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**SMALL RUMINANT RESEARCH IN
HIGHLAND BALUCHISTAN: A CASE
STUDY FROM PAKISTAN**

by

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**SMALL RUMINANT RESEARCH IN HIGHLAND BALOCHISTAN:
A CASE STUDY FROM PAKISTAN¹**

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Introduction

Meat, skins, wool, hair and milk products are the main outputs from the small ruminants that dominate the agricultural economy of Balochistan, Pakistan's largest province which shares borders with Iran and Afghanistan. The central and northern areas of the province are mountainous and an estimated 18 million small ruminants subsist on about 30 million ha of heavily degraded rangelands. Combinations of nomadic, transhumant and sedentary production systems are found, with the ranges providing at least two-thirds of the feed requirements although straw from irrigated and rainfed wheat grown in the valleys is also important.

This paper describes 10 years of research to improve the productivity of small ruminants in highland Balochistan. The research is being conducted by the Arid Zone Research Institute (AZRI) in Quetta which has been strengthened since 1985 by a grant² from the United States Agency for International Development (USAID) Mission to Pakistan. The International Center for Agricultural Research in the Dry Areas (ICARDA) was contracted to implement this strengthening effort and has had scientists posted at AZRI since 1985.

The paper illustrates how an international agricultural research center - ICARDA - with financial support from a donor - USAID - is helping to strengthen the research and research management capability of an institute - AZRI - of a national agricultural research system. It starts with a brief description of highland Balochistan, AZRI and ICARDA, and then summarizes the past research approach and achievements since 1980. The second part outlines the path that small ruminant research should take during the coming decade. The paper is therefore a combination of an *ex-post* and an *ex-ante* appraisal of a small ruminant project set in an environment where the topographic,

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climatic and socio-economic conditions make it essential that the project maintains a strong focus on adaptive research applicable to low-input production systems (LIPS). Only some of the numerous research results have been cited for the sake of brevity. The paper concerns highland Balochistan and sheep, except where otherwise stated.

Climate, Rangelands and Small Ruminant Production Systems

Climate. The aridity of the central-western Asian region and the altitude of central and northern areas of the province combine to give highland Balochistan a harsh climate. Minimum winter temperatures in the high valleys fall to -20°C and maximum summer temperatures in the lower valleys reach 40°C . Rainfall increases from 200 mm per annum around Khuzdar in the south to over 350 mm in the north at Zhob, and most of it falls in winter although monsoon rains along the north-eastern rim of the province can be significant. Wide between and within year variability of rainfall has a marked effect on range forage and crop production, leading to nutritional stresses on the animals.

Rangelands. Highland Balochistan has many flat valley bottoms surrounded by sloping rangelands that merge into mountains. The valley bottoms lie between 1000 and 2200 m altitude and the mountain peaks reach 3600 m. The rangelands of Balochistan have been broadly classified by FAO (1983) into 'poor', 'medium' and 'high' potential areas, each covering about 10 million ha, as well as two million ha under-grazed ranges. Most of the medium and high potential and the under-grazed ranges are in highland Balochistan. About 1.4 million ha of the land is cultivable and the main rainfed crop is wheat, the grain being the main staple food and the straw being used as animal feed.

Small ruminant production systems. Nagy *et al.* (1991) described the small ruminant production systems in highland Balochistan and only an outline is given here. About 30% of small ruminants are owned by landless *powindas*, and 50-65% and 5-20% are in transhumant and sedentary flocks, respectively. The main sheep breeds are the Balochi, Harnai, Bibrik and Rakhshani, and the main goat breeds are the Kajli and Khurassani (Hasnain, 1985). Average flock and herd size was 30 and 22, respectively. Lambing and kidding take place in winter and spring and lambing rate varies according to the weather conditions and feed supply but is typically in the range 65-75%.

AZRI, ICARDA and MART/AZR

The following section gives a brief outline of the three partners involved in the research effort to identify, develop and evaluate, *inter-alia*,

sustainable range-based small ruminant production systems for highland Balochistan.

