RESEARCH TRIANGLE INSTITUTE

RM 23U-1527

December 30, 1977

Integrated Report

Selected Materials for Preparing Proposals Under Title XII Collaborative Research Support Program on Small Ruminants

by

Paul F. Mulligan
James S. McCullough
Laurie Zivetz

Prepared for

Joint Research Committee
Board for International Food and Agricultural Development
United States Agency for International Development

RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

RESEARCH TRIANGLE INSTITUTE
POST OFFICE BOX 12194
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

December 30, 1977

Title XII Coordinator
Eligible Title XII Institutions

Dear Sir:

Enclosed is the Request for Proposal that has been prepared for the Collaborative Research Support Program on Small Ruminants to be funded by the Agency for International Development under Title XII. The request for proposal consists of this letter, the integrated report, and the BIFAD/JRC Guidelines for the conduct of collaborative research support activity (appendix B of the report). The proposals are due at the Research Triangle Institute by the close of business February 14, 1978. A postmark of February 10, 1978 will be accepted as evidence of a timely proposal. No extensions will be granted.

The integrated report, which includes instructions for proposal preparation, also contains statistical information on sheep and goats and an indication of research needs. This report should be read in conjunction with the Winrock State-of-the-Art study on The Role of Sheep and Goats in Agricultural Development. It is expected that proposers are familiar with the professional literature and will make use of it.

Although there is emphasis on the animal production aspects of sheep and goats, other factors must not be ignored. Institutional and cultural constraints, economic factors, environmental conditions, and marketing problems are very important and may determine whether the results of the research will be applicable, and thus worthwhile. Proposals that specialize on either the animal production or social science aspect of small ruminants will be welcomed as well as more comprehensive proposals that have an interdisciplinary approach.

Please note that the narrative portion of the proposal may not exceed eight (8) double-spaced, typewritten pages. Proposals that exceed this length will be returned. Other parts of the proposal in addition to the narrative are a one page cover sheet, a one page

budget, resumes (one page each), abstracts of previous projects and current research, and a list of relevant publications written by staff members of the proposing institution.

The purpose for the submission of proposals is to develop one or more Collaborative Research Support Programs, but is not simply a competition between submitted projects/programs for available funds. The proposals are not binding, may be conditionally accepted and/or may be incorporated in part or entirely in a comprehensive program proposal. RTI only has authority to make recommendations to the Joint Research Committee, but does not have authority to make decisions on program grants.

A summary of research from the CRIS file (the USDA's information bank on research in progress in the United States) will be mailed by RTI in about a week. This summary will represent most current sheep and goat research in the U. S. that is relevant to the problems found in the developing countries.

Sincerely,

Paul F. Mulligan

Paul F. Mulligan, Ph.D.
RTI Project Leader
(919) 541-6419

PFM:mja

Enclosure

1527

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Research Triangle Institute
Research Triangle Park, North Carolina
United States of America

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Chapter 1

Introduction

I. PURPOSE OF THIS REPORT

This report consists of information that will assist eligible institutions in the preparation of project proposals for the Collaborative Research Support Program (CRSP) on small ruminants to be funded by the Agency for International Development under Title XII, Section 298(d) of the International Development and Food Assistance Act of 1975.

This report is devoted to familiarizing the reader with the sheep and goat situation in the less developed countries and the constraints to increase production, and contains information that will be useful to scientists preparing proposals dealing with less developed countries. Virtually no information is provided about sheep and goats in the United States. The reason for this treatment is the belief that U.S. scientists are aware of sheep and goat problems and research in the United States or know how to obtain them. The information presented in this report is to be considered representative but not exhaustive of that available in most standard reference sources. For example, the FAO Production Yearbook contains separate information on the number of sheep and goats in each country. Although these two small ruminants were combined for reasons of brevity in this report, the composition by species is critical to the research programs proposed. In general, goats are much more likely than sheep to be found in the warm developing countries. Institutions with expertise in sheep, or perhaps even cattle, are urged to consider the adaptability or transferability of these skills and knowledge to goats. Range management, animal nutrition and genetics are areas where basic scientific skills probably can be applied to goat problems without a great deal of prior experience with goats.

Research projects need to be specific about the particular species/types of animals that will be studied. The constraints and potential for each species often vary within and across countries. Proposers are strongly urged to utilize information contained in this and the Winrock reports as well as that found in the professional literature.

II. OBJECTIVES OF TITLE XII COLLABORATIVE RESEARCH

The objectives of the Title XII program and this planning effort have already been discussed in the RTI letter of October 25 that was sent to notify the eligible universities of the timetable for this effort. Several points need to be reemphasized in order that the research proposals will be responsive to the objectives of this planning effort and the Title XII program. The Guidelines for Collaborative Research put out by the Joint Research Committee (JRC) of the Board for International Food and Agricultural Development (BIFAD) are included as appendix B of the report and should be studied. A brief summary is given below for your convenience.

The concept of collaborative research is built upon the idea of mutual interests and benefit among U.S. universities, American agriculture, and institutions and programs in LDCs (less developed countries). All are expected to benefit from the collaboration, and thus to share in the costs of the research. The collaborative research program is based on seven premises:

1. Continuing stream of new knowledge and useful technology is absolutely essential to both:
   a. agricultural development in the LDCs, and
   b. continued well-being of U.S. agriculture;
2. There exist a number of physical, biological, economic and social problems which are of common and mutual concern to the U.S. and to the LDCs;
3. The U.S. scientific community is already investing heavily in research in many of these critical problem areas;
4. There is growing scientific capacity and increased research investment in some of these problem area in the LDCs, the international agricultural research centers, the AID-graduate and the so-called "middle income countries";
5. Utility of U.S. research programs is hampered by lack of access to laboratories, data, phenomena abroad; and equally

6. Utility of LDC research efforts is constrained by barriers to cooperation with scientists in the U.S., the international centers, other LDCs and developed countries;
7. Innovative, imaginative, effective cooperation and collaboration among scientists working on common priority problems around the world would result in:
    a. increased usefulness of research to U.S. agriculture;
    b. increased utility of research in the LDCs.

Although the conduct of and results of the research projects are expected to be beneficial to U.S. agriculture and the participating U.S. universities, the Title XII CRSP funding must be utilized for the development of research activities having identifiable utility in the solution of LDC problems. The results of the research projects must be applicable to the needs of less developed countries, preferably where AID has country programs. The emphasis is on the production systems actually used by small farmers and poor people in urban-rural fringe areas who keep small ruminants. This objective will require that many research activities be carried out in these countries in order to maximize the probability of successful application. However, the collaborating institutions might be located in more advanced countries such as Brazil, Mexico, and Turkey if research cannot be performed efficiently in less developed countries.

III. ORGANIZATION OF THE REPORT

Five chapters plus several appendices comprise the report. The identification of research needs contained in chapter 3 and the instructions for proposal preparation in chapter 5 are probably the most important parts of the report. The other chapters contain additional background information. Chapter 2 provides a statistical review of the significance of sheep and goat products in the developing countries of the world. Chapter 4 reviews research institutions in developing countries that might collaborate with American universities in carrying out the research, and lists research underway in some of these institutions. This list is not intended to be complete though the Research Triangle Institute has made strenuous efforts to identify the institutions that are likely to have a significant research capability in the area of small ruminants.

Although the instructions for the preparation of the proposal do not appear until chapter 5, they should be read with care before beginning work on the proposal. The entire proposal, exclusive of the title page, budget, curriculum vitae (one page each), and abstracts of previous projects and current research must not exceed eight pages, double spaced. The proposals should be written for specific projects, rather than for a broad program. However, project proposals forming part of a multi-project consortium proposal should be clearly identified. Also, provision, if any, for U.S. subcontractors (non-eligible institutions) should be specified. Universities may submit proposals individually or as members of a consortium, but not both. Finally, all proposals must be received by February 14, 1978 (a February 10 postmark will be acceptable).

Chapter 2

The Current Situation

I. ANIMALS AND ANIMAL PRODUCTS

A large amount of statistical data has been compiled on small ruminants and is presented in country by country breakdowns in appendix A. These data are presented under four major headings:

A. Country Background Data
B. Contribution of Small Ruminants to Food Supply
C. Contribution of Small Ruminants to the Economy
D. Sheep and Goat Production Trends 1961 - 1976.

A. Country Background Data

A selected set of general background data has been assembled in this report for use in assessing the economic and nutritional contribution of sheep and goats as well as measuring the agricultural resources available to increase production. This general background data is presented on a country by country basis in appendix A, table A-1. The data elements included in the table are:

1. Total population, 1976
2. Gross national product per capita, 1970
3. Daily caloric intake per capita, 1976
4. Daily protein intake per capita, estimated, 1976
5. Percent of daily per capita protein from animal sources
6. Total land area
7. Area of cultivated cropland, 1976
8. Area of permanent pasture (cultivated or wild), 1976
9. Total agricultural land: total of cropland and permanent pasture, 1976
10. Percent of total land area accounted for by total agricultural land.

Table 1 below summarizes the data presented in table A-1 on a regional basis.

TABLE 1. BACKGROUND DATA BY REGION

	Total population (000's)	GNP per capita	Calories per capita	Total protein per capita	Animal protein per capita	Percent protein from animal	Total land	Arable and permanent land	Permanent pasture	Total arable land	Arable land as percent of total land
World	4,043,320	192	2568	69.0	24.4	35.4	13,075,336	1,506,149	3,046,404	4,552,553	34.8
Africa	412,905	127	2212	56.3	11.4	20.2	2,964,616	210,890	798,105	1,008,995	34.0
Near or Middle East and Southwest Asia	944,350	131	2062	51.1	7.5	14.7	1,057,434	269,125	179,196	448,321	42.4
Central America	105,618	567	2548	62.9	19.9	31.6	267,023	38,673	79,502	118,175	44.3
South America	224,154	545	2560	66.3	28.1	42.4	1,754,691	101,524	446,822	548,346	31.3
East Asia	327,851	129	2179	49.0	10.8	22.0	417,473	66,024	16,141	82,165	19.7

Source: see Table A1, Appendix

B. Contribution of Small Ruminants to the Food Supply

The information describing the contribution of sheep and goats to the food supply is presented in table A-2 of the appendix. The following data elements are presented in the appendix on a country by country basis.

1. Number of sheep and goats, 1976
2. Proportion of number of sheep and goats to total population
3. Number of cows and water buffalo, 1976
4. Number of cows and water buffalo in sheep and goat equivalents (conversion of large ruminant population in equivalent units of sheep and goats using one cow/buffalo equals eight sheep/goats)
5. Total number of ruminants in sheep and goat equivalents
6. Percentage of total ruminants in sheep/goat equivalents accounted for by sheep and goats
7. Tonnage of indigenously raised sheep and goat meat slaughtered, 1976
8. Total meat slaughtered within country (indigenous or import), 1976
9. Percentage of total meat production accounted for by indigenous sheep and goat production.
10. Tonnage of milk produced by sheep and goats, 1976
11. Total tonnage of milk produced from all ruminants
12. Percentage of total milk production accounted for by indigenous sheep and goat production.

Table 2 shows the information on these items aggregated on a regional basis.

C. Contribution of Small Ruminants to the Economy

Data pertinent to the contribution of sheep and goats to the economy is presented in table A-3 through A-6 in the appendix. Data elements included in the tables are:

1. Fiber and Hide Production, 1976 (Table A-3)
   a. Total tonnage of fiber and hides produced, 1976
   b. Tonnage of sheep and goat skins produced, 1976

TABLE 2. THE CONTRIBUTION OF SMALL RUMINANTS TO THE FOOD SUPPLY BY REGION

	Total population 1976 (000's)	# of sheep & goats 1976 (000's)	Sheep & goats per capita	# of cows & water buffalos (000's)	Cows & water buffalos in sheep & goat equivalents	Total # of ruminants in sheep & goat equivalents	Sheep & goats as % of ruminant total	Sheep & goat meat production (metric tons 000's)	Total meat production (metric tons 000's)	Sheep & goat meat % of total	Sheep & goat milk production	Total milk production	Sheep & goat milk % of total
World	4,043,320	1,450,619	.359	1,345,772	10,766,176	12,216,795	11.9	7,184	121,648	5.9	14,478	432,672	3.3
Africa	412,905	286,200	.693	162,851	1,302,808	1,589,008	18.0	1,101	5,277	20.9	1,762	12,371	14.2
Near or Middle East and Southwest Asia	944,350	308,583	.327	336,587	2,692,696	3,001,279	10.3	1,468	3,492	42.0	6,136	43,481	14.1
Central America	105,618	17,455	.165	48,773	390,184	407,639	4.3	39	2,309	1.7	229	6,882	3.3
South America	224,154	143,545	.640	216,691	1,733,528	1,877,073	7.6	369	9,833	3.8	175	24,260	0.7
East Asia	327,851	13,392	.041	38,082	304,656	318,048	4.4	50	2,681	1.9	5	561	0.9

Source: See Table A2, Appendix

c. Tonnage of wool (greasy) produced, 1976

d. Tonnage of cattle/buffalo hides produced, 1976

2. Contribution of Small Ruminants to Gross Domestic Product (table A-4)

a. Proportion of total meat production provided by sheep and goats

b. Proportion of agricultural production accounted for by livestock

c. Proportion of gross domestic product accounted for by livestock

d. Proportion of agriculture accounted for by sheep and goats

e. Percent of gross domestic product accounted for by sheep and goats

3. Contribution of Sheep and Goats to Income (table A-5)

a. Total national income, 1970

b. Per capita income, 1970

c. Total national income derived from sheep and goats, 1970

d. Per capita income derived from sheep and goats, 1970

4. Contribution of Sheep and Goats to Employment (table A-6)

a. Total economically active population in agriculture, 1975

b. Percent of total economically active population employed in agriculture, 1975

c. Number of persons involved in sheep and goat production, 1975

d. Proportion of economically active population involved in sheep and goat production, 1975.

Regional distributions on fiber and hide production shown in table 3. Regional distributions on the other data elements are discussed in section 2-III below.

D. Production Trends, 1961-1976

Production trends are presented in table A-7 of the appendix. Shown for each developing country are (1) the average number of sheep and goats for the period 1961 - 1965, (2) the number of sheep and goats for 1976, and (3) the percent change between the 1961 - 1965 figures and the present 1976.

TABLE 3. FIBER AND HIDE PRODUCTION 1976

	Total fiber and hides (metric tons)	Sheep and goat skins (metric tons)	Wool (greasy) (metric tons)	Cattle/ buffalo hides (metric tons)	Sheep skins (metric tons)	Goat skins (metric tons)
World	10,535,099	1,281,707	2,590,003	6,663,389	968,862	312,845
Africa	801,053	199,073	192,723	409,257	115,134	89,939
Near or Middle East and Southwest Asia	1,606,147	311,348	201,714	1,093,085	177,798	133,550
Central America	162,638	10,279	8,100	144,259	4,708	5,571
South America	1,409,864	97,139	293,843	1,018,882	80,888	16,251
East Asia	134,129	10,399	282	123,448	2,927	7,472

Source: Tables 95, 96. FAO Production Yearbook, Vol. 30, 1976.

II. THE CONTRIBUTION OF SHEEP AND GOATS TO HUMAN NUTRITION

Sheep and goats have a number of unique qualities which recommend them as important contributors to human nutrition in areas where they are raised. Because small ruminants can subsist on non-arable land they are not in competition with humans for food. Rather, they transform otherwise non-productive (i.e. inedible) vegetation into calories, protein and also, potentially, income. Income from fiber and hides can in some instances, represent an improvement in nutrition, since it has been widely recognized that incremental increases in income at subsistence levels will be spent on food. In addition, the animal dung represents a source of fertilizer which contributes to better crop yields and thereby better nutrition. Animal dung may also be used as fuel.

Malnutrition is a common by-product of underdevelopment. It also hinders development since it contributes to higher mortality and morbidity among the labor force, and places increased stress on already sparse health delivery systems. In 1975, it was estimated that between 1.2-1.3 billion, or 2/3 of the people in the developing world were undernourished.[1/] As shown in Figure 1, these populations are concentrated primarily in the low income countries of Asia and Subsaharan Africa where it was estimated that 70% of the populations are undernourished. In the Middle East and North Africa, 55% are considered undernourished, and the figure is 40% for Latin America. Calorie deficiency is usually accompanied by insufficient protein in the diet as well. Since the most significant contribution that sheep and goats can make to human nutrition is with respect to protein, populations which are significantly lacking in protein are of primary concern. However, insufficient protein intake usually correlates highly with insufficient calories.

Per capita consumption of protein and calories are listed on a country by country basis in Table A1 in the Appendix. The data represents an averaging of consumption rates across all economic groups in a

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[1/] International Fertility Research Project, July Report, page 1.

Figure 1

**AREAS OF ECONOMIC
AND NUTRITIONAL NEED**

particular country. This does not take into account the unequal distribution of income and food consumption which characterizes most developing countries. To adjust for this, the cutoff point used in Figure 1 was calculated at 120% of the minimum daily requirement for a lactating woman (who requires the highest daily intake of protein), estimated by King et al.[2/] King's estimate is conservative (46 gms/day) compared with the National Academy of Science estimate which recommends 75 gms of protein per day for the lactating woman.[3/]

The most nutritionally vulnerable groups in developing countries are women in their reproductive years and children in the first 5 years of life. Both groups manifest the most severe protein/calorie malnutrition based on their social status, consumer power and actually higher nutritional needs. In most developing countries, although women may make more or the same contribution to the labor force, their status in the family and society is such that they often times receive smaller portions of high protein foods which are generally more expensive and prized.

It is now recognized that severe malnutrition before and during pregnancy has detrimental and long-term effects on fetal growth and development. Malnutrition is also responsible for higher susceptibility to disease, increased maternal and child mortality and retarded physiological and mental growth. The amino acids, calcium, B vitamins and iron supplied by animal products are especially critical contributions to maternal health. Oftentimes, these nutrients are absent or inadequate in the mother's diet.

In most developing countries, the basic diet is characteristically bulky and high in carbohydrates. To the child who is being weaned on tubers or refined grains to the exclusion of complete protein it is difficult to derive enough essential nutrients (especially protein) to

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[2/] Nutrition for Developing Countries, Maurice King, Felicity King Leslie Burgess, David Moreley, Ann Burgess, Oxford Press, 1972.

[3/] Principles of Medical Science, Ralph Goldman, McGraw-Hill Book 6, 1973.

promote normal growth. Instead, the child, who fends for him/herself at the common pot, is bloated on starchy foods but receives only a minimal amount of nutrition. Severe lack of protein with sufficient calories results in Kwashiokor. This is often the case in tropical regions where the poor quality of the soil coupled with traditional eating habits result in high carbohydrate diets.

Marasmus caused by lack of both protein and calories, is found in more arid and over populated areas where food is scarce and unevenly distributed.

A significant percentage of non-Causian people are lactose intolerant. Such people experience discomfort after they drink milk. Because of the lower fat content of sheep and goat milk (as compared with cows), this milk is often more easily accepted by lactose intolerant people.

In addition, a process by which lactose can be hydrolysed by lactase prepared from a yeast, Saccharomyces lactis. has been developed by Gist-Brocade, Delft, Netherlands. Use of this approach for preparation of milk and milk products acceptable to lactase deficient people should be evaluated.

In areas where sheep and goats are produced, their contribution toward meeting protein deficiencies is particularly important. Sheep and goat milk (as opposed to meat) represent the most cost and energy efficient source of animal protein. Milk can be exploited as a consistently available source of calories and protein over a number of years. For example, a family goat raised under less than ideal conditions, yields an average of 1 litre of milk a day. As illustrated in Tables 4 and 5, this represents a contribution of about 650 calories, 32 grams of protein, and 1.2 grams of calcium a day or 6% of the calories, 21% of the protein and 30% of the calcium required by a family of 6. These added nutrients may make the difference between adequate nutrition and malnutrition. Although meat is higher in terms of calories and protein than milk, the nutrients gleaned from a slaughtered animal do not exceed the cumulative protein, calories and calcium which a lactating ruminant produces over a span of 4-6 years. In addition, problems of storage and transport render meat more perishable. A carcass may feed a family for a week or two, but a live animal will contribute to the family diet for many years.

TABLE 4: Daily Protein, Calorie and Calcium Daily Requirements of a Family of 6.

Family Member	Gms. Protein	Calories	Calcium (gms.)
Lactating/Pregnant female	46	2751	0.4
Adult male: average activity	37	2990	0.8
Female child: 8 years old	20	2201	0.8
Male child: 11 years old	30	2608	1.4
Infant: weaning diet	15	1000	0.6
TOTAL	153	11,550	4.0

From: Nutrition for Developing Countries, Maurice King, et.al Oxford Press, (1972)
and Principles of Medical Science, Ralph Goldman, McGraw-Hill Book 6, (1973)

TABLE 5: Nutritional Quality of Sheep & Goat Products Per 900 grms.

	Grms. Protein	Calories	Calcium (gms.)
Goat Milk	32	639	1.2
Sheep Milk	50	963	1.7
Goat Meat	168	1485	.1
Sheep Meat	159	1872	.1

* Based on conversion of 900 gms. = 1 litre milk.

From: Scientific Tables, 1970, Documenta Geigy, 7th Ed., 1970 Basel, Switzerland. Compiled from PAO and USDA data.

Goats are said to be more efficient than cows, buffaloes and sheep in terms of conversion of metabolizble feed into milk and meat. In addition, as pointed out in Table 6, conversion of forage into protein and calories for human consumption is much higher for milk than meat.

Raising the productivity of sheep and goats by improved breeding, management, nutrition and health techniques offers a potentially desirable impact upon the nutrition of both producers and consumers of sheep and goat products. In the long run, however, the marketing aspect of small ruminant products is as important as the production aspect.

This requires an examination of the marketing and distribution infrastructures in-place. Identification of tenuous links which may hinder the distribution of animal products to the people who need them most is essential. For example, will the extra milk and meat produced in smallholder production systems be consumed by the family or sold to more affluent (and less malnourished) segments of the population? How receptive are distributors, producers and consumers to sheep and goat products? Although it is difficult to ascertain the distribution of animal products within the family structure, some attention should be given to meeting the requirements of young children and females in their reproductive years.

In line with marketing research it is important to assess traditional systems of food production, storage, and transportation. If milk is processed and stored as cheese or yogurt, or meat as jerkey, can these methods be encouraged with respect to ruminant products or transferred to populations where they are not presently practised?

At present sheep and goats represent an important contribution to diets of certain populations. In places where much of the land is not arable, such as the Sahel, people may depend on grazing animals for the majority of their nutrition. Under such conditions, improving the productivity of small ruminants offers important potential for improving the lot of large segments of the poor and malnourished.

The role of ruminants as scavengers in densely populated urban fringe areas bears more attention. People living in these areas are often poor and, unable to grow their own food or purchase balanced diets

TABLE 6: Approximate Efficiencies of Energy and Protein Conversion in Goats

Goats	% Efficiency		Energy cost of protein (g./Mcal ME)***
	Energy*	Protein**	
Milk production (lactation)	24.0	23.7	14.5
Mutton production (fattening)			
On grass	4.7	9.1	5.1
On grass + concentrates	6.7	10.2	7.5

* Energy expressed as Kcal/100 kcal of metabolisable feed energy consumed.

** Proteins are expressed as edible protein per 100 g. of feed proteins consumed.

*** Edible protein per Mcal ME.

on inflated markets, malnourished. A family sheep or goat might represent a substantial improvement in the diet of these people.

In tropical areas the problem of abundant brush growth has been solved in the past by slash and burn agriculture. This is no longer feasible because of increased population growth which requires more intensive cultivation and no fallow periods. With proper management, using this brush as feed for small ruminants presents farm owners with a low cost supply of protein and calories.

In many places, residues from food, wood and other industries represent wasted calories when they are not recycled as ruminant food. In most countries, traditional production systems which are in place make efficient use of crop residues. However, the by-products of technologies are not commonly integrated into traditional systems.

In sum, the potentials of small ruminants in improving human nutrition must be examined according to the production, marketing, and agricultural systems which are in-place with a sensitivity to cultural food habits. All of these efforts should focus upon the most malnourished groups and the potentialities for improving their lot.

