GENERAL ASPECTS OF SMALL RUMINANT HEALTH:
MANAGEMENT, TECHNOLOGY AND EXTENSION

Tjaart W. Schillhorn van Veen
Depts. of Large Animal Clinical Sciences and
Microbiology & Public Health
Michigan State University
East Lansing, MI 48823

SUMMARY

Some general aspects of small ruminant health and the effect of health on production are reviewed. Examples are given of the management practices, new technologies and infrastructural changes which may improve the production and marketing of sheep and goats. Health improvement mainly by means of education through extension service and minor use of drugs and vaccines may considerably increase the production.
INTRODUCTION

Health is still a major constraint in efficient livestock production. Interventions which enhance health are very popular among livestock owners in Africa and elsewhere, and appear to have an attractive short term return. Despite these optimistic observations, there is still a lot to be done and learned about the improvement of health and production in African livestock. Although we are fairly knowledgeable about most of the deficiencies and disease problems, the control and prevention effort has been less successful than expected. Various reasons are given, as discussed elsewhere (Eicher, 1984; Schillhorn van Veen, 1984), but poor organization and a low priority of livestock services in, and outside, governmental organizations seems to be a major cause.

This paper discusses some of the constraints on production, the economic benefit and difficulties of introducing interventions, the effects of health on international marketing. It also lists some (bio)technological developments which may, ultimately, have some impact on livestock production in Africa.

The bias towards discussing mainly West African examples is partly related to the author's personal interest and experiences but also to the lack of published material from other parts of Africa.

MEASUREMENT OF PRODUCTION LOSSES

Not too long ago disease in African livestock was only measured in terms of mortality. Production diseases and deficiencies were rarely considered important. In the last decade, however, there has been an increased interest in measurement of production losses, which in some cases showed that the benefit of preventing diseases with a high morbidity but low mortality may be greater than
preventing occasionally fatal epidemics (Akerejola et al. 1979; Aklaku, 1980; Matthewman, 1980; Sumberg and Mack, 1985).

The methodology of measuring production losses, however, is still not universally standardized; criteria developed in Europe or the U.S. are often not applicable under African conditions. The common denominators for production in developed countries, e.g. weight (either body weight, fleece weight or milk production), total production per HA, and mortality, may not be the exact criteria to measure production under local conditions in Africa. Firstly, because animals are kept for additional reasons (manure production, skins, ceremonial use). Secondly, because the rest-value of old, diseased or dying animals is higher than in developed countries. During our survey in rural slaughterhouses in northern Nigeria in the early seventies, the rest-value of a diseased animal at the slaughterplace was approximately 50% of the price of a normal animal of the same size, and 25% if the animal had to be slaughtered in the compound of the owner or in the field.

The measurement of production losses as such is extremely difficult, especially under field conditions where control animals are still exposed to a variety of diseases, parasites and deficiencies. Or, briefly, it is still not clear how to define a "normal" animal. (For further discussion of production measurement, see Wilson, 1980.)

Bioscientists have made further efforts to define normal animals by looking at clinical and biochemical parameters (Oduye and Adadevoh, 1976ab; Saror and Schillhorn van Veen, 1977; Thomas and Chiboka, 1984; and others); or physiological criteria (Schillhorn van Veen and Folaranmi, 1978; Preston and Allonby, 1979; Buvanendran et al., 1981).

The latter studies revealed that the small ruminant population in Africa shows considerable variability in genetic build-up; which opens up interesting
avenues of research on genetically determined disease and production factors (see below). Results of this research should not be expected too soon, and in the meantime improvement in production can and has to be achieved by improvement of husbandry and management.

**MANAGEMENT**

Management is often mentioned as a major factor in the success or failure of a farm enterprise. Still, little effort is made to study management, apart from a few specialized areas (see Schillhorn van Veen, 1983). Table 1 provides an example of a number of production losses and diseases, nearly all of which are influenced by on-farm management. There is ample evidence, however, that the traditional African livestock owner is well aware of the role of management in the avoidance and control of animal disease (de St. Croix, 1945; Ba, 1984). There is little evidence in the literature, however, that controlled studies have been done on the effect of certain husbandry practices and their impact at farm and village level. Typically the discussion about these practices is often performed along disciplinary lines; sociologists and economists rarely make an effort to understand the technique of livestock raising, and veterinarians and animal scientists rarely take the "soft sciences" serious. More effort should be made to integrate these different aspects or viewpoints, as tried in an example in table 2.

