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VENISON, AQUACULTURE AND OSTRICH MEAT PRODUCTION : ACTION 2003

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Venison and Game Farming

In assessing the future a thorough review of the present is usually instructive. Game farming/ranching as the modus operandi of game utilisation has become an established part of land useage, and speculation need no longer be entered into.

Land Use

In considering the faunal resources of South Africa the most important fact is this country's situation on this Continent, in having a system of land tenure which permits private land ownership, to such an extent, that approximately 69% of its land surface is owned by private farmers, the balance occupied by the National States, urban Sprawl, infrastructural use, and a further 2,7% to Conservation Areas, Provincial or National (Bigalke, pers comm). Ownership of land, and the right to dispose of game privately are essential to the successful pursuance of the utilisation of wild animal resources. Parker & Graham (1975) and several other authors have commented on this aspect as a prerequisite for successful usage of game.

Game Populations

Several authors have provided estimates of game populations resident upon farms in the various provinces, but in the absence of a reliable return embodied in the official Agricultural census, these figures can be regarded with some reservation! No hard figures exist for populations but the occurence of species is well documented. The lack of numerical information does complicate rational planning and exploitation. Due to the Provincial system and its oversight of game, each provincial department has its own priorities that preclude a National approach to game. Some uniformity of statistical treatment between Provinces would be of great assistance in planning a Nation Game Strategy.

In the past, the prevalence of game on farms was due to conservational or recreational motives. In some cases the sheer ability of game to survive extinction has ensured their place on farms. The nomadic nature of, for instance, the Kudu in the Eastern Cape, together with hunting regulations, has ensured its survival against odds. With the arrival of commercial cropping there were considerable populations of game to be utilised. The culling

Table 1

Approximate numbers of five species of antelope in South and South West Africa on farms, national parks and nature reserves (Skinner, 1973)

	Transvaal	Cape Province	Natal	O.F.S.	S.W.A.	Total
Springbok	13 000	212 000	100	44 000	100 000	369 000
Eland	1 500	2 310	550	360	2 090	6 810
Blesbok	29 000	13 000	10 000	44 700	100	96 800
Impala	248 000	1 000	100 000	300	1 000	350 300
Kudu	Large No. no exact figure	13 000	4 500	50	80 000	> 97 550

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programmes of the various reserves is a form of utilization that has been operational for some time. The area devoted to the economic use of game alone or with domestics can only be guessed at but with 1,4 mil. ha reported for Transvaal, 2 403 certificates of enclosure for the Cape (2 403 x 3 000 ha av farm size 7 209 000 ha) and an unknown area for Natal and the O.F.S., 10 mil ha would not be an underestimate.

Multiple Land Use

Multiple land use considers that in addition to qualities of production, land also has recreational qualities that can be exploited. Such use can be rewarding to the landowner, more so as populations and urbanisation increase. The very low percentage of public land available in S.A., cf. the approximately 50% in the U.S.A. only serves to accentuate the possibilities of the recreational utilisation by the landowner. Several authors have commented on this aspect, among others, Schaefer-Kehnert & Brown (1975), Clawson (1975), and Bigalke (1982). The use of farmland for recreation is essential, failure to do so, will increase pressure to enlarge public recreational areas at the expense of agricultural production.

The income derived from game farming, an enterprise defined as "the economic use of game within the farm confines" embraces all forms of game utilisation, recreational and productive. When considering the justification for game farming/ranching, it is not of neccessity a meat producing enterprise.

The Hunter as Utilizer

This congress is dedicated to the contribution of the various animal species to the production of animal protein, and the hunter, as consumer can be a significant factor. The role of the hunter can be gauged from Table 2.

The same source also provides the number of hunters, and it is constructive to consider that Britain has 300 000, France c. 2 000 000 as has Italy, and the U.S.A. 16 000 000. The economic importance generally of the hunter as provider of meat and expenditure related to his hobby need not be emphasised.

The importance of game animals in less developed economies can be gauged from Butynski (1973) in a study of the value of the springhare (Pedetes capensis) in Botswana, where Bushmen take up to 346 000 and the Tswana hunters an estimated 2,2 mil., or a national kill of over 2,5 million with an estimated meat mass of 7,5 mil. kg.

Table 2

Annual bag of principle game animals in some European Countries

Country	Year	Roe	Red Deer	Boar	Rabbits	Hares
West Germany	1971 – 72	542 500	25 960	63 385	926 000	1 330 000
East Germany	1971	106 000	9 267	34 000	–	118 600
France	pre 1939	10 000	3 000	20 000	10 mil	1 000 000
Austria	1971	154 563	32 349	3 678	12 607	403 487
Switzerland	1971	28 832	1 300	100	369	21 367
Denmark	up to 1962	c. 28 000	–	–	–	max 475 000
Poland	1958 – 59	11 693	6 593	21 228	–	536 084
Yugoslavia	1967 – 68	28 600	4 042	4 000	–	638 000
U.S.S.R.	Annual	500 000 to 600 000 wild ungulates.				
Czechoslovakia	Annual	60 000	7 000			600 000

Bigalke (1975)

Hunting in South Africa

Generally the provision of hunting opportunities for the South African hunter is not catered for, except for the Tussen Riviere hunting reserve facilitated by the O.F.S. Administration, no public hunting areas are available. All other hunting takes place on private property, the organization and marketing of this utilization has far to go, Howard-Davies (1982).