III. CONTRIBUTION TO GROSS DOMESTIC PRODUCT, EMPLOYMENT AND INCOME

A. Objective of This Section

Sheep and goats are a subject of research because they are economic goods that contribute to the welfare of individuals in society. Their contribution to the nutritional status of people in the developing countries was discussed above. This section will address the more general contribution to the gross domestic product, employment and national and per capita income. The objective is to highlight areas of the world and individual countries (in the appendix) that are relatively dependent on these animals for real income and employment, even though much of the product does not enter the marketplace. The importance of these animals to people in the agricultural sector will be estimated because these people, particularly the poorer classes, are the target population. The potential for sheep and goats to contribute more to the welfare of the rural population is the rationale for the research effort under consideration. The present dependence, the opportunities for growth and improvement, and the probability of success are some factors that will influence the particular problems and target areas that are selected.

B. Contribution of Sheep and Goats to Gross Domestic Product

An aggregated approach was used to determine the contribution of sheep and goats to gross domestic product. Limitations of time and data prevented a micro approach based on the value of meat, milk, skin and fiber products consumed on the farm or sold commercially. International comparisons would have been difficult to make if this approach had been followed, because of price differences and similar methodological problems. The technique used consisted of estimating the share of livestock production accounted for by sheep and goats, the share of livestock in agriculture, and finally the share of agriculture in gross domestic product. The share of sheep and goats in livestock was calculated by dividing the amount of sheep and goat meat produced by the total amount of meat produced. Milk production in most developing countries is

relatively unimportant so the use of meat is appropriate*. FAO statistics were used even though some of the numbers are no more than educated guesses. The shares that livestock accounts for of total agricultural output in each country were based on United States Department of Agriculture figures. Unfortunately, estimates were not available for all countries. The share of agriculture in gross domestic product was taken from the United Nations' Statistical Yearbook, which includes most but not all countries. The year 1970 was used because this is the only year for which data are available on most countries in the Statistical Yearbook. Later data are available in other sources but they are not likely to be as comparable as that published by the United Nations.

The results for the four major areas of the developing world are found in table 7. The Near East and Southwest Asia area has by far the highest ratio of sheep and goats to total livestock of the four areas, followed by Africa and the Far East. Latin America is far back, though some individual countries such as Peru and Bolivia are far more dependent on small ruminants than the overall average would suggest. The importance of livestock in total agriculture and the shares of agriculture in total GDP follow different patterns. Livestock accounts for the largest share (30 percent) of agriculture in Latin America, followed by the Near East and Southwest Asia (26 percent), Africa (17 percent), and the Far East (5 percent). When the contribution of sheep and goats to total agriculture is considered, the Near East and South Asia and Africa still rank first and second, but Latin America is ahead of the Far East. When the contribution of sheep and goats to the total GDP is examined, Africa replaces the Near East and South Asia as the area most dependent on sheep and goats while the Far East changes places with Latin America.

Slightly more than 1 percent of gross domestic product in Africa and the Near East and Southwest Asia is accounted for by sheep and goats, but the figures vary substantially from one country to another in both

*In countries with important milk production, milk usually is obtained from all types of livestock, so the ratio that includes milk products is not likely to be much different from meat alone.

Table 7. The Significance of Sheep and Goats to Gross Domestic Product in the Developing World.

Area	1974 Ratio of Sheep and Goat Meat to All Meat	Share of Agriculture Accounted for by Livestock 1976	Share of Gross Domestic Product Accounted for by Agriculture, 1970	Share of Sheep and Goats in Agriculture	Share of Sheep and Goats in Gross Domestic Product
		(percent)	(percent)	(percent)	(percent)
Africa	.202	17*	35	3.43	1.20
Latin America	.037	30	15	1.10	0.17
Near East and Southwest Asia	.429	26*	10	11.16	1.12
Far East	.145	5*	38	0.72	0.20

* Estimated by Research Triangle Institute based on figures for individual countries and subregions.

Sources: Ned S. Raun, Nels Konnerup, and Merril Asay. Livestock Program in TA/AGR. USAID, TA/AGR/LV, Washington, D.C.: Mimeo, January 31, 1977. The information was based primarily on FAO, USDA and World Bank data.

United Nations, 1976 Statistical Yearbook, ST/ESA/STAT/Ser S/4. New York, 1977. Table 186.

regions as the tables in the appendix indicate. The number and significance of livestock on a per capita basis vary greatly among African countries, depending greatly on the presence or absence of the tse-tse fly. Per capita income differences among countries in the Near East and West Asia region have the effect of reducing the significance of sheep and goats in the richer countries. Sheep and goats are very important, however, in the poorer countries and also to the masses of the population not affected by oil revenues in the richer countries.

The contribution of sheep and goats to GDP is about one-fifth of 1 percent in both Latin America and the Far East. The figures may vary substantially from one country to another. For example, sheep are relatively important to the economy of Uraguay, but relatively high per capita income keeps the figure from being very striking. Several countries in the Altiplano and the Caribbean are relatively dependent on sheep and goats for food and other contributions to income, particularly to the low-income rural people in these countries. There are some areas in the Far East where sheep and goats are important even though the overall figures are very low.

C. The Contribution of Sheep and Goats to Employment

The management of sheep and goats in developing countries usually is not an activity that requires the full time of a person. In nomadic societies in Africa, the sheep and goats are kept together with cattle. In more sedentary production systems, livestock usually are kept in a system that also involves crop production. Women, old people, and children may be responsible for the care of these animals and devote some time to them. Because of the part-time nature of managing sheep and goats, it is impossible to estimate the number of people that depend on sheep and goats for their employment or livelihood.

The major approach to estimating the contribution of sheep and goats to employment was to calculate the full-time equivalent employment, which adds together all the part-time involvement. The major assumption is that the effect of sheep and goats on employment is proportional to the contribution of sheep and goats to total output in

agriculture. The process consisted of multiplying the number and percentage of the population economically active in agriculture by the share of agriculture accounted for by sheep and goats.

Table 8 lists the numbers of full-time equivalent persons dependent on sheep and goats for their employment in the four major developing areas of the world. More than the equivalent of four million persons in the Near East and Southwest Asia are dependent on sheep and goats for their livelihoods. This number is about 6.5 percent of the total labor force and more than 11 percent of the labor force in agriculture. As mentioned above, many more people than this are economically involved with sheep and goats, but on a parttime basis. The actual number of people who devote a significant amount of their attention to these animals probably is triple the number of fulltime equivalents. About 3.1 million full-time equivalents in Africa (including North Africa) are dependent on sheep and goats for their employment, which is about 2.5 percent of the total labor force and nearly 3.5 percent of the agricultural labor force. The absolute number of full-time equivalents is about two million in the Far East, but they represent only .7 percent of the agricultural labor force and less than .5 percent of the total labor force. About 400,000 full-time equivalent persons in Latin America are dependent on sheep and goats, which amounts to about 1 percent of the agricultural labor force and about .4 percent of the total labor force. Although the absolute numbers are substantially less than in the other areas, the percentage of the agricultural labor force dependent on sheep and goats is 50 percent greater than in the Far East. As in all areas, however, the percentage affected varies greatly from one country to another and even within countries.

D. The Contribution of Sheep and Goats to Income

The contribution of sheep and goats to total and per capita national income was calculated by multiplying the total and per capita income figures by the share of sheep and goats in gross domestic product. The differences between gross domestic product and national income should make little overall difference when comparing the four developing areas, though individual countries could be affected.

Table 8. The Contribution of Sheep and Goats to Employment in the Developing World, 1975.

Area	Economically Active Population in Agriculture		Full-Time Equivalent Economically Active Population Dependent on Sheep and Goats		Share of Agriculture Accounted for by Sheep and Goats
	(000's)	(percent)	(000's)	(percent)	(percent)
Africa	91,349	72.4	3,133	2.48	3.43
Latin America	38,044	37.3	418	0.41	1.10
Near East and Southwest Asia	35,900	58.1	4,006	6.48	11.16
Far East	269,991	65.4	1,944	0.47	0.72

Sources: Table 7
1976 FAO Production Yearbook. Vol. 30, FAO Statistics Series No. 7. Rome: Food and Agriculture Organization of the United Nations, 1977. Table 3.

The total amount of income attributed to national income ranged from $670 million in the Near East and Southwest Asia to $250 million in Latin America (table 9). Africa was in second place followed by the Far East. The national income figures were for 1970 and thus were not influenced by the huge increase in petroleum prices that began in 1973. Although one effect of oil price increases is to raise per capita income, most rural people in these societies have not been affected to the same degree. Thus, the 1970 figures may be superior to 1975. Furthermore, 1975 figures are not available for most countries.

The per capita income attributed to sheep and goats has a wider range than total national income. The Near East and Southwest Asia is highest at $3.83 and the Far East is lowest at $0.27. Africa is second with $1.52 and Latin America third with $0.94. The relatively high per capita income in Latin America explains the significant per capita figure (62 percent of Africa) even though the share of sheep and goats in gross domestic product is so low (14 percent of Africa).

A more significant measure of the importance of sheep and goats is their contribution to the per capita income of the agricultural population. For example, if the per capita income of the agricultural population in Africa is $80 instead of the economy wide $127, and if the national income accounted for by sheep and goats in attributed only to the agricultural population ($2.11 instead of $1.52), then sheep and goats account for 2.64 percent of the income of the rural population instead of the 1.2 percent figure that is true of the total population. The results of such an analysis would be similar to the numbers found in table 8, which deals with the effects of sheep and goats on the employment of the agricultural population. The last column in the table is the relevant one for determining the effects of sheep and goats on the income and employment of the rural population. Comparable numbers for individual countries are listed in the appendix.

Table 9. The Contribution of Sheep and Goats to Total and Per Capita Income in the Developing World, 1970.

Area	National Income		National Income Accounted for by Sheep and Goats		Share of Sheep and Goats in Gross Domestic Product	Population
	Total ($Mill.)	Per Capita ($)	Total ($Mill.)	Per Capita ($)	(percent)	
Africa	34,300	127	412	1.52	1.20	270
Latin America	147,300	550	250	.94	0.17	268
Near East and Southwest Asia	59,800	342	670	3.83	1.12	175
Far East	113,700	100	307	.27	0.27	1,137
TOTAL	355,100	192	1,639	.88	0.46	1,850

Sources: Table 7
United Nations. 1976 Statistical Yearbook, ST/ESA/STAT/SER/4. New York, 1977. Table 191.

Chapter 3

Identification of Research Needs

I. RESEARCH TARGET AREAS

A. Target Area Selection

In order to focus the proposed research on topics with the highest potential payoff, a set of Target Areas has been identified. Target areas have a geographic as well as substantive dimension -- they indicate where improvements in small ruminant production should be undertaken first, and what problems should be tackled in these regions. The selection of geographic target areas involves several discrete criteria. These criteria include: (1) evidence of need, (2) magnitude of potential impact, and (3) potential for filling special niches.

1. Evidence of Need

The first criterion involves the assessment of countries on the basis of economic and nutritional need. This initial step is intended to be inclusive in identifying the pool of countries that most warrant attention under the BIFAD program.

The map in figure 1 shows the countries that have low levels of GNP per capita and low levels of protein intake per capita. The map indicates that need is most heavily concentrated in Africa and Asia with some concentration occurring in the highland areas of South America. These countries (particularly those that rank low on both indicators) form the inclusive target group from which a more focussed targed area will be selected on the basis of the additional criteria.

2. Magnitude of Potential Impact

In assessing potential impact for small ruminant research we must examine both the current importance of sheep and goats to the food supply and economy and the resources available for expanding production. Generally, the areas of the developing world where sheep and goats are an important part of the food supply/economy do not have the feed supply potential (vegetation) for supporting increases in numbers of livestock.

On the other hand, areas of the developing world with extensive feed supply potential (the humid tropics) are not areas where sheep and goats play a major role in the agricultural system.

Both types of areas have large potential payoffs from improved productivity. In the areas where sheep and goats are an important part of the economy, small improvements in parts of the production system can be felt extensively and can have a large cumulative impact. In areas with large feed resource potential, large increases in the number of ruminants are possible, providing a different type of cumulative impact. Both are important and warrant attention.

Figure 2 shows the developing countries in which sheep and goats are important to the food supply/economy. Using the proportion of sheep and goats to the number of people as an indicator of food and economic importance, we see a clear pattern of concentration. The major areas are:

1. North and Sahelian Africa
2. Southern Africa
3. The Near East (including Afghanistan)
4. The highland areas of South America

In addition to those countries in which sheep and goats are found in large numbers are a number of countries where sheep and goats comprise a significant portion of the livestock population even though their numbers are not as large as those shown in figure 2. The countries in which sheep and goats comprise 25 percent of more of the total ruminant population (in sheep/goat equivalents -- see table A-2, appendix A) are as follows:

Country	Percent of Ruminant Population Accounted for by Sheep and Goats
Ghana	30.2
Ivory Coast	29.4
Liberia	55.6
Togo	42.3
Nigeria	27.7
Congo	25.5
Gabon	75.5
Zaire	24.6
Jordon	82.2
Lebanon	45.6

Figure 2

CONCENTRATIONS OF SHEEP AND GOATS IN DEVELOPING WORLD

These countries include a number in the tsetse fly infested region of Africa. The overall numbers of sheep and goats indicate that, while all ruminant livestock production may be depressed in subSaharan Africa because of the tsetse fly problem, sheep and goats do play a major role in the ruminant production systems that do exist there. In addition, a comparison of the percent of meat and milk produced by sheep and goats with the proportion of total ruminant livestock accounted for by sheep and goats (table A-2, appendix A) reveals that these same African countries have very low productivity from sheep and goats. Among the African countries listed above which account for 25 percent and greater of the total ruminant population (adjusted), sheep and goat products (milk and meat) account for only 10 percent of total meat and milk produced by ruminants in those countries. In these subSaharan African countries then, small ruminants are relatively significant in the total number of ruminants, but their productivity is comparatively low, making them candidate target countries for productivity improvements.

The identification of countries with underutilized feed resources is made difficult by the lack of consistent data on the amount of arable land and pasture land in developing countries. Generally, food resources are potentially great in areas with substantial rainfall, notwithstanding localized and topographic problems. Interestingly, these areas are those where sheep and goats are not found in large concentrations.

While nonarid regions do possess the food resource potential for vastly increasing small ruminant production, the question remains: why have sheep and goats not become more important or more productive in these areas? In some cases, such as the tse-tse fly area of Africa, the reason for low numbers of ruminants is obvious. Furthermore, sheep and goats are a numerically important part of the ruminant production system and the additional factor of low comparative productivity makes this region a compelling target area. The same cannot be said for the resource rich areas of Asia or Latin America which do not have readily identified reasons for the low number of sheep and goats.

3. Potential for Filling Niches

In addition to areas where broad impact from improved sheep and goat production can be anticipated are the areas where small ruminants

can fill a particular niche in the food production system. Two types of systems may be identified under this category:

a. extensive cattle grazing range systems where sheep/goats can fit as followers;

b. densely populated urban/suburban areas where goats may be used as efficient scavengers to provide milk (and some meat) to poor households.

Among the poor nations, the first area (extensive cattle grazing systems) is usually found in areas characterized by relatively large proportions of sheep and goats, with several notable exceptions: Nepal, Colombia and Paraguay.

The places that may be suited to goat-as-scavenger production are best described as the densely populated areas that can be found in almost every developing nation. Goats will consume a variety of vegetable wastes and can browze along roadways and drainage ditches. In addition, goats are very efficient milk producers -- a steady protein source for the poor. While the number of goats that can be supported in such a scavenger system are limited, this production "system" seems ideally suited to serve a target group that will not be served by many other systems encouraged by BIFAD programs -- the urban poor. Densely populated areas that should be considered include

B. Designation of Target Areas

The foregoing section has identified a number of the countries of the developing world that are condidate target areas for small ruminant improvement efforts for a number of different reasons. Taken together, these are the geographic areas to which Title XII small ruminant research programs should be addressed.

The number of countries in which sheep and goat improvement would appear to be a priority is so large that the list must be further refined to provide focal points for Title XII research efforts. This requires grouping target area countries into categories with similar problems, production systems, resources, climate and importance of sheep and goats to the food supply/economy. Such grouping allow us to see where needs are concentrated and how research resources might be appropriately deployed. This grouping is made with the intent that research applied

to problems of selected countries in a target group may be applicable and, to some extent, transferable to other countries in the group.

The four target groups are:

1. Arid/semiarid regions with extensive sheep and goat systems
2. Highland areas with extensive sheep and goat systems
3. Humid zone sub-Saharan Africa tsetse fly areas, and
4. Densely populated urban/suburban areas.

These four target groups are discussed in the following section.

II. OVERVIEW

A. Target Group Characteristics

Table 11 lists the target area countries by grouping. The groupings are obviously not perfect since single countries can fall into more than one grouping. However,the groupings do serve several useful functions. First of all, the groupings designate countries and regions to whose needs the research program should be addressed. Secondly, the groupings make it possible to determine research priorities on the basis of both the commonality of a given problem and the critical nature of the problem to sheep and goat production in countries in that grouping. For example, range conservation is a central problem in the arid/semiarid areas but is less important in the tsetse fly area than control of the trypanosamiasis carried by the fly.

Some selected comparisons among the Target Groups is instructive. Per capita GNP for the world in 1974 was almost $1000. For the developing countries in the Target Groups GNP/cap. is only a little more than $200, and for those in agriculture only about $120. These countries collectively have about one-third of the people, one-third the cattle and buffalo; about one-fifth of the sheep and more than half of the goats in the world.

Livestock contributes about five percent of the GNP in the Semiarid group of countries; about two percent in the tsetse fly infested countries, about six percent in the high altitude countries and about two percent in the high density ones. These values may be compared to the USA, where livestock and their products contribute about 2.5% of the GNP.

Feed resources also vary considerably among the Groups. Table 10 shows the land resources compared to current ruminant populations.

TABLE 10. Land Resources and Arable Per Livestock Unit

	Total Ha	Arable Land		Grazing Land	
		total	Ha/AU[1/]	total	Ha/AU
Semiarid	945	46	1.3	183	5.0
Tsetse fly infested	575	58	3.2	93	4.0
High altitude	795	88	0.9	218	1.8
High density	550	205	0.9	27	0.1
Subtotals	2865	397	1.0	531	1.3
World	13399	1473	1.2	2992	2.6

[1/] Each head of cattle is calculated at 0.8 AU, each head of sheep and goats at 0.1 AU.

TABLE 11. Target Areas

Arid/Semiarid Area

Egypt	Mali
Tunisia	Niger
Algeria	Chad
Morocco	Sudan
Mauritania	Somalia
Senegal	Upper Volta
	Yemen Arab Republic

Tsetse Fly Infested Area

Guinea	Togo	Gabon
Gambia	Benin	Congo
Sierra Leone	Nigeria	Zaire
Liberia	Cameroon	Angola
Ivory Coast	Tanzania	Equatorial Guinea
Ghana	Malawi	Central African Empire
Mozambique		

Highland Areas

Bolivia	Ethiopia
Peru	Lesotho
Ecuador	Afghanistan
Colombia	Pakistan
Morocco	

Densely Populated Rural and Urban Fringe Areas

Philippines	India
Indonesia	Sri Lanka
Thailand	Jamaica
Malaysia	Rwanda
Bangladesh	Trinidad
Burundi	Haiti

B. Arid/Semi-Arid Areas

1. Overview

The arid/semi-arid target area is comprised principally of North African, Sahelian, and Northeastern African countries. The total land area is roughly one-half of continental Africa and includes almost all of the low rainfall areas of the continent. The countries included within the arid/semi-arid target area include Egypt, Tunisia, Algeria, Morocco, Mauritania, Senegal, Mali, Niger, Chad, Sudan, Somalia, Upper Volta, Yemen Arab Republic.

The salient features of the target area include:

a. Desert shrub rangeland is the predominant feed resource.

b. Many of the people living in these regions depend on livestock for survival.

c. The number of sheep and goats per person is quite large.

d. Per capita protein consumption is high relative to the rest of the continent.

e. Populations are predominantly Moslem with sheep or goats having ritual as well as nutritional importance.

f. Sheep and goat species seem to be particularly well adapted to the sparse areas and in many areas are the only livestock (along with camels) that can survive.

g. Browse and forage is only seasonally available in most areas and nomadism and transhumance is common.

2. Climate and Topography

The climate of the target area is hot and dry with limited rainfall coming during a well defined rainy season. In recent years the rains have been well below normal producing the widely publicized drought in the North African region. The southern part of the region borders on the savannah grasslands of tropical Africa. This area is characterized by more extensive forage changing to desert shrub range as one moves north. The southern fringe may have some seasonal occurrence of the tsetse fly, corresponding to the rainfall patterns. The Sahara Desert is the dominant topographical feature of the region with the highlands of Ethiopia and the swamps of the southern Sudan being the only breaks in a relatively uniform ecozone from eastern Morocco to Somalia.

3. Production Systems

The livestock production systems of the region represent a relatively good adaptation to the severe environmental conditions of the region. The practise of nomadic and transhumant production allow the producers to follow the available forage and browse, and if properly maintained, allows the vegetation to regenerate year after year. Unfortunately such a system is finely balanced between livestock numbers and availability of vegetation which depends entirely on seasonal rainfall. In general, increase in feed resources tend to produce increases in livestock populations which tend require continued availability of forage/browse to be maintained. When the rainfall is inadequate to maintain the vegetation resource, some animals die off, reducing the herd numbers to the lowered carrying capacity of the feed resource. Therefore, the number of animals stays at the absolute carrying capacity of the land, even though that capacity will fluctuate.

This unrelieved pressure on the land has produced significant degradation of range lands in the region contributing in many instances to total desertification. However, reducing herd numbers below the absolute carrying capacity of the land is difficult for a number of social and economic reasons.

Livestock represents the principal wealth of the pastoral population. It is the most liquid asset available and serves as a very visible mark of wealth and status. To persuade herders to reduce this asset, or trade for another type of asset (such as cash), seems impossible unless other assets can be identified that serve as well as livestock.

Because livestock represents more than a food source in this region, production systems appear to be less than rational by western standards. For example, in this region, adult males may comprise up to 45 percent of the herd; lambs and kids are allowed to run with the herd, increasing mortality and consuming milk well beyond the point that they could be weaned. In addition to the pastoralist production systems are the sedentary smallholder systems found in areas of sufficient rainfall or irrigation water to permit settled agriculture. This type of system is becoming more important as the nomad population decreases through national settlement programs and competing attractiveness of town life.

In the sedentary small holder system, sheep and goats are raised on a combination of permanent pasture, crop residues, and seasonal pasture(transhumance). The relationship between sedentary small holder production and the pastoralist system has not been well explored but offers some potential for complimentary production. For example, small holders may obtain lambs/kids from herding groups to raise on intensive crop residue diets.

4. Potential and Problems for Arid/Semi-Arid Zones

The potential improvement in sheep and goat production for arid/semi-arid zones lies not in increasing production but improving productivity. In addition, there is a critical need for overall resource conservation so that there will be a resource base there in the future.

There is ample evidence that increasing the range resource in the short run will only result in raising the livestock numbers, increasing the chances for some future disaster. Therefore, improvements in the resource base must be tied to management strategies to protect the system. In this respect, the role of marketing may assume primary importance in reducing flock sizes and increasing productivity per animal. Although control of health problems can undoubtedly improve productivity, disease and parasites do not appear to be the principal constraints in the region. This is due both to the severe natural selection process in the region and the fact that the dry, hot climate is not conducive to the spread of parasites and diseases. On the other hand, mineral defciencies may be widespread and correctable through some programmatic intervention.

Genetic and reproductive constraints relate principally to the supply of good breeding stock and the problem of indiscriminate breeding within the flocks. Upgrading the stock through importation of exotic breeds has not met with much success because of poor adaptability to the harsh environment and lack of acceptance by local pastoralists. There is some evidence that the best breeds may already be in the area, and that selection among locally adapted breeds may be the best strategy for genetic improvement (Winrock report).

