



REPORT OF THE EXPERT

ON

**MANAGEMENT OF SMALL SCALE ANIMAL
PRODUCTION AND ENTREPRENEURSHIP
DEVELOPMENT IN OMAN**

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by

BABO FADLALLA

**AFRO-ASIAN RURAL DEVELOPMENT ORGANIZATION (AARDO)
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2, State Guest Houses Complex, Chanakyapuri
New Delhi 110 021
India

Phones : 91-11-26877783/24100475/26115936
Fax : 91-11-26115937/24672045
E-mail: aardohq@nde.vsnl.net.in
Website: <http://www.aardo.org>

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- Babo Fadlalla

1. Introduction

The Afro Asian Rural Development Organisation (AARDO) commissioned a livestock development/extension expert to visit the Sultanate of Oman during the period February 02-15 and review the management of small scale animal production entrepreneurship development in that country with a mandate to explore the opportunities, including economic viability, and draw a policy framework for the promotion of small scale animal husbandry in the rural areas in the Sultanate of Oman. In the Sultanate, the consultant visited almost all areas where livestock production is practised (Appendix 1). The findings and recommendations are presented in the following sections of this report.

2. Background

Recent surveys conducted by the Ministry of Agriculture and Fisheries Wealth show that there are 2.3 million hectares of land suitable for agricultural production in the Sultanate of Oman. However, the future exploitation of these lands depends, to a large extent, on water availability. So water maps must be matched with soil maps.

The results of the second agricultural census conducted in the Sultanate during 2005/2006 indicated that the holdings devoted to livestock (excluding poultry) were 63,000 while those devoted to poultry were 77,000. The total area of agricultural land holdings was 136,000 hectares, of which 43 per cent were found in Al-Batinah area, 14 per cent in Al-Dhahira area, 15 per cent in Al-Dakhiliya area, 10 per cent in the Al-Sharqiya area, 14 per cent in Dhofar, 3 per cent in Muscat and 1 per cent in Masandam area (Agricultural and Fisheries Development in the Sultanate of Oman, 2005). The 2005/2006 census did not address rangelands and forests as these were not privately owned and have no specific legally defined status. The area under perennial forage crops was 15,950 hectares, some 61 per cent of which was grown in Al-Batinah area.

The area under rangelands in the Sultanate of Oman amounts to 172,625 km² (17,262,500 hectares). The productivity of these lands is estimated at 0.2 tonnes/ha (Agricultural and Fisheries Development in the Sultanate of Oman, 2005). This means that the range resources provide some 3.45 million tonnes of feed/year. As can be seen from Table 1, there are 647,250 TLU (Tropical Livestock Unit) in the Sultanate of Oman. Assuming that one TLU requires 3 tonnes of feed/year, the amount needed for the national herd will be 1.94 million tonnes indicating a surplus of 1.5 million tonnes/year. The surplus gets larger when irrigated forages are added (about 0.69 million tonnes/year). However, field observation and the prevailing prices of feed do not support the conclusion that there is surplus feed. On the contrary, all reports point towards a large deficit and overgrazing. The discrepancy might be

explained by the assumption that the productivity figures are overestimated or that large areas included in the productivity figures are inaccessible.

3. Livestock Resources

The livestock numbers for 2005 are given in Table 1. There were 302,000 cattle, 117,000 camels, 351,000 sheep and 1,557,000 goats. The total livestock population amounts to 647,000 Tropical Livestock Units (TLU).

3.1. Livestock Production Systems

Three production systems dominate and are listed below:

- i) Traditional rearing of animals in unimproved pens.
- ii) Animal rearing in improved pens.
- iii) Animals rearing on open rangelands.

The bulk of pen reared animals are found in Al-Batinah area whereas Dhofar is the main area where animals are reared on rangelands.

3.2. Constraints to Livestock Production

Livestock production in the Sultanate of Oman is constrained by a host of factors that must be mitigated for any real development breakthrough to occur. Some of these constraining factors are as follow :

- i) The overriding constraint is inadequate nutrition. Apart from Dhofar, the Sultanate almost lacks natural rangelands. Livestock production, therefore, depends largely on limited forage production from irrigated lands on some of the narrow streams (Aflaj) and other places where limited amount of ground water is available. Use is also made of the residues of food crops such as grains, pulses and date palm. Moreover, there is strong reliance on imported feed mainly oilseed cakes and grains. The scarcity of feeds led to elevated costs of both feeds and animal products. This reduced the ability of animal products from the Sultanate to compete with similar imported animal products despite the subsidies provided by the government. Production under the rangelands of Dhofar is less expensive compared with that under irrigation. However, Dhofar rangelands are undergoing severe degradation due to overgrazing by an increasing number of livestock especially camels. The Ministry

of Agriculture and Fisheries Wealth started implementing plans to reduce livestock numbers in Dhofar. The plans are associated with some range management strategies in order to conserve this valuable resource. It is too early to judge whether these efforts are having a positive impact on the range and that the set objectives are met.