Hunter associations exist and recently a national body was formed. Trophy Hunting as a separate entity has its own professional Association. The occurrence of malpractises in this industry has caused the Transvaal and Natal Provincial authorities to prescribe standards of equipment and competence, in S.W.A. this state has existed for some time. The development of hunting both for trophy and as a sport is important to the industry, since generally, the more marginal land is suitable to this end, and distance from the larger centres is not a liability. Game which can only be cropped at great expense commercially can be taken by hunters instead.

Game Cropping

The Republic differs from nearly every other game producing country in its private "ownership" and exploitation, of game. Venison produced and marketed internationally is largely taken from feral populations on public lands, and in the case of N.Z. are regarded as vermin. Australia has commenced with the exploitation of the Kangaroo which is also regarded as vermin in that country (Child, 1975). Venison is produced in large quantities by the European Communist block, and as such no monetary benefit accrues to a private landowner.

The imports of venison into Germany in 1973/74 amounted to 116 million mark and 25 000 tons, in 70/71 this figure was Dm 72 mil. and 18 600 tons (Steinert, 1976).

Economic aspects

An indication of the importance and potential of game farming can be gauged from Table 3. Since there is no central authority colating the statistics of the South African Game industry, due to the provincial structure, the figures obtained from the Department of Agriculture of S.W.A./Namibia, can be taken as a reflection of growth and the sources of income for this country as well.

Both sets of figures from the Annual report: Nature Conservation Branch S.W.A. Department of Agriculture and Nature Conservation.

Income derived from Trophy Hunting	R 4 392 825
Trophy licenses	38 200
Game shot and sold by farmers	359 748
Income from Night Shooting	3 348 594
Game shot and sold by Nature Cons. Dept.	53 653
Game shot by hunters for own use against payment	2 352 630
Game culled for range protection	129 400
Gameskins exported	303 652
Levy on Gameskins	26 272
Live game exports to S.A. and foreign	985 840
Game sold by the Administration	183 916
Game sold by game traders in S.W.A.	66 280
Hunt by S. von Bach	1 258
Trophies sold and exported	274 335
Total	12 483 595

Table 3

Numbers of Springbok, Kudu, and Gemsbok shot for export in S.W.A. 1976 to 1980 and gross income derived in S.A. Rand

Year	Springbok	Kudu	Gemsbokke	Total	Gross Income
1976	7 730	110	239	8 089	244 780
1977	23 764	1 117	1 237	26 118	913 234
1978	34 487	1 389	1 359	37 235	1 665 185
1979	43 663	3 547	3 020	50 230	2 756 741
1980	40 232	3 496	3 294	47 022	3 194 041
Total	149 876	9 659	9 159	168 694	8 773 954

Biological Aspects

The recent introduction (c. 1972) of commercial game cropping for export has led to the realization of the potential inherent in the African ungulate fauna that has been examined and commented on in articles and review articles by several authors. These works have been important in laying the foundations of this new enterprise. Of the earlier authors, Dassman & Mosmann (1962), Talbot *et al* (1965) and Skinner (1973) are important. Carcass composition and yield has been examined in particular by von la Chevallerie (1970 & 1972), and generally favourable findings result. Disease and parasitic studies have been undertaken particularly by Young (1975). The reproductive performance of game species has also been examined Skinner (1978), and Fairall (1970). Grunow (1977) in particular has addressed the problems associated with game, their feeding habits and the effect on the veld. Mentis (1977) has discussed carrying capacity and production strategies. Behavioural studies have been undertaken by a host of investigators especially Bigalke, Skinner, Liversidge, etc. Examination of the earlier works show general optimism for game/venison production. However more recent authors Bigalke, Skinner, Grunow, etc. have been more cautious regarding the prospects of game being a primary meat producer. The fond expectation that Game, through its ability to utilise a larger segment of available herbage when in a multi-species mix or with domestics, will of necessity be more efficient in toto than a monospecies utilisation, has not as yet been a persuasive argument for game farming. Bearing in mind that 20 years have elapsed since Dassman & Mossman's 1962 work and the present, with relatively slow growth evident, is grounds for caution in making predictions for the next 20. On the grounds of dietary efficiency alone, there is also scant reason to found arguments of elevated production through the use of game. However, rigorous on-farm examination of the multispecies situation has not, in my opinion, been made. Some African studies are inconclusive eg. the Galana

Table 4

Game species of economic importance, or potentially useful, their distribution, and grazing preference

	Region	Acocks designation	Species	Grazing Habit
1.	Eastern Tvl Lowveld	10, 11, 15	Impala	Graze/browse
		10, 11, 15	Kudu	Browse
		10, 11, 15	Buffalo	Graze
		10, 11, 15	Giraffe	Browse
		10, 11, 15	Wildebees	Graze
		10, 11, 15	Warthog	Graze
2.	Northern Tvl Bushveld	13, 14, 18, 19, 20	Impala	Graze/browse
		13, 14, 18, 19, 20	Kudu	Browse
		13, 14, 18, 19, 20	Giraffe	Browse
		13, 14, 18, 19, 20	Eland	Browse
3.	Transvaal Highveld O.F.S.	48, 49, 50, 52, 57, 61 62. for B.bok. 36, 41,48,50,51. S. Bok	Blesbok Springbok	Graze Graze
4.	N. Cape/Kalahari	16, 17, 40	Springbok	Graze
		16, 17, 40	Kudu	Browse
		16, 17, 40	Gemsbok	Graze
		16, 17, 40	Eland	Browse
5.	Karoo	26, 27, 29, 30, 32, 35 36, 37	Springbok Gemsbok	Graze Graze
6.	Eastern Cape	21, 23, 24, 26, 37, 38	Kudu	Browse
7.	Natal	21, 23, 24, 26, 37, 38	Impala	Graze/Browse
		21, 23, 24, 26, 37, 38	Giraffe	Browse
		21, 23, 24, 26, 37, 38	Kudu	Browse

Acocks (1953) A case can be made for other species, the mountain reedbuck *Reduna fulvorufulva* (rooiribbok) is a strong contender. Irby 1975.

