

Veterinary needs of dogs in two resource-limited communities in the Gauteng and North West provinces of South Africa

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ABSTRACT

Information on the socioeconomic aspects and the health status of dogs in 2 resource-limited communities in the North West and Gauteng provinces of South Africa was gathered using semi-structured interviews and a standardised questionnaire. The dogs were examined clinically to determine their health status, and their body condition and age were scored. Most of the dogs (93 % in Jericho and 90 % in Zuurbekom) were infected with hookworm, which poses a threat to animal and human health in the 2 study areas. Many dogs were also being given a protein-deficient diet, which together with hookworm parasites would impact considerably on the dog's health. Dogs were mainly kept for security reasons. The need indicated to be most important by the residents of the 2 communities was a lack of available and affordable veterinary services.

Key words: dogs, Gauteng, North West Province, resource-limited communities, veterinary needs appraisal.

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INTRODUCTION

Poverty results in a lack of political power to make choices, access to education and information by the communities and limited or less than optimal use of resources². Understanding the needs of these communities is therefore essential and can be achieved through a variety of assessment methods¹⁴. One such method is the Veterinary Needs Appraisal (VNA)^{9,11}. This provides a rapid means of assessing the socioeconomic needs and health status of animals within human communities.

In a recent survey of animal welfare needs in Soweto, just southwest of Johannesburg in the province of Gauteng, treatment of sick animals was seen as a priority by 29.6 % of owners interviewed^{5,13}. However, less than 1 % actually made use of private veterinarians. In 2 other studies the animal owners in resource-limited communities indicated an awareness of the importance of animal health and the need for accessible and affordable veterinary services^{8,16}.

The objectives of the current study were to assess the health status and availability of veterinary care for dogs and the socio-

economic factors influencing the health of dogs in 2 resource-poor communities in the Gauteng and North West provinces of South Africa.

MATERIALS AND METHODS

Two VNAs^{9,11,16} were conducted to assess the veterinary needs, health status, diet, care and helminth and other parasite occurrence of dogs in 2 areas. The occurrence of helminths and other parasites in these studies has been reported earlier¹⁶. The methodology followed that of the Mašhishing (Mpumalanga) VNA undertaken in May 1996⁹. The 2 study areas were Jericho and the surrounding villages west of Pretoria in North West Province, and Zuurbekom and surrounding townships southwest of Johannesburg in Gauteng (Fig. 1). The Jericho VNA was conducted from 11–14 March 1997 and the Zuurbekom VNA from 19–22 January 1998.

Jericho is a rural Setswana farming community with a formal local governing body led by the village headman, who in turn answers to the chief headman. The livestock in Jericho are kept and raised extensively in a communal grazing system.

Zuurbekom is a peri-urban community that falls under the Gauteng Provincial Farmer Settlement Programme (July,

1997). The government bought commercial farms (29 000 ha) in the area, divided them into smaller (7–9 ha) stands and resold them to 800 prospective small-scale farmers. The residents belong to various ethnic groups and there is no formal presiding authority in place. The resettlement process is still under way, with many farmers still settling in.

The socioeconomic information was gathered via semi-structured interviews with each dog owner using a standardised questionnaire. Dog owners indicated to the community leaders whether they wished to take part in this study, and whether they or their representative was available on the day the VNA team visited the area. Interviewees were guided through the questions with the assistance of an interpreter when necessary. This helped to gain information with regard to the environment, the owner's economic situation, and practices that potentially affect the dog's health and level of parasitism. Some additional information was gathered by careful observation of the environment, for example the size of the area where the dogs were kept, the type of food available to the dogs, shelter, bedding and restraint.

Before both VNAs, meetings were arranged with the community leaders to inform the residents about the purpose of the studies and to encourage their co-operation. The dog owners were visited in the mornings, the dogs examined and the animals' home environment assessed. Daily report-back sessions were held each afternoon of the same day with the community. All information was consolidated in the final meeting on the last day.

The appraisal team included 2 veterinarians, a veterinary technologist and an animal health officer-in-training who also served as an interpreter when required. The owners were interviewed during the clinical examination of their dogs, after which biological samples were collected from the dogs. Samples were not taken from all the dogs examined, as some dogs were too sick, heavily pregnant, small, nervous or aggressive to handle.