ii) The prevalence of the phenomenon of absentee livestock producers led to a situation where there is lack of prompt decisions on important farm issues. In a lot of cases, the labourers attending the animals in the farms are poorly equipped to address issues requiring urgent attention. Moreover, most of the hired labourers are not in a position to keep records.

iii) Records are rarely kept for most farms which weakened producers decision making capabilities. This is particularly important in culling strategies and may explain at least in part the presence of a large number of unproductive animals among producer herds/flocks. Records showing milk yields, sales, returns, herd/flock management (births, services, conception, return to oestrus, forage production, crop water requirements etc.) all assist in farm decision making.

iv) Marketing of livestock products and in particular milk and eggs is a major constraint facing producers. In view of the small size of business, remote and isolated farms producers are unable to reach consumer markets and are forced instead to sell their produce to whoever they meet at the farm gate at low prices. This constraint may be mitigated through organising producers and empowering them to establish cooperatives for marketing their products and purchasing needed production inputs.

v) The lack of efficient and hygienic processing of milk at the farm or community level is aggravating marketing problems in dairy farms.

vi) Lack or scarcity of information on cost of production is limiting ability to provide alternative production options.

vii) The inadequacy of trained manpower is slowing down the pace of the attempts made to develop the livestock sector and specifically providing prompt assistance to small holder projects. The number of personnel involved in livestock production and extension activities is too little in relation to the areas to be covered and the numbers of animals under consideration. The deficit involves veterinarians, extension officers and supporting staff. To take one example, there is an area that holds over 20,000 heads of small ruminants and more than 3,000 heads of camels with only one veterinarian and one unskilled labourer and no extension officer or range and pasture specialist.

3.3. *Attempts to Promote Livestock Production*

During the period 1989-1995, the Ministry of Agriculture and Fisheries Wealth launched an ambitious livestock development programme to which considerable efforts and resources were devoted. The objectives of that programme were:

- a) To attain food security from animal products.
- b) To raise animal productivity through the development of prevailing traditional livestock production systems.
- c) To link the implementation of livestock programmes and plans to overall policies and plans of the Ministry of Agriculture and Fisheries Wealth.
- d) To subject the problems facing livestock production on the farm to further investigation at the research institutions and the results should be published and transferred to producers.
- e) To raise the awareness of producers regarding the most appropriate methods to market their produce, diversify their income sources and improve their economic and social life.
- f) To increase the cooperation and coordination between livestock and crop extension services so as to achieve the development objectives of the livestock sector.
- g) To reach most livestock producers.
- h) To mitigate, halt and finally reverse the on-going degradation of natural rangelands of the Sultanate especially at Dhofar.

The implementation of the livestock development programme was vested with the animal extension service that plans and implements producer training programmes with the intent to raise their knowledge and skills in the appropriate management methods of goats, sheep, cattle, camels and poultry. The extension service also conducts field surveys to define, inventory and analyse livestock production constraints from the producer standpoint and advise on solutions, when appropriate technologies are readily available, and refer those that require further investigation to the relevant research institutions. The extension services also encourage livestock producers to increase herd/flock productivity through provision of advice and liaison with veterinary officers on disease control and implementation of artificial insemination programmes.

3.4. *Livestock Development Projects Executed*

In an attempt to achieve the set objectives of the livestock development programme, a number of projects were formulated and executed. Some of these projects are referred to below:

- i) Distribution of production inputs: A number of projects were contemplated the most notable of which are the distribution to producers of improved male and female animals (mainly small ruminants), mineral salt blocks, water troughs and scissors for shearing and de-hoofing. In addition incubators were also distributed to those practising poultry production.
- ii) Artificial insemination which is mainly directed to cattle. The preferred breed was the Jersey.
- iii) Provision of veterinary services.
- iv) Feeds subsidy: Purchase of feeds constitutes the highest single cost of production amounting to 65-75 per cent of the total costs.
- v) Conservation of local breeds.
- vi) Improved animal housing which involves the sale to producers of improved animal pens at subsidised prices.
- vii) Rural women development.