Project, and the presence of a reasonably sophisticated market is a necessity. Most studies have foundered in that no true market existed for venison or, that it was very rapidly saturated, especially in more primitive situations (Parker & Graham, 1975).

Research Status

In this country, the different approaches followed by biologists on the one hand, and agricultural researchers on the other, has hampered applied research. Provincial and National Departments of Nature Conservation are probably not concerned with the problems of utilisation or production, and the Department of Agriculture and Fisheries did not see Game as being within their brief, so very little research was/is conducted on the phenomena and potential of the multi-species situation, Skinner (1975). The Provinces have differing priorities regarding the statistical management of data, which makes overall planning difficult.

Recognition of Game Farming

The recognition of "game farming" as a branch of farming by the Department of Agriculture and Fisheries should remedy this defect, and the introduction of a Game Commodity Committee within the S.A. Agricultural Union, is organisationally a very important step in the realisation of the full potential of Game.

Production

Every potential species has as disparate a biology and behavior, as exists between various domesticated species. A common approach is impossible and divisions both spatial and specific need to be recognised. The Republic can conveniently be divided into several regions vis a vis game.

The supposed maximum yield is obtained when the grazing habits of the species are such as to make use of the available spectrum of herbage both in regard to plant species, and spatially, cf. the giraffe which browses tree-tops and the warthog which is a close grazer, and digs as well. However, from a purely productive point the cost of restraining some of the larger species, such as buffalo, giraffe, kudu, eland, who are either superb jumpers or capable of destroying even stout fences, can be prohibitive. The addition of the hunting component can make fencing a proposition. The important plains species, springbok, blesbok and gemsbok (oryx) are readily restrained by smallstock fences. The occurence of the larger species in the areas that are prone to foot and mouth disease can be a limiting factor. However, the erection of canning facilities within these areas should be considered.

The potential use of game in petfoods should be investigated and can substitute for the large animal protein input that industry consumes, larger in fact than the consumption of balanced pig rations. This will be of particular application where game carcasses cannot measure up to the hygenic requirements for human consumption, are derived from culling operations and not necessarily the most palatable, eg. elephant, or generally acceptable eg. zebra, and will broaden the production base and income in the f & m areas.

Table 5 examines the potential production of several species of game.

Note this table (5) is an approximation and is indicative of possible yields. There is a large variation between authors regarding live mass, population estimates, and can thus be considered as a indication of a potential. Cattle with similar carcass yields would have a fat percentage of approximately 25%. In terms of lean, the total mass would correspond to a cattle slaughter mass of 11 840,26 tonnes or the equivalent of 45 365 slaughter units of 261 kg. to provide the same lean mass, and a population of 181 616 cattle (25% slaughtered per annum). On-farm figures of production are hard to come by and has persuaded me to investigate my own data. This data is taken from the farm and sales records of a farm situated in the central Karoo, District Victoria West. The area devoted to sheep production is 13 331 ha. for an average camp size of 242 ha, with Springbok occupying 4 183 ha. of this area with an average camp size of 380 ha.. Of this latter area 1 608 ha. is a floodplain with better than average vegetal cover and carrying capacity. The average monthly number of sheep for 1981/82 was 4 045 (all age groups) giving a grazing intensity (total ha/av sheep no) of 3,2 ha/sheep. The game/sheep camps were grazed over the same period at 3,16 ha/sheep. These camps then carried a full complement of sheep in addition to an estimated Springbok population of 1 000. By implication there is either over stocking, or superior carrying capacity is involved, or a synergistic situation exists. In the absence of vegetal cover data over a number of years, these figures presented here are merely indicative of a potential.

In financial terms the return per ha for 81/82 were as follows, sheep R8.57/ha including wool income, Springbok including own consumption R4.48/ha. Where buck and sheep were kept the income/ha was R13.05. If buck were kept at the full equivalent stocking rate as for the mixed situation the income would be interesting! The production of surplus animals for the same area for four years is tabulated in Table 6.

The Uitenhage valley bushveld area has become an important Kudu producing area and at writing 40 000 ha

Table 5

Summary of live mass carcass yield, estimated population, cropping potential and potential yield of several species of game

Species	Av. Live mass kg	Carcass yield %	Est. Tot. Populat.	Est. Yearly Cropping %	Pot. Yield in Tonnes	Monetary value at R2,00/kg
Impala (Repyceros melampus)	41.0 *1	58 *5	300 000	*1 30	2 140.2	4 200 400
Springbok (Antidorcas marsupialis marsupialis)	33.0 *4	58	470 000	*5 30	2 698.7	5 397 480
Blesbok (Damaliscus dorcas phillipsi)	55.0 *1	55	100 000	*1 20	605.0	1 210 000
Wildebees (Chonochaetes taurinus)	182.0 *1	58	25 000	*? 20	527.8	1 055 600
Gemsbok (Oryx gazella)	135.0 *2	57	10 000	*? 25	192.4	384 750
Kudu (Tragelaphus strpesicerso)	170.0 *4	58.7 *5	100 000	*1 25	2 494.8	4 989 500
Warthog (Phocohoerus aethiopicus)	43.8 *1	48 *?	8 000	*1 50	84.0	168 000
Eland (Taurotragus oryx)	300 *3	61	5 000	? 15	137.3	274 500
				Total	8 880.2	17 760 230

References:
*1 Mentis (1977) *2 King & Heath (1975) *3 von la Chevallerie (1978) *4 von W Lambrechts
*5 Own estimate and figures for the 1974 game census by the Cape Prov Administration *? Guestimate!!