AZRI. AZRI was established in 1974 and became fully operational in 1985 when the MART/AZR project started. It is a federal institute of the Pakistan Agricultural Research Council and has a national responsibility for conducting research on range resource management, small ruminants and rainfed agriculture in the arid and semi-arid areas of Pakistan. AZRI has its headquarters in Quetta and has sub-stations in each of the other three provinces of Pakistan: Umerkot (Sindh), Dera Ismael Khan (North-West Frontier Province) and Bahawalpur (Punjab). Its headquarters scientific staff of about 30 is divided between six discipline-oriented sections: range management, small ruminants, germplasm selection and evaluation, agronomy, agricultural economics and extension. Much of the research is devoted to designing new and sustainable feed producing systems, marketing meat and skins, and testing new technologies with the participation of farmers. Details of the current research program can be found in ICARDA/AZRI (1991, 1992).

ICARDA. ICARDA was established in 1977. Its headquarters is in Aleppo, Syria and it currently has a core budget of about \$20 million. It is one of 16 international agricultural research centers belonging to the Consultative Group for International Agricultural Development, with headquarters in Washington DC. ICARDA is conducting research to assist the countries from Mauritania to Pakistan and from Turkey to Ethiopia increase food production using sustainable farming systems. The primary research areas of ICARDA are the genetic improvement of wheat, barley, and lentils, and studies on farm resource management and natural and introduced pastures, forages and small ruminants. About two-thirds of its 60 scientists are based at headquarters and the rest are posted in selected countries throughout the region. Five ICARDA scientists were posted at AZRI from 1985-89 as part of the MART/AZR project, and since 1990 there have been three resident advisors.

MART/AZR. The AZR is one of several components of the \$33 million MART project which started in 1985 and ends in August 1994. Its main focus has been to strengthen the institutional capability of AZRI through resident advisors, providing operating budget and equipment, and sponsoring the long-term training of AZRI staff at universities in the United States. To date, four AZRI staff have returned from training, one with a PhD and three with MS degrees. Another six are currently studying for PhDs and will return to AZRI by 1995. By that time AZRI will have become a fully fledged national and regional research institute for arid zone research and be an active partner with similar institutes in the ICARDA Highland Regional Program which covers Turkey, Iran, Afghanistan and Balochistan.

A Review of the Past Research Approach and Achievements

The research on small ruminants at AZRI has already passed through two phases. The first lasted from about 1980 to 1985, a time when the buildings and laboratories were being completed. The second phase started in 1986 at the beginning of the MART project and continued until 1991. The third phase is discussed in a later section of the paper.

Phase I (1980-85)

During the early 1980s AZRI still only had a skeleton scientific staff with bachelor's and master's degrees, but no laboratory or field facilities for experimental work. The staff at that time showed foresight by choosing to conduct descriptive surveys of sheep and goat production practices in several districts of Balochistan (Iqbal *et al.*, 1981, 1982b, 1983; Rafique and Munir, 1983), and they made a survey of wool production and marketing (Iqbal *et al.* 1982a). Hasnain (1985) reviewed the sheep breeds of Pakistan and Mian and Khan (1988) collected valuable information about the sheep and goat breeds on research stations close to Quetta. What is unclear from these surveys is the actual level of management and health care program applied to achieve the levels of production reported and the extent to which the measurements made on research station animals apply to farm animals. It is therefore not possible to apply economic principles to define optimal levels of inputs. As Coop (1987) points out, "there is a continuing need to study existing breeds, but under a more rigorous scientific regime and under more practical conditions. Whenever possible several breeds should be compared at the same time so that more accurate comparative performance data are obtained".

As well as the valuable information these early AZRI surveys provide, they also cite previous reports concerning small ruminant production in Balochistan. The surveys thus fulfil one essential step at the start of any project, namely the collection of all available information which needs to be thoroughly reviewed before planning of the new project can begin. These surveys and the documents they report, give an insight into the thinking of small ruminant production experts about the types of 'technologies' that should be applied to improve small ruminant productivity in Balochistan. It is pertinent to briefly review the appropriateness of these technologies, bearing in mind that the majority of small ruminant owners in highland Balochistan are extremely poor.