The breeds of dogs were recorded as

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SOUTH AFRICA

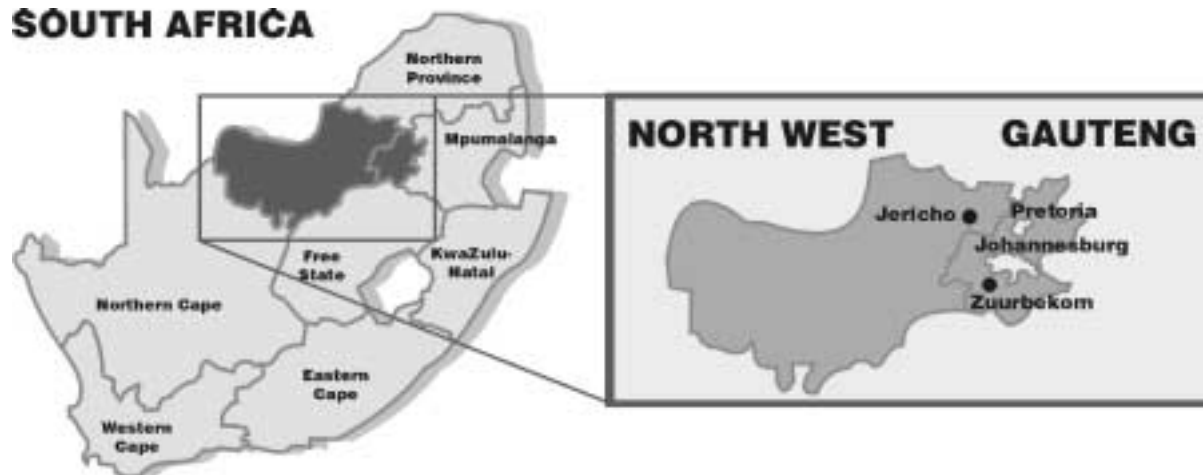


Fig. 1: Geographic locality of the Jericho and Zuurbekom study areas.

well as their ages, based on the size of the animal, body proportion, tooth development and feedback from the owner when available. The body condition score (BCS) was also recorded. In this study body condition was scored on a scale of 1–5, where 1 represents severe emaciation, and 5 represents severe obesity, with numbers 2–4 indicating intermediate stages of body condition. The BCS method developed by Laflamme⁷ was simplified for the current study. Laflamme used a scale of 1–10, and the current study a scale of 1–5.

RESULTS

The villages visited in the 2 areas, the number of owners interviewed, the numbers of dogs examined and samples obtained are summarised in Table 1. 'Dogs sampled' refers to dogs from which at least 1 sample of a possible set of 3 (blood, faeces and adhesive tape swabs) was collected.

In these resource-limited communities, residents kept an average of 3 dogs.

Seventy-one percent of the dog-owners in Jericho and 53 % in Zuurbekom had 3 dogs or fewer, and 94 % and 68 % residents owned 5 dogs or fewer, respectively. One person in Jericho owned 17 dogs.

Table 2 lists the diets of dogs that were normally provided by their owners. This may have been supplemented by scavenging in many cases, as 66–74 % of all dogs roamed the area freely. Various combinations of food were given on the basis of 'when available', and occasional supplementation regarded as leftovers included bones, fat and meat broth. Some owners also added milk or food scraps to the basic diet of porridge. Meat was given to the dogs in various forms (e.g. mince, butcher's sawdust and slaughter scraps).

Table 3 gives the BCS of the dogs in the 2 communities. Dogs of several breeds and crossbreeds were identified in both areas. In Jericho 88 % and in Zuurbekom 100 % of owners kept dogs for security reasons, while 6 % of owners in Jericho

also kept their dogs as pets. One owner in Jericho had 8 greyhounds that he used for hunting small game, and an owner in Vereeniging had 2 border collies, which he found particularly useful for herding cattle and sheep. The dogs were therefore expected to work, in addition to being kept for the enjoyment of the owners and their families.

Dogs from all age groups were included in the study. In many cases the owners did not know the age of their dogs, and in some cases the true owners were not there to provide the information. All the dogs were therefore classified into the 4 age groups listed in Table 4¹⁸.

Health problems of dogs in Jericho observed by the appraisal team by examination or testing were hookworms (93 % of dogs examined), cestode infection (2 %), Transmissible venereal tumour (TVT), benign skin neoplasm, parvovirus, distemper, ectoparasites (*Cordylobia anthropophaga*, ticks, fleas, lice) and skin afflictions (trauma, tick bite necrosis, reaction to old motor-car oil).