C. Tsetse Fly Infested Area

1. Overview

The tsetse fly infested area is located entirely in Africa and stretches along the west coast, through the Congo basin to the lowland areas of East Africa along the coast. The total land area is about one-third of Africa, and substantially more than one-third of the total arable land. The countries included within the tsetse infested area include: Guinea, Gambia, Sierra Leone, Liberia, Ivory Coast, Ghana, Togo, Benin, Nigeria, Cameroon, Equatorial Guinea, Central African Empire, Gabon, Congo, Zaire, Angola, Tanzania, Malawi, and Mozambique. Parts of other countries extend into the tsetse fly infested area, but these countries generally are not characterized as having a significant tsetse fly problem. Some of these countries include Senegal, Upper Volta, Chad, Kenya, Uganda, Zambia, Rhodesia, and Botswana. These latter countries should not be considered as locations for carrying out research on problems associated with the tsetse fly.

The broad belt of the tsetse fly across Africa is interrupted in a few places by highland areas. Most of these areas are in East Africa and include most of Uganda and Kenya, Burundi, Rwanda, substantial parts of Tanzania, Zambia, Malawi, and Mozambique. The only part of Botswana infested by the tsetse fly is located in the Okavango swamps, which are not inhabited by a significant population of people. The only breaks in the tsetse fly zone in West Africa are the Fouta Djallon, a mountainous area in Guinea, and the central highland area of Cameroon, extending from the coast along the border with Nigeria for about 400 miles.

2. Climate and Topography

The dominant forms of flora in the tsetse fly infested area are the tropical forest and savannah woodland. Much of this forest has been cut in the fairly recent past, but the rainfall and other characteristics are still the same. The forest area fades into the tropical savannah as the rainfall diminishes. The savannah is grasslands with substantial numbers of trees, but not a closed canopy. Both the forest and savannah regions can be characterized as belonging to the humid tropics, with relatively short dry seasons. The substantial amount of

rain is what distinguishes the vegetation and other ecological conditions of this area from other areas in Africa. The rainfall, vegetation, and elevation combine to create a climate that is hospitable to the tsetse fly, the vector for trypanosomiasis. The tsetse fly seldom is found in the absence of trees, because they use trees for nesting and other purposes. The flies also cannot stand the lower temperatures found outside these regions or in areas of higher elevation.

3. Production and Production Systems

The tropical forest is characterized by small-holder crop production using a fallow rotation system of agriculture. That is, the farmer cuts the trees and other underbrush each year, burns it and plants his crops without any fertilizer or other improvements to the land. After two or three years, the soil loses its fertility and the farmer must rotate his farming activities to another area. The abandoned land then lies fallow for 10 - 20 years until it is used again in sequence. Livestock plays a very small role in the farming systems found in the tropical forest and the savannah areas directly adjacent to the forest, which are infested by the tsetse fly. The small holders may have sheep and goats in herds of one to five head that are tolerant of the tsetse fly. Small herds of animals are sometimes found in the urban areas as well, owned by people who do not own their own land and graze the animals on whatever forage can be found in public areas or on waste products. Occasionally, livestock are found in conjunction with land that has been planted in perennial crops such as rubber, coffee, cocoa, oil palm, etc. On balance, however, livestock is not important and that which exists is relatively unproductive, even compared with other places in sub-Sahara Africa.

The tropical savannah extends north and south from the tropical forests. For example, the northern parts of Ivory Coast, Ghana, Guinea, Nigeria, and some other places in central Africa have to be characterized as savannah, even though there are substantial numbers of trees. These areas also have small holder farming activities carried in a sedentary fashion. The land in these areas is more likely to be in constant use rather than in a fallow-rotation system. As the rainfall

drops off, transhumant production systems also are found. Animal production usually include cattle and sometimes wild life as well. The tsetse fly is not as much of a problem in these areas and may only be found on a seasonal basis. The animal owners can take their animals into other regions when the tsetse fly appears. The total area infested by the tsetse fly, and especially that in the tropical forests area, has very small numbers of sheep and goats relative to its area and population. These areas have at most 15 percent of the sheep and 20 percent of the goats found in Africa north of South Africa and Rhodesia. In fact, many of these animals are found in parts of the countries that are outside the fly-infested zones but are still considered part of the tsetse fly infested area. For example, this area has 3.2 hectares per animal unit (a measure that counts a head of sheep or goat as .1 animal unit and a head of cattle .8 animal unit) while the semiarid zones have 1.3 hectares per animal unit and the high altitude and high density areas have only 0.9 hectares per animal unit. Thus it is very apparent that livestock is not nearly so important in this area.

4. Potential and Problems of Tsetse Fly Infested Areas

The potential for increased small ruminant production in the tsetse fly infested area is very great. This area enjoys high rainfall and produces large quantities of vegetation. Most of the crop residues and grass are not utilized because there are so few animals. Forage production could be increased greatly because the relatively short dry seasons do not interfere significantly with the growth of forage. The large quantity of feed resources is the basic advantage of this area.

There are substantial barriers to increasing the output of small ruminant products in the tsetse fly infested area. The foremost barrier, of course, is the tsetse fly itself. The tsetse fly not only cuts down on the number of ruminant animals that can exist, but also the size of the human population as well. There are different approaches that could be taken to overcome this problem such as eradication, development of vaccinations, and the breeding of trypanosomiasis resistant animals. Even overcoming this constraint will not be the total answer because other disease problems exist in abundance in the humid tropics. Some of

these are tick-borne diseases, respiratory diseases, and internal parasites just to name a few. Even if the health problems are overcome, there would be barriers in the form of scarce managerial skills, barriers to marketing, and so forth.

D. Highland Areas

1. Overview

A number of countries in the target group are found in mountainous regions in which sheep and goats are an important part of the agricultural and total economic system. These include Bolivia, Peru, Ecquador, Columbia, Morocco, Ethiopia, Lesotho, Afghanistan, and Pakistan. As in the arid/semi arid zones, sheep and goats have gained prominence through their adaptability to a harsh physical environment and a pastoralist system which follows seasonably available feed supplies.

What distinguishes this target group from the arid/semi arid group are a number of factors:

1. Environmental conditions that determine access to forage are quite different, involving limiting topography, cold and snow, and seasonal flooding.

2. Sheep outnumber goats in these countries two to one, and wool production is an important source of clothing fibre as well as an important component of the economy.

3. The countries do not form a contiguous region, but are spread across the three continents.

4. The characteristics and problems of livestock production in these areas is not well explored.

5. There is wide variation in the production systems reflecting, in part, regional differences.

2. Climate and Topography

There are two broad types of highland topography represented in the target group:

a. The upland plain surrounded by peripheral mountains (the Alti-Plano of Bolivia and Peru).

b. Continuous mountain ranges with interspersed high valleys (the other countries in the Target Group).

The two groups have distinctly different climatic and topographical characteristics. The Alti-Plano is characterized by comparatively

gentle topography, poor soil, and a rainy season that comes during very severe winter months. Range vegetation is predominantly browse (mesquite). While irrigation was practiced in pre Columbian times, very little irrigation occurs now.

The principal climatic/topographical consideration of the continuous mountain range areas is the occurrence of complementary grazing areas in relative proximity. The three major types of grazing areas that are found in the highlands are:

(1) summer mountain pastures
(2) Temperate foothill or valley rangeland
(3) winter desert rangeland

In some of the highlands, all three types of areas are found in close proximity and are used in a year-round rotation. In others, livestock production moves back and forth between two of the areas.

3. Production and Production Systems

Most of the countries listed in this group have high concentrations of sheep and goats as measured by the ratio of numbers of sheep and goats to the number of people. Exceptions include Nepal, Pakistan, and Ecuador. Nevertheless, these have significantly more sheep and goats per person than other countries in their regions. Nepal, Pakistan and Ethiopia are also notable in having a larger proportion of goats in the small ruminant population than the other countries in the Group.

The importance of sheep as fibre producers in the Highland Group is illustrated in Table 3 which shows the percent of animal fibre and hides accounted for by wool.

The production systems of the two types of Highland area are considerably different, reflecting in part, topographical factors. In the Alti-Plano, livestock production is primarily sedentary with ruminants taken to pasture daily on the sparse rangeland surrounding the settlements. Supplemental feed is occasionally available through crop residues, particularly cornstalks.

Sheep and goat production in the other Highland areas is predominantly transhumant with herders moving their flocks among the seasonably available grazing areas: from winter desert ranges to spring foothill grazing to summer mountain pastures to either fall foothill ranges or into croplands to graze crop residues (Winrock State-of-the-Art Report, 1977).

The transhumant system found in the Highland areas differs from the nomadic system of the arid zones in that transhumants have a settled base (typically a valley settlement) from which they operate. The transhumant system tends to be closely integrated with the sedentary system of the base settlement since the two systems are periodically merged when the flocks are at home--usually in spring or fall. There may also be some limited crop cultivation at the summer ranges.

4. Potential and Problem Areas

The highland production systems tend to have much of the same potential and problem areas discussed in the section on arid and semi arid zones. Generally, the animals and production systems are well adapted to the harsh environment. The pastoralists place heavy, but not exclusive reliance on livestock. Wool production is an important economic activity and sheep clearly overshadow goats as the principal ruminant.

Genetic improvement should focus on selection of adapted local breeds (with some examination of adapted highland breeds from other areas of the world.) Indiscriminant breeding is a problem. Unlike the nomadic systems, the sedentary base of Highland production makes more feasible the introduction of selected breeding stock.

The movement of flocks from range to range reduces the problem of parasitic infection but increases the potential for epizootic diseases.

The integration of pastoral and sedentary systems opens opportunities for complementary production activity, much of which is already incorporated into present transhumant systems. In the Alti-plano, the potential for irrigated cropland and forage was established long ago by the Incas. With irrigation, total ruminant production there could be greatly expanded.

E. Densely Populated Rural and Urban Fringe Areas

1. Overview

Some of the poorest and most malnourished people on the planet live in the most densely populated countries of the underdeveloped world. These areas are generally humid, tropical and intensively cultivated. The majority of the populations are involved in subsistence agriculture. Animal protein is of secondary importance in the diets of these people, and the emphasis on livestock centers around cattle as draught animals. Hence sheep and goat density in this target area as a whole is 1:7 (ruminant:person) as opposed to 8:10 in the semiarid region. Sheep and goats are raised on a small scale and as a rule contribute directly to the owner's diet or bartering power.

The countries that fall into this descriptive framework include the Asian countries of the Philippines, Indonesia, Thailand, Malaysia, Bangladesh, Southern India and Sri Lanka; the Caribbean countries of Jamaica, Trinidad and Haiti; as well as the East African countries of Rwanda and Burundi where the tsetse fly is not a major problem.

The small ruminant may be found in urban fringe settings in most of the developing countries discussed in this report. Since the role that a family sheep or goat may play is somewhat analogous in the densely settled urban and rural settings, these two areas are considered together. In the urban fringe, sheep and goats may make a substantial contribution to the protein intake of family units.

2. Climate and Topography

The countries in this target area fall into the subhumid and humid tropical ecozones. Rainfall ranges from 800 mm to 8,000 mm annually with an average of 1,500 mm in most regions of Southeast Asia. In general, sheep and goats (especially hair sheep) do not thrive as well in humid climates, which may partially account for low sheep and goat densities in these regions.

As a rule, most of the available arable land is intensively cultivated. Sheep and goats may play a secondary role in double or even triple cropping systems by utilizing crop residues. Thick forest vegetation is often subject to slash and burn agriculture whereby an

area of land is cleared, cultivated, and left fallow. The abundant vegetation in these regions, much of which is inedible to humans, presents a source of nutrients for the small ruminant. Ironically, erosion is often attributed to ruminants who graze the land where cultivation is no longer possible. Although poor management may lead to overgrazing, in many instances the presence of sheep and goats antedates poor agricultural management such as slash and burn techniques. The ruminant is the only food producer which can exploit the niche.

3. Production and Production Systems

Sheep and goats in these areas are generally owned, in small numbers, by sedentary farmers or landless peasants. The production systems range from grazing on crop residues; tethering near bush or roadsides; continuous confinement wherein feed is cut and carried to the animal in the stall.

In the Carribean, extensive production is perhaps the most traditional method of rearing goats (Devendra, 1971a). Two types of management sytems are recognized:

(i) small scale production of about 5 to 40 goats in urban fringe areas

(ii) large scale production of about 40 to 400 goats in rural fringe areas

In the rice growing countries such as in Thailand, Indonesia, Malaysia and Philippines, goats and sheep often graze the stubble in between rice harvests. In Indonesia and Malaysia, it is common to cut leaves of Leucaena glauca, tapioca (Manihot esculenta), Jackfruit (Artocarpus heterophyllus) of Hibiscus (Hibiscus Rosa-sinensis) feed goats. Feeding of cut tree leaves is also common in the West Indies. Very little stall feeding of cut grass is provided during shelter. No conservation of forage, either of grass or silage is practised.

In Jamaica, intensive goat production on Pangola grass (Digitaria decumbens Stent) with a carrying capacity of 37 to 45 goats per hectare has been demonstrated (Devendra, 1971b). An avenue that merits exploitation on an intensive basis, is the feeding of agro-industrial by-products

like rice straw with molasses-urea supplementation, since rice straw is abundantly available in monsoon Asia with yields of about 2.5 tonnes/ha. With goats, this systems of feeding also has the advantage of control over them. Integration of sheep and goats into plantation agriculture has been tried, although perhaps not on a large scale, in Sri Lanka, Malaysia, Indonesia, and the Philippines.

Because of the pressure of over-population, the carrying capacity of the land has been exploited to its maximum. In seasons of scarcity, small ruminants in these areas receive less nutrients since they are competing with cattle. Goats, however, are apparently more productive than sheep and cattle in terms of meat and milk production in these countries which may be attributable to their ability to metabolize a wider range of forage. This makes them particularly valuable in the urban fringe settings. As pointed out in the Winrock Report (VI-8), goats represent an important contribution to the nutrition and income of landless farmers and urban dwellers in Asia.

4. Potential and Problems in High Density Areas

The potential for improving small ruminant production in high density areas faces two stumbling blocks: (1) the provision of an adequate nutrition for the animals; and (2) socio-political attitudes towards small ruminants.

The first problem merits further research into exploitation of industrial by-products as well as using ruminants for brush control. It is generally agreed that the niche occuppied by the small ruminant in traditional agriculture is being exploited to its fullest capacity. In terms of nutrition, more attention should be placed on the ruminant as scavenger in the urban setting. The second problem is rooted in both the cultural favoritism toward cattle (for agricultural and religious reasons) as well as the low esteem small ruminants receive in the eyes of government officials and researchers. In these densely populated areas, ruminants are under-utilized as producers of milk, which is particularly poignant in areas where milk is being imported.

The health and breeding problems of small ruminant production are also important. Internal parasites present a problem particularly when coupled with undernutrition. Although some work in genetics and breeding is on-going, particularly in India, this area deserves more attention.

III. PRODUCTION SYSTEMS

Sheep and goat production systems may be grouped into three major categories: sedentary, transhumant and nomadic. Briefly, these systems may be characterised as follows.

A. Sedentary

This describes any system of livestock production wherein the animals and people remain in the same locale year round. There are four kinds of sedentary production systems:

1. Tethering

   This is more commonly used with goats by pegging them to a rope about 3 metres in length. By shifting the peg once daily free access to fresh browsing area is provided. Water is provided when the goat or sheep is shifted to a shelter at night. Very little or no concentrates, salt or mineral bricks are provided. Occasionally supplements, household scraps, small quantities of grains or their by-products are given. Tethering is a common practice in South East Asia, Central America and the Caribbean and elsewhere.

2. Extensive Production

   Extensive production is probably the most popular system of goat and sheep production. In Guyana for example, 48 percent of sheep and goats are managed extensively (Devendra, 1975a). Small flocks of about five to 10 animals are common, let loose to browse and graze on waste vegetation, hedges, and on marginal land. Quite often, unpaid family labor help in herding goats and sheep together to graze wayside or waste vegetation. Very little management is exercised except letting them loose and shutting them at night. For the large herds, usually some form of paid labor is employed. Probably because of cheap family labour and higher returns from this system of management, the flock size tends to be relatively larger compared to those in the intensive method.

3. Intensive Production

Intensive production of goats either on cultivated fodders and pastures or stall fed in pens is not very common. Goats and sheep can be fed, for example, with cut Napier grass (Pennisetum purpureum) or Guinea grass (Panicum maximum) with or without limited concentrates. Alternatively, both species can be grazed on sown pasture. For Kambling Katjang goats in Malaysia, daily live weight gains of 26g. for Guinea grass ad libitum and 76g. for Guinea grass plus concentrates have been recorded (Devendra, 1967).

4. Integration into Crop Agriculture

This system can be considered to be either extensive, intensive, or semi-intensive, but the fact that it is integrated with crop agriculture justifies a separate identity. It involves the integration of goats and of sheep into estates involved with such plantation crops as rubber, oil palm, and coconut cultivation.

This integration is potentially valuable since the undergrowth in the plantations (mainly grasses, weeds and legumes) can be utilized and converted to useful animal products. The success of this integration depends on a judicious manipulation of stocking rate with available dry matter production in the context of diversified agriculture. The success of this system is dependent on the availability of herbage, yield of dry matter, right time of introduction of the animals, correct stocking rate, no effect on the crop and profitable returns from the crop and animal integration. It is a system that can be exploited very much more.

The Benefits of this Integration include:

a. Increased fertility of the land by return of dung and urine.
b. Control of waste herbage growth.
c. Reduced loss of nutrients to the crop supplied by fertilizers

d. Easier management of the crop

e. Possibilities of increased yeild of the crop due to a., b., and c.

f. Greater economic returns to the farmer from both the crop and animal components.

B. Transhumant

This production system is common in places where seasonality of forage requires movement of the herd. Mountain people often relocate in the winter when the harshness of the climate prohibits grazing. By moving the animals, they are allowed to graze all year long.

C. Nomadic

This production system is primarily found among desert people who have no fixed home. Sheep and goats are moved, usually according to fixed routes, and often times depending upon rainfall and seasons. In many cases, the location of market places will determine the route as well. The greatest stumbling blocks to production is the lack of reproductive management and range management, discussed in more detail in the Arid and Semi-arid areas.

IV. POTENTIAL AND CONSTRAINTS FOR IMPROVING SMALL RUMINANT PRODUCTION

A. Introduction: The Need for Multidisciplinary Approaches

It is recognized that small ruminants such as goats and sheep complement rather than compete with man in nutrient and land use. Further it is widely held that due to their small size, they can be managed by practically anyone in a family and thus utilize family labor. There is low investment per animal, adaptability to a wide range of grazing conditions and a high value of product. They are particularly suited to small farming in LDC's because small carcasses are consumed within a day, not requiring much storage or processing. Goats and sheep can be the ultimate scavengers for gleaning crop residues. They themselves can be a human food source of the last resort. They can serve as the foster mother for the young child, and as a source of daily cash income when there is no other. For these reasons, they are a valuable, but often overlooked resource, in the further improvement of the condition of LDC 'small farmers'.

In most of the LDC's small farmers historically have maintained a few animals to provide these additions to family sustenance amd income. In nomadic and transhumant societies, goats and sheep may be the almost exclusive source of food, clothing, and cash income. In the intensively cropped areas of many areas of the developing world they are an integral part of the small farming system.

In the absence of technological innovation or changing markets, it can be assumed that the existing system is biologically and economically an optimum one that has evolved over years of trial and error. This applies irrespective of political or ecological zone. Thus, it is important for scientists and other innovators to understand the prevailing systems. Invaluable to all researchers are on-site studies of farming systems in the ecozone conducted in the field and involving an assessment of the many resources and their inter-relationships.

In addition to specialized research into specific technological improvements in breeding, health, management, marketing and nutrition, it is important that social, economic and environmental characteristics of predominant

systems be studied and understood. It should be clear that changes in the production systems that follow from the proposed research will have wide-ranging impact on the societies.

Social, agricultural and health scientists should work alongside each other in these field surveys. Views of inhabitants as to local constraints tend to be considerably different from those of the outsider; thus, ideas for research priorities may be changed appreciably following on-site appraisals. For this reason, it is desirable that multidisciplinary approaches be employed in the research efforts. While specific problems can be isolated and investigated away from the "field", the true value of solutions to these problems will be in their field application.

B. Improvement of Sheep and Goat Production Through Improved Breeding

1. Overview

The contribution of better animals to better production in developed countries has been amply demostrated in poultry, swine, dairy cattle, beef cattle, and sheep. Unfortunately, there has been a limited effort to explore these opportunities with goats and sheep in the less developed countries (LDC's).

There are two elements in improving animal stocks:

(1) Improved genetic material, and

(2) Controlled breeding

2. Improving Genetics

Transfer of improved genetic material is one of the introduced technologies easiest to implement, not only with grains and other plants but with animals as well. Two complementary strategies seem most promising in this area. The first is the large scale selection of adapted native breeds in the target areas. The second is the cross breeding of native breeds with carefully selected exotics. A good example of this complementarity can be seen in the most isolated tropical savannas of Columbia where genetic improvement programs have been undertaken with cattle. In this area, cattle are still managed under the primitive conditions that existed 400 years ago without vaccination, mineral supplements, fencing, improved pastures, or most of the inputs considered

necessary for good production. Despite these factors, it has been possible to make genetic improvements through introducing Zebu bulls to cross with local Criollo cattle. Spectacular results were obtained with little change in the prevailing system. Since much of the improvement was due to hybrid vigor, it is clear that additional work is required in preserving, expanding, and improving the Criollo breeds so that crisscrossing between the two breeds might be followed in the future.

The evolved resistance and adaptability of the native breeds is an important base upon which to superimpose genetic methods for increasing efficiency in production of milk, meat, and fiber. It would be a great injustice to imply that breeders in these areas have done little to improve their breeds in the characteristics desired. Lists of breeds which have comparatively outstanding productive capability, particularly in milk, will be presented subsequently. This seems very likely to have been increased through many generations of effort on the part of farmers. However, the rate of improvement can be greatly accelerated as it has been in the last thirty years in some of the developed countries.

3. Resources for Hybridization or Crossbreeding

While many areas of the world have, to some degree, crossed native animals with more specialized milk, wool, and meat breeds of the West, there are still opportunities to test these introductions under a variety of ecozones. The best opportunities appear to be, however, in crossing breeds originating from the tropical zones. Just as the Zebu x Criollo (both tropical types) has given superior results in the Latin tropics, the Chios or Awassi milking sheep breeds may greatly enhance production in crosses with the Red Masai of Central Africa or the hair sheep of Latin America. Similarly, the transhumant, whether he be in Mexico or Nigeria, may find that his goats greatly benefit from a cross with the Jamnupari of India. These kinds of introductions may be impossible for farmers and even difficult for governments. There are avenues, however, now by which health restrictions may be controlled and such exchanges can be made.

Mass selection for easily measured traits may be done on a large scale on a cooperative basis between farmers and the research institutions.

These approaches are applicable irrespective of national or ecological boundaries; however, it may be of interest to point out some specific opportunities.

a. Arid/Semi-arid and Highland Zones

At Tlahualilo, Mexico with its 2500 milking does, the herd is of optimum size for maximizing genetic improvement through the use of progeny testing and the extended use of a few of the sires that have exceptionally high progeny proof. Such a herd would have the advantage of being under environments more typical of the Middle East, Africa, and Asia than in Europe where improved milk herds were developed. Presently, Mexico depends heavily on imported bucks from the United States, which limits improvement in adaptability to the region. Similar opportunities could be encouraged in graduate countries in the Middle East, Africa, and Asia with goats and milking sheep. In a relatively short time, surplus males from these herds and flocks could be drawn upon for improvements in subsistence or small commercial farms. Another important aspect of these centers could be the preservation and improvement of major indigenous breeds adapted to the local ecozone which otherwise may be lost with continual outcrossing.

In cattle, some of the Criollo breeds of Latin America were on the verge of extinction and would have been lost except for the efforts of ICA, Instituto Colombiana Agropecuario, Colombia. Now it is known that as crossbreds with Zebu, these Criollo are highly productive and have fully justified the efforts at preservation.

b. Tsetse Fly Infested Zone

A most relevant opportunity is the breeding for increased trypanosomiasis resistance in the tsetse fly areas in Africa. It is commonly held that some local breeds have a considerable tolerance and Pagot (World Food Conference 1976) has dwelt upon this as an important researchable topic. The affected area in Africa is so large that the economic impact could be very great. Further, the animal centers in Africa (ILRAD and ILCA) are becoming deeply involved in this problem.