On-farm management is strongly influenced by local conditions. Spharim and Seligman (1983) identified 18 different husbandry systems in the relatively small northern Negev in Israel and reviewed these systems with respect to various inputs. Their model indicated, for instance, that highly fertile Finn sheep required a fairly labor intensive system when compared to less fertile Awasi sheep; these results are comparable to sheep ranches in the arid western U.S. where high fertility is considered a liability rather than an asset.
It has to be admitted, however, that management capabilities are difficult to measure, especially under varying field conditions. Simple management improvements are still widely promoted (e.g. not widely accepted) for example:

- feeding from feed bunks rather than from the ground
- provision of trace mineral supplements
- controlled breeding
- adequate feeding of pregnant ewes or does
- ensure intake of colostrum in day-old lambs and kids
- foot care

Introduction of such management practices requires a good extension network and a continuous effort, which can be combined with other health related activities (Boundy, 1981; Hindson, 1982).

NEW DEVELOPMENTS IN ANIMAL HUSBANDRY AND HEALTH

Among the many developments in animal science and biomedicine are a few which may be of benefit to the African livestock industry in the foreseeable future:

1. Herd health approach
2. Better understanding of undernourishment
3. Development of bio-engineered vaccines and diagnostics
4. New drug delivery systems
5. Utilization of disease resistant breeds

Herd Health Approach

The herd health systems presently developed in Europe and the U.S. may have some benefit to Africa. Ideally the method provides for sound data collection, either by farmers themselves or through enumerators* and simple analysis. Dedicated record keeping over a period of a year or more does indeed provide very valuable data (Wilson, 1980; Mack, 1983). Ten years ago we used this

* I am suspicious of recall data collected in interviews, especially when collected on only one or two occasions; being a livestock owner myself I would have difficulties to recall reliably livestock numbers and farm events which occurred more than 2 weeks ago, and were not recorded at that time.
method at the Ahmadu Bello University and obtained good data on production constraints (Buntjer unpubl.) and on the seasonal changes in disease incidence as measured by (emergency) slaughter in small villages exemplified in fig. 1., which shows the different reasons for slaughter of sheep in a rural northern Nigerian village. It seems that sound data on a given system are crucial for the introduction of interventions, and are a minimal requirement for any development project.

**Undernourishment**

Seasonal or general undernourishment has been a major problem in African livestock. Livestock management interventions such as planned breeding, fodder preservation, early slaughter, mineral supplementation, and treatment of chronic disease are of value to prevent serious losses but they are rarely implemented.

On the other hand, bioscientists are better able to understand the physiology of undernourishment. Examples are the effect of hormones such as cholecystokinin which influence feed intake (Symons, 1978), and the purification of cachectin, a macrophage factor which suppresses the activity of the enzyme lipoprotein lipase, leading in experimental models to a chronic wasting disease (Beutler et al., 1985). A better understanding of the role of such hormones may help to solve wasting diseases in African livestock such as chronic parasitism and trypanosomiasis.

**Bioengineered Vaccines and Diagnostics**

During the early eighties a number of technological innovations in biochemistry and immunology has lead to an explosion of new ideas and approaches to health problems in man and animals. So far, however, the substantial, and mainly commercially sponsored, research effort has not yet lead to major applications in animal health.
It is doubtful whether these developments may in the next decade indeed produce innovations which are applicable and affordable in Africa. The bioengineered foot and mouth disease vaccine and malaria vaccine produced in the U.S. is still in the developmental stage, other vaccines lag behind. Improvement in the diagnosis of disease with help of monoclonal antibodies still has considerable drawbacks but has successfully been used to identify East Coast Fever strains in cattle in Kenya which were fairly effective in regional vaccination trials.

**New Drug Delivery Systems**

There exists an increasing interest in drug delivery in human as well as in veterinary medicine. In animals this has lead to drugs and feed additives incorporated in feedblocks, to intra-ruminal slow-release devices and subcutaneous implants. At present, technology is being developed for pulse release mechanisms, removable implants and local release devices. These methods may have benefits in the control of many livestock diseases in Africa which so far required frequent single treatments and the use of long-acting drugs (such as disophenol for control of haemonchosis, isometamidium for the control of trypanosomiasis). The unwelcome consequence of long-acting drugs are drug residues in meat and milk which pose a potential hazard to the consumer—and, at the national level, to export markets. A more delicate use of drugs and feed additives with the help of these newer devices would not only improve the image of the livestock industry, but could in the long run lead to economic benefits as the volume of drugs used is reduced. Again, however, most are still in the developing stage and may well be too expensive for routine use.