Health problems observed by examination or testing in dogs in Zuurbekom were hookworms (also 93 % of dogs infected), keratitis, distemper, external parasites (ticks, fleas, lice, mites, bites by stable flies), superficial skin wounds and photosensitivity (collie nose), motor vehicle accidents (lower back injury and loss of digits) and a fractured mandible.

External parasites on dogs in both areas were identified as *Rhipicephalus sanguineus* ticks, and to a lesser extent *Haemaphysalis leachi*. *Cordylobia* sp. (skin bot) infestations were seen only in Jericho, probably because of the warmer subtropical climate and the higher rainfall experienced during the 1997 summer.

Standard veterinary procedures such as vaccination, deworming, castration and spaying were not normally performed on the dogs, but the owners would certainly consider these if there was a veterinarian

Table 1: Villages visited, number of owners interviewed, numbers of dogs examined and samples obtained in the Jericho and Zuurbekom Veterinary Needs Appraisals.

Study area/date	Village	Owner (n)	Dogs (n)	Dogs sampled (n)
Jericho				
11 March 1997	Fafung	7	21	21
11 March 1997	Sepai	2	3	3
12 March 1997	Legonyane	10	22	20
13 March 1997	Rooiwal	5	8	8
13 March 1997	Vaalbos	4	14	9
14 March 1997	Waterval	3	6	3
14 March 1997	Jericho	3	16	6
Total		34	90	70
Zuurbekom				
19 March 1998	Doornkop	2	15	4
19 March 1998	Zuurbekom	4	22	9
20 March 1998	Vereeniging	4	12	8
21 March 1998	Elandsfontein	4	20	10
22 March 1998	Rietfontein	5	27	9
Total		19	96	40

Table 2: Diets of dogs observed during interviews with their owners in Jericho and Zuurbekom.

Diet	Jericho owners (n)	Zuurbekom owners (n)
Maize porridge/samp with or without milk	7	2
Porridge supplemented with bones, meat shavings and/or leftovers	6	7
Porridge supplemented with commercial dog food	12	4
Commercial dog food only	6	5
Leftovers only	2	1
No information available	1	0
Total	34	19

Table 3: Body condition scores of dogs examined in Jericho and Zuurbekom communities.

Condition score*	1	2	3	4	5	Total
Jericho	2	40	47	1	0	90
Zuurbekom	6	31	57	2	0	96
Total	8	71	104	3	0	186
%	4.3	38.2	55.9	1.6	0	100

*Adapted from Laflamme⁷.

in the vicinity, and if they could afford it. Of all the dogs sampled, 88 % had not been given any form of veterinary attention. Some dogs had been vaccinated during the government's rabies vaccination campaigns. Some dogs had docked tails; this procedure had been performed by their owners.

During the personal interviews, the owners expressed a general desire for veterinary services. An overall perception of how much money dog owners were prepared to pay for a number of standard veterinary procedures is given in Table 5.

DISCUSSION

Between 80–94 % of the dogs in the 2 study areas had a body condition score of 2–3. In addition, 93 % of the dogs examined in Jericho and 90 % in Zuurbekom

harboured hookworms¹⁶, which may not only cause disease in the dog but is a zoonotic threat (cause of cutaneous larva migrans) to the humans in the community¹². Most dogs are fed mainly maize meal, a diet that is deficient in protein. The combination of infection by internal parasites (e.g. *Ancylostoma caninum*) and a protein-deficient diet could give rise to stunted growth, suboptimal body condition, nutritional and hormonal imbalances and increased susceptibility to disease^{17,19,20}.

Although most owners provided shelter for their dogs against the elements, some did not consider bedding a necessity. Despite the majority of properties being fenced off, dogs could easily escape and roam well beyond the property boundaries. Some owners reported that

their dogs never left their properties but that they occasionally took them along when they visited family and friends in the neighbourhood. Some dogs were chained, but most were let loose during the day when the owner was home, or at night to guard the property. One owner at Elandsfontein, Zuurbekom, chained his dogs in and around the cattle kraal at night to protect his stock from thieves. There was a tendency to chain larger dogs, especially where free-ranging chickens were kept, to prevent them from catching chickens or eating the eggs. Smaller dogs were generally allowed to run free. On a few occasions it was necessary to advise owners about the risk to the dog's life and health where they were tied up in an unhygienic environment in the heat with no access to fresh water.