Exotic breeds. Exotic breeds, such as the fine-woolled Rambouillet introduced at Maslakh Range in the 1950s (Rafi, 1965), are often assumed to be the answer to the low productivity of local breeds. This implies that local breeds are unproductive, and a failure to appreciate that these breeds have evolved in a harsh environment where survival takes priority over output. For example, twins are uncommon among local sheep breeds since they are less likely to survive than singles. However, twins are far more common in goats than in sheep.

Exotic breeds also tend to be larger since they were selected under favourable management conditions. This too makes them less suited to the harsh conditions in Balochistan where ewes of local breeds are 25-35 kg liveweight. These exotics are unlikely to reach their genetic potential under the prevailing poor management conditions, and when under-nourished, succumb more easily to the local strains of diseases and parasites.

Increased reproductive frequency. Three lambings in two years, associated with super-ovulation and synchronized oestrus, is considered a useful method of increasing flock productivity. Once again, the environmental conditions dictate that one lambing each year is more appropriate. Furthermore, livestock owners often have too few animals and are too poor to afford the costs of advanced technologies, and local veterinary services are unable to give the necessary support. Indeed, FAO (1983) budgets, updated to 1991 prices, suggest that livestock owners may only have Rs10.00/head (\$0.40) to spend annually on feedstuffs and medicines. In contrast to sheep, goats have the innate ability to kid more frequently.

Early weaning of lambs and feedlot fattening. Early weaning and feedlot fattening aims to increase output per lamb and remove pressure on the heavily degraded rangelands. Once again, there are good reasons why these technologies are inappropriate although there may be some farmers who have sufficient management skills to apply them. Firstly, both balanced early weaning rations and feed grains and protein and vitamin/mineral supplements for growing and fattening lambs and kids are not available in Balochistan, or they are too costly for the producers. Secondly, these technologies require excellent management to be successful, supported by good veterinary services, neither of which exist in the province.

Phase II (1986-91)

During the period 1986-91 there was an active program of research in all the disciplinary sections at AZRI, with an emphasis on strategies to increase feed resources in highland Balochistan. This illustrates how feed is considered to be the first factor limiting small ruminant production in Balochistan.

Surveys, usually descriptive or diagnostic, were conducted by the Agricultural Economics/Farming Systems Section (see Nagy *et al.*, 1991 for a summary of the findings of the surveys). Noteworthy were the results from the *ex-ante* analysis comparing different interventions such as disease control, improved management, different supplementary feeding regimes, and introduction of improved rams (Nagy *et al.* 1988-90). The results showed that health and management interventions were the most profitable and use of high energy feeds the least. The results have influenced the thinking of AZRI scientists when formulating future research plans, as indicated below.

The Germplasm Section evaluated new species of forage legumes, with woollypod vetch (*Vicia villosa* ssp. *dasycarpa*) showing particular promise, as well as barley which is not extensively grown in Balochistan even though it yields more than wheat which farmers grow for family consumption. The Agronomy Section evaluated the new and locally grown crops using a system of water-harvesting which allows rainfall to run from a catchment area to a cropped area. In the Range Section, studies investigated the response of range plants to protection or deferred grazing and studies were initiated on a promising perennial fodder shrub, fourwing saltbush (*Atriplex canescens*) (FWSB) which is indigenous in the western states of the USA.

Since 1987 the Livestock Section at AZRI has conducted research in three areas: fertility and productivity of sheep, small ruminant parasites, and the feeding value of different local and exotic plants and their components³. More emphasis was given to sheep than goats which have a ratio of about 1.6:1 in Balochistan. The research on fertility and productivity was conducted at two stations of AZRI established in 1987/88, Tomagh near Loralai and Zarchi near Kalat. The parasite studies used samples taken from sheep and goats in farm flocks and the feeding trials were conducted using simple facilities at AZRI headquarters.

Fertility and productivity. Two studies confirmed how flushing, an improved level of feeding before mating, improves lambing percentage in Balochi and Harnai ewes (ICARDA/AZRI, 1991; Rafique *et al.*, 1991). However, the increases in lambing rates from the high levels of supplements used were probably too low to be economic and were thus unattractive to farmers. A third study showed how targeting supplementation only to ewes with low body condition scores allowed savings in feed costs (ICARDA/AZRI, 1992). Other studies indicated how lamb birth weight and growth rate were improved, and mortality reduced, when ewes received supplementary feeding during late pregnancy and early lactation.