From the outset, these projects appear to address production problems that face any livestock producer. Nonetheless, most of the projects have not achieved their set objectives. In fact many were terminated despite the subsidies provided or soon after the end of the subsidy phase of the project. It is well recognised that when there is a subsidy scheme farmers tend to accept project proposals from technical or government staff with little or no arguments. This is usually not the case when the full costs are shouldered by the producer. In the case under consideration, the following assumptions may at least in part explain why most of these projects have not realised their set objectives:

- i) The objectives of the projects were not clearly spelled out so that both technical personnel and producers can work together towards achieving them.

ii) Producers might not have been adequately consulted regarding priority setting. When there are subsidies, farmers are not inclined to embark on lengthy arguments on the relevance of a project. Their short term aim will be to guarantee that funds are allocated to them no matter what happens in the future. In many instances, subsidies distort producer priorities.

iii) The economic and social feasibility of some of the projects might have not been adequately scrutinised.

iv) In almost all cases, the technological interventions contemplated by some of these projects are up-to-date. However, they may not be appropriate. Many of the latest innovations may be location specific or may be relevant to some cultural or social circumstances but not to others. It is therefore essential to differentiate between innovative or latest technology and appropriate technology. The latter is more likely to suit rural communities in developing countries.

v) It is well-known that management considerations play a major role in the success or failure of a project. Mention has been made earlier to the phenomenon of absentee producers and the inability of illiterate or inexperienced farm labourers to take vital decisions at the right time.

vi) The lack of a strong and effective monitoring and evaluation system contributed to the inability of management to critically reconsider project performance during implementation and introduce necessary adjustments at the right time.

vii) Other factors may also be playing a role.

4. The Way Forward

Having assessed the present status of the smallholder development projects and the problems limiting their success, it might be appropriate at this juncture to suggest new project ideas and activities with the aim to increasing productivity and ultimately the income of smallholder livestock producers while at the same time caring for the sustainable use of the resource base. This can best be brought about by the generation and transfer of more relevant technologies, strengthening the extension services, increasing the efficiency of implementation and management skills, and introducing some new practices that may improve performance in one way or another. It is pertinent to consider the following :

i) The research system should not assume that improved technologies are always applicable across the Sultanate. The concept of a recommendation domain may be

relevant here which entails that production enhancing technologies have to target homogeneous groups of producers who have similar resource endowments. Many technologies which have shown success in some areas may be irrelevant in others due to a host of factors such as level of income, education, location, markets and social and environmental attributes. To give an example, in the Mahot area emphasis may be given to animal nutrition, improved husbandry practices and water use efficiency.

ii) The relationship between research and extension should be stronger than what it appears to be at present. It seems that the annual research reports are not lodged at the Areas or at best they are not there on time. The research findings should ideally be quickly simplified and made accessible to extension personnel at the lower level i.e. to those who are directly involved with farmers.

iii) The research findings should initially be tested on selected progressive producers' pens, farms or herds/flocks before final release on large scale. This allows testing the relevance of the technology to producer circumstances and prevents any hazard of backfire when extended to other producers which may affect the credibility of both the extension service and the technology generation institutions.

iv) The consultant had a chance to visit the Animal Wealth Research Station at Wadi Gryat. Administratively, the station is answerable to the Al-Dakhiliya area while technically it is affiliated to the Research Centre, Ministry of Agriculture and Fisheries Wealth. The consultant arrived at the station rather late at 16.30 hrs and there was no scientist to brief us on the ongoing research programme and the station's manpower. The infrastructure of the station looks quite large and the facilities available are comparable with what one would expect to find anywhere in the developed world. There were good looking animals on the station with the best pens and adequate feeds. The goat breeds available were the Al-Jabal Al-Akhdhar, the Al-Batinah and the local goats. There was also the local sheep breed. It came to our knowledge that there may be only one or two scientists in this station. If that is the case then it reflects a serious under utilisation of the available resources. Such a station should have a research team comprised at least of an animal breeder, an animal nutritionist, a range scientist, a forage agronomist, a dairy scientist, an agricultural economist and a sociologist. Such a team will work closely together on farmer perceived problems and the outcome of the research will be addressing all aspects of the problem thus enhancing the chances of adoption of the improved technologies released. Many yield enhancing technologies may not be adopted for reasons other than just the increase in biological yield. It is recommended that this station as well as other stations should work to capacity.

v) Camels are widely kept in the Sultanate. They are mostly managed extensively though some are kept in pens. It was brought to our notice that racing camels fetch high prices frequently in excess of 10,000 Riyals in the United Arab Emirates. This seems like an area where a breeding programme should be started. Distribution of breeding males or the establishment of an artificial insemination centre may contribute substantially to increasing producer incomes and engendering an impact on the camel rearing industry.