Only the residents in the central Zuurbekom area had access to municipal water. In the surrounding areas, and in Jericho and surrounding villages, the only source of household drinking water is from boreholes. In many cases, the water had to be carried from a central communal waterpoint to the homes.

Health problems perceived by dog owners in Jericho were babesiosis, loss of appetite, coughing and dyspnoea, distemper, vomition and lameness, and by those in Zuurbekom ticks, babesiosis, dystochia and postnatal mortality. External parasite control measures in the 2 areas are much the same and include the use of a carbolic acid-based household disinfectant (Jeyes Fluid, Adcock Ingram Pharmaceuticals), stock dips such as diazinon (Dazzel N F, Agricura-Bayer Animal Health), amitraz (Triatix L S, Intervet SA, previously Hoechst Roussel Vet.), pyrethroids (Ektoban, Novartis Animal Health/Bayer Animal Health), insecticides such as carbaryl and γ BHC (Gamma Benzene Hexachloride, Blue Death powder, CGP Holdings) and also old motor-car oil. A few owners also used carbaryl powder (Kabadust, Efecto) on their dogs. Only a small number of owners were aware of the presence of helminth parasites, and the remedy of choice for these was Bob Martins (Martin and Martin) tablets. One owner also regularly dosed his dog with potassium permanganate (KMnO₄) in its drinking water to reduce worm infection. The possibility of manganese poisoning with continued therapy in the latter case was explained to the owner. Manganese toxicity in dogs is not well-documented, but presents as lowered fertility, reduced feed intake and growth, as well as stiffness and stilted gait in pigs¹.

Helminth parasite levels in dogs belonging to owners who said they

Table 4: Age distribution of dogs examined during the Jericho and Zuurbekom VNAs.

Age group	Jericho	Zuurbekom	Total
Pups (<3 months)	10	38	48
Subadults (3 months – 1 year)	35	8	43
Adults (1–8 years)	41	48	89
Old (>8 years)	4	2	6
Total	90	96	186

Table 5: Fees for various procedures proposed by dog owners interviewed in Jericho and Zuurbekom.

Procedure	Fee proposed
Deworming	R3.50–20.00
Vaccination	R5.00–50.00
Sterilisation	R20.00–100.00
Wound dressing and/or sutures	R2.00–50.00
Bone fracture fixation	R30.00–100.00

dewormed their dogs regularly (18 %) were not different from those of dogs of owners who did not deworm their animals. Clearly, the worm control strategies practised were not entirely effective. With good management (e.g. regular removal of dog faeces, restricted movement of dogs and improved hygiene), deworming may be reduced to a minimum. Chemical parasite control, if applied with appropriate knowledge and understanding (correct diagnosis together with effective dewormer, regular deworming of pups and young dogs, deworming of pregnant and lactating bitches and sick animals) can be cost-effective.

Eighteen of the 53 dog-owners (34 %) in the 2 studies removed dog faeces from the environment. This is significant because it is probably the helminth parasite control measure that can have the most impact on worm levels in the environment^{3,6}. In these study areas where dogs roam freely there is a high level of transmission. Deworming together with faecal removal is a strategy that reduces worm levels significantly in other hosts such as donkeys (S Matthee, Faculty of Veterinary Science, Onderstepoort, pers. comm., 1999).

Parasitism in dogs in these communities is even more alarming if one considers the accumulation of infective stages of helminths in the environment and the threat they pose to the human population⁴. Most of the dog helminths encountered in these study areas were zoonotic, and the children were at high risk, since they are barefooted and play in muddy areas where infective hookworm larvae may be available. The men often work in the cities or elsewhere and have less frequent contact with the infective environment and infected dogs.

Most dog owners adopted a policy of 'wait and see' when asked what their actions would be should their dogs become ill. Many said they would not do anything specific but just let the disease run its course. A 'no intervention' or 'wait-and-see' approach may not be in the animal's best interest. Although some degree of resistance to parasites by hosts develops in time¹⁵, many parasites persist. The lack of veterinary care is even more serious in households where there is more than 1 dog, as reinfection and cross-infection continue to take place. Dog owners may argue that they cannot afford the cost of deworming their dogs, but that argument is not supported when owners have large numbers of dogs. Feeding an extra dog for a year costs more than deworming 2 dogs for a year. Restricting movement of dogs also becomes more difficult for owners who

have many dogs.