Table 6

The sales or production of surplus animals for the years 1978/79 to 1981/82

Year	Sheep surplus 13331 ha	Buck surplus 4183 ha	Sheep surplus per ha	Buck surplus per ha
1978/79	1858	407	0.139	0.097
1979/80	1150	431	0.0863	0.103
1980/81	866	573	0 065	0.137
1981/82	1621	556	0.123	0.133
Total	5487	1967	Av. 0.103	Av. 0.118

Note. Opening and closing balances for sheep population were accounted in the calculation.

have been enclosed, the contracted sales for the coming season is set at 2 500 carcasses; dressed, the price/kg will be R5.15 (head shots) down to R1.85 whole in skin (body shot). These animals are being marketed locally, and a demand for 7 000 carcasses is reported. Past records indicate a 96 kg average slaughter mass. In terms of grazing equivalent, 5 angora are equated to 1 kudu; in terms of competitive grazing, 3 angora to 1 kudu by these farmers (Rudman, pers. com.).

The modes of utilisation will differ between each main utilization category, hunting, trophy production, and cropping. However each of these enterprises will find expression in different locales, be it on the same farm! In confining the approach to meat production, several avenues of research present themselves.

Research Priorities

Genetic manipulation

Genetic advances are made slowly especially in animal populations. Game with a supposedly high degree of homogeniety, as evidenced by a general lack of overt signs of degeneration in inbreeding situations, will be intractable. Observations on the extent and nature of existing variation would nonetheless be needed, in the immediate future no significant advances can be expected. The conservation of genetically distinct populations also deserves attention (Greig, 1979).

Population dynamics

A thorough study of population dynamics, and population manipulation for increased production will deliver the most immediate and spectacular results. The mere manipulation of sex ratios and early culling of young animals can deliver rapid results with relatively small managerial inputs (Mentis, 1977/1978). Farm related studies will be fruitful.

Disease control

It is well known and documented (Young, 1975) that game act as a reservoir of diseases affecting domestic animals and humans. Parasites, internal and external, are also important, both as vectors of disease, and affecting meat quality adversely. Recent attempts to control internal parasites through medicated lick blocks have shown some success, and increased production reported (O. Donavan, 1979). The establishment of disease free herds is also of importance, especially regarding wildebees and malignant catarrh (snot siekte). Development of immunogenic tests for diseases such as Foot and Mouth will be helpful in deriving free populations, and in Quarantine situations. Fortunately the important cropped species are reasonably free from serious disease processes, in the major production areas rejection rates by Vetrinary Services for Exported Springbok is very low.

A systematic appraoch toward the actual treatment and prevention of game diseases could be productive. The very fact that gameproof fences are being erected in some of the areas where many diseases are endemic should facilitate control. Sound management of domestic livestock can also serve to reduce game infestation, as reported by Parker and Graham (1975).

Nutrition

Experimental work involving game is obviously more involved than with domestics, and the results not as readily interpreted, ruminal and fecal studies can determine dietartry intake and digestive efficiency, and have been undertaken by several authors, Liversidge (1972), Robinson (1979), Jooste (unpublished) and Hall Martin (1974). The review by von La Chevallerie (1970) is useful in this respect. The potential application of game on the farm as a primary protein producer alone, or in the company of domestics will depend upon their efficiency, price differentials, and the competition or synergysims that exist relative to production. The recent table produced by Meissner (1982), is very useful in the calculation of relative productivity in mixed communities. Further studies on the nutritional requirements of game should be rewarding.

Veld and Range management

There is reason to believe that any monoculture will in the long run result in environmental change and degradation, even if carefully managed and controlled. This is ture of both crop production and animal husbandry. The lamented desertification of this country is a symptom of a long pursued smallstock monoculture. Conversely it cannot be argued that the reconstitution of the earlier faunal species spread and population, will, if not reconstitutete the previous floral state, halt the degradation of the veld. The conditions of migration, range selection, and predation no longer pertain, and has been commented on by Grunow (1977) in particular. Farm game will in essence be as "artificial" as any domestic livestock but with the added advantage of adaptability to particular environments, by way of dietary preference, and selection, adaptation to desert conditions, and specific disease and parasite tolerance (Louw, 1970).

Research aimed at the optimisation of these characteristics at farm level are needed. Problems associatted with overgrazing, the practical problems associated with camp rotation, need to be solved, even to the point of routine handling. Intensification of management and technique is in fact called for. The problems with fencing and controlling larger species need to be assessed and if possible, cheaper solutions found.