Of the many breeds in the world available, the following outline indicates breeds and target areas in which the breeds may be useful for crossing with local stock. The target areas are identified as (A) Arid, Semi-arid; (B) Tsetse Fly Zone; (C) Highland Zone; and (D) Densely Populated Rural/Urban Fringes. Breeds considered to be particularly relevant are underlined.

LATIN AMERICA

Goat Breeds	Target Zones	Sheep Breeds	Target Zones
Jamnupari (India)	A B D	Tabasco (Mexico)	A B D
African Dwarf	B	Red Masai	A B D
Criollo (C.America)	A B D	Barbados Black Belly	A B D
Granadina (Spain)	A B D	Pelibuey (Brazil)	A B D
Nubian	A B D	Santa Ines "	A B D
Alpine	A B C D	Blackheaded Persian	A B D
Saanen	A B C D	Criollo (Colombia)	A B D
Buhj (Brazil)		Afrikander "	A B D
Moxota "			
Marota "			
Caninde "			

AFRICA

Nubian		Red Masai (Africa)	A B D
Jamnupari	A B D	Fulani (W. Africa)	A B D
Galla (East Africa)	A B D	Somali Blackhead	A B D
Dwarf breeds			
E. Africa	A B D		
W. Africa (tolerant to tsetse borne diseases)	A B D		

MIDDLE EAST

Awassi (milk) (Lebanon)	A B C D
Chios (milk) (Turkey)	A B C D
Akaraman (Merino type)	A B D
Arabi (Iraq)	A B D
Nejdi (Saudi Arabia)	
Rahmani (Egypt)	A B D

ASIAN SUBCONTINENT

Goat Breeds	Target Zones	Sheep Breeds	Target Zones
Jamnupari	A B D	Nellore (Hair breed, rain forest	A B D A B D
Beetal		Mandya	
Barbari	A B D	Sonadi	
Saanen	A B C D	Malpura	
Alpine	A B C D	Kashmir Merino (Himalayas)	
Toggenberg	A B C D	Karakul	A B D
Anglo Nubian	A B C D		

4. Factors in Selection

Selection goals will differ greatly between both political/cultural areas and between ecologically oriented target zones. In LDC's pedigree breeding often will be limited to institutional herds where sufficiently sized herds of identified breeding animals may be scientifically selected. Surplus males from these elite herds may then be offered to farmers and stockmen.

ILRAD is approaching the problem immunologically. ILCA is said to be interested in breeding for tolerance. They may welcome collaborative assistance from United States universities that have strength in population genetics and hemoparasitology. The problem would challenge the the best science available.

5. Control of Breeding

Control of breeding in sheep and goal herds is a management issue, but closely tied to any efforts to upgrade the animal stock. In pastoralist systems, control of breeding requires significant changes in the herd management, a more informed herder and, most likely, reduction in total herd size as surplus males are removed, or separated, from the herd.

This has further implications for the marketing systems, both in improving means of disposing of surplus males, and in the market value of higher grade carcasses. Since the control of breeding has such a significant impact on the social and economic role of livestock, it cannot be adequately addressed by a narrow technical approach.

6. Summary

1. Genetic improvement is an acceptable, low cost, and easily transferred technology that often can be a first step in overall improvement.
2. Hybridization of breeds using mostly tropically adapted breeds offers promise for rapid improvement.
3. Crossbreeding results will indicate the necessity for the preservation of certain of the adapted breeds that may otherwise face extinction. Some projects should include the identification and preservation of these breeds.
4. Mass selection particularly for resistance to tsetse fly borne diseases and dairy qualities in goats and sheep could be implemented by the application of modern population genetic methods in large populations.
5. Techniques for controlled breeding should focus on selecting appropriate techniques, devising techniques implementing the strategies, and the potential impact of such practices on social and economic factors.

C. Disease, Parasite and Environmental Constraints to the Production of Sheep and Goats

It is difficult to accurately determine the economic loss due to diseases in sheep and goat production throughout the world because these statistics do not show up in production figures; however, the disease and parasite problem is regarded as one of the major constraints to sheep and goat production wherever they are raised. The 1975 World Health Yearbook FAO-WHO-OIE lists 30 diseases of sheep and goats, but this list is extremely brief since there are some 300-400 diseases that ultimately may affect production. These diseases fall into classic subdivisions:

Infectious	
viral rickettsial mycoplasma bacterial protozoal	Diseases of this group generally show obvious clinical signs; can be high in morbidity and mortality; can be controlled through drugs, vaccines and management.
metazoal	The ecto- and endo-parasitic diseases are not well understood, but they are very important because of the role they play as vectors of many important diseases.

Noninfectious	
metabolic poisoning congenital hereditary	These diseases increase in importance as production systems are intensified, crossbreeding with exotic breeds and with the introduction of modern production technologies.

Many factors can seriously alter the production cycle in sheep and goats. Nutritional stress, infectious diseases, mineral deficiencies and internal parasites can interfere with fertility. The effect of

these diseases and deficiencies on the lifetime productivity of females can be considerable, but has been largely ignored, despite potentially drastic losses in production. Likewise factors which cause abortion are numerous. A number of diseases can result in abortion in the ewe, including poor nutritional conditions. When nutritional level is low but not sufficiently poor to cause fetal loss, it may still result in decreased lamb survival because of low birth weights. Lamb birth weight, of primary importance in its survival, is reduced by disease and nutritional stress on the dam.

High infant mortality among newborn lambs and kids often occurs as a result of poor hygiene. For example, navel ill is a problem causing lamb loss throughout the world. Tetanus frequently follows tagging, docking and castration. These kinds of problems could largely be prevented by management improvements. Other lamb diseases, such as contagious ecthyma, may discourage or entirely stop lamb suckling behavior and lead to loss of condition or even death. Metabolic diseases in the dam can be brought about by stress, and milk supply is reduced by infections such as mastitis. This disease occurs in the sheep and the goat and is a problem for the suckling offspring and for commercial milk production.

Adult mortality can often be prevented by quick recognition and control of diseases. However, in most areas of developing countries where sheep and goats are raised in abundance, veterinary and diagnostic services are inadequate to cope with these problems.

In adults, the severest effects of diseases and parasites are not from mortality, but rather in terms of production losses over time. The production life of an animal can be severely reduced by the debilitating effects of mineral deficiencies. Debilitating diseases which cause large production losses, can often be controlled by improved management. Livestock introduced into a new environment tend to be highly susceptible to such diseases. Exotics and crossbreeds are more readily infected by disease carried by wild animals than are the indigenous, adapted livestock. Breed differences in susceptibility can be a limiting factor to the success of crossbreeding programs.

Helminth infections are a major cause of low productivity wherever sheep and goats are raised. Their control can have a dramatic effect on improving growth rates of lambs and kids. A parasite burden dramatically alters the growth and production of weaned or adult animals dependent on pasture. Subclinical infections cannot be overemphasized in terms of their detrimental effects on productivity.

The land mass south of the Sahara over which the tsetse fly is distributed is about 4 million square miles. This area is virtually devoid of cattle because of trypanosomiasis, a disease transmitted by the tsetse fly. There is little information on the distribution of trypanosomiasis among small ruminants. However, it is known that the disease does occur in both West and East Africa. Some investigators recognize a significant difference in the susceptibility of various species of trypanosomiasis. For example, the dwarf goat of West Africa seems to survive quite well in the tsetse fly belt. If this huge land area could be freed of trypanosomiasis and brought into livestock production, it is estimated that the present cattle production of Africa could be doubled.

Improved treatments with new drugs and new technologies for the control and elimination of all parasites (internal, external and blood) would make a significant contribution to improving the productivity of sheep and goats wherever they are raised.

The intensification of a livestock system may lead to greatly increased disease problems if management is not sufficiently improved at the same time. The stress of intensification, or simply the transport of livestock, leads to increased susceptibility to pneumonia. Where management is lax or needs further development, other diseases such as enterotoxemia may occur. Coccidiosis is a common disease that occurs in the intensive production system that is overstocked.

In many areas of the world predation is a severe constraint to livestock production systems. Protection of livestock generally involves confinement overnight, which leads to the same disease problems associated with intensively confined livestock.

Various parasites and diseases may have their effect on productivity at the level of the final product. For example, wool is downgraded if fungal infections are present, and fleece quality is reduced by internal helminth infections. The same consideration applies to skins. Significant loss of food occurs when the offal is infected by liver flukes and tapeworms.

Many diseases may be seasonal in occurrence. Thus, their influence on production may fluctuate in magnitude. Some diseases are extremely important from the standpoint of public health. Tuberculosis and brucellosis are excellent examples of zoonotic diseases generally considered a threat to the public health. These diseases are viewed as less important in sheep and goats by some investigators.

Overall, the most important points to be emphasized in relation to disease, parasite and environmental constraints in the production of sheep and goats are that diagnosis, research and veterinary service could be vastly improved.

D. Animal Nutrition and Feeding

1. Overview

Inadequate supplies of feed and selected nutrients is a problem in almost all parts of the developing world. These seasonal or absolute scarcities tend to exacerbate disease and health problems, low fertility, and degradation of range lands from erosion caused by overgrazing. While these severe conditions result in animals that are tolerant of seasonal deficiences of food, unfortunatley this tolerance is usually associated with slow maturity and poor production of meat and milk. The lack of food supplies prevents the introduction of exotic breeds that are more productive under "normal conditions" but cannot tolerate the stress caused by semistarvation. Programs to upgrade indigenous animals through inbreeding and the introduction of germ plasm are constrained by the necessity of maintaining this tolerance to food scarcities unless there is a concurred program to maintain the food supply year round.

These scarcities are due to seasonality (wet and dry, cold and hot) and absolute lack of animal feeds and storage systems. There is some doubt whether sufficient animal feed could be produced in the arid and semiarid areas to carry the animals through the rest of the year at a relatively constant levels of food intake. The conditions and problems of the arid and semiarid range lands are unique enough to warrant separate treatment in this discussion. They are discussed in detail in Section 3.IV.E below.

The densely settled areas cannot afford to divert production from human to animal food crops so there is an absolute scarcity of animal feed in these areas. These animals subsist by scavenging crop residues, weeds and grass growing along roads, and other waste products.

2. Potential for Increasing Supplemental Feed

The role of supplemental feed is critical in making major improvements in ruminant production. This requires, as a first priority, the integration of pastoral production with sedentary crop production.

Instances of the integration of nomadic, transhumant, and sedentary ruminant production systems with crop production is common to all ecozones.

Traditional relationships among graziers and cultivators utilize crop residues to a greater or lesser degree. Cereal pastures of fall-sown grain provide winter feed in many areas of the Near East. Berseem and other annual legumes may be sown between crop seasons as in Eqypt. Harvested forage--crop residues, hay and silage-- could provide additional amounts of supplemental feed of higher metabolizable energy and digestible protein content.

Irrigated areas growing sugar crops, cotton and oil seed crops, offer opportunity for supplemental feed sources. Sugar beet crops and pulp are excellent feeds. Leaves of sugar cane, molasses bagasse are substantial feel sources in many areas; copra and cassava are expandable sources of supplemental feed in other areas.

The oil seeds--cotton seed, soy, sesame, rape, sunflower, safflower--all provide residues from oil extraction of high value as feed supplements. High in digestible protein content, small quantifies may be transported economically to flocks, while use of bulky crop residues and other forage is economically useful only close to the sites of their production.

Supplemental feeding of any sort depends on at least minimal commercial production of small ruminant products. The simplest arrangement for securing supplemental feed involves bartering manure for crop residues gleaned by sheep and goats. Milk, cheese, wool or hair, live animals and meat may also be bartered. Beyond bartering, full exploitation of supplemental feeding depends on cash markets for sheep and goats and their products; these provide for the acquisition of feed reserves and their selective use for milk production or fattening.

Integration of grazing and cultivation offers increasing opportunities for supplemental feeding and may make such feeding a necessity. This is demonstrated in rainfed tropical savannahs that are brought under cultivation by small holders (for example, the African Sahelian and Sudanean ecozones which have more than 800 mm annual precipitation).

Integration of small ruminant production with traditional or modified slash-and-burn cropping systems can utilize both browse and weeds resulting from abandonment of depleted areas; bananas, yams, cassava and leafy waste excess from human consumption.

Principal opportunities for small holders in newly developed cultivated areas and old cultivated areas near urban areas lie in the intensive milk production. Milk goats of high genetic capacity may produce 500-1500 kg per lactation period. A few such goats could be provided green and harvested forage from small holding with less than 5 Ha. In order to sustain yields of 5 kg. a day or more, they must be given supplemental feed. Non-millable grain, milling offals and oil seed meals could provide such feed. Molasses, urea, cassava and copra could provide part of the feed in areas of their production.

The poorest of the poor may become poorer still as affluence grows in some developing countries. Development of a middle class with means to buy preferred foods may lead to increased imports and to development of large scale intensive livestock establishments to supply this demand. Smallholders are likely to be disadvantaged because of the cost of assembling their small lots of salable produce and because such produce is likely to be highly variable and often inferior in quality. As national affluence increases, large scale producers of grain and other foods are more likely to be able to obtain technology, supplies, services and credit to increase production for sale than are smallholders.

For example, small producers of grain may lose their traditional markets or find buyers only at very low prices. They may need to supply even more of their food wants from their own production or work parttime at wage work to supplement their subsistence from the market place.

In either case, as they increase their own production of grain they may find a larger return by feeding some of it to milk producing goats or ewes to supply their own needs or to market locally.

Total confinement, large scale, sheep and goat dairies offer opportunities in metropolitan areas where markets exist for milk and cheese of high quality at prices sufficient to invite capital and technology essential to successful operation of such enterprises. Such large scale enterprises with several hundred or thousands of productive females could be integrated with smallholders' enterprises through rearing replacement females by smallholders, through establishment of a market for locally produced forage of high digestibility and of grain or cassava in excess of demand for use as human food. In this system, formulated

feed supplements could be most economical for feed concentrates since they can be formulated on a least-cost rather than a locally available basis.

Large scale feedlots and feeding pastures in irrigated areas may be useful both for fattening the stock from desert ranges following long trail drives to market areas and for imported live animals. This latter option is especially important in the Middle East where foreign exchange is likely to be available. Custom and lack of refrigeration are both conducive to live animal rather than meat imports. Imported feed stuffs may have an important role as they do in large scale poultry production in these countries.

E. Rangeland Potential and Problem Areas

1. Introduction

The low productivity and increasing destruction of many of the rangelands of the developing world are serious problems that need to be solved in order to improve, or even sustain, sheep and goat production in these areas. Although there is a great deal of information available about range management in the developed countries (particularly the western U. S.), this information needs to be adapted and tested under field conditions in other countries. A substantial amount of research still remains to be done, however, on range types not found in the developed countries. Furthermore, the social and institutional factors that will influence management prescriptions need to be analyzed and filled into overall approaches.

While there are a number of different types of rangelands in the developing countries, the types that require the most immediate attention are the desert shrub rangeland and the woodland shrub range that are in immediate danger of desertification, principally in Northern and Sahelian Africa and in Southwestern Asia.

Overgrazing has been very common in these areas, producing very poor results over vast areas. In the drier areas (100 - 200 mm), range rehabilitation can only be achieved through a change in grazing practice that will permit natural recovery of these degraded rangelands. In areas of 200 mm of precipitation and greater, artificial seeding can be utilized to rehabilitate rangelands because of the greater probability for success.

Range improvement attempts are futile without control of grazing education programs to instill among users the basics of proper grazing and good range managment.

Goat grazing on desert shrub rangelands is very important because of the type of vegetation, overall feed shortage and limited water supply. On heavy shrub-covered rangelands, browsing goats perform well compared to cattle and sheep. There is potential in these areas for biological in these areas for biological control ob brush with pasture productivity improving through the use of browsing as a management technique.

A major constraint to improved livestock production is the absence of an effective land tenure system that allocates grazing rights on communal land. Without control of acess to rangeland, it is difficult to maintain the animal population below the absolute carrying capacity of the land and to undertake range renewal.

Mixed species grazing can very efficiently utilize the feed resources, particularly when sheep and goats follow cattle in a regular pattern. Even though mixed species grazing and browsing may constitute the most efficient feed utilization, this practice may result in severe degradation of plant communities on these rangelands. This, in turn, could result in accelerated soil erosion and complete degradation of the site potential. The likelihood of this occurring is increased under conditions of extensive management where no control of grazing is exercised.

Improved management of rangelands to increase productivity of sheep and goats may entail reduction of animals, grazing control accompanied by range renovation, improved livestock water and more efficient migration systems. Improving land use through greater grazing control and allocation of grazing rights is basic to maintaining or improving productive rangelands. Major investments in rangeland improvement and range management research and education programs are clearly needed but must be preceded by greater control of rangeland use.

Range renovation could be accomplished by either natural recovery through improved grazing management or by artificial means (seeding of rangeland with adapted grasses and legumes). In most areas, seeding is generally not possible except where rainfall is 200 to 400 mm per year and the soils are favorable. Then seeding of adapted forage species with present knowledge and techniques is generally successful in the more favorable areas. Natural regeneration of rangelands is not feasible in many drier

and more harsh areas because a seed source is no longer present. Planting by seed has often failed because of the aridity and unfavorable soil conditions. Under these conditons shrub transplanting for range improvement has been recommended.

In support of range conservation or improvement efforts, considerably more knowledge of specific range characteristics in LDC's is required. This can only be accomplished through inventorying range resources. While this is a time consuming and often expensive undertaking without direct, immediate payoff, it is crucial to mounting any sustained range improvement program.

2. Summary of Most Urgent Range Research Needs

   a. Classify and inventory existing range resources to develop an understanding of the basic rangeland resources.

   b. Develop, apply and evaluate grazing management systems including efficient and effective distribution of stock water and supplemental feeding.

      (1). Investigation multispecies production systems including multispecies (cattle, sheep, goats and possibly game animals) grazing on rangelands. Study the effects of this grazing on animals and on the range resources (soil and vegetation).

      (2). Initiate deferred grazing management (including rest-rotation grazing) and investigate range recovery in relation to successful stage of vegetation and site characteristics.

      (3). Measure changes effected by deferred grazing in productivity and site characteristics including those of soil erosion.

      (4) Study the comparative use by specific grazing species (sheep, goats, or cattle) and combinations of species within deferred grazing systems and investigate the effects on the animals and on pertinent aspects of rangeland ecosystems.

c. Develop and evaluate methods to improve range plant communities for forage production.

(1) Establish trials and evaluate results to determine best range improvement methods (e.g., weed and brush control, reseeding, new varieties, species mixtures) for development of most effective technology acceptable to target populations.

(2) Emphasize development of methodologies that would incorporate sheep and goat grazing as a means of range improvement, for instance, for biological control of brush.

(3) In specific instances, develop methodology that will incorporate small ruminants in reforestation programs.

(4) Develop and evaluate grazing management methods with range improvement technologies to recommend most effective and efficient systems for optimum development and utilization of rangeland communities.

F. Socioeconomic Factors

Socioeconomic factors are very important in explaining the patterns of livestock production found in many parts of the world. They need to be considered in any program of research because they can constrain implementation of the results and many have been responsible for the problem in the first place. This section will review several socioeconomic factors that may be relevant to small ruminant research.

1. Economic and Cultural Situation

Sheep and goats in most parts of the world are low status animals that are kept mainly because of their economic benefits. They have a somewhat different cultural role than cattle. They often are tended by children, the elderly or women, in contrast to the cattle situation where men or young boys generally care for them. Ceremonial prices are not quoted in terms of sheep or goats although they can be substituted for cattle. Nevertheless, sheep and goats are integral parts of the culture of these areas. For example, many nomadic societies exist almost entirely on the products of these animals, which naturally

causes them to be very important socially and culturally. On the other hand, the economic function of the animals as a form of insurance or protection from famine causes herds to contain more adults than can be justified on a commercial basis or even on efficient utilization of the range resources. In some places, lambs and kids are slaughtered earlier than the optimum age because they are needed for ceremonial purposes under Islam.

2. Land Tenure

Land tenure arrangements in many parts of the world are a cultural phenomenon that interferes with the efficient utilization of range resources. The common use of grazing lands and prohibitions against fencing often lead to overgrazing. Although the opening of markets might cause more animals to be sold at an earlier age and thus increase the turnoff from the herd, this approach probably would not solve the overgrazing problem. Animal numbers would increase up to the carrying capacity of the range, and beyond.

In many areas of settled agriculture, land tenure does not interfere with efficient transhumant systems of production. That is, people bring the animals off the range to graze on stubble and other crop residues in exchange for the manure and urine left behind on the farmers' fields.

3. Marketing

Marketing of small ruminant products is a problem in some areas and not in others. For example, livestock owners in the Sahel often drive their animals to the West African coast where they are sold at prices that usually exceed beef. Goat meat is especially desirable for cultural reasons. Unfortunately, the animals lose a substantial part of their body weight and can die of disease during the long trip. Another problem that exists is that much of a demand is seasonal, due to Ramadan. This seasonality often results in inefficient timing of sale and slaughter.

The opportunities for increased sale of sheep and goat products are very great. For example, the Near East imports substantial quantities of lamb and mutton and probably would import more if it were available. The proximity of Africa to the Near East is a great advantage to

African countries that would like to increase export earnings from small ruminants. Of course, there may be substantial barriers of transportation, preservation, and disease that would have to be overcome in addition to the production problems. The market for goat and sheep milk appears to be far from saturated, although most of the demand probably would be local (goat and sheep cheese does travel in international trade, however). Goat milk is especially attractive because it is more readily digestible than cow's milk.

V. POTENTIAL BENEFITS AND COSTS

An analysis of the ratio of potential benefits and costs cannot be performed until specific projects are proposed by the eligible institutions. Furthermore, the benefits from research are not gained until the applications phase, which is quite far down the road. The potential for benefits is very great, however, and will be reviewed briefly.

Sheep and goat production in most developing countries is at a very low level of productivity based on worldwide averages and the known potential under various situations. For example, average meat and milk production per animal in the developing areas of the world are less than half of the world average for sheep and not much better for goats, even though 80 percent of the world's goats are in the developing world. Very little has been done to improve the productivity of small ruminants, even in countries where research has been done. Disease prevention and other health measures are almost unknown; breeding generally is not controlled, nor has there been much introduction of superior animals or germ plasm as artificial insemination techniques are not fully developed to allow it. Range management and supplemental feeding are almost never practiced, while animal husbandry and overall management are very poorly developed. It must be recognized, however, that goats and sheep in these areas have developed important tolerances to parasites and other diseases that would quickly debilitate exotic breeds, that they can survive on wide seasonal variations in the quantity and quality of forage, and they often make use of food resources that cannot be utilized by people or other animals.

The potential benefits to the results of any one research project are difficult to estimate in advance. A number of different improvements may be necessary in order to boost productivity. For example, improved animal health may not boost output if food shortages exist. Removal of the major constraints should lead to at least a doubling of productivity and output. This would mean an increase of $1.6 billion (in 1970 dollars and income) for the developing countries or nearly a dollar in per capita income. In 1975 prices, this doubling in some countries could raise the income of rural people by 15 percent or more.

Chapter 4

Research Capabilities in LDC's

Over the last three months, the Research Triangle Institute (RTI) has been compiling a list of research institutions in developing countries where interest in sheep and goat research exists. The letter which was sent to these institutions is included in Appendix B. This letter was sent to all of the institutions listed on the following pages. This list represents a composite of institutions: (1) visited by Winrock; (2) suggested by representatives of various U.S. agricultural organizations, and (3) suggested by U.S. universities in response to a specific request by RTI.

The breadth of responses indicates the country-specific nature of research needs. Animal nutrition and breeding received a good deal of attention in the ecological context of the research being discussed.

Although only scattered references were made to linkages with specific U.S. institutions, the responses from LDC's expressed a unanimous desire to collaborate with U.S. experts to improve research in LDCs. However, a perusal of the list indicates gaps in responses (which could mean no interest, or non-receipt) in rather critical areas such as many of the tsetse and Sahalian countries.

As a rule, pre-existing research infrastructures are concentrated in areas where sheep and goat production is more sophisticated. Some of these countries, such as Mexico, Brazil and Nigeria are not included in the target area classification because they are relatively less underdeveloped. An exception to this rule is India where institutional capabilities in small ruminant research exist. Research at the more developed country institutions may be applied to other countries with similar ecological zones and production systems. These countries represent an intermediary step between the rather advanced orientation of U.S. research and the very basic and pragmatic production problems of the least-developed countries.