Nearly all the dog owners interviewed considered the lack of, or difficult access to veterinary services and advice as a problem. The communities identified a need for veterinary procedures such as vaccination and sterilisation. Judging by the relative dog age distribution patterns in these 2 communities, slightly less than half the dog population consisted of pups and sub-adults, indicating a low average life span, and thus a low survival rate. Dogs roamed freely, and even in households where the dogs were chained, the property boundaries were not dog-proof, inviting visitors and resulting in indiscriminate breeding.

Only in the Doornkop section of Zuurbekom was veterinary assistance within easy walking distance. Residents in the Vereeniging part of the Zuurbekom area were situated about 5 km from the nearest co-operative, but they still had to travel at least 10 km to the nearest veterinarian. All the other areas visited were 10 km or more from the nearest veterinarian or animal welfare organisation.

All the residents interviewed considered that a mobile veterinary clinic to serve the area would be an excellent idea, but their enthusiasm was dampened somewhat when the question of costs was raised. One dog owner said that he would not be prepared to pay for such a service, while another was willing to pay a flat rate of R5.00, whether for deworming, sterilisation or internal fixation of fractured bones. Most of the other owners, however, were willing to pay a more reasonable fee for services (Table 5). Two dog owners from Zuurbekom were willing to pay for the treatment of wounds and fractures, whatever the cost might be. This latter response was in agreement with the study in Moretele 1, North West Province⁸, where owners were prepared to pay for services.

Besides the distance to and accessibility of veterinary and paraveterinary services, the economic situation score (ESS)¹⁰ of households will to a great extent indicate the potential for awareness, management and quality of veterinary care in a community. Criteria used to assess this score are size of the home and number of rooms, type of building material used, presence of a ceiling, gutters, electricity supply, electrical appliances, telephone lines and type of floor cover. In this assessment the smallest, most simple structures (e.g. single-room corrugated-iron construction with no ceiling or floor, with roof held down by stones, and where the cooking is done on an open fire) scored 1, and the most luxurious well-furnished, plastered and painted houses with more

than 3 bedrooms, flush toilets, and with all extras added scored 5. Some homes with both television and electricity, but comprising only a single room corrugated iron structure, did not fit into any category of this scoring system. A more appropriate system is needed to adequately assess the economic and social level in such communities. The ESS in Jericho ranged from 1–4, and averaged 2. Although the ESS of the Zuurbekom area varied between 3 and 4, it could not be taken as a reflection of the true economic situation of the residents in the community. This is because Zuurbekom is a government resettlement area for small farmers, and resettlement is still in progress. The old farmhouses were taken over by the new owners, and therefore give the wrong impression of the economic situation of their new owners.

This study indicates that the lack of available and affordable veterinary services has a negative impact on general animal health in resource-limited communities, and that the presence of zoonoses such as helminths of dogs may put community health at risk. Written and oral information should be offered to these communities so they can understand the risk of these parasites. In this study, medical information was not available about the occurrence of the zoonotic conditions caused by these helminth parasites in these communities. However, the availability of such information combined with similar veterinary studies is needed to provide an indication of the level of risk to these communities.

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REFERENCES

1. Fraser C M 1986 *The Merck veterinary manual* (6th edn). Merck., Rahway, New Jersey
2. Fraser-Moleketi G 1997 Poverty and government. *Aambeeld* 25: 44–47
3. Herd R P 1986 Epidemiology and control of equine strongylosis at Newmarket. *Equine Veterinary Journal* 18: 447–452
4. Holland C, O'Connor P, Taylor M R H, Hughes G, Girdwood R W A, Smith H 1991 Families, parks, gardens and toxocarasis. *Scandinavian Journal of Infectious Diseases* 23: 225–231