Cropping and meat quality

The problems associated with cropping, carcass loss and quality has enjoyed the attention of authors such as von la Chevallerie (1972). Organoleptic trials has confirmed the palatability of various species and ranked the species involved. The acceptability of many species has been confirmed, and the demand for especially springbok overseas has confirmed the correctness of these trials. The quality aspects of cropping deserve attention especially where it impinges on hygeine, venison quality, keeping characteristics, so that regulations are formulated with a sound scientific background. Consumer preference may in fact dictate some ripening of the meat, Cohn (1977).

Cost Aspects

Cropping is a business and the problems of carcass loss through poor techniques overcome. The use of helicopters and competent shottists has become a regular feature. Shooting at night can deliver very high quality carcasses at slightly less cost. Body shots account for less than 5% loss. However the costs involved in transport, refrigeration, storage, and inspection are considerable and can be broken down as shown in Table 7.

It is evident that for commercial cropping and processing to flourish these costs should be reduced to the minimum. An investigation into the international venison trade, and of the production practises in various exporting countries needs to be made. It is interesting to note that venison is not regarded as part of the meat trade, but categorized with fish and poultry.

Research Summary

Whilst pointing out the various fields of research and the need, the means to execute such programmes may be limited. The report of the Inter Departmental Committee on Game Farming (1981), admits the inability of the Department of Agriculture and Fisheries to staff these functions. It is suggested that the Universities, and the various Institutes attached to them such as the Mammal Research Institute, should be involved in these projects.

Infrastructure

The need to have a regulatory, administrative and legal famework for any industry to operate successfully is generally recognized. The novelty of many aspects of game utilization means that some of these aspects do not exist, or are not in the best interests of the industry. A sympathetic approach is warranted for the full development of the industry in all its facets.

Financing and Organisation

Whilst most agricultural comodities are levied during the marketing process, it is difficult at this juncture to suggest a source of funds for the advancement of the industry, its research, promotion and advertising, product development and infrastructure. Indeed the freedom that attends the sale of game and its products precludes the imposition of levies on the whole industry. The most obvious source of funding would be for the cropper to pay the levy on behalf of the producer, but the provider of hunting and trophy opportunities is not as easily approached, or the landowner who does not involve an intermediary.

The newly created instrument within the S.A.A.U. will be able to address these problems. This body is made up from the representatives of the various Agricultural Unions as follows:

The Eastern Cape Game Management Association, Northern Cape Game Farmers Association, The Natal Game Ranchers Association, the Nature Conservation and Game Farming Committees of the Transvaal and Free State Agricultural Unions. These bodies have made it their purpose to disseminate knowledge and information concerning Game related matters and to make representations on behalf of their members to local, and provincial authorities and to provide a forum for discussion.

Table 7

Approximate cost per kilogramme to crop using Helicopter or Night shooting

Cost Night team less than 8c – Fuel & Vehicle

H/copter	Pilot	Shottist	Inspector	Admin.	Factory	Handling	Freight	Total Rand
0.60	0.15	0.15	0.15	0.15	0.47	0.05	0.30	2.02

Figures supplied by J. Westcott 1982 pers comm.

Other local societies and bodies exist such as the Griqualand West Trophy Hunting Club to facilitate their industry at local level. Nationally the Wildlife Management Society serves the Professional Biologist, and draws its membership from the Universities, Provincial and National Conservation and Park Authorities. Its membership is largely responsible for the research that has been done on S.A. Fauna. Institutions such as the S.A.S.A.P. and the Grasslands Society have been, and will increasingly be involved in future development. Indeed examination of the literature confirms this Societies involvement and concern in this field. The introduction of a Protein Supply Commission can only be welcomed as a co-ordinating body with suitable representation from bodies concerned with game related issues.

Legal and Administrative aspects

Fauna and FLora are, according to the Constitution of S.A. the wards of the Provinces, the position of "res nullius" ensures that ownership may not be exercised by individuals, and that game may only be taken by "legal" means during a "hunting season", as defined by various local, or Provincial authorities, accordingly no uniform code of ordinances exists, nor in many cases would it be desireable. A detailed resume of these ordinances would in this context be superfluous. Game animals are classified as to their numerical status into categories such as being Ordinary Game, Protected Game, Vermin etc. and licenses to take these various categories are issued by the relevant bodies.

Generally the land owner, his employees and immediate family are excluded from these restrictions and may hunt by "legal" means out of season on his property the relevant category, but not protected or endangered species.

Ownership of "Game" can only be exercised over the dead animal (Yssel, 1980). Legal hunting refers to the use of a firearm of appropriate caliber (where this is applicable) for the species hunted, and precludes the use of Bow and arrow, Poison, Fire, Spotlights, Helicopters etc. This situation would preclude commercial exploitation completely, as an accommodation the Provinces have provided for an enabling mechanism, in the form of a "Certificate of Adequate Enclosure" (Cape Province) and various other enabling certificates and permits that involve the relevant Provincial Departments. The importance of Ownership in the development of game as an industry has been emphasized by several Authors including Parker & Graham (1975). Live game capture and transport involves the Province, and across border relocation involves "export permits", and Authorisation by the regional Veterinary Officer. Although farmers purchase game for restocking purposes they do not in fact own them. Technically the Province can lay claim to, and remove game from farms at will. By the same token stock increase in game numbers on a farm are not taxable, as is the case with livestock, only the proceeds from sales is taxable.