LDC INSTITUTIONS AND INDIVIDUALS CONTACTED WITH
REFERENCE TO RESEARCH IN SHEEP AND GOATS

	Institution/Individual	Response
AFRICA	Abdul Kader Kerba Ministry of Agriculture and Agricultural Reform C.N.R.Z. B. P. 3 Birtouta, Algeria	
	Director National Research Centre Al-Tahrir Street Dokki, Cairo Arab Republic of Egypt	
	Director Egyptian Desert Institute Mataryia, Cairo Arab Republic of Egypt	
	Director FAO Regional Office for the Near East P.O. Box 2223 Cairo, Arab Republic of Egypt	
	A. Mekky, Director Animal Production Research Institute Cairo, Arab Republic of Egypt	Research finished 1972: 1. improved mutton production through reproduction, nutrition 2. intensive lamb production 3. use of agricultural by-products for animal nutrition 4. animal breeding Research needs/plans: 1. extension services to small farmers
	Mohamed Oloufa, Chairman Animal Husbandry University of Cairo Cairo, Arab Republic of Egypt	
	Owen Brough International Center for Agricultural Research in the Dry Areas Cairo, Arab Republic of Egypt	

Institution/Individual	Response
Gordon McLean Ford Foundation Cairo, Arab Republic of Egypt	Sheep and goats compete with draught animals for scarce forage. Research needs: 1. conversion of agricultural wastes to animal feed 2. traditional eating habits
Jerry Edwards Agricultural Development Officer US/AID American Embassy Cairo, Arab Republic of Egypt	
Mohammed Farid Desert Institute Animal Research Institute Al-Matareya Cairo, Arab Republic of Egypt	
Dr. A.S. El. Sheikh Faculty of Agriculture Al-Azhar University Nasr City Cairo, Egypt	On-going research: 1. intensive lamb production using 3 native breeds and 3 exotics
Eldred B. Oldham Ain Shams University Cairo, Arab Republic of Egypt	
Dr. Ibrihan El Kimary Animal Science Department University of Alexandria Alexandria, Arab Republic of Egypt	
Chief Animal Production Officer Division of Animal Production Ministry of Agriculture Government of Botswana Gaborone, Botswana	
Inter-African Bureau for Animal Resources Livestock Project Management Unit Ministry of Agriculture Government of Botswana Gaborone, Botswana	
Director Institute d'Elevage et de Medecine Veternaire de Pays Tropicaux Wakwa, Cameroon	

Institution/Individual	Response
Dr. Emanuel Tobong Chief of Center Institute of Zootechnical Research B. P. 80 Bamenda, Cameroon	
Mr. Joseph Atekwana, Director Small Stock Programs I.Z.P.V. B. P. 65 Ngaoundere, Cameroon	
Director National College of Agriculture University of Yaounde Nkolbisson, Cameroon	
Director Institute d'Elevage et de Medecine Veternaire de Pays Tropicaux Adsamena, Chad	
Director Institute d'Elevage et de Medecine Veternaire de Pays Tropicaux Debrezeit, Ethiopia	
Dr. E. Salah E. Galal FAO Sheep and Goat Production Specialist Institute for Agricultural Research P.O. Box 2003 Addis Ababa, Ethiopia	On-going research: 1. genetic improvement of sheep and goats 2. improved range/feedings management Research needs: 1. transportation/marketing of sheep and goat products 2. consumption taboos against goats 3. tick-borne diseases
Dr. Robert S. Temple Director of Animal Science International Livestock Center for Africa P.O. Box 5689 Addis Ababa, Ethiopia	Integrated approach to livestock production On-going research: 1. sheep development project, Kenya 2. livestock development, Botswana 3. nomadic livestock production, Mali 4. cooperation on National Range Development Program for Ethiopia 5. range and ranch management - Nigeria 6. breeding typanotolerant livestock

Institution/Individual	Response
Abraham Wubishet H.S.T.U. College of Agriculture P.O. Box 138 Dire Dawa, Ethiopia	
Director FAO Regional Office for Africa P.O. Box 1628 Accra, Ghana	
Director Institute d'Elevage et de Medecine Veternaire de Pays Tropicaux Bouake, Ivory Coast	
Hassan R. Gharaybeh Ministry of Agriculture Amman, Jordan	
Director Department of Agriculture University of Nairobi Nairobi, Kenya	
Director National Animal Husbandry Research Station Nairasha, Kenya	
W. N. Masiga, Director East African Veterinary Research Organization Muguga, Kenya	On-going research concerning disease problems of small ruminants
Director Tasro Research Center Tsaro, Kenya	
Director Wellcome Institue Nairobi, Kenya	
Director International Laboratory for Research on Animal Diseases Nairobi, Kenya	On-going research on Trypanosomiasis and East Coast Fever
Mr. Frank Abercrombie Rangelands Officer US/AID Nairobi, Kenya	No AID-funded research in ruminants

Institution/Individual	Response
Mr. Z. Owiru Animal Production Division Ministry of Agriculture Nairobi, Kenya	
Mr. Dennis Purcell/N. T. Clark Livestock Officer for East Africa IBRD Nairobi, Kenya	There is World Bank interest in sheep and goat research in East Africa
Dr. Edward W. Allonby FAO Specialist - Sheep and Goats Veterinary Research Laboratory Kabete, Kenya	
Seklau Elizabeth Worjloh Ministry of Agriculture Monrovia, Liberia	
Institut des Recherches Agronomiques Tropicales Mopti, Mali West Africa	
Institut des Recherches Agronomiques Tropicales Sotuba, Mali West Africa	
Institut des Research Agronomiques Tropicales Katibougou, Mali West Africa	
Institut des Recherches Agronomiques Tropicales Same, Mali West Africa	
Institute des Recherches Agronomiques Tropicales M'Pesoba, Mali West Africa	
Director National Directorate of Production Government of Mali Bamako, Mali	

Institution/Individual	Response
Director Centres d'Animation Rurale Government of Mali Bamako, Mali	
Institut d'Economie Rurale Ministere de Development Rurale Recherche Zootechnique Bamako, Mali	
Director Central Veterinary Laboratory Bamako, Mali	
Travis Voelkel U.S. Embassy Bamako, Mali	
Director Institute d'Elevage et de Medecine Veternaire de Pays Tropicaux Tananarive, The Malagasy Republic	
Director Institute d'Elevage et de Medecine Veternaire de Pays Tropicaux Kiansosoa, The Malagasy Republic	
Fouad Guessous and Alain Bourbouze Institut Agronomique et Veterinaire Hassan II Rabat, Morocco	
Dr. Abonyoub Ahmed, Director National Agricultural School Meknes, Morocco	
T. Bouix, Chef de la Section Zootechnie M.A.R.A Direction de la Recherche Agronomique Station Central d'Agronomie Salaiarienne Rabat, Morocco	
Director Institue d'Elevage et de Medecine Veternaire de Pays Tropicaux Niamey, Niger	

Institution/Individual	Response

M. Moussa Adama
INRAN-CNRA de Tarna
B.P. 240
Mardi
Republique de Niger

Director
Federal Department of Veterinary Research
Vom, Nigeria

Dr. Titus O. Okolo
61 Balogun St.
Lagos, Nigeria

Director
West African Institute for
Trypanosomiasis Research
Vom, Nigeria

Dr. S. Nuru, Director
National Animal Production Research
Institute, Shika
PMB
Zaria, Nigeria

Dr. B. N. Okogbo
Director of Farming Systems
IITA
PMB 5320
Ibadan, Nigeria

Dr. O. Nduaka, D.V.M.
Veterinary Division
Ministry of Agriculture & Natural
Resources
Owerri, IMO State
Nigeria

Dr. F. O. Olubajo
Faculty of Agriculture
Department of Animal Science
University of Ibadan
Ibadan, Nigeria

Dr. A. A. Adegbola, Head
Department of Animal Science
The University of Ife
Ile-Ife, Nigeria

Institution/Individual	Response
Institut des Recherches Agronomiques Tropicales Bambey, Senegal West Africa	
Director Institute d'Elevage et de Medecine Veternaire de Pays Tropicaux Dakar, Senegal	
Director Ministry of Rural Development Government of Senegal Dakar, Senegal	
Animal Production Research Administration Ministry of Agriculture Khartom, Sudan	On-going research: 1. animal health: survey and diagnosis 2. adaptability of desert sheep 3. nutrition of sheep and goats 4. breeding superior dairy goats
A. S. Heiba The Arab Organization for Agricultural Development P.O. Box 474 Khartoum, Sudan	
Dr. Abdel Hamid Osman Faculty of Veterinary Science University of Khartoum P.O. Box 32 Khartoum, Sudan	
Director Serengeti Research Station Serengeti, Tanzania	
Mr. Russ Wallace Tanzania Rural Development Bank P.O. Box 268 Dar es Salaam, Tanzania	
Dr. N. K. Maeda, Livestock Director Kilimo Dar es Salaam, Tanzania	

Institution/Individual	Response
Professor Martin L. Kyomo, Dean Faculty of Agriculture University of Dar es Salaam P.O. Box 643 Morogoro, Tanzania	On-going research: 1. breeding 2. management 3. animal nutrition 4. seasonality as it relates to physiological functions
Mr. Jackson Kategile, Head Animal Science Department Faculty of Agriculture University of Dar es Salaam P.O. Box 643 Morogoro, Tanzania	
Dr. Will Getz Livestock Production Specialist MARTI Private Bag, Mpwapwa, Tanzania	On-going research supported by the Ministry of Agriculture: 1. improvement of sheep and goat production for meat and fat 2. development of milk goats 3. effect of weaning lambs at different ages 4. goat behavior and bush control Research needs: 1. development of "production system packages" to include: a) management systems b) genetic limitations c) utilization of feed supply 2. marketing
Dr. L. L. Ilmoleyan, Director Ministry of Agriculture Tanzania Livestock Development Division P.O. Box 9152 Dar es Salaam, Tanzania	On-going research on breeding Research needs: 1. management 2. nutrition 3. breeding 4. health
Director National Agricultural Ranch Corporation P.O. Box 9113 Dar es Salaam, Tanzania	
Director Tanzania Livestock Marketing Company P.O. Box 20669 Dar es Salaam, Tanzania	

Institution/Individual	Response

Hamza Abedi
Lilimanjaro A. I. Scheme
P.O. Box 99
Moshi, Tanzania

M. B. Inman
Chief of Party
Texas A & M Program
Dar es Salaam, Tanzania

Director
Institut National de la Recherche
Agronomique de Tunisia
Ariana, Tunisia

Salah Ayachi
Rue Sidi Abbas
Ksar-Gsfsa, Tunisia

James Dickey
USAID/Tunisia
U.S. Embassy
Tunis, Tunisia

Director
Nuffield Unit of Tropical Animal Ecology
Nuffield, Uganda

A. W. Qureshi
Box 7184
Kampala, Uganda

Director
Institut des Recherches Agronomiques
Tropicales
Farako-ba, Upper Volta
West Africa

Director
Institute des Recherches Agronomiques
Tropicales
Sawa, Upper Volta
West Africa

	Institution/Individual	Response
EUROPE	Centre Nationale de Recherches Agronomiques Etoile de Choisy Rue de Saint Cyr Versailles, France	
	Institut National de la Recherche Agronomique 149 rue de Grenelle Paris, 7e France	
	Dr. J. C. LeJaouen Institut Technique de l'Elevage Ovin et Caprin 14 g Rue de Bercy 75579 Paris, Cedex 12 France	
	Dr. P. M. Fehr Dr. D. Sauvant Laboratoire de Recherches de la Chaire de Zootechnie 16 Rue Claude Bernard, 75231 Paris, Cedex 05 France	
	Dr. B. Vissac, Geneticist Department of Animal Genetics and Breeding Jouy en Josas, 78350 France	
	Dr. J. M. Corteel, Physiologist Laboratoire de Physiologie de la Reproduction Centre de Recherches de Tours 37380 Nouzilly, France	
	M. L. Huget, Range Scientist Station d'Amelioration des Plantes Fourrageres S.A.P.F. Lusignan, France	On-going research: 1. green forage utilization for goats 2. ensilage utilization for milk goats 3. comparison of various feeding systems for milk goats

	Institution/Individual	Response
	Hoved komiteen for Norsk Forskning Akersgt 49 Oslo, Norway	
	N.C. Jones Commonwealth Agricultural Bureau Farnham House, Farnham Royal Slough, Bucks SL23 BN United Kingdom	Do not engage in research but have computerized listing of research: CAB ABSTRACTS
	Commonwealth Bureau of Animal Breeding and Genetics King's Buildings West Mains Road Edinburgh EH93 JX, United Kingdom	
	Dr. A. S. Demiruren FAO-UN Via Delle Terme di Carcalla, 0010 Rome, Italy	Support provided for research concerning sheep and goats: Niger - Hides and Skins Niger - Pilot research on the tsetse fly problem; Rwanda - Tick control Morocco - improvement of forest pasture Antigua - Small scale pilot center for hides, skins, and by-products Guatamala - Increasing sheep production Haiti - Program development in collaboration with UNDP on goat production for milk Kenya - Sheep development project with emphasis on breeding
SOUTH AMERICA	Guillermo Joandet Est. Exp. INTA Cerrillos, SALTA Argentina	
	Nicholas Mulcahy Suipacha 1244 Capital Federal, Argentina	
	Dr. Bernardo J. Carrillo Estacio Experimental INTA Balcarce (BA) Argentina	

Institution/Individual	Response
Instituto Nacional de Tecnologia Agropecuaria, INTA Rivada via 1439 Buenos Aires, Argentina	
Simon Riera, Deputy Secretary Research and Extention Ministry of Agriculture Government of Bolivia La Paz, Bolivia	
Winston Suarez Santa Ana Del Yacuma Beni, Bolivia	
J. H. Maner Rockefeller Foundation Caixa Postal 511 40.000 Salvador, Bahia Brazil	
Waldecy Ferreira dos Santos, Coordenador Plano de Assistencia Tecnica a Caprino-Ovinocultura Ministerio da Agricultura Recife, Pernambuco Brazil	On-going research: 1. EMBRAPA/CPATSA on semi-arid a. problems of seasonality of breeding and reproduction b. range management c. health and zootechnical improvements 2. EPPA-IPA (Pernambuco) Comparison of native goats under traditional system production and improved management and feeding conditions Research needs: 1. Seasonality of feed supply in arid areas - nutrition and management 2. Health problems 3. Marketing 4. Breeding
Joao Ambrosio de Araujo, Range Scientist Universidade Federal de Ceara Fortaleza, Ceara Brazil	On-going research: 1. Breeding woolless sheep for meat and hide production
Jose Ismar G. Parente, Director Empresa de Pesquisa Agropecuaria do Ceara (EPACE) AV. Rui Barbosa 1246 Fortaleza, Ceara Brazil	On-going research: 1. Range management/sheep and goats 2. Breeding of goats Research needs: 1. Feeding 2. Sanitation 3. Management 4. Breeding

Institution/Individual	Response
Darlan Filqueira Maciel Centro Nacional de Pesquisa de Caprinos EMBRAPA Rua Conselheiro Jose Julio, 286 Praco Osvaldo Rangel Caixa Postal 10 62.100 Sobral, Ceara Brazil	On-going research: 1. Time of emasculation of goat 2. Goat reproduction 3. Sheep and goat production system management
Frank Campbell USAID Program Officer American Embassy Brasilia, D.F. Brazil	
Delmar A.B. Marchetti Chief - Scientific Tecnical Department Palacio Do Desenvolvimento 90 Andar - C.P. 1316 Brasilia, D.F. Brazil	
Daniel Perotto Rue Japorra No. 143 Ricardo de Albuquerque 20.000 Rio R.J. Brazil	
Donald F. Winslow COPED-Coordenacoo CEPLAC CAIXA Postal 7 Italuna, Bahia Brazil	
Carlos Magno Campos Da Rocha Centro De Pesquisa Agropecuaria Dos Cerrados KM 18-BR-020 Caixa Postal 70/0023 70.600 Planaltina-D.F. Brazil	
Dr. Sergio Bronze Rua Aracy Vas Callado 401-APTO 101 Estreito 88.000-Florianopolis Santa Catarina, Brazil	

Institution/Individual	Response
Dr. Valdir Welte Rua Padre Agostinho 182 80.000 - Duritiba Parana, Brazil	
Nelson Barria Facultad Medicina Vet. Casilla 5539 Santiago, Chile	
Sergio Bonilla Director of Research Instituto Investigaciones Agropecuaria La Platina, Santa Rosa Sur Santiago, Chile	
Raul Cabrera Instituto de Alimentacion y Nutricion Casilla 15138 Santiago, Chile	On-going research: 1. Ruminant metabolism 2. Nonprotein sources of ruminant nutrition 3. Integration of sheep and goats into urban fringe subsistence
Dr. Fernando Garcia Depto. Produccion Animal Universidad Catolica Santiago, Chile	
Dr. Texia Gorman Facultad de Medicina Veterinaria Casilla 13 Correo 15 - La Granja Santiago, Chile	
Dr. Patricio Berrios Arturo Claro 1429 Santiago, Chile	
Dr. Hector Alcaino Dr. Hector Manterola Badilla Esc. Med. Veterinaria Universidad de Chile Casilla 13, Correo 15 La Granja Santiago, Chile	On-going research: 1. Breeding 2. Lamb production 3. Seasonality of production 4. Animal hair 5. Intensive production of sheep

Institution/Individual	Response
Director Oficina Regional de la FAO Para America Latina Casilla 10095 Santiago, Chile	
Director Instituto de Investigaciones Agropecuarias Casilla 5427 Santiago, Chile	
Patrick Moore Animal Science Training Coordinator Centro Internacional de Agricultura Tropical Apartado Aereo 67-13 Cali, Colombia South America	On-going research: 1. Hemoprotozal disease 2. Range management on phosphorus deficient soil 3. Agricultural by-products
Dr. Edgar Ceballos, Director Animal Sciences ICA - Tibaitata Apartado Aereo 151123 El Dorado Bogota, Colombia South America	
Manuel A. Corzo Calle 47, No. 24-42 Bogota, Colombia	
Dr. Javier Cruz, Director Livestock Program Division ICA Calle 37 #8-43 Bogota, Colombia South America	
Dr. Hugo Campo Bonilla, ICA Regional Director Dr. Mario Zapata ICA Tibaitata Apartado Aereo 151123 El Dorado Bogota, Colombia South America	On-going high altitude research on sheep: Breeding
Dr. Riberto Bautista Sheep Programs Caja Agraria Edificio Avianco - Oficina 2505 Bogota, Colombia South America	Research needs: 1. Animal health/sanitation 2. Range management 3. Socio-economic constraints to smallholder production

Individual/Institution	Response
Fernando Gomez-Gomez K 12 A No. 77A-42 Bogota, Colombia	
Erasmode J. Zuleta Facultad de Medicina Veterinaria Universidad de Medicina Veterinaria Universidad de Cordoba Monteria, Colombia	
Dr. Galo M. Izurieta Jefe De Epidemiologia Ministerio de Agricultura P.O. Box 108 Quito, Ecuador	
Director Ministry of National Development and Agriculture Georgetown, Guyana South America	
David L. Peacock, Rural Development Officer USAID/Paraguay c/o American Embassy Asuncion, Paraguay	
Ted Arvizo, Jr. Jefe de Grupo Ministerio de Agricultura Y Ganaderia Embajada de los EE.UU. Asuncion, Paraguay South America	
Eduardo Ruiz Almada, Dean Facultad de Ciencias Veterinaria Universidad Nacional de Asuncion Asuncion, Paraguay South America	Department of Animal Production is new. Need veterinary training.
Ricardo Samudio, Director Ministerio de Agricultura y Ganaderia PRONIEGA Asuncion, Paraguay South America	
Director General de Investigacion Ministerio de Alimentacion Hernan Velarck 143 Sta. Beatriz Apdo 2791 Lima, Peru	

Institution/Individual	Response
Dr. Raoul Vera Guana 2229, Apt. 7 Montevido, Uruguay	
Director Oficina REgional de Instituto Internacional Ciencias Agricolas Zona Sur Casilla de Correos 1217 Montevideo, Uruguay	
Director Ministry of Agriculture and Research Government of Uruguay Monevideo, Uruguay	
Drs. Garcia and Castillo Campo Experimental y de Produccion de Caprinos Loma de Leon Barquisimeto, Laro Venezuela	
Dr. Tom Schultz Facultad de Ciencias Veterinarias Universidad Central de Venezuela Maracay, Venezuela	On-going sheep research: 1. Nonprotein nitrogen supplementation 2. Use of agricultural by-products and crop residues as animal feed Research needs: 1. Breeding for environmental adaptability
Ivan A. Hernandez Facultad de Agronomia University del Zubia Apartado 526 Maracaibo, Venezuela	
Ali L. Lopez Apartado 4751 Maracay Aragua Venezuela	
William H. Mark Apartado 99 Barines, Estado Barines Venezuela	
Enrique Portal Consejo Zuliano de Planificion y Promocion Calle 77, No. 9B-50 Maracaibo, Venezuela	

	Institution/Individual	Response
CENTRAL AMERICA	Enrique Vigues Roig, Director General Instituto Interamericano de Ciencias Agricolas (IICA) San Jose, Costa Rica	
	Alvaro Munoz Quesada, Jefe Dpto. Ganaderia Alvaro Castro Ramirez, Jefe Seccion Especies Menores Ministerio de Agricultura Y Ganaderia Avenida 1, Calle1 San Jose, Costa Rica Centro America	On-going research in highland and low-altitude goats and sheep: HEIFFER PROJECT INTERNATIONAL 1. Breeding for adaptability 2. Range management 3. Animal nutrition: seasonality 4. Internal parasites and brucellosis Research needs: 1. Production capacity for milk 2. Comparison of various production systems 3. Goat nutrition (supplements)
	Hector Munoz, Head Department of Animal Production CATIE Turrialba, Costa Rica Centro America	
	Director School of Agriculture San Carolos University Guatemala City Guatemala, Central America	
	Dr. Juan Medrano INCAP Division de Cencias Agricolas y Alimentas Carretera Roosevelt, Zona II Guatemala, Guatemala	
	Director Rockefeller Foundation Guatemala City Guatemala	
	Director Instituto de Ciencia y Tecnologia Agricolas Edificio Biener, 3er Piso 5a. Arenida 12-31, Zona 9 Guatemala City, Guatemala	
	O. L. Richardson Banco Interamericano de Desarrello Apartado Postal No. 935 Edif. Etosa, Plazuela Espana Zona 9 Guatemala City, Guatemala	

Institution/Individual	Response
Augusto Juarez Lozano, Director Tecnico Centro de Cria Caprino Tlahualilo Tlahualilo, Durango Mexico	
Vincente Borrazo-Montoya, Administrator Sociedad Local de Credito Ejidad de Responsibilidad Imfinitada Gustova Diaz Ordaz (SLCERI GDO) Ejido Oquendo Tlahualilo, Durango Mexico	Center for investigation of ruminants did research on production in arid area; Research needs: 1. Animal nutrition 2. Range management
Carlos Arellano Sota, Director General Instituto Nacional de Investigaciones Pecuarias (INIP) Apartado Postal 41-652 Mexico, D.F. Mexico	
Jose Buentello APDO 206 Cd. Victoria Tamps, Tamps, Mexico	
Jorge de Alba, Director J. Cervantes 102-307 Tampica, Tamps. Mexico	Research on productiveness of tropical haired sheep
Mario Q. Licon Colle 2A Nte 313 Delicias, Chihuahua Mexico	
Joel Maltos Livestock Specialist Instituto Interamericano de Ciencias Agricolas de la OEA Zona Norte, Apartado 1815 Guatemala, Mexico	
Jose L. Loyo Monto Alban 131 Z.P. 12 Mexico D.F., Mexico	
Jose del Martinez Hacienda de Sauta Eugracia Tamaulipas, Mexico	

Institution/Individual	Response

J. Manuel Cuca Garcia, Professor Ciencia Animal
Colegio de Postgraduados
Escuela Nacional de Agricultura
Chapingo, Mexico