Small ruminant parasites. Sheep and goats in Kovak valley showed the following rates of infection with helminth parasites; *Nematodirus* spp. 86%, *Haemonchus contortus* 63%, *Strongyloides papillosus* 49%, *Trichostrongylus* spp. 43%, *Marshallagia marshalli* 42% and *Fasciola hepatica* 33% (Khan *et al.*, 1988). All the animals sampled were infected with at least one of these species. In another study at two locations, there appeared to be differences in infection levels due to breed although this comparison was confounded by the location.

Feeding value of local and exotic feeds. The feeding value of FWSB was studied in two experiments. In the first, Harnai lambs grazing FWSB and range alone for 10 weeks slowly gained liveweight, but at a rate below lambs

³Details of this research can be found in the MART/AZR Research Report series and in the Annual Reports of the ICARDA Highland Program in Balochistan.

grazing FWSB supplemented with 100 g barley grain or 100 g lucerne hay (Rehman *et al.*, 1988). In the second study, a diet containing FWSB and cottonseed cake (CSC - 21% crude protein in the dry matter) in the ratio 2.22:1, maintained Harnai lambs as well as iso-nitrogenous diets containing wheat straw and lucerne hay (0.32:1 ratio) and wheat straw and CSC (1.44:1 ratio), the three diets being offered in similar amounts (Rehman *et al.*, 1990). Other studies compared the intakes of lambs grazing two genotypes woollpod vetch and three genotypes of barley at the pre-flowering, flowering and seed hardening stages of maturity (ICARDA/AZRI, 1991). At the pre-flowering stage intakes of the different forages were similar. However, barley tended to have higher intakes at the flowering and seed hardening stages than woollpod vetch, a surprising result in view of the low content of crude protein in the barley compared with the vetch.

The Future Focus for Small Ruminant Research at AZRI

Research on small ruminants at AZRI is now moving into a new phase which will incorporate two important methodological precepts: increased measurements per experimental unit and more on-farm research. These characteristics are described in the following section. A later section outlines the research topics that will receive attention during the coming decade.

Methodological Precepts

Increased measurements per experimental unit. Whenever possible more parameters will be measured in each experiment, thus increasing the amount of information from experimental animals and flocks which are very costly to maintain whether or not they are generating results. Indeed, it is highly unlikely that a national institute such as AZRI can afford the luxury of two experimental flocks without assistance from a donor. However, it may be possible provided the costs of feeds and medicines can be covered by the earnings from the sales of animals and wool.

More on-farm research. AZRI will conduct as many of its activities as possible on farm animals. This has two immediate benefits, the most important being the testing of new technologies on farm flocks and herds with the full participation of farmers which has not yet been achieved at AZRI in any of its research activities. This on-farm research - variously known as adaptive, downstream, and farmer participatory research - ensures that technologies are relevant and acceptable to farmers, and this increases the chances that they will be adopted. Most researchers are still reluctant to make such research a part of their efforts, wishing instead to conduct research that gives them prestige and is publishable in discipline-oriented journals. The second benefit of on-farm research is that the farmer owns the experimental animals and this reduces operating costs. Some incentives have to be given to the farmers who cooperate with researchers but these incentives should not interfere with the management of the flock. For

example, flour for family consumption is a better way to reward a farmer for his cooperation than feed or drugs for his animals.

Future Research Topics

These are largely continuations of the research started during the period 1986-91, implying that the original directions were generally correct.