Hygeine

Sale of carcasses by farmers to individuals, be it privately, or through municipal market agents, is not subject to any regulation. It may not enter an abbatoir, since no dead animal can acess an abbatoir, it may not be held in a butchery cold storage facility together with meat, separate facilities must in such a case be provided. Depending on Provincial, or Local Authority enactments venison may be sold through butcheries on the procurement of a permit. Generally, any food article sold must be "fit for human consumption" as defined by local health authority.

The export of venison to European countries, was initiated in 1972, and is subject to the sanitary import requirements of the countries of destination, to this end the Dept. of Vetrinary services has made arrangements and carcasses are inspected post shooting by a stock inspector. With subsequent treatment per regulation and as required by the country of destination. Specifications laid down for Germany being the most stringent. Generally carcasses destined for other European Countries on a Vetrinary Certificate "C" must be "Fit for Human consumption, free from foreign substances, and derived from a Foot and Mouth disease free area". No warthogs or bushpigs may be exported. The endemic foot and mouth areas are defined as follows, but are subject to change during outbreaks. Kruger Park, the districts of Whiteriver, Barberton, Pilgrims Rest, Letaba, Sibasa, Messina, Soutpansberg north of the Mountain, S.W.A. between the Police Zone and the Angola Border, and Botswana. While these areas may not allow the egress of game carcasses or unsterilised products, canning is permitted.

Production facilities

Production facilities are presently situated in Harrismith and Cape Town where game for export can be inspected, and carcasses sectioned and packaged. These plants are to German specification, currently a plant is being erected at de Aar. Other plants to process game products are situated in the Kruger Park where culled animals are processed and canned and in Northern Natal a processing plant also exists.

Three Cropping firms are engaged in the cropping of game for export, past competition has eliminated several others. The lure of seemingly large profits to be made in the export of venison, underestimates the arduous nature, and high level of organisation and capital

requirements to survive this enterprise. The failure to develop a local market, and the rise in redmeat prices in South Africa, coupled with the cost of capital, and high cost of transport incurred, make this a high risk enterprise.

Game Production – Future Trends

Regarding the future of Game Farming as an established enterprise the following "scenarios" can be considered.

Venison Production

1. As a related aspect of Trophy Hunting, it bears no consideration, as an additional source of income to the Trophy Farmer who must perforce also crop or cull it will be a stabilising factor.

2. As an essential part of Sport or "Biltong" hunting it will be sa substantial production element of unpredictable size. The efficiency of production vis a vis, feed conversion or land resource utilisation is not an issue, however marginal lands can be effectively utilised. The return from both the sale of the game and the opportunity to hunt can exceed the income from conventional farming.

3. As an end in itself will depend upon, a) relative prices; should venison reutrns as a farm enterprise exceed that of domestics whether solely or in a multispecies mix in the face of inefficiency of production, it will tend to compete with domestics and reduce total redmeat production. b) If it can be shown that it can be more efficient in certain localities, or in mixed situations then it will ipso facto contribute to increased total animal protein production. This to my mind requires proof, especially in the on-farm situation, but indications are that at least in certain situations this will in fact obtain.

Table 8

Quantity and value of ostrich products sold by the Klein Karoo Ko-operasie Oudtshoorn during 1980

Product	No/Quantity	Value R.	Percent
Skins	50 000	5.9 mil	50
Feathers	120 000 kg	4.5 mil	39.7
Meat	1 000 000 kg	1.2 mil	10.3
	Total	11.6 mil	

Export

The export of venison, which has been the stimulus to greater farm production, and responsible for the increased interest shown in game at all levels, remains a difficult field to operate in. The facillitation of this enterprise by way of sympathetic treatment at official level is essential, and decentralised facilities encouraged. Export is however linked to a number of factors over which the producer and exporter have not control, and for stability to be achieved all forms of local marketing and exploitation encouraged.

Official Attitudes

The attitutude of the Dept. of Agriculture and Fisheries toward game must be one of positive involvement, and not to consider it a threat to existing practises and vested interests. Game Farming has much to offer both the farmer and the country. As the leading earner of hard currency in the "meat" field, and potentially the only, it deserves every encouragement, and especially positive action to keep production costs as low as possible. The problems as outlined must be addressed and the necessary biological and managerial parameters set. Legal and regulatory measures must be arrived at in conjunction with the producer and his representative bodies.

Ostrich Meat Production

The Ostrich, Struthio camelus, shares the distinction with the camel of being the only African species serving in domestication. Ostriches have been part of farming in the Oudtshoorn District and surrounding areas since c. 1865. The fashions of the times, and the fact that the feathers were light and easy to transport provided both a ready market, and an ideal product to produce during those times. The crash of the ostrich market early this century and the decline of the industry are well known historical facts. The resurgence of the ostrich industry due to the recovery of feather prices, coupled to the market created for its skin, and latterly its meat has led to a renewed interest and industry. The first abbatoir to slaughter ostriches was erected in 1965, primarily as a facility to obtain suitable skins. The discovery of "fillet and steak" as an exportable commodity has led to the enlargement and improvement of this facility during 1981.

Ostriches are slaughtered at 14 months of age, after the first picking of feathers, and the skin reaching the desirable area of 120 sq decemeters, 90% of all birds are slaughtered at this age.

Table 8 summarises the quantity of products and the value derived.

According to Swart (1981) the legs, which are virtually the only important part are a fairly constant 38% of the carcass mass irrespective of age or carcass mass, with an average slaughter mass of 28 kg. Deboned, 17kg of meat is available. Of this the "fillets" have a mass of 3.5 kg and the "steak" 4.5 kg, these are exported except for approx 1 kg per bird retained for local consumption, Appel (pers comm). The balance is converted into biltong with a conversion ratio of 3.4 : 1, and goulash. The only other carcass portions of significance, the neck,rump and gizzard constitute the offal, and is sold locally.