Carlos Robels, Director
Centro Exp. Pecuario de Hueytamalco (Las Margaritas)
Pue. Apdo. Postal Num. 20
Teziutlan, Puebla
Mexico

Hector Castillo, Director
Centro Experimental "La Posta"
Paso del Toro
Ver. Apdo. Postal 898 Sucursal "A"
Veracruz, Ver.
Mexico

Mario Valencia, Director
Centro Exp. Mococha
Col. Yucatan
Mexico

Leonel Martinez, Director
Centro Exp. Pecuario de Tizimin
Yuc. Carretera Tizimin Km. 16
Col. Yucatan
Mexico

Vicente Trujillo
Leandro Valle 2221
Texcoco, Edo de Mexico
Mexico

Dr. Jose Barajas-Rogas
Faculty of Veterinary Medicine
Department of Bacteriology
University of Mexico
Mexico City, DF
Mexico

Director
Instituto Nacional de Investigaciones Pecuarias
Km. 15.5
Carretera, Mexico-Touca
Palo Alto, D.F.
Mexico

Dr. Ricardo Buitrago, Animal Scientist
National Bank of Nicaragua
Managua, Nicaragua

	Institution/Individual	Response
CARIBBEAN	Harold C. Patterson, Livestock Officer Ministry of Agriculture Bridgetown, Barbados West Indies	
	Dr. Lyndon E. McLaren Agricultural Extension Agency Kingston, Jamaica West Indies	Research need: Goat production for meat
	John H. Sanfiorenzo University of Puerto Rico Agricultural Experiment Station Rio Peidras, Puerto Rico	
	Mr. Claude Job Technical Officer, TGO S/BRD Tobago, West Indies	
	Laurence Iton, Head Animal Production and Research Division Ministry of Agriculture, Land & Fisheries St. Joseph Farm St. Joseph, Trinidad West Indies	Existing capability: Interested in goat for meat and milk production
	K. A. E. Archibald, Ruminant Production Department of Livestock Science University of West Indies St. Augustine, Trinidad West Indies	
	P.O. Osuji, Animal Nutrition St. Clair Ford CARDI St. Augustine, Trinidad West Indies	On-going research: 1. Breed improvement on goats 2. Sheep and goat nutrition: use of agricultural by-products 3. Sheep and goat management Research needs: 1. Nutrition 2. Management 3. Internal parasites 4. Small farmer credit/extension
	J. Spence, Dean Faculty of Agriculture University of West Indies St. Augustine, Trinidad West Indies	

	Institution/Individual	Response
NORTH AMERICA	Director National Research Council of Canada Ottawa, KIA OR6 Canada	
	Director FAO UN Liason Office Suite 2258 United Nations Headquarters 42nd Street and 1st Avenue New York, New York 10017	
	FAO 1776 F Street, N.W. Washington, D.C. 20437	No on-site expertise
	Barbosa do Nascimento c/o Paul Fanning American Embassy APO New York, New York 09676	
	Samir A.M. Ghannam c/o W. E. Harvey Foreign Training Division USDA Foreign Agriculture Service Washington, D.C.	
	Dr. Thurston Teele Director of International Operations Chemonics, Inc. Washington, D.C.	
ASIA & THE PACIFIC	Dr. Abdul Habib Quirishi University of Kabul Kabul, Afghanistan	
	A. E. Hayward Acting SAA/FAO Country Representative United Nations Development Program Kabul, Afghanistan	No research on goats. Sheep project in Herat
	Dr. M. Yunus Barak Director General of Animal Husbandry and Animal Production Department Government of Afghanistan Kabul, Afghanistan	

Institution/Individual	Response
Mr. H. J. Stuart Marples Herat Livestock Development Corporation P.O. Box 1 Herat, Afghanistan	On-going research (World Bank): marketing, fodder production, nomadic range & flock mgt., groundwater development, veterinary services
Abubaker, President Ministry of Agriculture and Irrigation Department of Animal Science Kabul, Afghanistan	
Australian Institute of Agricultural Science 101 Royal Parade Parkville, Vic. 3052 Australia	
Quddoos Abdul Vill. Rajabazar P.O. Tejgaon Dacca 5, East Pakistan	
Ashraf I. Bhuiyan East Pakistan College of Veterinary Science and Animal Husbandry Mymensingh, East Pakistan	
INDIA: On-going research	Goats: 1. Milk components at Karnal (Hayana) and Kerala Agricultural University 2. Fibre component at Rahaun (M.S.), Izatnagar (V.P.) and Upsi Farm, Leh-Ladakh (J&K) 3. Meat component at Assam Agricultural University, Avikanagar (Raj.), Ranchi Veterinary College (Bihar)
Dr. Swamenathan Dr. B. K. Soni Director General of Indian Council of Agricultural Research (ICAR) New Delhi, India	There are plans to establish a national goat research institute apart from the National Dairy Institute at Karnal
Dr. V. D. Mudgal National Dairy Research Institute ICAR Karnal, India	On-going research: 1. Comparitive energy utilization in ruminants 2. Goat nutrition: protected proteins and feed utilization 3. Protein requirements for maintenance and milk production in goats 4. Comparison of treated and untreated protein in goat nutrition 5. Goat nutrition - urea vs. biuret feeding

Institution/Individual	Response
Dr. O. P. S. Sengar Department of Animal Husbandry Raja Balwant Singh College Bichpuri (Agra), India	On-going research: 1. PL-480 investigation on milk and meat potentialities of Indian goats (completed 1970) 2. Roughage utilization in ruminants 3. Breeding for increased productivity milk and meat 4. Quality of wool and meat as influenced by nutrition of sheep Research needs: 1. False prejudices towards small ruminants 2. Feed and genetic resources 3. Breeding, feeding and management practices 4. Marketing
R.K.R. Balasvbramanian #1 Advance Field Vet. Hospital c/o APO 56 New Delhi, India	
Nityananda Pati P.O Keshiary District Midnapore West Bengal, India	
Dr. H. P. Singh, Principal R. B. S. College Agra, India	
Director Centre for Animal Research and Development CIAWI, Indonesia P.O. Box 123 Bogor, Indonesia	
A.S. Al-Barhawi Ras AL-KOOR 63511 Mosul, Iraq	
A. R. Siregar Animal Husbandry Research Institute Lembago Penelitian Peternakan J 1. Gunung Gede Bogor, Indonesia	Research needs: 1. Internal parasites 2. Breeding between/within flocks 3. Pasture/forage 4. Farm size, management and marketing 5. Technical training/equipment

Institution/Individual	Response
Asikin Natasasmita Department of Animal Production Faculty of Animal Husbandry Bogor Agricultural University Bogor, Indonesia	
Dr. Rubasah, Head Agricultural Bureau National Planning Agency Bappenas, Indonesia	
Faculty of Animal Husbandry Universitas Padjadjaran, J 1 Bukit Dago Utara Bandung, Indonesia	Research in: 1. Socioeconomic aspects 2. Nutrition
Dr. Baihiqi Abmad, Head Department of Animal Husbandry University of Indonesia Bogor, Indonesia	Research in: 1. Nutrition 2. Socioeconomic aspects of sheep and goat production 3. Breeding
Dr. Allen Tillman Rockefeller Foundation University of Indonesia Yogyakarta, Indonesia	On-going research 1. Components of goat project at Gadjah Mada University Research needs: 1. Intensive livestock production system 2. Range management and use of grasses and legume by-products 3. Identification of production systems and data gathering 4. Systematic animal health program 5. Marketing 6. Management scheme and extension
Faculty of Animal Husbandry Universitas Gajah Mada Yogyakarta, Indonesia	Multi-disciplinary approach project to increased goat production
Dr. Hutsoit, Director General Livestock Department of Agriculture Djakarta, Indonesia	
Dr. Roy Henson IBRD Resident Staff in Indonesia P.O. Box 324-JKT Djakarta, Indonesia	

Institution/Individual	Response
Verle Lanier Agricultural Attache' American Embassy Djakarta, Indonesia	
Aminudin Parakassi, I.M.T. FAPET-IPB G. Gede Bogor, Indonesia	
Dolok T. H. Sihombing Institute Pertanian Bogor FAPET-IPB Bogor, Indonesia	Research in sheep and goats - no specific information available
Bedjo Soewardi 22 Djl Dr. Sumeru, Bogor Indonesia	On-going project on integrated agricultural development with livestock as a component Research needs: 1. Breeding sheep 2. Assessment of small ruminant in smallholder system
Adi Sudono Djl. Pangrango 10 Bogor, Indonesia	
Toha Sutardi Djl. Banten 21 Bogor, Indonesia	
Mozes R. Toelihere Jl. Melati 5 Kampus IPB Darmago Bogor, Indonesia	
Dr. Siavash Haghighi 1, 17 Aria St. Gorgan Avenue Tehran, Iran	
Animal Husbandry Research Institute Ministry of Agriculture Teheran, Iran	
Dr. Kays H. Tuma Animal Production Department College of Agriculture Abu-Ghraib Baghdad, Iraq	

Institution/Individual	Response

National Council for Research and Development
Building No. 3
Hakirya
Jerusalem, Israel

Dr. Dong Ho Bae
Livestock Experiment Station
Office of Rural Development
Suwon, Korea

Sultan Haidar/G. Akl
Animal Production Office
Ministry of Agriculture
Beirut, Lebanon

E. Choueiri
Agricultural Research Institute
Terbol, Lebanon

A. Bhattacharya
Faculty of Agricultural Sciences
American University of Beirut
Beirut, Lebanon

F. Sleinan
National Scientific Research Council
Beirut, Lebanon

Director
Arid Lands Agricultural Development Program
P.O. Box 2379
Beirut, Lebanon

Dr. C. Devendra
Malaysian Agricultural Research and
Development Institute
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Sungai Besi, Serdang
Selangor, Malaysia

Rudy Ingwer Hutagalung
Faculty of Vet. Med. & Animal Science
University of Agriculture, Malaysia
P.O. Box 203
Serdang, Selangor
Malaysia

Institution/Individual	Response
Agricultural Research Division Ministry of Agriculture and Fisheries P.O. Box 2298 Wellington, New Zealand	
Dr. Abdul Wahid University of Karachi Karachi, Pakistan	
Pakistan Animal Husbandry Research Institute Veterinary Research Institute G.P.O. Peshawar, Cantt. Pakistan	
Steve Harris Peace Corps CLSU, Munorg Neuva Ecija Philippines	
Dr. Alfonso Eusebid Livestock Research Director University of Philippines Los Banos, Philippines	No on-going research. Proposed projects in: 1. Breeding - artificial insemination 2. Grazing on coconut residues 3. Management/nutrition 4. Utilization of slaughter by-products
M. Fouad Al Rabbat Department of Animal Production University of Damascus Box 536 Damascus, Syria	
Dr. C. Madamba Animal Production and Health Commission for Asia, the Far East, and Southwest Pacific Phra Atit Road Bangkok, Thailand	
His Excellency Mr. J. Ozal, Minister Ministry of Food, Agriculture and Livestock Government of Turkey Ankara, Turkey	
Dr. Duzgnnes Department of Animal Husbandry University of Ankara Ankara, Turkey	

Chapter 5

Proposal Instructions

I. INTRODUCTION

A. Objectives

The proposal that you are being asked to prepare will be sent to the Research Triangle Institute (RTI). RTI has no funds or any authority to negotiate with universities to award contracts. We have been authorized by the Agency for International Development (AID), the BIFAD Board (Board for International Food and Agricultural Development), and the Joint Research Committee (JRC) to solicit proposals from universities and to arrange them in a research program that addresses the needs for small ruminant research in developing countries. Our recommendations will be reviewed by the JRC, BIFAD, and AID, which will then negotiate with universities.

A brief review of the objectives of the Title XII program is in order at this time. The Title XII program was designed to add an international dimension to programs in U.S. institutions that have a high performance potential as judged by commitment or willingness to become committed. That is, the intention of Congress was to utilize the research strengths of universities by applying these strengths to the food and agriculture problems found in developing countries. The ongoing university research with small ruminants should have local support and bear some relevance to research needs in developing countries. Besides sheep and goat programs already in existence, some related expertise also might be significant, such as feeding systems for cattle that could be modified for use with small ruminants.

Another point that needs to be emphasized at this time is that the proposed research must be collaborative in nature, linking institutions having common interests in programs of research on related problems. This will require that certain research must be carried out with and through institutions in developing countries in order that the results

will be directly applicable in these countries. The collaborating institutions might be ones with which American universities already have organizational links or these links might be established prior to or during the early stages of this program. Although the collaborating institutions in LDCs will be required to make in-kind contributions, the American universities must plan on providing some funds from their grants to these institutions in order to carry out specific international components of proposed research programs. For example, it may be necessary to provide funds to purchase a herd of animals, or to feed them, or to fence them, or to hire technicians to take care of them. In general, it is not expected that the salaries of professionals in the developing countries will be paid through this program, though the necessity might arise under certain circumstances.

B. Logistical Considerations

The proposals that are prepared must be received by the Research Triangle Institute by Tuesday, February 14, 1978. Proposals that are mailed will be accepted if they have a postmark not later than Friday, February 10, 1978. The proposals must be received by January 31 in order to maintain the schedule that calls for the review panel to convene about February 27. This time interval is just barely sufficient to send the proposals to the members of the review panel in time for them to read them before the February 27 meeting. No extensions will be granted for any university because all are operating under the same conditions.

A separate proposal should be written for each individual project that a university proposes. Universities or consortia that submit multiple projects must submit a separate proposal for each project, although a significant part of each project proposal might be the same. The proposals must not exceed eight typewritten, double spaced pages plus supporting documents. The supporting documents are a one-page cover that also contains an abstract, a one-page budget, and one-page resumes for each key individual, single-page abstracts of previous projects, and lists of publications done by institution personnel.

C. Scheduling and Funding

It is important to list the expected length of the project. The Title XII program will be authorized initially for five years. It is

quite legitimate for a research project to be planned for more than five years. For instance, a 10-year time frame might be necessary for projects that involve animal breeding. It is expected however, that some results will be forthcoming in less than five years in order that progress can be evaluated.

The small ruminants research program will likely not begin operations before the beginning of fiscal year 1979 (October 1, 1978). A substantial part of the first year might be given over to the establishment of firm institutional linkages with research institutions in developing countries and to an assessment of the actual problems that will be researched. That is, even though a specific project is proposed, an assessment may be necessary in order to obtain sufficient data and background information on institutional constraints in order to carry out a fruitful project.

The Title XII CRSP is a new program without a definite budget. Given its high priority, however, funding appropriate to the nature and dimension of the problem is contemplated. Program grants will cover expenses of all participating U.S. universities, U.S. subcontractors and activities in developing countries that are carried out to support the proposed research projects. It is unlikely that the limited funds will support full-scale research programs in all four of the ecozones that have been analyzed. Furthermore, it is unlikely that all the funds will be awarded to one university or even one existing consortium.

II. COVER SHEET AND ABSTRACT

The first page of the proposal is a cover sheet which contains the following items:

(1) the name of the U.S. eligible institutions (and U.S. sub-contractors if applicable) at which the research will be performed,

(2) the name of the project (a short title should be included if the full name exceeds one line);

(3) the foreign location at which the research will be performed,

(4) name of the collaborating foreign institution,

(5) the period of the project in years,

(6) the total annual budget with two categories: Title XII funds and other support,

(7) name of the principal investigator and other key personnel.

An abstract of not more than 200 words is required which states the significance of the topic, synopsizes the study plan, and predicts the expected results of the research. The abstract should receive a great deal of attention as it will provide basic orientation on the proposal.

III. NARRATIVE

The narrative is the main part of the proposal and may not exceed eight type written, double-spaced pages. The narrative should consist of five main categories:

(A) The Significance of the Topic,

(B) Research Plan

(C) The Application of Research Results,

(D) Personnel,

(E) Organizational Qualifications.

Each of these items will be elaborated upon in the following sections. Your proposal should follow this same format. The research plan should be the largest part of the narrative, followed by approximately equal length sections dealing with personnel and organizational qualifications. The significance of the topic and the application of research results should have shorter sections.

A. Significance of the Topic

The first section of the narrative should be a discussion of the significance of the research topic that is being proposed. The discussion should place the research topic in the overall framework of small ruminant production in the ecozones that are being proposed. The discussion should indicate the investigator's grasp of the subject and the way in which the research fits into the overall production system. That is, he must point out why the topic is a problem in the country and why the results are likely to be useful.

B. Research Plan

The research plan should include six sections. The first section should be a discussion or a listing of the objectives of the research. These objectives should be as specific as possible (not a vague statement such as "improvement of indigenous breeds of goats"). The second section which is optional, should be a justification and rationale for the approach selected in attacking the problem. The problem might be inadequate nutrition for the local sheep and goats during certain times

of the year. The approach taken could be the provision of additional feed through storage, the development of forage that will grow during dry seasons, or the development of sheep and goats that have the ability to withstand reduced levels of food intake. The particular approach should be justified.

The third item in the research plan is an outline of the research procedures and the timing of the procedures that will be followed. This section should be as detailed as is possible within the constraints of the available space. Vague plans will likely result in low ratings by the review panel.

The fourth item in the research plan is the anticipated collaboration with a foreign institution. The nature of the present or contemplated relationship should be discussed. The particular ecozone and region/country in which the research would be carried out is pertinent information to be included in a responsive proposal. However, it may be subsequently determined that a different location(s) should be considered.

The fifth item is a description of any activities that might be carried out by a U.S. subcontractor (non-eligible institution).

The sixth item is a description of how the project and its performance fits into an overall consortium program (if one exists). That is, what will be the linkages among the member institutions of a consortium in terms of administrative controls and technical supervision?

C. Application of Research Results

The third major section of the narrative will be a discussion of how the results of the research could be implemented in developing countries. That is, it must be necessary to demonstrate that the results could be applied even though the researcher would not be the implementing agency and is not going to develop a detailed implementation plan. This discussion should take into account the total production system in existence in the countries that are relevant to the research that is being proposed. For example, a research project to improve the productivity of indigenous sheep and goats must indicate how the superior animals that are developed could be used to upgrade the large numbers of sheep and goats that exist now and are owned by large

numbers of poor and isolated farmers. Such a project must also discuss how the superior animals would fare on a diet of inadequate nutrients during long periods of time during the year and how they would respond to existing health and disease problems.

D. Personnel and Expertise

This section of the proposal, which deals with the principal investigator and other personnel, will be very important in the ratings of the proposals made by the review panel. The ability of the principal investigator(s) is an important consideration in the selection of projects. This ability should be demonstrated through previous performance in research areas directly relevant to small ruminants. The purpose of Title XII is to build upon performance potential in small ruminants that exists in the United States and to extend this expertise to foreign areas.

The personnel section of the proposal should be done in two parts. The first part will contain a discussion of the principal investigator and other key personnel. The second section will deal with other project personnel, some of whom might be hired. The section on principal investigators and other key personnel should discuss their expertise in the context of sheep and goat research. That is, their experience and ability in small ruminant research and in areas that are directly relevant to small ruminants is the major consideration. The other item that should be handled in the paragraphs on the principal investigator and other key personnel is their expected involvement in the proposed project. This involvement should include their role in the project and the amount of time that they will devote to the project over the total duration of the project.

The other section under personnel should be a short discussion of the other project personnel who would be hired, in part because of the project. Such a research effort often requires institutions to expand their staff by hiring people who would not otherwise be needed. Because there is no prohibition against this type of action, the institution should discuss the number and type of persons who would be hired if the project were selected and the fraction of their time that would be devoted to this particular project. Their role in the project also would have to be discussed in some detail.

E. Organizational Qualifications

The first item to be handled under organizational qualifications is the American institution's experience and expertise in research relevant to sheep and goats. It is likely that most of this experience will have been in the United States, though perhaps some will have been in other countries as well. The research need not have been directly on sheep and goats so long as it is relevant to sheep and goats. Although exact definitions cannot be made of what is relevant to sheep and goats and what is not, the members of the review panel probably will have no difficulty in evaluating the relevance of such experience. As mentioned below, the intention of the Title XII program is to utilize the present and future expertise in eligible universities and other U.S. institutions for the benefit of developing countries; the intention is not simply to develop new centers of excellence in the United States.

The second item that needs to be covered under organizational qualifications is a discussion of relevant publications by members of the institution. Both the numbers and types of publications should be listed. The titles should be listed in a separate appendix rather than in the body of the narrative. For example, one could divide publications into published books, articles appearing in referreed journals, experiment station bulletins, articles in trade journals and popular magazines, speeches, and so forth. Naturally, added weight will be given to publications that have survived a rigorous review process by peers.

The third item to be covered under organizational qualifications is the administrative plan for collaboration between the U.S. institution and the foreign research institution(s) that would carry out the research. The present status of the relationship with the proposed foreign institution should be discussed if one exists. Plans and expectations for such a relationship should be discussed insofar as it is possible. The sharing of administrative responsibilities and technical responsibilities should be outlined. RTI and AID strongly urge the responding universities to avoid any actions that would raise false hopes and expectations inimical to successful completion of this planning effort. Proposals from universities without existing institutional linkages will receive

the fullest consideration on their own merits. There will later be an opportunity to establish or finalize linkages, either during the development of a detailed program proposal or possibly during the early stages of implementation of the program.

IV. BUDGET

The proposed budget for the project should be contained on a single page. The columns of the budget should give the expected expenses for each fiscal year starting with FY 79 and extending through FY 83 (if the project requires that much time). For each year and each item, the amount of funds from AID (Title XII), collaborative support from the university, and from other sources should be listed separately.

The categories of expenses should consist of international travel (specify only destinations and total costs), subcontracts with the foreign institutions(s) including any equipment and supplies destined for them (total amount only), subcontracts with non-eligible U.S. institutions, and other costs in the United States (total amount only). Although U.S. costs need not be separated into labor, travel, supplies, equipment, etc., it is necessary to list the amount of time (in fractions of person years) for each scientist named in the proposal and for each of the professionals (by type) that would be hired as a result of the Title XII CRSP.

A summary row should specify the amount of AID funds required and those funds that are to be provided by the university. Be aware that Title XII projects can include programs that are being reoriented toward the international area.

No overhead charges are permitted because this is a collaborative program.

V. APPENDICES

Three appendices may be included with the resumes. The first appendix should include one-page resumes for the principal investigator and other key technical personnel who would participate in the project. Because each resume will be limited to one page, special attention should be devoted to including publications that appeared in referreed journals in the last five years. Such publications are likely to carry the most weight with the review panel.

The second appendix, which is optional, can consist of one page abstracts of previous projects and ongoing research that are relevant to the proposed project. Each abstract may be one page and should include the subject, the sponsor, the period of performance, the approach, the principal findings, and the key personnel involved in the project.

The third appendix should be a list of publications that have been done by personnel at the institution proposing the project. The emphasis is on recent publications that are relevant to sheep and goat research and which appeared in locations with some professional status. However, there is no limit on the number of items that can appear in this appendix. Only the author, title, source and page numbers (if a journal), and the date (and volume number) should be given. Arrangement of these publications in a logical order by topic, type or time period will be of assistance to the review panel. They are unlikely to be influenced by a very long list which consists primarily of publications with little professional prestige and little relevance to sheep and goat research.

VI. REVIEW CRITERIA

The review panel will not be held to a strictly quantitative basis for evaluating projects. Guidelines will be supplied to the reviewers for their use in reviewing the individual projects. When the review panel meets, however, the discussions that occur will lead to an overall evaluation of each project. A number of criteria are listed below in no particular order.

A. Does the proposal as a whole constitute an integrated systems approach, embracing biological, environmental, social science and engineering aspects?

B. Is the proposal likely to lead to substantial improvement in the well being of small holders and urban poor by increasing the quantity, quality, and availability of sheep and goat products on a sustained basis within 10 years from this date?

C. Is the proposal likely to result in conservation of grazing lands and their sustained productivity? This criteria need not be applied to all projects, because there are some sheep and goat production systems that do not make use of grazing lands.

D. Is the proposal relevant to and compatible with general development policies and objectives of target regions?

E. Are there established linkages among the proposed U.S. participating institutions and between such institutions and scientists in proposed target countries?

F. How impressive is the expertise of the principal investigator and the other key personnel? Are the listed personnel going to participate in the project to a significant degree?