Research on sheep productivity and fertility. Research planned for 1992-94 on sheep productivity and fertility aims to define the productivity of two local sheep breeds under good and well documented levels of management which allow them to express their genetic potential. Defining the potential of local breeds under controlled conditions is an essential first step in a research program. The information will be used to fine-tune the prevailing LIPS. This aim acknowledges that current production practices are unsustainable which is evident from the serious degradation of the ranges, and also that the pastoralists are so poor that they are unable to invest in even the simplest new technology. Even though there may be a contradiction here - introducing a sustainable system requires some investment - ways have to be found to stop the degradation which will gradually reduce the vegetation cover on the ranges even more. This process will be exacerbated by a small ruminant population that should now be close to 30 million head. Such an estimate is based on the small ruminant population of 18.4 million in 198 and an annual growth rate of nearly 7% during the early 1980s (GOB, 1986). This is in a province of 34.7 million ha where only about 10 million ha of rangeland has a standing biomass of 200-300 kg dry/ha (FAO, 1983)!

Studies are planned to determine levels of body condition that allow lambing rates to reach 100%, and to assess the duration of the fertile period in sheep. Results from this research will allow supplementary feeding practices to be formulated for the mating season, and open the possibility of timing lambing, and thus lamb sales, to coincide with periods when prices are high. The marketing research mentioned below aims to determine price seasonality.

Internal parasites. More detailed studies on internal parasites are needed.

Whilst it is acknowledged that helminth parasites are a constraint on productivity, it is not yet known the threshold at which this occurs. Another topic deserving attention is the link between caprine pleuropneumonia and lungworms. Pleuro-pneumonia is considered to be one of the most serious local diseases of small ruminants but treating it may not be attacking the source of the problem. AZRI is planning to start screening animals in farm and experimental flocks to determine the range of parasite loads and their effects on productivity. At a later stage studies may be conducted to see how these loads vary between individual animals or breeds. Breeding sheep for resistance to specific helminths is a promising area of research in Australia (Gray and Woolaston, 1991).

Alternative feeding systems. Alternative feeding systems are needed which remove some of the grazing pressure on the ranges and result in higher animal productivity. These systems will integrate production of the local staple food, wheat, with a perennial shrub such as FWSB using a simple method of water-harvesting. Such research has already been started by AZRI on farms around Quetta and will be expanded in the future. Studies will also define management practices for FWSB that ensure sustained production. The resulting information will be given to departments of agriculture and extension, livestock and forestry who will then be responsible for programs to introduce the systems on a wider scale.

Socio-economic studies. As a follow-up to the first study of Mahmood and Rodríguez (1991), research on the marketing of small ruminants and wool is now receiving more attention at AZRI (ICARDA/AZRI, 1991, 1992). Such research provides government departments with essential information for developing government policy which should encourage small ruminant producers to market a better quality product. Economic analyses of animal productivity data collected during previous studies will allow optimum levels of supplementation to be defined. There are good *a priori* reasons to think that these levels will be low and this will vindicate the need to conduct studies that fine-tune the prevailing LIPS, rather than introduce technologies suited to high-input 'intensive' production systems (HIPS).

Conclusions

This case study about the small ruminant research at AZRI shows an evolution of an approach, starting with general surveys and ending with more detailed experiments on specific aspects of small ruminant nutrition, health and reproduction. In many respects the approach is similar to the one followed at ICARDA headquarters in Syria and at the International Livestock Centre for Africa (Thomson, 1992). However, unlike these international research centers, AZRI still needs to conduct on-flock or on-herd testing of improved management practices. The approach may not be a panacea, but it does emphasize the importance of knowing the system one is trying to improve, and stresses the need for low-cost and simple technologies in pastoral systems where the climate and topography are particularly harsh and the pastoralists are exceedingly poor. The approach is also well suited to a national agricultural institute which, like those in most developing countries, suffers from an acute shortage of operating funds, laboratory facilities and equipment.

Some of the views presented may seem overly negative about the role new technologies can play in improving the productivity of the range-dominated small ruminant production systems of Balochistan. However, this is considered to be a realistic view given the harshness of the environment, the poverty and illiteracy of the producers, and the lack of such essentials as good roads, effective human health care and veterinary clinics, and extension

services. As already indicated, the fine-tuning approach applied to the local breeds is still considered to have the best chance of improving the productivity of small ruminants in Balochistan. This is likely to be the approach applied at AZRI during the coming decade and it is also applicable to many other neighbouring countries with similar climate, topography and infra-structure.

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