistence hunting. Fears of over-exploitation of a common resource are slowing down efforts to allow communities legal access to these protein sources and political lobbies are resisting the establishment of institutions which pass control of wildlife resources to the village level.¹²

As a result of deregulation in the large-scale sector, there has been a significant expansion of game ranching in Zimbabwe despite heavy subsidization of the competing land-uses and very poorly developed wildlife infrastructure. If one accepts the neo-classical assumption that producers are motivated by profit, the increased allocation of resources to wildlife protection must indicate that returns to wildlife are greater than other land use options. The land area allocated solely to wildlife grew by 6% per annum from 1974 to 1984 when 23% of the ranch land in south-eastern Zimbabwe was devoted to game ranching (Child, 1984). Studies carried out in the Midlands have shown that wildlife populations have increased in both size and distribution since the introduction of legislation giving ranchers the right to exploit their wildlife. Leopard, cheetah, zebra, waterbuck, sable, tsessebe, wildebeest and eland occurred more widely in 1984 compared to 1975 (Child, forthcoming). Small antelope remained at similar densities whilst all the larger species and warthog increased except for klipspringer and reedbuck. The decline in the latter can be partially attributed to increasing cheetah and

¹¹ Of the Z\$5.8 million earned by safari hunting in communal areas Z\$3.3 had been paid out to District Councils and Z\$2.5 was held back by Treasury in 1987/88 (Hansard, 1988).

¹² M. Murphree of Centre for Applied Social Studies, University of Zimbabwe and R. Martin, Dept. of National Parks and Wildlife Management, Zimbabwe are amongst the leaders in the research into establishing appropriate institutions

the drought affecting vleis areas. These increases are primarily attributed to active encouragement of game (with mineral licks and access to water etc) and the increased use of game guards. Only a few of the ranchers had physically reintroduced animals. In 1986, a Wildlife Producers' Association was formed under the auspices of the Commercial Farmers' Union and the Association had 450 members by 1987, some 10% of the total number of commercial farmers. The sale of state animals which are sold at fixed prices has to be rationed on a quota system and demand far exceeds supply. Wildlife has increased significantly throughout the commercial farm sector and the evidence in Zimbabwe supports that from Zambia where elephant and rhino poaching was reduced tenfold over two years in an experimental area (400km²) outside protected areas with the introduction of a system involving benefit sharing with local farmers and their participation in the management (Lewis, Kaweche and Mwenya).

The Economics of Wildlife Utilisation

In 1984, Child conducted surveys to obtain estimates of the comparative returns of cattle and game ranching. Accurate estimates were very difficult to obtain but broadly it appeared that in the more arid zones, income from wildlife was higher than both cattle and mixed cattle/game ranches, whereas mixed ranches were the most profitable in areas with slightly higher and more consistent rainfall patterns. The results of more detailed case studies, however, indicated that wildlife was highly profitable in both the lowveld and the midlands and the net revenues per hectare are given below:

		Cattle	Wildlife
Buffalo Range	(\$500mm) Z\$/ha	0.10	0.72
Iwaba Ranch	(650mm) Z\$/ha	3.78	6.35
(Child & Child 1986)			

In a further study of Buffalo Range carried out in 1986 (Child and Taylor) an analysis was made of the changes in rangeland on economic productivity. The results indicate that on the cattle section there was a decline in livemass gain per hectare which was not attributable to poor rainfall but rather to veld deterioration. There was also a decline in calf production from 1975 and despite increased producer prices, profitability of the cattle section declined from 1975. Although revenue increased, unit costs increased at twice the rate of unit returns. Thus, both environmental degradation and terms of trade contributed to the declining profitability.

In a comparison of meat yield, it was estimated that wildlife averaged 5.5 kg of meat per ha per year compared to 6 kg from cattle (Child and Taylor). There was some indication that

impala^a could produce more meat per hectare than cattle but more research is required to consider this hypothesis. Beef prices are higher than game meat prices so that it is unlikely that game could be more profitable than cattle on a meat only basis, unless cattle productivity continues to decline.

A number of other advantages to game ranching are clarified by the analysis. These include the fact that ranchers will be more prepared to reduce stocking rates and maintain an ecological balance with wildlife since the financial returns are less closely related to biomass than they are for cattle. The rainfall risks are more spread because of the off-ranch safari concessions so that the game section made a small loss in one of the drought years whereas the cattle section lost heavily in drought years. The terms of trade have moved in favour of game ranching and against beef; a trend which is expected to continue (Child and Taylor).