vi) It has been stated earlier that 3.45 million tonnes of feed are produced/year from the rangelands of the Sultanate to feed 647,250 TLU with a surplus of 1.5 million tonnes/year. It was also noted that these figures do not support what can be observed on the ground regarding the scarcity of feeds and the elevation of feed prices which necessitates a re-assessment of the feed resources especially from the natural rangelands with emphasis on productivity/hectare, accessibility and palatability. Such a re-assessment will match the feed resources with the number of animals thus opening a venue for the sustainable management of the rangelands.

vii) For projects to be sustainable, they must address farmer priorities, should cover their costs and have to be environmentally friendly. The projects under consideration are mostly subsidised. It may be understandable that some projects may be subsidised at the early stages of implementation to show producers that the projects are beneficial. However, full cost recovery with some profit must be the ultimate goal for projects targeting individuals. The subsidy issue may be a policy of the country. Nonetheless, at least some thought must be given to whether the projects financed inflict least losses to the country or not. It might also be worth considering directing more subsidies to products rather than inputs. In many instances, producers divert subsidies away from the production of the goods intended by the subsidy to other activities which may have no relationship to production.

viii) Projects need to be continuously monitored during implementation to make sure that they do not diverge from their set objectives, that implementation is progressing according to schedule and that disbursement reflects the level of implementation. This means that there should be established within each project or programme a unit for monitoring and evaluation with the mandate to monitor implementation through analysis of performance and production of periodic reports. Reporting should always be against the set objectives and targets of the project.

ix) Indigenous knowledge is being increasingly accredited worldwide. This acknowledgement should be more relevant in developing countries where there is a wealth of indigenous knowledge in all aspects of life and more so in the field of livestock and range management and animal diseases. This field of knowledge should be furthered through the marriage with solid science whenever possible.

x) The interventions in animal production from natural rangelands are generally more difficult compared with those from sedentary production systems. This attributed to the fact that generation of production enhancing technologies under uncontrolled and/or mobile conditions presents practical difficulties which make scientists shy away from working on problems addressing pastoral production. For many scientists publishable results are more easily obtained from research conducted under controlled conditions than from under pastoral conditions. The effort and resources needed are also less in the former. This explains the scarcity of production increasing technologies under pastoral conditions. In fact in many cases results obtained under research station conditions are extrapolated to pastoral conditions with little impact due to differences associated with lack of control of access and the extra energy requirements posed by animal mobility. For example, in Sudan, it was found that lactating sheep grazing on natural rangelands during the mid-dry season and walking about 20 km/day between watering point and grazing area spend 29 per cent of the metabolizable energy of the feed consumed simply as energy lost to walking (Fadlalla, 1987). It is obvious that results obtained from pen-fed animals may not apply here. The rangelands are the major source of feed in the Sultanate and they are the future reserve of the country. Efforts should, therefore, always be made and funds be availed to keep rangelands productive. Some of the work that may be contemplated to assist pastoral communities should involve :

a) Expansion of veterinary services to reach more pastoralists and especially those in remote areas. In view of the vast areas to be covered and the inadequate number of professional veterinary officers, it might worth considering making use of the Para-vets modality to assist in providing veterinary and animal production services. This has been successfully adopted by a number of countries with similar extensive and mobile environments. The system involves the training of individuals from within the pastoral community on basic veterinary care and animal husbandry practices, supply them with veterinary kits and let them do the routine work. They are usually affiliated to professional veterinarians to whom they can refer when there are problems that require special knowledge and skills.

b) The development of carefully selected new water facilities so as to reach previously inaccessible lands and at the same time use water as a tool to manage the range.

c) One approach to increasing the carrying capacity of the rangelands is to develop effective water harvesting programmes that may allow the germination of seeds and seedlings from selected herbaceous and browse plant species. External expertise may be sought in order to make use of experiences from other parts of the world.

d) The development and adoption of an effective range management strategy that initially halts and finally reverses the ongoing degradation is crucial. Some of the programmes and projects that may be attempted in order to contribute to the achievement of the objectives of the strategy may include, but are not limited to, the establishment of range reserves that can be opened to grazing only during periods when grazing is not detrimental to the plants e.g. after seed set in the case of annual plants or after the end of the growing season of perennial plants.

xi) Range re-seeding should be practised in areas suitable for such activity. Special emphasis should be given to the establishment of adapted browse trees on the range

xii) There is need for the development and adoption of livestock husbandry systems compatible with the seasonality of the range resources. It is well established that livestock requirements for energy and protein increases significantly with the increase in production. A management system may therefore be developed that avoids parturitions and thereby lactation during the periods of scarcity. It may also be possible to adopt a sort of strategic supplementary feeding such as flushing and steaming up of dams just before mating and before parturition respectively. This has been found to result in increased conception rates, heavier birth weights, reduced lamb and dam mortality and enhanced mothering ability of the dams (El-Hag *et al*, 1998).

xiii) The processing of livestock products should be promoted. It adds value to the products and increases their shelf life thus mitigating the severity of the marketing problems in remote and isolated areas.

xiv) More research efforts and funds must be directed to address pastoral problems.