Ostriches are widely distributed on farms throughout the country, frequently as "watchdogs", the growth of the industry will be limited by the fact that both the expertise, while the only plant for the processing of the carcasses is situated at Oudtshoorn, the Klein Karoo Ko-op constitutes an obligatory Co-Op, and they have a monopoly of all primary ostrich products. The major products are fashion related and an oversupply situation can lead to an uneconomic situation developing. As a supplier of meat with a significant growth potential it will not be a factor!

Freshwater Fish Production

In his review of animal production strategies van Marle (this issue) notes that the total production of beef, mutton pork and poultry will have to increase as much as 60% during the ensuing 18 years, to satisfy the protein needs of the estimated 49 mil.population predicted. It is apparent that humans and domestic animals will be competing for high protein grain products, and he recommends that unicellular protein and agricultural waste will have to be efficiently applied to the production of meat production. Fish can be a significant contributor to a future strategy if it does not occupy high potential agricultural ground (which can be applied to protein production) or require high protein commercial feed-stuffs. Fish comply to this requirement: i) areas unfit for other farming activities or existing water surfaces are employed; ii) they can efficiently utilise organic waste of human, animal, or industrial origin. The liquid phase of such waste which is not fit for domestic animal use, can be used; iii) Fish can utilise unicellular protein in the unprocessed state.

Whilst S.A. is an arid country the availability of water should not be seen as a limiting factor in the optimal utilisation of unicellular protein. Contrary to popular expectation fish do not require large quantities of water. It requires less water per unit surface area than for instance irrigation of grains. Water which is unfit for irrigation, eg. saline water, or in coastal areas seawater can be utilized.

Aquaculture can deliver a valuable contribution in planning future strategies for protein production, provided the expertise and infrastructure is provided for the optimal conversion of suitable waste products to fish. The better utilisation of state waterworks and dams, production in brakwater and the conversion of un-processed unicellular organisms to fish, can also be important. The contribution of marine fish is not discussed since it is a limited resource according to Bross (1981).

The Current Status of Freshwater Fish Production in South Africa

According to Bross (1981) only 383 tonnes of fresh-water fish were produced in S.A. during 1981. Ninety percent of this tonnage was made up by trout fed commercial fish pellets. The balance were in all likely-hood also fed commercial pellets or grains. Stagnation in the industry, especially the warm water fish farming sector is due in the main to market related problems, high cost of production, and competition from marine fish. The integration of warm water fish farming with other farming activities. The use of waste, rather than grains or commercial feeds, and the availability of a better selection of fish species in a polyculture situation, should improve the competitiveness of the industry and increase production.

Bross (1981) mentions that at present only 50 tonnes of fish are netted from State dams. At present this aspect enjoys a reasonable research effort and interest from various sources, including vested marine interests. It can be expected that activity on this front will improve immediately.

The Utilisation of Natural Fish Production in Storage Dams

The larger storage dams in this country cover a total area of 220 000 ha (pers. comm. Dept. Water Affairs). A fraction of the natural fish population is taken by anglers, but the majority are underutilised, or contain fish (such as Labeos) that are not taken by anglers at all.

Since none of the State dams have been subjected to maximal production no practical knowledge exists as to the optimal sustained yield. Bruwer & Claasen (1978) attempted to estimate yield using models used in other parts of the world. Their estimate for the 60 largest dams vary between 14 and 143 kg per ha with an average of 46 kg/ha/year. Studies by the Institute of Environmental Sutides of the U.O.F.S. on a muddy dam near Bloemfontein, based on fish biomass, and survival rates, arrived at a yield of 40 kg/ha/year. Accepting this figure as an average, applied to the larger storage dams a potential yield of 8 000 tonnes per annum is derived. A portion of this tonnage is already being taken by anglers, but several thousand tonnes would be available for commercial use.

The Utilisation of Organic Waste in Fish Production

Sewerage

The various sewerage effluents of sewerage plants contain significant residual energy which can be applied to fish production. Based on a study undertaken locally, it should be theoretically possible to harvest 150 – 200 tonnes of fish from the Bloemfontein sewerage works wihout any additional feed. This plant serves a population of 200 000 people. Should the sewerage effluents of 25% of the populations of 40 million of the year 2 000 be utilised in this manner, a fish tonnage in excess of 3 000 tonnes per annum could theoretically be derived. Utilizing treated solid organic material in a production cycle this figure could be quadrupled! Practical problems associated wth such schemes are availability of ground and the occurrence of human bacterial pathogens. Recent studies by Schoonbee (pers. comm.) show that these pathogens can be destroyed by short exposure to high temperatures without the structure of flesh being harmed in any manner. Studies by this institute also indicate that significant quantities of fish can be produced in the present maturation ponds using floating cages.

It can be expected that there will be considerable consumer resistance to feedstuffs produced in sewerage water for some time. O. Kinne of Germany stated during a recent world congress on aquaculture that circumstances will dictate a change in attitudes: "In my opinion we have no choice: in the coming 5 decades or so we must learn to produce healthy palatable foods from our wastes which now pollute our lands, rivers and seas and we must learn to eat these wastes with pleasure.