**Utilization of Disease Resistant Breeds**

The utilization of disease resistance has obtained increasing attention during the last decade, especially with respect to trypanotolerance (ILCA,
which, in cattle, appears to be an incomplete dominant trait. Biochemists try to determine the genetic base at the molecular level for resistance factors and are even thinking about inserting relevant genetic material in the nuclei of embryos to improve their genetic build-up.

The two diseases in which applied research on disease resistance has been carried out are trypanosomiasis (Murray, Trail and Grootenhuis, 1984; Griffin and Allonby, 1979; Toure et al., 1983) and haemonchosis (Preston & Allonby, 1979). In addition, efforts are made to improve the tick and ectoparasite resistance. The results of these research efforts are promising but many problems have to be understood before a wide application can be expected (Albers et al., 1984). Whitelaw et al. (1985) were unable to demonstrate resistance against *T. congolense* in a selected number of African goat breeds and crossbreeds and suggested that the "resistance" was probably related to the fact the goats are less attractive to tsetse flies.

Most African breeds are naturally selected for their particular environment. Movement out of that environment or cross breeding may lead to a decline in adaptation as demonstrated by numerous cross breeding experiments over the last fifty years. The view that a certain disease or deficiency is the major or only constraint is biased, and other factors (drought resistance for instance) may be more important in the natural selection process (Schillhorn van Veen and Folarami, 1978). Moreover, with an intensification of production, the disease pattern changes; important diseases in nomadic systems may be a minor problem in settled systems and the reverse (Wilson et al., 1984). Research is and should be continued, as the improvement in the knowledge about the immunological basis of disease resistance may ultimately lead to applicable innovations.
Small ruminants appear to be an attractive export product for many African countries. Potential markets in North Africa, the Middle East and southern Europe are fairly close.

For various reasons, live animal export has been preferred by these countries which enhances the advantage of African producers over competitors in Australia and New Zealand (Holtzman, 1982). Production for export, however, is risky as demand may rapidly change, influenced by political considerations, currency changes and, most of all, by the quality of the product.

Animal health is important not only from a quality viewpoint, but also from a political viewpoint; too often markets are closed for (public) health reasons whether justified or not. Governments interested in export of small ruminants should try to provide an infrastructure which reduces the risk of market changes for disease reasons. With respect to Europe and the U.S. this may, at least for the time being in most African countries, be impossible. For the other nearby markets, it is surely feasible. Table 3 shows that, at present, many of the infectious diseases in producing countries in Africa are also present in most of the potential market countries. This should provide little comfort, however, as most Middle East countries are very active in their development of animal health programs, which includes eradication of these diseases. Also, economic situations may change rapidly as was experienced by East African cattle producers in the mid seventies when the beef market collapsed (Shapiro, 1980) and many countries imposed import restrictions to protect their livestock industry, often using "disease risk" as the argument. Fortunately, small ruminants are a fairly special product and their marketing in Africa is not directly influenced by the world market.
Still, some of the restrictive diseases which prevent export of cattle or beef are also carried by sheep and goats, for example foot and mouth disease, brucellosis and blue tongue disease, and restrictions aimed at cattle may affect export of small ruminants. Further discussion of this subject can be read in Watson, (1984).

CHANGE

Understanding the constraints, developments and options of the present small ruminants production system allows a decision about change and/or improvements. In many respects we should be reluctant to make such decisions as there are still too many unknowns. Often, however, the farmers themselves make changes without outside help or advice using available means and remedies (Chavanduka, 1984). This is probably the best model of change; let the livestock owner decide and let all the others involved in livestock support or research provide the producer with the information needed to make sound decisions, but not interfere with his decision making. This requires a good extension system backed up by research data.

Unfortunately, livestock extension is neither well developed nor well supported in many African countries. Agents are young and inexperienced and as such not accepted by producers. Often they are not kept up to date, especially in those extension services not connected with a university or research institute.* Extension efforts combined with dipping services and/or vaccination campaigns has, logistically, various advantages (Muriithi, 1984) but may be less acceptable when such services are enforced. A critical evaluation of the exten-

* It would be of interest to compare the effectiveness of government controlled extension services to those which cooperate closely, or are controlled by universities or research institutes.
sion effort, especially in the area of small ruminant health and management, could lead to major improvements and probably to considerable benefits of the industry.