5. Hudson W G B, Gummow B 1997 Perceptions of teenagers about the role of the veterinarian in practice: a cross-cultural study. *Journal of the South African Veterinary Association* 68: 59–61
6. Krecek R C, Guthrie A J 1999 Alternative approaches to control of cyathostomes: an African perspective. *Veterinary Parasitology* 85: 151–162
7. Laflamme D P 1993 Body condition scoring and weight maintenance. In *Proceedings of the North American Veterinary Conference, Orlando, Florida*, 16–21 January 1993
8. Letsoalo S S, Krecek R C, Botha C A J, Ngetu X 2000 Animal husbandry in Moretele 1 of North-West Province: implications for veterinary training and research. *Journal of the South African Veterinary Association* 71: 92–96
9. McCrindle C M E (ed.) 1996 Veterinary needs appraisal: Mašhišhing. Report prepared for Medunsa, State Veterinary Services, Civics Association, Environmental Justice Networking Forum, Mpumalanga Parks Board and private veterinarians, Lydenburg. Community and Outreach Unit, Medunsa
10. McCrindle C M E, Tice G, Mogajane E M, Stewart C G, Mosupi H 1994 An investigation into the potential veterinary needs of a semi-rural, low-income community. *Journal of the South African Veterinary Association* 65: 90–96
11. McCrindle C M E, Stewart C G, Kiwanuka A 1996 Methodology to assess animal health needs and extent of activities. *Primary animal health activities in southern Africa. Workshop held in Mzuzu, Malawi*, 26 February – 8 March 1996. Deutsche Stiftung für Internationale Entwicklung, Feldafing, Germany: 136–150
12. McCrindle C M E, Hay I T, Kirkpatrick R D, Odendaal J S J, Calitz E M 1996. A primary health care approach to an outbreak of cutaneous larva migrans. *Journal of the South Africa Veterinary Association* 67: 133–136
13. McCrindle C M E, Cornelius S T, Schoeman H S 1997 A survey of animal welfare needs in Soweto. *Journal of the South African Veterinary Association* 68: 137–139
14. Mettrick H 1993 *Development orientated research in agriculture – an ICRA textbook*. International Centre for Development Oriented Research in Agriculture, Wageningen
15. Miller T A 1968 Pathogenesis and immunity in hookworm infection. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 62: 473–485
16. Minnaar W N, Krecek R C, Rajput J I 1999 Helminth parasites of dogs from two resource-limited communities in South Africa. *Journal of the South African Veterinary Association* 70: 92–94
17. Nelson R W, Couto C G 1998 *Small animal internal medicine* (2nd edn). Mosby, St Louis
18. Odendaal J S J 1998 *Applied veterinary ethology of cats, dogs* (1st edn). Easi Learn, Pretoria
19. Roitt I M 1997 *Roitt's essential immunology*. Blackwell Science, Oxford
20. Tizard I R 1996 *Veterinary immunology – an introduction* (5th edn). W B Saunders, London

Book review — Boekresensie

Tierzucht in den Tropen und Subtropen [Animal breeding in the tropics and subtropics]

Edited by Peter Horst and Ingeborg Reh

1999. Eugen Ulmer, Stuttgart, 452 pp., hard cover, in German. Price DM 248. ISBN 3 8001 3204 4.

This is a completely new edition that has been expanded to include production techniques for animals species that are less well known to students, veterinarians, extension officers in community services and agrarian specialists who would like to understand the problems of animal production in the tropics and subtropics.

Twenty-three authors from 6 different parts of the world have contributed. They have with tremendous diligence compiled information on problems of animal production mainly in Africa, but also in Southeast Asia, Malaysia, Indonesia, Australia, India, and South and Central America.

It is estimated that 55 % of sheep, 69 % of cattle, 95 % of goats, and almost all buffaloes and camels are kept in tropical and subtropical regions. There are almost insurmountable problems relating to animal breeding, nutrition and health that face practitioners and scientists when planning systematic animal improvement.

Only by listing the chapters can the amount of work covered by the authors be appreciated: Animal production world-wide; Problems of animal production in the tropics and subtropics; Nutrients and the provision of feed; Animal diseases and control measures; Breeding and production improvement; Production techniques in utility animals (cattle, buffalo, sheep, goats,

equines including donkeys and mules, poultry, rabbits, guinea-pigs, bees and silk-worms). An important chapter deals with the use of wild-life (antelope, rodents, kangaroos, ostriches and crocodiles). Aquaculture is of great importance in tropical and subtropical areas, and the most important fish species are listed with their production potential. The final chapter is a discussion of the improvement of natural pastures, where the human factor, problems of ownership, climatic and soil conditions are the overriding difficulties facing technology transfer.

The book represents a major contribution to the knowledge of animal production in the tropics and subtropics. The authors and especially the editors went to great lengths to pursue all possible pathways to improvement of production animals for the better nutrition of people in these regions.

It is exceptionally well produced, with good clear illustrations, and is a pleasure to read. It is therefore highly recommended to students, veterinarians and agrarian specialists who would like to gain a better insight into animal production problems in developing countries.

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