G. Does the institution have previous experience that is relevant in the context of sheep and goat research?

H. Is the research plan a well designed, professional approach to solving the problem? Is it based on facts about production systems in the target area and the constraints on sheep and goat production within the area?

I. What is the probability of success in the research plan and will the results be applicable to the target countries?

J. Is there a critical need for the research project that has been proposed? Has the proposer demonstrated that he is familiar with the literature and has not overlooked previous research that has already treated this subject?

K. Is there an opportunity for innovative approaches in the conduct of the research? Is the research plan so inflexible that it cannot be changed when conditions dictate?

L. Is the AID (Title XII) component an addition to or reorientation of an ongoing university research program?

VII. REVIEW PROCEDURES

When the proposals are received at Research Triangle Institute, not later than February 14, 1978, RTI will duplicate all the proposals and send them to the members of the review panel. The composition of the review panel was discussed in the cover letter that went out in October to all eligible institutions, along with the Winrock state-of-the-art report. The review panel will include representatives of United States, developing country, and international institutions who are familiar with the problems of sheep and goats in developing countries. The foreign members of the review panel will arrive early in order to read the proposals before meeting with the full panel.

The total review panel will assemble approximately February 27, and review all the projects. After the review session RTI staff members may visit some or all of the foreign institutions that were proposed in the high ranking projects. They will probably also visit all or some of the American universities that sponsored the projects in order to discuss possible administrative arrangements. Upon their return, the RTI staff members will assemble from the recommended projects a research program that is integrated and attacks problems in a comprehensive manner. They also will recommend an administrative entity for carrying out the research.

The recommended research program will be submitted to AID and the Joint Research Committee (JRC) in early April. The JRC will then review the entire program and also may review the original project proposals. The JRC may make modifications and changes in the recommended research program. Their recommendations will be submitted to the Board for International Food and Agricultural Development (BIFAD) for review. BIFAD will then make their recommendations to AID. AID will then accept, reject, or modify the program as put forth. AID then will negotiate with the individual institutions and the proposed administrative entity in the development and implementation of a small ruminants program.

Appendix A

Tables of Individual Country Data on Sheep and Goats

Table A1. Country Background Data

	Total population[1] (thousands)	GNP per[2] capita	Calories[3] per capita	Total[4] protein per capita	Animal[5] protein per capita	Percent[6] protein from animal	Total[7] land	Crop[8] land	Permanent[9] pasture	Total[10] arable land	Arable[11] land as percent of total land
NORTHWESTERN AFRICA	412,905		2 212	56.3	11.4	20.2	2,964,616	210,890	798,105	1,008,995	34.0
Algeria	17,346	295	2,121	57.1	11.7	20.5	238,174	7,050	38,452	45,502	19.1
Cameroon	6,571	179	2,373	59.3	11.5	19.4	46,944	7,345	8,300	15,645	33.3
Central African Republic	1,829	119	2,300	44.7	9.1	20.4	62,298	5,910	100	6,010	9.6
Chad	4,016	70	1,781	60.2	12.6	20.9	125,920	7,000	45,000	52,000	41.3
Dahomey (Benin)	3,160	76	2,007	51.0	9.2	18.0	11,062	2,950	442	3,392	30.7
Equatorial Guinea	319	253	--	--	--	--	2,805	230	104	334	11.9
Gambia	520	101	2,334	58.5	12.3	21.0	1,000	260	340	600	60.0
Ghana	10,161	236	2,317	53.4	15.8	29.6	23,002	2,700	10,700	13,400	58.3
Guinn Bissau	534	247	2,352	49.0	10.2	20.8	2,800	285	1,280	1,565	55.9
Guinea	4,527	79	1,943	42.7	4.2	9.8	24,586	4,170	3,000	7,170	29.2
Ivory Coast	5,014	324	2,654	64.5	20.5	31.8	31,800	9,120	8,000	17,120	53.8
Liberia	1,750	189	2,013	36.0	9.1	25.3	9,632	380	240	620	6.4
Libyan Arab Republic	2,325	1,412	2,765	70.1	20.8	29.7	175,954	2,544	6,800	9,344	5.3
Mali	5,842	53	1,774	52.8	9.7	18.4	122,000	11,720	30,000	41,720	34.2
Mauritania	1,310	136	1,891	61.9	29.7	48.0	103,040	1,005	39,250	40,255	39.1
Morocco	16,038	221	2,614	70.5	10.3	14.6	44,630	7,630	12,500	20,130	45.1
Niger	4,732	81	1,827	62.0	8.5	13.7	126,670	15,000	3,000	18,000	14.2
Nigeria	64,887	130	2,084	46.4	4.5	9.7	91,077	23,750	20,750	44,500	48.9
Reunion	511	769	2,539	68.2	31.3	45.9	251	61	8	69	27.5
Senegal	4,526	219	2,309	67.1	19.0	28.3	19,200	2,400	5,700	8,100	42.2
Sierra Leone	3,059	150	2,224	50.9	11.5	22.6	7,162	4,094	2,204	6,298	87.9
Togo	2,312	125	2,198	52.1	7.4	14.2	5,360	2,285	200	2,485	46.4
Tunisia	5,893	260	2,096	67.4	15.2	22.6	15,536	4,360	3,250	7,610	49.0
Upper Volta	6,173	62	1,859	59.2	3.3	5.6	27,380	5,613	13,755	19,368	70.7
SOUTHERN AFRICA	--	--	--	--	--	--	--	--	--	--	--
Angola	6,561	264	2,021	42.2	11.4	27.0	124,670	1,830	29,000	30,830	24.7
Botswana	709	132	1,976	67.5	22.9	33.9	58,537	512	41,100	41,612	71.1

Table A1 (Con.)

	Total population (thousands)	GNP per capita	Calories per capita	Total protein per capita	Animal protein per capita	Percent protein from animal	Total land	Crop land	Permanent pasture	Total arable land	Arable land as percent of total land
SOUTHERN AFRICA (con.)											
Burundi	3,863	60	2,308	60.5	4.6	7.6	2,565	1,255	435	1,690	65.9
Congo	1,380	213	2,179	38.6	11.4	29.5	34,150	652	14,300	14,952	43.8
Gabon	526	468	2,301	49.7	26.9	54.1	25,767	155	4,800	4,955	19.2
Kenya	13,701	127	2,114	59.8	11.5	19.2	56,925	1,765	3,780	5,545	9.7
Lesotho	1,173	91	2,288	70.4	11.0	15.6	3,035	355	2,500	2,855	94.1
Madagascar	8,263	127	2,386	56.5	12.9	22.8	58,154	2,860	6,800	9,660	16.6
Malawi	5,035	66	2,397	68.4	6.4	9.4	9,408	2,278	1,840	4,118	43.8
Mauritius	914	223	2,458	55.8	17.9	32.1	185	106	7	113	61.1
Mozambique	9,461	216	1,975	37.2	4.8	12.9	76,553	3,880	44,000	47,880	62.5
Namibia	909	--	2,122	69.9	32.7	56.8	82,329	653	52,906	53,559	65.1
Rwanda	4,362	54	2,086	51.3	3.0	5.8	2,506	920	596	1,516	60.5
Rhodesia	6,493	258	2,593	74.6	17.0	22.8	38,767	2,480	4,856	7,336	18.9
South Africa	25,375	662	2,887	78.0	30.2	38.7	122,104	14,500	81,800	96,300	78.9
Swaziland	483	212	2,068	55.6	21.9	39.4	1,720	168	1,310	1,478	85.9
Tanzania	15,872	94	2,002	47.1	13.6	28.9	88,604	6,070	44,760	50,830	57.4
Uganda	11,701	127	2,096	54.0	12.2	22.6	19,971	5,251	5,000	10,251	51.3
Zaire	25,098	76	1,884	32.0	7.8	24.4	226,760	7,820	24,803	32,623	14.4
Zambia	5,167	365	2,052	58.8	15.0	25.5	74,072	5,000	30,000	35,000	47.3
NORTHEASTERN AFRICA	--	--	--	--	--	--	--	--	--	--	--
Egypt	38,429	202	2,634	70.7	10.3	14.6	99,545	2,862	--	2,862	2.9
Ethiopia	28,854	68	1,912	58.7	9.1	15.5	110,100	13,730	64,800	78,530	71.3
Somalia	3,258	87	1,822	55.1	22.4	40.7	62,734	1,055	28,850	29,905	47.7
Sudan	18,850	109	2,071	60.5	19.9	32.9	237,600	7,495	24,000	31,495	13.3

Table A1 (Con.)

	Total population (thousands)	GNP per capita	Calories per capita	Total protein per capita	Animal protein per capita	Percent protein from animal	Total land	Crop land	Permanent pasture	Total arable land	Arable land as percent of total land
NEAR OR MIDDLE EAST	--	--	--	--	--	--	--	--	--	--	--
Bahrain	--	888	--	--	--	--	62	2	4	6	9.7
Cyprus	681	873	2,804	86.1	38.1	44.3	924	432	93	525	56.8
Iraq	11,453	309	2,433	60.4	16.3	27.0	43,397	5,290	4,000	9,290	21.4
Israel	--	--	--	--	--	--	--	--	--	--	--
Jordan	2,779	261	2,213	52.9	12.1	22.9	9,718	1,360	100	1,460	15.0
Kuwait	1,154	2,814	--	--	--	--	1,782	1	134	135	7.6
Lebanon	2,959	589	2,517	67.9	17.8	26.2	1,023	348	10	358	35.0
Qatar	--	1,837	--	--	--	--	1,100	2	50	52	4.7
Saudi Arabia	9,238	495	2,476	63.1	14.5	23.0	214,969	805	85,000	85,805	39.9
Syria Arab Republic	7,490	259	2,580	66.0	14.7	22.3	18,420	5,476	8,631	14,107	76.6
Turkey	40,908	350	2,848	75.7	19.1	25.2	77,076	28,286	27,550	55,836	72.4
Yemen Arab Republic	6,868	77	1,976	58.3	8.7	14.9	19,000	1,570	7,000	8,570	45.1
Yemen Dem.	1,710	92	2,037	50.3	14.3	28.4	28,768	170	9,065	9,235	32.1
SOUTHWESTERN ASIA	--	--	--	--	--	--	--	--	--	--	--
Afghanistan	19,796	83	2,022	62.1	6.9	11.1	64,750	8,500	5,950	14,450	22.3
Iran	33,957	352	2,367	55.7	12.1	21.7	163,600	16,490	11,000	27,490	16.8
Pakistan	72,859	163	2,132	57.5	12.8	22.3	77,872	19,450	5,000	24,450	31.4
SOUTHERN ASIA	--	--	--	--	--	--	--	--	--	--	--
Bangladesh	75,529	59	2,023	45.2	6.6	14.6	13,391	9,512	600	10,112	75.5
India	628,608	94	1,971	48.1	5.5	11.4	296,608	167,200	12,550	179,750	60.6
Nepal	12,877	73	2,093	51.1	7.5	14.7	13,800	2,000	2,000	4,000	29.0
Sri Lanka	14,282	166	2,018	41.0	6.9	16.8	6,474	1,979	439	2,418	37.3

Table A1 (Con.)

	Total population (thousands)	GNP per capita	Calories per capita	Total protein per capita	Animal protein per capita	Percent protein from animal	Total land	Crop land	Permanent pasture	Total arable land	Arable land as percent of total land
EASTERN ASIA	--	--	--	--	--	--	--	--	--	--	--
Burma	31,992	73	2,214	57.9	9.4	16.2	65,888	10,400	362	10,762	16.3
Hong Kong & Macao	4,283	747	2,574	76.9	43.7	56.8	105	11	1	12	11.4
Indonesia	139,635	70	2,128	43.9	5.6	12.8	181,135	18,600	9,875	28,475	15.7
Khmer Republic	--	--	--	--	--	--	--	--	--	--	--
Laos	3,381	71	2,075	56.3	9.4	16.7	23,080	960	10	970	4.2
Malaysia	10,393	345	2,203	45.4	8.5	18.7	13,159	2,935	30	2,965	22.5
Singapore	2,284	870	2,839	74.5	38.0	51.0	57	8	0	8	14.0
Thailand	43,490	167	2,360	50.0	13.3	26.6	51,177	16,580	308	16,888	33.0
Vietnam	44,412	--	2,267	56.9	14.5	25.5	32,836	5,570	4,870	10,440	31.8
Philippines	45,920	164	1,963	46.1	17.4	37.7	29,817	7,899	656	8,555	28.7
NORTHERN ASIA	--	--	--	--	--	--	--	--	--	--	--
Japan	--	--	--	--	--	--	--	--	--	--	--
Korea Republic	35,340	250	2,715	72.7	15.6	21.5	9,819	2,418	18	2,436	24.8
Korea DPR	16,256	--	2,665	79.0	13.6	17.2	12,041	2,150	50	2,200	18.3
CENTRAL AMERICA	--	--	--	--	--	--	--	--	--	--	--
Costa Rica	2,014	525	2,535	61.0	26.3	43.1	5,066	507	1,558	2,065	40.8
Cuba	9,682	--	2,712	70.0	31.4	44.9	11,452	3,110	2,720	5,830	50.9
Dominican Republic	5,291	334	2,212	45.5	15.6	34.3	4,838	995	1,460	2,455	50.7
El Salvador	4,239	281	1,912	50.4	14.8	29.4	2,107	651	670	1,321	62.7
Guatemala	6,312	320	1,994	52.8	12.6	23.9	10.789	1,735	890	2,625	24.3
Haiti	4,626	94	2,026	48.6	7.0	14.4	2,756	860	655	1,515	55.0
Honduras	3,143	266	2,041	51.8	14.0	27.0	11,189	885	2,000	2,885	25.8
Jamaica	2,058	641	2,663	68.2	29.1	42.7	1,080	260	215	475	44.0
Mexico	61,196	632	2,725	67.0	19.1	28.5	197,255	28,000	67,000	95,000	48.2

Table A1 (Con.)

	Total population (thousands)	GNP per capita	Calories per capita	Total protein per capita	Animal protein per capita	Percent protein from animal	Total land	Crop land	Permanent pasture	Total arable land	Arable land as percent of total land
CENTRAL AMERICA (con.)											
Nicaragua	2,396	393	2,387	68.1	25.4	37.3	12,100	965	1,850	2,815	23.3
Panama	1,725	646	2,419	58.8	27.9	47.4	7,505	560	1,150	1,710	22.8
Puerto Rico	2,936	1,738	--	--	--	--	886	145	334	479	54.1
NORTHERN SOUTH AMERICA	--	--	--	--	--	--	--	--	--	--	--
Bolivia	5,551	175	1,849	48.4	13.1	27.1	108,547	3,284	27,200	30,484	28.1
Brazil	112,890	468	2,515	62.2	21.3	34.2	845,651	36,600	170,000	206,600	24.4
Columbia	26,713	310	2,182	47.1	21.2	45.0	103,870	5,130	17,350	22,480	21.6
Ecuador	7,319	250	2,123	47.4	17.9	37.8	27,684	4,325	2,200	6,525	23.6
Guyana	808	323	2,350	57.0	22.7	39.8	19,685	379	999	1,378	7.0
Peru	15,777	302	2,359	61.7	22.0	35.7	128,000	3,230	27,120	30,350	23.7
Surinam	434	650	2,376	52.2	20.1	38.5	16,147	45	10	55	0.3
Venezuela	12,575	932	2,422	98.5	61.6	62.5	88,205	5,317	16,768	22,085	25.0
SOUTHERN SOUTH AMERICA	--	--	--	--	--	--	--	--	--	--	--
Argentina	25,719	984	3,406	107.3	67.2	62.6	274,669	34,550	143,700	178,250	64.9
Chile	10,441	659	2,825	78.3	29.4	37.5	74,880	5,792	11,700	17,492	23.4
Paraguay	2,724	239	2,714	75.1	29.8	39.7	39,730	1,000	15,000	16,000	40.3
Uruguay	3,139	809	3,070	98.5	61.6	62.5	17,491	1,870	13,570	15,440	88.3

Sources:

1/ FAO Production Yearbook Volume 30, 1976. Table 3.

2/ United Nations. 1976 Statistical Yearbook, ST/ESA/STAT/SER/4. NY, 1977. Table 191.

3/ FAO Production Yearbook, Volume 30, 1976. Table 97.

4/ FAO Production Yearbook, Volume 30, 1976. Table 98.

5/ FAO Production Yearbook, Volume 30, 1976. Table 98.

6/ Calculated from (4) and (5) above.

7/ FAO Production Yearbook, Volume 30, 1976. Table 1.

8/ FAO Production Yearbook, Volume 30, 1976. Table 1.

9/ FAO Production Yearbook, Volume 30, 1976. Table 1.

10/ Addition of (8) and (9) above.

11/ Calculated from (7) and (10) above.

Table A2. Contribution of Small Ruminants to the Food Supply

	Total[1] population 1976 (000's)	# of[2] sheep & goats 1976 (000's)	Sheep[3] & goats per capita	# of[4] cows & water buffalos (000's)	Cows &[5] water buffalos in sheep & goat equiv-alents	Total[6] # of rumi-nants in sheep & goat equiv-alents	Sheep[7] & goats as % of rumi-nant total	Sheep[8] & goat meat pro-duction (metric tons 000's)	Total[9] meat pro-duction (metric tons 000's)	Sheep[10] & goat meat % of total	Sheep[11] & goat milk pro-duction	Total[12] milk pro-duction	Sheep[13] & goat milk % of total
NORTHWESTERN AFRICA	412,905	286,200	.693	162,851	1,302,808	1,589,008	18.0	1101	5,277	20.9	1,762	12,371	14.2
Algeria	17,346	11,286	.651	1,281	10,248	21,534	52.4	55	128	43.0	262	642	40.8
Cameroon	6,571	3,738	.569	2,655	21,240	24,978	15.0	15	82	18.3	--	56	0.0
Central African Republic	1,829	642	.351	610	4,880	5,522	11.6	1	35	2.9	--	3	0.0
Chad	4,016	4,848	1.207	3,658	29,264	34,112	14.2	18	50	36.0	54	174	31.0
Dahomey (Benin)	3,160	1,690	.535	800	6,400	8,090	20.9	5	28	17.9	4	16	25.0
Equatorial Guinea	319	38	.119	4,750	38,000	38,038	0.1	--	406	0.0	--	--	0.0
Gambia	520	189	.364	310	2,480	2,669	7.1	1	7	14.3	--	5	0.0
Ghana	10,161	3,800	.374	1,100	8,800	12,600	30.2	10	93	10.8	--	8	0.0
Guinn Bissau	534	250	.468	258	2,064	2,315	10.8	1	7	14.3	1	9	11.1
Guinea	4,527	805	.178	1,550	12,400	13,205	6.1	2	22	9.1	4	40	10.0
Ivory Coast	5,014	2,000	.399	600	4,800	6,800	29.4	5	98	5.1	--	5	0.0
Liberia	1,750	351	.201	35	280	631	55.6	1	12	8.3	2	3	66.7
Libyan Arab Republic	2,325	4,485	1.929	123	984	5,469	82.0	19	53	35.8	44	59	74.6
Mali	5,842	8,148	1.395	4,080	32,640	40,786	20.0	30	68	44.1	46	114	40.4
Mauritania	1,310	5,600	4.275	2,000	16,000	21,600	25.9	13	29	44.8	97	166	58.4
Morocco	18,038	24,000	1.331	3,400	27,200	51,200	46.9	75	214	35.0	41	538	7.6
Niger	4,732	7,400	1.564	2,700	21,600	29,000	25.5	21	47	44.7	117	174	67.2
Nigeria	64,887	30,900	.476	11,300	90,400	121,300	25.5	103	475	21.7	--	316	0.0
Reunion	511	42	.082	21	168	210	20.0	--	8	0.0	--	7	0.0
Senegal	4,526	2,613	.577	2,380	19,040	21,653	12.1	7	62	11.3	16	110	14.5
Sierra Leone	3,059	247	.081	305	2,440	2,687	9.2	1	12	8.3	--	7	0.0
Togo	2,312	1,380	.597	235	1,880	3,260	42.3	3	17	17.6	--	3	0.0
Tunisia	5,893	4,426	.751	880	7,040	11,466	38.6	38	95	40.0	47	238	19.7
Upper Volta	6,173	3,600	.583	1,900	15,200	18,800	19.1	13	37	35.1	17	58	29.3

Table A2 (con.)

	Total population 1976 (000's)	# of sheep & goats 1976 (000's)	Sheep & goats per capita	# of cows & water buffalos (000's)	Cows & water buffalos in sheep & goat equiv-alents	Total # of rumi-nants in sheep & goat equiv-alents	Sheep & goats as % of rumi-nant total	Sheep & goat meat pro-duction (metric tons 000's)	Total meat pro-duction (metric tons 000's)	Sheep & goat meat % of total	Sheep & goat milk pro-duction	Total milk pro-duction	Sheep & goat milk % of total
SOUTHERN AFRICA													
Angola	6,561	1,110	.169	3,000	24,000	25,110	4.4	3	75	4.0	--	140	0.0
Botswana	709	1,475	2.080	2,200	17,600	19,075	7.7	5	41	12.2	3	78	3.8
Burundi	3,863	964	.250	800	6,400	7,364	13.1	3	19	15.8	6	56	10.7
Congo	1,380	153	.111	50	400	553	27.7	--	9	0.0	--	--	0.0
Gabon	526	123	.234	5	40	163	75.5	--	22	0.0	--	--	0.0
Kenya	13,701	7,711	.563	7,500	60,000	67,711	11.4	23	178	12.9	39	802	4.9
Lesotho	1,173	2,555	2.178	580	4,640	7,195	35.5	5	22	22.7	--	17	0.0
Madagascar	8,263	2,000	.242	9,842	78,736	80,736	2.5	5	189	2.6	--	29	0.0
Malawi	5,035	827	.164	700	5,600	6,427	12.9	3	28	10.7	--	29	0.0
Mauritius	914	70	.077	53	424	494	14.2	--	5	0.0	--	22	0.0
Mozambique	9,461	702	.074	1,420	11,360	12,062	5.8	3	67	4.5	13	73	17.8
Namibia	909	7,000	7.701	2,850	22,800	29,800	23.5	24	55	43.6	--	65	0.0
Rwanda	4,362	822	.188	717	5,736	6,558	12.5	2	21	9.5	9	31	29.0
Rhodesia	6,493	2,820	.434	6,100	48,800	51,620	5.5	10	183	5.5	--	255	0.0
South Africa	25,375	36,201	1.427	12,700	101,600	137,801	26.3	167	855	19.5	--	2,560	0.0
Swaziland	483	295	.611	620	4,960	5,255	5.6	3	18	16.7	--	33	0.0
Tanzania	15,872	7,502	.473	14,362	114,896	122,398	6.1	29	181	16.0	46	724	6.4
Uganda	11,701	3,250	.278	4,900	39,200	42,450	7.7	13	114	11.4	13	340	3.8
Zaire	25,098	2,967	.118	1,144	9,152	12,119	24.5	9	189	4.8	--	27	0.0
Zambia	5,167	333	.064	2,300	18,400	18,733	1.8	1	70	1.4	--	50	0.0

Table A2 (con.)