Few data are available on the cost/benefit of health interventions in the tropics. A few, rather crude, data on the effects of certain interventions in Table 4 show that vaccination for PPR, anthelmintic treatment and mineral supplementation are beneficial in particular areas of study. Such data have to be developed at many sites in Africa as local conditions and diseases vary. Extrapolation of data from different countries as well as from different species may be risky, and the suggestion of introducing large scale vaccination campaigns for the control of PPR similar to those for rinderpest in cattle (Sumberg and Mack, 1985) may need some further discussion considering the longevity and number of goats at risk and the logistics and cost of these campaigns. Based on earlier findings, ILCA has introduced "health packages" in some of their trial villages (Mack, 1983) but still has to demonstrate that such packages will, in the long run, be accepted (e.g. paid for) by the livestock owner. Comparable packages which included anthelmintic treatment and dipping for mange were popular in Nigeria during the fifties. So popular that they became a drain on government resources (Schillhorn van Veen, 1978). For some time they were then offered by private drug suppliers but they were ultimately discontinued, and it may be of interest to determine the reasons for this discontinuation. It is clear, however, that ultimately it is not the role of government to fully care for the livestock sector, but provide information and incentives for the producers to sustain and expand their production. In this respect, governments should take a hard look at their livestock development support structures which are often divided over different ministries and are poorly supported.
Livestock Support Infrastructure

Studies by Anteneh (1985) indicate that government support for the livestock industry is mediocre in most African countries. Indirect, non-measurable, support such as stimulation of private industry, facilitating transport (road and railways from rural areas), marketing, and export facilitation can also be improved. Livestock marketing systems work but are not very beneficial to the producer. Private veterinary services (partly subsidized) and supplies of feed and supplements are also deficient, or at least unreliable. Data on livestock experiments are either not published or written up in cryptic reports not available to the general public.* Provision of such services should have a high priority; without these there is little hope for sustained improvements.

Recognition of Opportunities

Most of the livestock industry in Africa is still regarded by individual governments in a colonial mode of thinking. Changes proposed by internal government, or outside, agencies are expected to be applicable across the board in that particular country, if not in most of Africa. Innovations which make use of local opportunities are rarely initiated. Breeding and marketing sheep for Muslim festivals, for instance, tried by Brinkman (unpubl) in the early seventies, did not receive wide application. The profitability, however, was demonstrated, and recently confirmed (Kolff and Wilson, 1985). Other opportunities with respect to marketing (religious festivals; proximity of urban markets), availability of fodder (river flood plains, crop residues), use of byproducts, availability of expertise etc. should be considered and stimulated.

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* African journal managers are notorious for their poor performance and most librarians and other subscribers have abolished their efforts to obtain African journals, subsequently research in Africa rarely gets the credit it may deserve.
at the local level. Examples of such opportune foci of small ruminants production are abundant in other parts of the world and should provide a healthy base for production in a given area. Computer model data as well as field observations by Spharim and Seligman (1983) demonstrate the viability of different systems in a limited geographical area. They note, however, that existing opportunities were not always utilized because of government constraints or inflexibility of local social structures.

Identification of such opportunities requires considerable effort, and cannot be achieved on research stations. A good cooperation between extension and research staff is paramount in these, as well as in other, efforts to improve the small ruminant industry.
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sevrage dans les systemes africains traditionnels d'elevage de caprins. 
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Table 1. Major causes of production losses and constraints which are the underlying cause.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On-Farm</td>
</tr>
<tr>
<td></td>
<td>Management</td>
</tr>
<tr>
<td>Lamb mortality</td>
<td>**</td>
</tr>
<tr>
<td>Predator losses</td>
<td>**</td>
</tr>
<tr>
<td>Accidents</td>
<td>**</td>
</tr>
<tr>
<td>Poisoning</td>
<td>**</td>
</tr>
<tr>
<td>Disease (epidemic, PPR etc.)</td>
<td>*</td>
</tr>
<tr>
<td>Disease (stress rel.)</td>
<td>**</td>
</tr>
<tr>
<td>Disease (production)</td>
<td>**</td>
</tr>
<tr>
<td>Parasitism</td>
<td>**</td>
</tr>
<tr>
<td>Tickborne disease</td>
<td>**</td>
</tr>
<tr>
<td>Undernourishment</td>
<td>**</td>
</tr>
<tr>
<td>Deficiency</td>
<td>**</td>
</tr>
</tbody>
</table>

**: major role
*?: indirect role (mainly related to availability of vaccine, medicine and supplements)
*: minor role
Table 2. Impact of certain changes in management and disease control.