4.1. Policy Framework

This section addresses issues relating to project formulation and implementation and institutional interrelationships as all of these are crucial to project success.

4.2. Project Formulation

Careful formulation of projects is crucial to their success. Most important here is that projects must have specific and clear objectives. It is vital that projects are sustainable and encompass objectives that are realistic, measurable, achievable, and time-bound. A logical framework attached to a project proposal provides a systematic and organised structure for specifying project components. It offers the logical linkages between a set of means and a set of ends. It also places a project in its larger framework of objectives, within a programme and within the national strategy. When deciding on

project components producer priorities must be taken into account and a bottom-up approach should always be followed in defining priorities.

4.3. *Project Implementation*

The presence of capable management with proven technical and managerial skills is a prerequisite to successful project implementation. Management with such qualifications will be able to steer the project towards achieving its set objectives. Other support personnel must also be availed in appropriate numbers and qualifications. During field visits it was noted that some technical personnel are responsible for some 30 villages each of which has over 50 livestock owners. This spreads efforts thinly and does not allow a close, frequent and effective supervision.

4.4. *Human Resources Development*

Training of project personnel to upgrade their knowledge and skills is needed in order to prepare the staff to perform their duties more efficiently. When employees are promoted or when their terms of reference have changed they ought to be trained so they can competently handle the responsibilities pertaining to the new assignment. Training is therefore a continuous process and should be based on carefully determined needs assessment. The audience targeted with training are the livestock and range officers, technicians, producers and their families and policy makers. Awareness among the latter group about project objectives will secure the support of these influential people to the project cause. Training must go beyond the purely technical aspects of livestock production to cover frequently overlooked issues such as project preparation and implementation, report writing, monitoring and evaluation and impact assessment. It is becoming increasingly apparent that projects with good technical capacities may be defeated by lack of skills in the above mentioned areas. These must therefore become an integral part of any training programmes meant to develop human resources. A final aspect of training though not the least is the need for exchange of experiences. Short visits to other projects within the country or abroad with the aim to observe, scrutinize, introduce and adapt relevant experiences are commendable as an effective and time saving approach. Organizations such as IFAD have now developed the practice where they select some progressive producers from some of the projects they finance and send them to other counties in the region or to a developed country to see a specific experience of relevance to their mode of production. The outcome was that producers who see a living successful experience incorporate it very quickly into their farming systems and it will then be available to neighbouring producers as well as others from distant areas.

4.5. *Socio-economics*

In the past, projects were formulated with little or no consideration to socio-economic aspects. This has invariably led to the failure of otherwise well conceived projects. Many technically sound interventions had a little chance of adoption because of one or more of the socio-economic problems. It is now normal that projects include as part of their organisational structure a unit for monitoring and evaluation manned with economists and sociologists. In addition to monitoring the progress of project implementation and its impact on target beneficiaries, such a unit has a role to play in priority setting through its interaction with producers. It is also involved in the development and operation of a rural information management system within the project area. It is recommended that each of the agricultural management areas of the Sultanate add a monitoring and evaluation unit to its organisational structure so it can deal with both livestock and plant crops projects.

4.6. *Institutional Inter-relationships*

An integral relationship between research and extension is crucial to the process of technology generation and transfer to the benefit of producers. Research scientists working divorced of the extension system may be addressing problems of relevance largely to their own disciplines of specialisation but with little relationship to producer perceived problems. Likewise, extension services working in isolation of the research system will ultimately degenerate and fail to cope with producer expectations. During field trip it was noted that research findings are not available at the lower field level in most cases. It is surprising, however, that there are very good extension manuals at headquarters in Muscat that contain high-quality information based on findings of research conducted within the Sultanate. It seems that these are not distributed to the lower levels. It is highly recommended that coordination between research and extension be enhanced and that research findings and reports be deposited at all levels of agricultural organisation and management.

It is equally applicable that the coordination between the livestock sub-sector and the plant crop sub-sector within the Ministry of Agriculture and Fisheries Wealth be improved. Many synergies between the two systems do exist and can be capitalised on for the benefit of producers. The state of affairs on the ground at the farmer/producer level does not dissociate much between crops and livestock. It is therefore recommended that more integration between the two sub-systems be realised than what is taking place at the present time.