The economics of wildlife as an alternative or complementary productive activity in Africa are not yet clearly established. There is increasing evidence that it is profitable under certain conditions (Murray, Joubert, Teer, Hopcraft). Empirical evidence from the Matetsi Safari Area indicates returns greater than Z\$ 11/ha which is much higher than that obtained from extensive cattle ranching in the area. A recent feasibility study of crocodile ranching in specified communal areas, has indicated that returns to both capital and land would be very much higher than for conventional irrigation schemes (Hutton and Muir).

Sufficient evidence exists to make research into the opportunities and markets for wildlife products and services a serious and urgent task for land use planners. It would seem that in many areas mixed production systems are possible where the opportunity costs of wildlife utilisation are low and the inclusion of wildlife in the financial returns to the farmer encourages habitat and species protection. In some areas mixed systems are not feasible and the table below details the advantages and disadvantages of wildlife utilisation as an alternative to conventional land-use systems.

Table 2 A COMPARISON OF CATTLE AND WILDLIFE PRODUCTION SYSTEMS

Cattle

Wildlife

Ecology and Production

Evolved in Europe (with limited S.African and American input)

Less efficient at using water

A bulk-roughage grazer suited to good grassland and pasture conditions

Suited to higher rainfall areas (over 700mm)

Wide base of germplasm to choose from for breeding

Specifically bred for meat or milk production

Higher food conversion ratio into meat

Good response to improved feeding

Cattle can be managed to distribute grazing pressure

Cattle can be vaccinated against and treated for diseases

Feeding strategies remain the same regardless of conditions

Slow recovery following drought

High stocking rates stress the environment, resulting in a decline in environmental capital and declining returns

Well established and subsidised research on development, management and disease control

Evolved in Africa

Physiological and behavioural water conservation mechanisms

Diverse species with varied dietary strategies. Suited to environments with less but more varied and higher quality food

Suited to more arid environments

An important custodian of genetic diversity

No breeding or selection

The diversity of feeding habits means more vegetation available

Response unknown but appears low except in extreme drought

Wildlife populations are usually more mobile and this distributes grazing pressure

Indigenous species are hardy and resistant to some endemic diseases

More change in feeding strategy with season

Rapid recovery from drought

It may be possible to reduce biomass and allow veld recovering whilst maintaining or increasing incomes

Virtually no investment in research for utilisation or production

Economics and Institutions

Commercial exploitation limited to consumptive uses

In some communities provides ritualistic and prestige values

Economic returns are related entirely to biomass

An accepted form of land use

Individual ownership and control possible

In peasant communities cattle are an important source of draught-power, manure and savings

Well established and subsidised infrastructure and institutions (finance, veterinary and marketing)

Harvesting is simple and cheap for the producer and less erratic

Higher fat content reduces shrinkage

Beef is a widely accepted and preferred food

Beef production and consumption are often directly subsidised

Exports to the EEC heavily subsidised under Lome

The technology is already well advanced and returns to research and development are likely to be limited

Both consumptive and non-consumptive commercial use

International aesthetic value, important gene pools. Provides ritual values to fewer communities

Economic returns less dependent upon large herbivore biomass

Not widely recognised as a productive land-use system

Migratory habits make ownership, control and the distribution of costs and benefits difficult

Wildlife provides by-products for rural craft industries. Destroys crops, and is dangerous to domestic animals and humans

No infrastructure and very poor market development of all commodities

Offtake is more difficult and expensive and results in inconsistent supplies

Higher dressing out percentage

There is cultural resistance to various specific animals

No direct or indirect subsidies to wildlife production

Exports penalised by veterinary controls and conservation lobbies

The technologies for production and marketing are undeveloped, returns to research and development should be high

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Wildlife Utilisation in Peasant Farm Systems

There is evidence throughout most of Africa which points to the importance of hunting and gathering in most peasant economies (Asibey, Scudder, Murray, Marks). The evidence, although convincing, is difficult to find and very seldom available to those responsible for development. There is an urgent need to carry out research into the past and current role of wild flora and fauna and into the institutions which existed for managing these resources. Where the value of these resources to local populations are ignored, the true opportunity costs of conventional development are not correctly calculated so that even where development schemes are financially successful they may in fact leave the communities no better off (and in some cases worse off) where the development reduces hunting and gathering.