Industrial organic wastes

Large volumes of organic waste eminate from, canning plants, breweries, sugar refineries etc. The solids in this effluent can be removed at low cost and be used as animal feeds. The liquid fraction is usually subjected to an expensive treatment process to reduce pollutants and purify it. Based on studies undertaken at this institute, the liquid fraction eminating from the sorghum breweries alone would be capable of producing 400 tons per annum. By 2 000 the total industrial organic effluent would support the production of several thousand tons of fish.

Agricultural wastes

Dickson (1981) estimates that cattle feedlots, piggeries, and chicken producing units currently produce 913 000 kg air dry waste. He is also of the opinion that intensive production systems must be extended to cope with increased demands for meat. The Director of Agricultural Marketing Research, M.J.K. Siertsema is of the same opinion and estimates that 48% of all slaughter stock will be finished in feedlots by the year 2 000 (Landbou Weekblad: 30 October 1980). The expectations are that by that time approximately 2 million tons of waste will eminate from these enterprises. Studies have shown that this type of waste can be applied to polycultural fish-ponds in the dry or liquid state, and should be capable of producing 600 000 tonnes of fish per annum. To achieve this a water supply of approximately 1 400 million cu meters would be required with a surface area of 100 000 ha. For obvious reasons such a figure will not be attained in practise, but it is indicative of the potential.

Fish Production with unprocessed Unicellular Protein

It has been shown that unprocessed unicellular protein such as algae, bacteria (including activated sludge) yeasts etc. can be substituted for fish or soymeal in feed pellets because of their high protein analysis. The use of this resource in fish culture should be discouraged when it competes with domestic animals for high protein feeds in a shortage situation. Certain fish species have the ability to feed on unprocessed unicellular protein at source. These are the filterfeeders and have the ability to filter microscopic organisms from the water directly. Two such fish are available, namely the blue bream (Oreoechromis mossambicus) and the silver carp (Hypophthalimichtys molitrix). Research into the utilisation of unicellular protein is still in its infancy, but is delivering very promising results. Further research is required before practical application is achieved. Through direct utilisation the costly and energy intensive harvest of these organisms is eliminated. Energy saved could rather be applied to increased production through heating for instance.

Algae deliver a much greater yield per unit area than conventional crops. High tempo algae culture in a water depth of 10 – 15 cm can under actual conditions produce up to 200 tons dry material/ha in the Bloemfontein vicinity cf. the 15 ton/ha for lucerne in the same area (information supplied by the Dept. Agriculture U.O.F.S.). The protein content of such algae is 40 – 60%, and only inorganic feedstock is required in production. Preliminary investigation shows that between 40 and 80 tons of fish (live weight) can be produced from 200 tons unprocessed algae, without any additional feed. Algae can be produced on any terrain provided the water, even water too brack for irrigation can be used in such a fish algae cycle.

Utilisation of Eutrophication in State Storage Dams for Production

With a population increase dams are increasingly subject to eutrophication. Eutrophication refers to the increase in nutrients such as nitrogen and phosphates, due to sewerage effluent, and runnoff from fertilised lands

etc. The Hartebeespoort dam is an indication. Recently water hyacinth increased to such an extend as a result of this enrichment, that all other reactions were inhibited. Although extremely undesireable it is proof of the concept that this type of pollution can be applied to the production of organic material. Composted hyacinth can be used as fertilizer in dams (Torien, pers. comm.) for fish production. The eutrophication of dams concievably can be utilised to meet part of a future protein shortage.

Discussion

Although the figures provided are largely speculative, it serves to indicate that freshwater fish can be applied to a significant degree to alleviate the expected protein deficit, without competing with other protein production. The utilisation of waste products and unicellular protein is a foreign concept to most South Africans. The extention and application of this potential will largely depend on a well co-ordinated, research effort, extention service and the provision of an infrastructure and concommitant factors.

The following guidelines can serve for future development in this field.

i) If the Protein Supply Commission, as recommended by Dr. van Marle is established, it must also have Aquaculturalists on its panel to determine research priorities, co-ordinate, finance and evaluate research, and facilitate development and the application of research findings. Such a function can be performed in association with existing research co-ordinating bodies such as the C.S.I.R. and the Water Research Commission.

ii) Existing research institutes that have built a corpus of knowledge and expertise, must receive financial aid on a long term basis. It is important for demonstration units to be erected where research findings can be demonstrated in practise, and information and extention be passed on to the interested parties.

iii) The Department of Agriculture and Fisheries and the Agricultural Unions must be actively involved in the creation of the infrasturcture to supply requisites and breedstock, and to deal with extention and marketing.

iv) Financial assistance must be accorded to Aquaculture to supply it with the waste products, and to integrate it with other farm activities.

v) Natural production in State storage dams must be optimised in respect of both angling and commercial production.

Conclusion

The economic utilization of game in the farm situation is a recognised practise not neccessarily linked to the production of venison as a prime concern, its contribution to increased protein production is limited to areas not suited to domestic livestock, and other marginal areas. Should it not compete absolutely with domestics for available herbage its contribution will be larger by the amount of non over lapping consumption. Research into this and other aspects is required. Market related factors need extention and development.

Ostriches as meat producing animals are non starter, their monetary contribution cannot be ignored, and expansion is coupled to unpredictable factors.

Freshwater fish show the greatest and most urgent potential since their culture can solve problems of both economic waste disposal and protein deficits. Marketing problems and research and practical facilitation are priorities.

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