4.7. *Livestock Extension Services*

The extension services are the government body nearest to producers. They rely on two dimensions, the content of the extension message to be transferred and the vehicle used to deliver the service. The content of extension messages should be carefully selected so that they suit the target communities and target environment. Extension services should not always insist on modern or latest technologies but rather on appropriate technologies. It is well established that not all modern technologies are necessary appropriate or relevant for all communities or locations. Moreover even technologies developed within a country or an area within a country may not always be universally applicable. A specific extension message or technology should be generated for and ought to target a specific recommendation domain.

The method to deliver extension messages depends largely on the extension personnel available, the level of training and other supporting services. It is imperative that extension personnel have intimate links with producers. This requires securing a minimum number of contact hours in order to have an impact and this is associated with the number of extension personnel on the ground. Observation by the consultant during field trip revealed a scarcity in the number of extension personnel leading to a situation where they are thinly scattered over large areas. Shortages are found in particular among extension specialists, veterinary officers and experienced technicians in almost all areas visited and these are negatively impacting on producers. To overcome such a situation some countries with similar conditions introduced a system that makes use of para-extension personnel or village extension agents (VEAs) and for the livestock sub-system these are called community animal health workers (CAHWs) or para-vets. CAHWs are individuals who are selected from within the community based on specific criteria and trained on the treatment of livestock health and other problems that are of concern to producers and that are, therefore, likely to face them in the field. They are furnished with veterinary kits and are certified to handle some of the livestock health and other problems facing community members especially in isolated areas or when communities are mobile as the case with pastoral communities. Due to concerns regarding the misuse of drugs each group of para-vets or CAHWs within a specific area will be attached to an experienced veterinary officer or to a private veterinary company licensed to practise in the field of veterinary treatment. The CAHW will treat minor veterinary health problems that he is able to diagnose or alternatively he will follow up on treatment already prescribed by a veterinarian. Of course, he can always refer to the veterinarian for advice in cases beyond his expertise. This system has proved useful in many countries and has substantially reduced the time required by the veterinarian for follow-up and released valuable veterinarian time to be devoted to problems that can only be handled by the veterinary officer himself. It is, therefore, recommended that the CAHW type of service be introduced after the appropriate

controlling legislations are in place. This will release the time of veterinary officer to deal with major health problems.

The research system : The General Directorate of Agricultural and Livestock Research is answerable to the Undersecretary for Agriculture and Animal Wealth just like the General Directorate for Agriculture and the General Directorate for Animal Wealth. It has its headquarters in the suburbs of Muscat and has outstations in other areas of the Sultanate. The research system was not part of the visit programme though a stopover was made at the research station at Wadi Gyriat out of working hours as mentioned earlier.

The authorities in the Sultanate have taken a decision to reduce the size of the farms that grow irrigated forages to not more than 50 feddans. This was done in response to reports that there is a draw down of the water table which necessitates introduction of measures to economise on water. The research system can play a role here and contribute to the efforts targeting the alleviation of the problem of water shortage. The introduction of the concept of livestock water productivity and directing research on feeds to take this concept into consideration may contribute to a better understanding of the water economy and forage production. The value of forages as animal feeds should be considered in terms of the number of units of animal product that can be produced from one cubic metre of irrigation water (e.g. kg of milk/cubic metre of water). This should give a better assessment of forages under the conditions of the Sultanate and may well prove that more reliance should be on crop residues and by-products instead of green forages.

Finally, the research system should give more emphasis to adaptive research. The technologies generated at the present research stations should undergo multi-location testing or at least they should be tested at the target areas and preferably under producers' conditions before they are ultimately released.

5 Recommendations

The infrastructure and financial support given to the livestock sector is considerable and as such it can contribute tremendously to the development of the livestock sector. It is hoped that some of the recommendations listed below may assist in improving the chances of realising the set development objectives.

5.1 Policies

The projects reviewed appeared to be constrained by the subsidies of inputs which make efforts to assess impact through adoption rates difficult as producers tend to

adopt subsidised technologies anyway. If subsidies continued to be a policy of the Sultanate then these may better be directed more to products rather than to inputs.

The development of natural rangelands need to be moved further upwards the scale of the national development agenda.

Appropriate methods of processing of milk and other livestock products should be encouraged as it contributes to attenuating marketing problems in dairy farms through extending the shelf life and reducing spoilage of milk.

Organisation and empowerment of producers to establish cooperatives to market their produce and purchase needed production inputs.

Introduction of the CAHW type of service into the Sultanate after the appropriate controlling legislations are in place. This will release valuable time of veterinary officers to be devoted to major health problems.

More research efforts and funds must be directed to address pastoral problems.

In order to mitigate the acute feed shortages it is proposed that the Sultanate engage in bilateral agreements to jointly finance and establish feed factories in countries with potential feed surplus.

5.2. *Project Implementation*

The establishment of a strong and effective monitoring and evaluation system to enable management of projects to critically reconsider project performance during implementation and introduce necessary adjustments at the right time.