In Zimbabwe subsistence hunting is officially illegal. Murindagomo recently conducted a survey in Angwa communal land in the Zambezi Valley where a significant number of the community had recently been released from jail after serving sentences for 'poaching'. Murindagomo estimated that despite the legal restrictions, wild flora and fauna contributed approximately 60% to total family income and that wild animals accounted for 74% of subsistence income. This illegal poaching gave a return of Z\$8.2 per ha in Angwa (using a value of \$2 per kg) far exceeding the estimated damages to crops. The annual per capita adult consumption rate of 88.19 kg was similar to that found by Marks in Luangwa valley in Zambia of 91.5 kg. Of particular note was the fact that (with the exception of buffalo and to a lesser extent kudu) there was little conflict between subsistence hunting and safari hunting. The importance of guns to the economic viability of subsistence hunting was highlighted by the fact that whilst only 17% of the hunters have access to guns they account for 30% of total offtake. There is no direct personal benefit from safari hunting concessions to residents and even the indirect benefits through local development projects account for only 6% of cash income. Using the returns from the hunting safari concessions it would appear that if wildlife utilization in that area could be properly organized and managed and more of the benefits distributed to local residents, it should produce returns three to four times greater than those currently realised.

If wildlife is the most lucrative and ecologically benign land-use system for particular areas, the challenge for its adoption by peasant societies, will be to develop institutions for allocation and management which are politically and socially acceptable whilst at the same time more closely linking the costs and benefits from wildlife utilisation.

There are a number of experimental systems which have been proposed or are being implemented. The idea of buffer zones and benefits to local populations from protected areas and national parks is incorporated in the American system (Pulliam) and recommended for various countries in Africa (Parker; Martin and Taylor; Cumming). Proposals for the incorporation of wildlife into communally-owned, peasant farming systems is more recent. Current work in Zambia (Larsen) and in Zimbabwe (Martin; Murphree; Cumming).

The colonial era alienated traditional allocation and management systems so that whilst wildlife utilisation remains important in some peasant economies, the fact that it is illegal with ineffective enforcement, leaves it as an open access resource in danger of overexploitation. Local control and management systems are undermined when all utilisation is banned. In Zimbabwe since independence limited control and benefits have been distributed to District Councils but as these bodies incorporate significant populations and areas which are unaffected by wildlife but which benefit from and participate in the wildlife utilisation schemes, it is unlikely that the local populations will receive adequate returns for the opportunity costs involved. Systems will have to be developed which involve the local inhabitants of wildlife areas as the primary beneficiaries and custodians, with taxes paid to local and national authorities. The fact that the Zimbabwe government has held back revenues owing to populations in some of the poorest areas of the country and the fact that even where these revenues have been paid only a small proportion has benefited those living with the wildlife, illustrates the prevailing belief that the benefits from wildlife belong to everyone regardless of who is required to pay the cost. This attitude is inimical to the development of populations in wildlife areas and has serious consequences for the survival of wildlife resources.

Conclusion

There is sufficient evidence to indicate that wildlife could be a viable alternative to conventional land-use and that it may be able to increase incomes in arid land farm systems. There are, however many constraints which need to be addressed by research into the production, marketing and distribution of the benefits. The most immediate constraints which must be addressed are those relating to all common property resources and the disadvantages which arise from the fact that it must compete with well established and often subsidised conventional commodities.

An analysis¹³ of the market for the various wildlife products and services both within Africa and externally is vital before any major development strategies incorporating wildlife are implemented.

Less work has been carried out on other indigenous products although Arntzen mentions the importance of developing 'veld-products' for some communities in Botswana. Indigenous hardwoods have long been mined in Africa but little work exists on managing these resources and in many instances they are state controlled with few benefits passing to local communities. As with wildlife where the state controls cannot be effectively implemented open access is the result of removing management and offtake rights from local people. There are numerous wild fruits, edible fungi (truffles were once found in some parts of Botswana and very large edible mushrooms are found in Zimbabwe and Zambia) insects and small mammals. Some of these could be more effectively marketed to meet local demand, other products may require some selective breeding and still others could be marketed as exotic foods or even pets (beetles) to the Far and Near East. Although often site specific the potential increase in local incomes would be very much higher than from higher yielding millets, cassava or extensive livestock which are conventionally advocated for arid regions.

The most important of the principles highlighted in this paper are:

- * that returns from conventional agriculture cannot be significantly increased in many of the arid areas in Africa, whether sustainable or not
- * Africa has a diversity of indigenous flora and fauna in arid areas which has not been developed or exploited
- * these resources represent an unexplored potential for specialisation and development
- * the exploitation of indigeneous species will probably be less harmful to the brittle, arid environments
- * multiple and non-consumptive uses of these resources will increase the returns to land without necessarily increasing pressure on the environment
- * a high-value output is required initially in order to finance the investment in research, development, infrastructure, institutions and marketing of the new products & services.

¹³ See Muir for a preliminary discussion on the marketing of wildlife products and services

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