<table>
<thead>
<tr>
<th></th>
<th>Social</th>
<th>Technical</th>
<th>Economic Material</th>
<th>Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclose animals at night</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Separate male/females</td>
<td>-</td>
<td>a</td>
<td>-</td>
<td>a</td>
</tr>
<tr>
<td>Fence pasture</td>
<td>A</td>
<td>a</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>Vaccination</td>
<td>-</td>
<td>A</td>
<td>a</td>
<td>A</td>
</tr>
<tr>
<td>Keeping records</td>
<td>Aa</td>
<td>a</td>
<td>-</td>
<td>a</td>
</tr>
<tr>
<td>Feeding salt</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>-</td>
</tr>
<tr>
<td>Controlled breeding</td>
<td>Aa</td>
<td>a</td>
<td>-</td>
<td>a</td>
</tr>
<tr>
<td>Preserve fodder</td>
<td>Aa</td>
<td>a</td>
<td>-</td>
<td>a</td>
</tr>
<tr>
<td>Introduce legumes</td>
<td>-</td>
<td>a</td>
<td>a</td>
<td>-</td>
</tr>
</tbody>
</table>

a = impact at farm level
A = impact at village or district level
Table 3. Prevalence of some contagious diseases of small ruminants in selected countries which import African livestock or are potential markets.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S. Arabia</td>
</tr>
<tr>
<td>Rinderpest</td>
<td>+</td>
</tr>
<tr>
<td>Blue tongue disease</td>
<td>+</td>
</tr>
<tr>
<td>Brucellosis (melitensis)</td>
<td>+</td>
</tr>
<tr>
<td>Caprine arthritis</td>
<td>-</td>
</tr>
<tr>
<td>Foot &amp; mouth disease</td>
<td>+</td>
</tr>
<tr>
<td>Maedi/Visna</td>
<td>nd</td>
</tr>
<tr>
<td>Sheep pox</td>
<td>+</td>
</tr>
<tr>
<td>Scrapie</td>
<td>-</td>
</tr>
<tr>
<td>Caprine pleuro pneumonia</td>
<td>+</td>
</tr>
<tr>
<td>Pulm. adenomatosis</td>
<td>nd</td>
</tr>
<tr>
<td>Cont. agalactia</td>
<td>-</td>
</tr>
<tr>
<td>Heartwater disease</td>
<td>-</td>
</tr>
</tbody>
</table>

nd = no data. + = reported sporadic. ++ = reported commonly
Table 4. Effect of some technical interventions on production in small ruminants.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Effect on Production</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mortality</td>
<td>Growth</td>
</tr>
<tr>
<td>Vaccination for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPR</td>
<td>red 19%</td>
<td>n.d.</td>
</tr>
<tr>
<td>Pasteurellosis</td>
<td>red 2%</td>
<td>n.d.</td>
</tr>
<tr>
<td>Treatment with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anthelmintics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 x month in wet season</td>
<td>red 90%</td>
<td>up 40-60%</td>
</tr>
<tr>
<td>2 x per year</td>
<td>red 75%</td>
<td>up 30%</td>
</tr>
<tr>
<td>Trypanocide</td>
<td>n.d.</td>
<td>up 60%</td>
</tr>
<tr>
<td>Supplementation with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobalt</td>
<td>n.d.</td>
<td>up²</td>
</tr>
</tbody>
</table>

red = reduced, up = increased

1. Combined with anthelmintic treatment
2. No data given
BROKEN LEGS/ACCIDENTS

"HANTA" (LIVERFLUKE INF)
"SAMORE" (UNTHRIFTINESS)
"ZAWO" (DIARRHOEA)
"LAFIYA" (HEALTHY)

OTHERS

Wet season

Early dry season

Late dry season
Figure 1. Graphic representation of the seasonal changes in reasons for slaughter of 225 sheep slaughtered in a rural village in northern Nigeria, 1972-1973.