Project preparation skills need to be enhanced. Projects must originate from and address producer priorities. They have to be economically, socially and technically viable, have clear and quantifiable objectives, with indicators to measure impact and assist on monitoring and evaluation and provided with sufficient human and financial resources.

5.3. *Technology Generation and Transfer*

It is recommended that the number of personnel working in the extension delivery system be increased and the quality enhanced through capacity building, and exposure to similar experiences elsewhere.

The research findings should initially be tested on selected progressive producers' pens, farms or herds/flocks before final release on large scale. This allows testing the relevance of the technology to producer circumstances and prevents any hazard of backfire when extended to other producers.

Research work should be carried out by teams formed of adequate number of personnel conversant in diverse disciplines comprising biological sciences and socio-economics as well as administration and policy.

Research institutions should start research programmes addressing water use efficiency with special emphasis on livestock water productivity.

The concept of a recommendation domain may be of value when technologies are being generated by the research system. Production enhancing technologies have to target homogeneous groups of producers who have similar resource endowments.

The excellent though underutilised livestock research facilities at Wad Gyriat should quickly be manned with an adequate number of highly qualified scientists to work closely together on farmer perceived problems so as to supply the extension system with farmer relevant production enhancing technologies.

5.4. *Institutional Issues*

There is need for increasing the integration and coordination between the various administrations responsible for the agricultural sector.

5.5. *Feed Resources*

It is recommended that an effective range management strategy be developed. This strategy should aim at initially halting the ongoing degradation and finally reversing it. Some of the components of such a strategy include the establishment of range reserves, matching animal numbers to carrying capacity, matching animal species to plant community, and range re-seeding in suitable areas with special emphasis given to the establishment of adapted browse trees on the range.

The estimates of feed resources available to the Sultanate of Oman from natural rangelands should be re-assessed in order to reconcile the apparent discrepancy between feed figures and animal requirements.

In order to improve on feed availability from rangelands there is need for a careful development of selected new water facilities so as to reach previously inaccessible lands and at the same time use water as a tool to manage the range.

One approach to increasing the carrying capacity of the rangelands is to develop effective water harvesting programmes that may allow the germination of seeds and seedlings from selected herbaceous and browse plant species.

It is recommended that livestock husbandry systems compatible with the seasonality of the range resources be developed in order to avoid the concurrence of high production with times of feed scarcity. This should be supported with strategic supplementary feeding.

References

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- 2 El-Hag, F.M., Fadlalla, B. and Elmadih, M.A. (1998). Effect of Strategic Supplementary Feeding on ewe Productivity under Range Conditions in North Kordofan, Sudan”, *Small Ruminant Research*, 30, 67-71.
- 3 Fadlalla, B. (1987). The Dry Season Nutritional Status of Transhumant Baggara sheep, Sudan. *Proceedings of the International Conference on Animal Production in Arid Zones (ICAPAZ)* held at Damascus, Syria, 7-12 September 1985. Part Two, pp. 834-844. Organised by the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD) and the Arab Organization for Agricultural Development (AOAD).
- 4 FAO (1991). “Guidelines for Land Evaluation for Extensive Grazing”, *Soil Resources Management and Conservation Service*, Land and Water Development Division, Rome, Italy, p.138.

Appendix 1 : Programme Schedule

Friday	02/02/2007	Arrival at Muscat
Saturday	03/02/2007	Ministry of Agriculture and Fisheries
Sunday	04/02/2007	Al-Dakhiliya Area (Nizwa, Al Jabal El Akhdar)
Monday	05/02/2007	Al-Sharqiya Area (Sur)
Tuesday	06/02/2007	Central Area (Mahot Wilaia, Haj Town)
Wednesday	07/02/2007	Salala
Thursday	08/02/2007	Travel to Muscat
Friday	09/02/2007	Muscat
Saturday	10/02/2007	Al-Batinah (Suhar)
Sunday	11/02/2007	Al Biraimy
Monday	12/02/2007	Al-Dhahira (Ibri) Wadi Al Ain
Tuesday	13/02/2007	Muscat (preparation of lecture)
Wednesday	14/02/2007	Lecture at the Ministry of Agriculture
Thursday	15/02/2007	Back to Khartoum

Appendix 2 : Officials Visited

Ministry of Agriculture and Fisheries Headquarters :

- i) Engineer Ali Bin Mohammed Bin Salim Al Kalbani, Director General, Animal Wealth, Ministry Agriculture and Fisheries Wealth
 - ii) Dr Sultan Al Ismaili, Assistant Director General, Animal Wealth.
 - iii) Mr Abdullah Bin Salim Saed Al Shukaili, Director, Animal Extension, Ministry of Agriculture and Fisheries Wealth
 - iv) Mr Yahiya Al Sabe Bin Hamad Al Hanae, Head, Livestock Indigenous Knowledge Section, Ministry Agriculture and Fisheries Wealth
 - v) Mr Masalam Bin Salam Bin Masalam Al Gosaimi, Head of Animal Extension, Ministry of Agriculture and Fisheries Wealth
 - vi) Mr Salih Bin Rabei Al Khudori, Head, Poultry Development Projects Section, Ministry of Agriculture and Fisheries Wealth
 - vii) Mr Suleiman Bin Nasir Al Hagri, Head, Livestock Development Projects, Ministry Agriculture and Fisheries Wealth
 - viii) Mr Shubuta Bint Said Bin Hamoud Al Bousaidi, Livestock Extension Specialist, Ministry Agriculture and Fisheries Wealth
 - ix) Mr Khalfan Bin Sultan Al Farisi, Head, Range Resources Development Section, Ministry Agriculture and Fisheries Wealth.
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Areas :

A) Al-Dakhiliya Area (Nazwi):

- i) Engineer Yagoub Al Aishi, Assistant Director General, Animal Resources. (Nazwi)
- ii) Mr Khalaf Ambosaidi, Livestock Production Specialist (Nazwi)
- iii) Mr Badr Al Nabahani, Head Range Resources Section (Nazwi)
- iv) Mr Salim Bin Rashid, Director, Agricultural Development, Al Jabal Al Akhdar

B) Al-Sharqiya Area (Sour)

- i) Mohammed Nasir Al Alawi, Director General, Agriculture and Animal Wealth, Al-Sharqiya Area

C) Al-Wusta Area

- i) Mr Masallam Ali Bin Saeed Al Gosaibi, Head Livestock Services Section (Mahot)
- ii) Engineer Ali Bin Khamees Al Oraibi, Director, Agriculture, Animal and Fisheries Wealth (Mahot)
- iii) Dr Al Rayah Fadlalla Awad, Veterinarian (Mahot)
- iv) Dr Abdelgabbar Salih Ahmed, Veterinarian (Haima)

D) Salala

- i) Mr Saeed Hamad Khamees Al Alawi, Director, Range Resources
- ii) Engineer Mubarak Kofan, Director, Animal Wealth
- iii) Engineer Mohammed Suhail Al Shanfari, Livestock Production Specialist
- iv) Mr Ahmed Bakheet Suhail Al Maashani
- v) Mr Ahmed Mohammed Mostaheel Al Kishri, Range Extension Specialist

E) Al-Batinah Area

- i) Engineer Mohammed Al Mirza
- ii) Engineer Mohammed Shandool, Head Extension and Livestock Production Section
- iii) Engineer Salim Al Omrani, Director, Animal Wealth, Al-Batinah
- iv) Engineer Mohammed Al Shini, Head Animal Wealth, Saham
- v) Engineer Ahmed Bin Ali Bin Mohammed Al Farisi, Director, Agricultural and Fisheries Development (Liwa, Al Rasa)

F) Al Biraimi

i) Engineer Sultan Al Sikaiti, Head, Livestock Development Section

G) Al-Dhahira Area

i) Mr Obeid Al Sikaiti (Ibri)

ii) Mr Abdullah Masoud Al Khuwaitil Al Shaikili, Director Agricultural Development (Wadi Al Ain)

iii) Mr Abdullah Bin Saeed Bin Abdullah Al Shikaili, Technician, Animal Production (Wadi Al Ain)

iv) Hassan Mohammed Said Makkawi, Veterinarian, (Wadi Al Ain)

Producers :

Many producers, both men and women, were also met and their production problems discussed.

Table 1 : Number of Livestock in the Sultanate of Oman ('000)

Region	Cattle	Camels	Sheep	Goats	Total (TLU)
Muscat	4.45	0.05	13.86	47.71	
Al-Batinah	66.41	5.63	110.57	430.01	
Musandam	0.33	0.04	5.61	67.98	
Al-Dhahira	22.55	15.64	95.05	243.60	
Al-Dakhiliya	19.25	6.73	43.50	203.06	
Al-Sharqiya	14.64	12.78	60.01	322.86	
Al-Wusta	0.04	22.91	14.87	71.82	
Dhofar	173.89	53.53	7.61	170.12	
Total	301.56	117.3	351.07	1557.15	
TLU	226.17	117.3	70.21	233.57	647.25

Note : According to FAO (1991), one TLU is equivalent to 1.00 camel, 0.75 cows, 0.85 horses, 0.60 donkeys, 0.20 sheep and 0.15 goats.