	Total population 1976 (000's)	# of sheep & goats 1976 (000's)	Sheep & goats per capita	# of cows & water buffalos (000's)	Cows & water buffalos in sheep & goat equivalents	Total # of ruminants in sheep & goat equivalents	Sheep & goats as % of ruminant total	Sheep & goat meat production (metric tons 000's)	Total meat production (metric tons 000's)	Sheep & goat meat % of total	Sheep & goat milk production	Total milk production	Sheep & goat milk % of total
NORTHEASTERN AFRICA													
Egypt	38,429	3,372	.088	4,750	38,000	41,372	8.2	48	406	11.8	27	1,892	1.4
Ethiopia	28,854	40,129	1.391	25,963	207,704	247,833	16.2	131	409	32.0	98	629	15.6
Somalia	3,258	15,000	4.604	2,600	20,800	35,800	41.9	57	92	62.0	217	346	62.7
Sudan	18,850	25,367	1.346	15,395	123,160	148,527	17.1	117	340	34.4	480	1,346	35.7
NEAR OR MIDDLE EAST													
Bahrain	--	12	--	5	40	62	19.4	--	3	0.0	--	6	0.0
Cyprus	681	740	1.087	33	264	1,004	73.7	9	35	25.7	44	67	65.7
Iraq	11,453	10,984	.959	2,256	18,048	29,032	37.8	52	142	36.6	412	704	58.5
Israel	--	--	--	--	--	--	0.0	--	--	0.0	--	--	0.0
Jordan	2,779	1,292	.465	35	280	1,572	82.2	7	19	36.8	37	46	80.4
Kuwait	1,154	197	.171	9	72	269	73.2	1	19	5.3	10	21	47.6
Lebanon	2,959	564	.191	84	672	1,236	45.6	7	45	15.6	29	97	29.9
Qatar	--	87	--	6	48	135	64.4	1	3	33.3	11	16	68.8
Saudi Arabia	9,238	2,158	.234	180	1,440	3,598	60.0	9	79	11.4	96	129	74.4
Syria Arab Republic	7,490	6,950	.927	557	4,456	11,406	60.9	60	94	63.8	305	575	53.0
Turkey	40,908	60,130	1.469	14,802	118,416	178,546	33.7	386	778	49.6	1,718	4,916	34.9
Yemen Arab Republic	6,868	10,600	1.543	102	816	11,416	92.6	49	66	74.2	177	477	37.1
Yemen Dem.	1,710	2,160	1.263	102	816	2,976	72.6	9	15	60.0	33	40	17.5

Table A2 (con.)

	Total population 1976 (000's)	# of sheep & goats 1976 (000's)	Sheep & goats per capita	# of cows & water buffalos (000's)	Cows & water buffalos in sheep & goat equivalents	Total # of ruminants in sheep & goat equivalents	Sheep & goats as % of ruminant total	Sheep & goat meat production (metric tons 000's)	Total meat production (metric tons 000's)	Sheep & goat meat % of total	Sheep & goat milk production	Total milk production	Sheep & goat milk % of total
SOUTHWESTERN ASIA													
Afghanistan	19,796	20,350	1.027	3,713	29,704	50,054	40.7	115	182	63.2	262	596	44.0
Iran	33,957	49,600	1.460	6,780	54,240	103,840	47.8	219	498	44.0	839	2,123	39.5
Pakistan	72,859	23,295	.185	24,403	195,224	218,519	10.7	91	331	27.5	853	5,893	14.5
SOUTHERN ASIA													
Bangladesh	75,529	13,549	.179	28,721	229,768	243,317	5.6	53	253	20.9	576	1,419	40.6
India	628,608	110,581	.175	241,415	1,931,320	2,041,901	5.4	383	829	46.2	699	25,446	2.7
Nepal	12,877	4,683	.363	10,583	84,664	89,347	5.2	16	65	24.6	30	693	4.3
Sri Lanka	14,282	592	.041	2,599	20,792	21,384	2.8	1	35	2.9	5	196	2.6
EASTERN ASIA													
Burma	31,992	730	.023	9,000	72,000	72,730	1.0	3	169	1.8	5	401	1.2
Hong Kong & Macao	4,283	--	--	11	88	88	0.0	--	189	0.0	--	5	0.0
Indonesia	139,635	10,670	.076	9,551	76,408	87,078	12.3	39	391	10.0	--	43	0.0
Khmer Republic	--	--	--	--	--	--	0.0	--	--	0.0	--	--	0.0
Laos	3,381	38	.011	1,667	13,336	13,374	0.3	--	54	0.0	--	6	0.0
Malaysia	10,393	379	.036	593	4,744	5,123	7.4	1	124	0.8	--	17	0.0
Singapore	2,284	2	.001	12	96	98	2.0	--	63	0.0	--	1	0.0
Thailand	43,490	84	.002	9,675	77,400	77,484	0.1	1	441	0.1	--	10	0.0
Vietnam	44,412	50	.001	102	816	866	5.8	--	589	0.0	--	43	0.0
Philippines	45,920	1,402	.031	7,323	58,584	59,986	2.3	6	642	0.9	--	31	0.0

Table A2 (con.)

	Total population 1976 (000's)	# of sheep & goats 1976 (000's)	Sheep & goats per capita	# of cows & water buffalos (000's)	Cows & water buffalos in sheep & goat equivalents	Total # of ruminants in sheep & goat equivalents	Sheep & goats as % of ruminant total	Sheep & goat meat production (metric tons 000's)	Total meat production (metric tons 000's)	Sheep & goat meat % of total	Sheep & goat milk production	Total milk production	Sheep & goat milk % of total
NORTHERN ASIA													
Japan	--	--	--	--	--	--	0.0	--	--	0.0	--	--	0.0
Korea Republic	35,340	256	.007	1,641	13,128	13,384	1.9	1	254	0.4	6	128	4.7
Korea DPR	16,256	467	.029	816	6,528	6,995	6.7	2	117	1.7	--	28	0.0
CENTRAL AMERICA													
Costa Rica	2,014	3	.001	1,894	15,152	15,155	0.1	--	77	0.0	--	270	0.0
Cuba	9,682	432	.045	5,500	44,000	44,432	1.0	2	272	0.7	--	625	0.0
Dominican Republic	5,291	406	.077	1,950	15,600	16,006	2.5	--	94	0.0	--	293	100.0
El Salvador	4,239	15	.004	1,109	8,872	8,887	0.2	--	49	0.0	--	186	0.0
Guatemala	6,312	596	.094	2,270	18,160	18,756	3.2	3	106	2.8	--	320	0.0
Haiti	4,626	1,465	.317	747	5,976	7,441	19.7	5	54	0.0	25	66	62.1
Honduras	3,143	63	.020	1,800	14,400	14,463	0.4	--	62	0.0	--	187	0.0
Jamaica	2,058	335	.163	280	2,240	2,575	13.0	1	45	9.3	--	54	100.0
Mexico	61,196	14,100	.230	28,700	229,600	243,700	5.8	28	1,349	2.1	204	4,164	4.9
Nicaragua	2,396	8	.003	2,600	20,800	20,808	0.1	--	84	0.0	--	225	0.0
Panama	1,725	6	.003	1,361	10,888	10,894	0.1	--	60	0.0	--	74	0.0
Puerto Rico	2,936	26	.009	562	4,496	4,522	0.6	--	57	0.0	--	418	100.0
NORTHERN SOUTH AMERICA													
Bolivia	5,551	10,615	1.912	2,926	23,408	34,023	31.2	22	139	15.8	38	73	47.9
Brazil	112,890	41,300	.366	94,972	759,776	801,076	5.2	65	3,547	1.8	101	10,768	99.1

Table A2 (con.)

	Total population 1976 (000's)	# of sheep & goats 1976 (000's)	Sheep & goats per capita	# of cows & water buffalos (000's)	Cows & water buffalos in sheep & goat equivalents	Total # of ruminants in sheep & goat equivalents	Sheep & goats as % of ruminant total	Sheep & goat meat production (metric tons 000's)	Total meat production (metric tons 000's)	Sheep & goat meat % of total	Sheep & goat milk production	Total milk production	Sheep & goat milk % of total
NORTHERN SOUTH AMERICA (con.)													
Columbia	26,713	2,668	.100	23,859	190,872	193,540	1.4	5	306	1.6	--	2,893	100.0
Ecuador	7,319	2,350	.321	2,725	21,800	24,150	9.7	13	687	1.9	8	798	99.0
Guyana	808	170	.210	280	2,240	2,410	7.1	1	17	5.9	--	12	100.0
Peru	15,777	19,270	1.221	4,300	34,400	53,670	35.9	37	170	21.8	19	1,044	99.1
Surinam	434	10	.023	28	224	234	4.3	--	8	0.0	--	8	100.0
Venezuela	12,575	1,570	.125	9,404	75,232	76,802	2.0	9	460	2.0	--	1,193	100.0
SOUTHERN SOUTH AMERICA													
Argentina	25,719	42,100	1.637	59,100	472,800	514,900	8.2	144	3,511	4.1	--	5,526	0.0
Chile	10,441	6,407	.614	3,336	26,688	33,095	19.4	24	306	7.8	10	1,06[illegible]	0.9
Paraguay	2,724	455	.167	5,049	40,392	40,847	1.1	2	170	1.2	--	122	0.0
Uruguay	3,139	15,986	5.093	10,701	85,608	101,594	15.7	46	465	9.9	--	750	0.0

Sources:

1/ FAO Production Yearbook, Volume 30, 1976, Table 3.

2/ FAO Production Yearbook, Volume 30, 1976, Table 81.

3/ Calculated from (1) and (2) above.

4/ FAO Production Yearbook, Volume 30, 1976, Table 80.

5/ Calculated by multiplying the number in (4) above times 8.

6/ Addition of (3) and (5) above.

7/ Calculated from (3) and (6) above.

8/ FAO Production Yearbook, Volume 30, 1976, Tables 85 and 86.

9/ FAO Production Yearbook, Volume 30, 1976, Table 88.

10/ Calculated from (8) and (9) above.

11/ FAO Production Yearbook, Volume 30, 1976, Table 91.

12/ FAO Production Yearbook, Volume 30, 1976, Tables 90 and 91.

13/ Calculated from (11) and (12) above.

Table A3. Fibre and Hide Production, 1976

	Total fiber & hides (metric tons)	Sheep & goat skins (metric tons)	Wool (greasy) (metric tons)	Cattle/buffalo hides (metric tons)
NORTHWESTERN AFRICA	801,053	199,073	192,723	409,257
Algeria	29,900	8,060	16,740	5,100
Cameroon	11,937	3,027	--	8,910
Central African Republic	652	376	--	276
Chad	8,327	3,267	--	5,060
Dahomey (Benin)	2,509	835	--	1,674
Equatorial Guinea	30	24	--	6
Gambia	631	85	--	546
Ghana	4,537	1,818	--	2,719
Guinn Bissau	850	175	--	675
Guinea	2,049	249	--	1,800
Ivory Coast	9,560	3,800	--	5,760
Liberia	564	254	--	310
Libyan Arab Republic	15,250	9,000	5,300	950
Mali	13,149	6,077	300	6,772
Mauritania	3,062	1,262	--	1,800
Morocco	51,800	14,400	21,000	16,400
Niger	7,550	3,750	--	3,800
Nigeria	54,360	23,760	--	30,600
Reunion	151	12	--	139
Senegal	8,728	2,278	--	6,450
Sierra Leone	1,169	158	--	1,011
Togo	5,266	406	--	4,869
Tunisia	19,307	6,875	6,400	6,032
Upper Volta	3,900	1,920	--	1,980
SOUTHERN AFRICA				
Angola	7,454	854	--	6,600
Botswana	4,354	729	--	3,625
Burundi	4,492	1,047	--	3,445

Table A3 (Con.)

	Total fiber & hides (metric tons)	Sheep & goat skins (metric tons)	Wool (greasy) (metric tons)	Cattle/buffalo hides (metric tons)
SOUTHERN AFRICA (con.)				
Congo	221	34	--	187
Gabon	94	82	--	12
Kenya	26,390	5,890	1,600	18,900
Lesotho	6,592	1,052	4,200	1,340
Madagascar	16,855	810	--	16,045
Malawi	1,982	512	--	1,470
Mauritius	297	47	--	250
Mozambique	6,647	772	--	5,875
Namibia	12,050	3,175	4,600	4,275
Rwanda	2,432	540	--	1,892
Rhodesia	22,864	1,614	--	21,250
South Africa	190,800	25,000	102,800	63,000
Swaziland	1,934	309	--	1,625
Tanzania	32,954	5,251	40	27,663
Uganda	15,034	2,686	--	12,348
Zaire	5,173	2,313	--	2,860
Zambia	5,047	217	--	4,830
NORTHEASTERN AFRICA				
Egypt	39,479	6,275	2,900	30,304
Ethiopia	77,100	25,304	12,043	39,753
Somalia	10,856	5,856	--	5,000
Sudan	50,953	16,056	14,800	20,097

Table A3 (Con.)

	Total fiber & hides (metric tons)	Sheep & goat skins (metric tons)	Wool (greasy) (metric tons)	Cattle/buffalo hides (metric tons)
NEAR OR MIDDLE EAST				
Bahrain	266	136	--	130
Cyprus	2,410	1,320	750	340
Iraq	34,975	10,070	18,000	6,905
Israel	--	--	--	--
Jordan	6,301	2,341	3,700	260
Kuwait	2,116	1,698	120	298
Lebanon	4,240	1,800	1,000	1,440
Qatar	445	391	--	54
Saudi Arabia	10,574	5,830	2,800	1,944
Syria Arab Republic	25,875	9,750	14,000	2,125
Turkey	160,907	65,302	54,000	41,605
Yemen Arab Republic	10,360	8,200	--	2,160
Yemen Dem.	2,024	1,778	--	246
SOUTHWESTERN ASIA				
Afghanistan	54,659	19,000	26,000	9,659
Iran	83,844	38,100	23,000	22,744
Pakistan	144,321	23,161	21,100	100,060
SOUTHERN ASIA				
Bangladesh	114,644	12,400	930	101,314
India	916,266	104,445	32,121	779,700
Nepal	25,204	5,326	4,158	15,720
Sri Lanka	6,159	219	--	5,940

Table A3 (Con.)

	Total fiber & hides (metric tons)	Sheep & goat skins (metric tons)	Wool (greasy) (metric tons)	Cattle/buffalo hides (metric tons)
EASTERN ASIA				
Burma	24,298	490	242	23,566
Hong Kong & Macao	4,401	45	--	4,356
Indonesia	32,725	7,855	--	24,870
Khmer Republic	--	--	--	--
Laos	--	31	--	4,677
Malaysia	2,678	270	40	2,368
Singapore	345	286	--	59
Thailand	33,680	102	--	33,578
Vietnam	13,506	66	--	13,440
Philippines	17,237	1,233	--	16,004
NORTHERN ASIA				
Japan	--	--	--	--
Korea Republic	9,071	146	--	8,925
Korea DPR	3,749	320	--	3,429
CENTRAL AMERICA				
Costa Rica	8,691	3	--	8,688
Cuba	25,705	405	--	25,300
Dominican Republic	5,208	60	--	5,148
El Salvador	3,764	--	--	3,764
Guatemala	10,600	503	--	10,097
Haiti	3,285	1,030	--	2,255
Honduras	6,551	53	--	6,498
Jamaica	1,591	161	--	1,430
Mexico	79,710	8,030	8,100	63,580
Nicaragua	8,375	--	--	8,375
Panama	5,738	--	--	5,738
Puerto Rico	3,420	34	--	3,386

Table A3 (Con.)

	Total fiber & hides (metric tons)	Sheep & goat skins (metric tons)	Wool (greasy) (metric tons)	Cattle/buffalo hides (metric tons)
NORTHERN SOUTH AMERICA				
Bolivia	21,470	6,035	7,767	7,668
Brazil	369,697	13,479	--	356,200
Columbia	97,643	1,068	19,176	77,399
Ecuador	13,012	1,954	1,800	9,258
Guyana	835	135	--	700
Peru	38,950	10,350	10,600	18,000
Surinam	183	9	--	174
Venezuela	36,434	684	--	35,750
SOUTHERN SOUTH AMERICA				
Argentina	625,054	46,248	167,000	411,806
Chile	51,210	5,108	19,176	26,926
Paraguay	17,099	299	--	16,800
Uruguay	74,925	11,200	5,600	58,125

Source: FAO Production Yearbook, Volume 30, 1976. Tables 95 and 96.

Table A4. Contribution of Sheep and Goats to Gross Domestic Production

	Proportion of sheep and goat meat to total meat	Proportion of agriculture accounted for by livestock	Proportion of GDP accounted for by agriculture	Proportion of agriculture accounted for by sheep and goats	Percent of GDP accounted for by sheep and goats
NORTHWESTERN AFRICA					
Algeria	.41	.30	--	.1230	--
Cameroon	.17	.07	--	.0119	--
Central African Republic	.03	--	.31	.0093	--
Chad	.27	--	.50	.1350	--
Dahomey (Benin)	.11	--	.31	.0341	--
Equatorial Guinea	--	--	--	--	--
Gambia	.20	--	--	--	--
Ghana	.11	.05	.51	.0055	.28
Guinn Bissau	.12	--	--	--	--
Guinea	.12	.11	--	.0132	--
Ivory Coast	.05	--	.26	--	--
Liberia	.14	.03	.25	.0042	.10
Libyan Arab Republic	.38	--	.03	--	--
Mali	.43	--	--	--	--
Mauritania	.44	--	.23	--	--
Morocco	.32	.28	.28	.0896	.50
Niger	.44	--	.51	--	--
Nigeria	.19	.10	.36	.0190	.68
Reunion	--	--	--	--	--
Senegal	.10	.12	--	.0120	--
Sierra Leone	.09	.02	.32	.0018	.05
Togo	.19	--	.34	--	--
Tunisia	.46	.32	.19	.1472	.79
Upper Volta	.43	.15	.42	.0645	.70
SOUTHERN AFRICA					
Angola	.04	.16	--	.0064	--
Botswana	.10	--	.32	--	--

Table A4 (Con.)

	Proportion of sheep and goat meat to total meat	Proportion of agriculture accounted for by livestock	Proportion of GDP accounted for by agriculture	Proportion of agriculture accounted for by sheep and goats	Percent of GDP accounted for by sheep and goats
SOUTHERN AFRICA (con.)					
Burundi	.17	.04	--	.0068	--
Congo	--	--	--	--	--
Gabon	--	--	.09	--	--
Kenya	.11	.24	.27	.0264	.71
Lesotho	.29	--	.42	--	--
Madagascar	.02	--	.29	--	--
Malawi	.12	--	.47	--	--
Mauritius	--	--	.44	--	--
Mozambique	.05	--	--	--	--
Namibia	.51	--	--	--	--
Rwanda	.20	.04	.59	.0080	.47
Rhodesia	.03	.27	--	.0081	--
South Africa	.25	.35	.08	.0875	.70
Swaziland	.18	--	.28	--	--
Tanzania	.17	.18	--	.0306	--
Uganda	.08	.24	.48	.0192	.92
Zaire	.04	--	.15	--	--
Zambia	.02	--	.10	--	--
NORTHEASTERN AFRICA					
Egypt	.12	.20	.29	.0240	.69
Ethiopia	.32	.43	.48	.1376	.60
Somalia	--	--	--	--	--
Sudan	.27	.27	.34	.0729	.47

Table A4 (Con.)

	Proportion of sheep and goat meat to total meat	Proportion of agriculture accounted for by livestock	Proportion of GDP accounted for by agriculture	Proportion of agriculture accounted for by sheep and goats	Percent of GDP accounted for by sheep and goats
CENTRAL AMERICA					
Costa Rica	--	.20	.20	--	--
Cuba	--	--	--	--	--
Dominican Republic	--	.27	.25	--	--
El Salvador	--	.17	.24	--	--
Guatemala	.03	.17	.28	.0051	.14
Haiti	.08	.18	.44	.0144	.63
Honduras	--	.24	.29	--	--
Jamaica	.05	.24	.08	.0124	.10
Mexico	.03	.27	.10	.0081	.08
Nicaragua	--	.23	.22	--	--
Panama	--	.21	.16	--	--
Puerto Rico	--	--	.03	--	--
NORTHERN SOUTH AMERICA					
Bolivia	.17	.31	.15	.0527	.79
Brazil	.03	.30	.12	.0090	.11
Columbia	.01	.25	.27	.0025	.07
Ecuador	.10	.14	.21	.0140	.29
Guyana	.05	.06	.17	.0030	.05
Peru	.10	.14	.16	.0140	.22
Surinam	--	--	.13	--	--
Venezuela	.02	.54	.06	.0108	.06

Table A4 (Con.)

	Proportion of sheep and goat meat to total meat	Proportion of agriculture accounted for by livestock	Proportion of GDP accounted for by agriculture	Proportion of agriculture accounted for by sheep and goats	Percent of GDP accounted for by sheep and goats
SOUTHERN SOUTH AMERICA					
Argentina	.05	.37	.12	.0185	.22
Chile	.07	.52	.06	.0364	.22
Paraguay	.01	.28	.37	.0028	.10
Uruguay	.12	.69	.12	.0828	.99
NEAR OR MIDDLE EAST					
Bahrain	--	--	--	--	--
Cyprus	.02	--	.16	--	--
Iraq	.56	.65	.14	.3640	.60
Israel	.02	.40	.05	.0080	.04
Jordan	.41	--	.16	--	--
Kuwait	.07	--	.0	--	--
Lebanon	.23	--	.10	--	--
Qatar	--	--	--	--	--
Saudi Arabia	.39	--	.01	--	--
Syria Arab Republic	.76	.02	.18	.0152	.27
Turkey	.47	.17	.26	.0799	.08
Yemen Arab Republic	.75	--	.61	--	--
Yemen Dem.	.40	--	.19	--	--
SOUTHWESTERN ASIA					
Afghanistan	--	--	.51	--	--
Iran	.62	.35	.09	.2170	.95
Pakistan	--	--	.31	--	--

Table A4 (Con.)

	Proportion of sheep and goat meat to total meat	Proportion of agriculture accounted for by livestock	Proportion of GDP accounted for by agriculture	Proportion of agriculture accounted for by sheep and goats	Percent of GDP accounted for by sheep and goats
NORTHERN ASIA					
Japan	--	.15	.05	--	--
Korea Republic	--	.05	.25	--	--
Korea DPR	.02	.05	--	.0010	--
SOUTHERN ASIA					
Bangladesh	.20	--	.59	--	--
India	.47	--	.43	--	--
Nepal	.25	--	.69	--	--
Sri Lanka	.03	.02	.36	.0006	.02
EASTERN ASIA					
Burma	.03	--	.42	--	--
Hong Kong & Macao	--	--	.02	--	--
Indonesia	.10	--	.33	--	--
Khmer Republic	--	--	--	--	--
Laos	--	--	--	--	--
Malaysia	--	--	.28	--	--
Singapore	--	--	.02	--	--
Thailand	--	--	.31	--	--
Vietnam	--	--	--	--	--
Philippines	.01	.18	.28	.0018	.05

Source: Ned S. Raun, Nels Konnerup, and Merril Asay. Livestock Program in TA/AGR. USAID, TA/AGR/LV, Washington, D.C.: Mimeo, January 31, 1977. The information was based primarily on FAO, USDA and World Bank data.

United Nations, 1976 Statistical Yearbook, ST/ESA/STAT/Ser S/4. New York, 1977. Table 186.

Table A5. The Contribution of Sheep and Goats to Income

	National income total 1970 (millions U.S. $)	National income per capita 1970 (U.S. $)	Total national income derived from sheep and goats (millions U.S. $)	Per capita national income derived from sheep and goats (U.S. $)
NORTHWESTERN AFRICA				
Algeria	4,225	295	--	--
Cameroon	1,047	179	--	--
Central African Republic	192	119	--	--
Chad	256	70	--	--
Dahomey (Benin)	206	76	--	--
Equatorial Guinea	72	253	--	--
Gambia	46	101	--	--
Ghana	2,036	236	5.70	.66
Guinn Bissau	121	247	--	--
Guinea	310	79	--	--
Ivory Coast	1,399	324	--	--
Liberia	287	189	.28	.18
Libyan Arab Republic	2,812	1,412	--	--
Mali	266	53	--	--
Mauritania	157	136	--	--
Morocco	3,298	221	16.49	1.10
Niger	327	81	--	--
Nigeria	7,148	130	48.60	.88
Reunion	346	769	--	--
Senegal	791	219	--	--
Sierra Leone	382	150	.19	.07
Togo	245	125	--	--
Tunisia	1,334	260	10.53	2.05
Upper Volta	333	62	2.33	.43
SOUTHERN AFRICA				
Angola	1,587	284	--	--
Botswana	76	132	--	--

Table A5 (Con.)

	National income total 1970 (millions U.S. $)	National income per capita 1970 (U.S. $)	Total national income derived from sheep and goats (millions U.S. $)	Per capita national income derived from sheep and goats (U.S. $)
SOUTHERN AFRICA (con.)				
Burundi	201	60	--	--
Congo	253	213	--	--
Gabon	234	468	--	--
Kenya	1,431	127	10.16	.90
Lesotho	84	91	--	--
Madagascar	854	127	--	--
Malawi	294	66	--	--
Mauritius	180	223	--	--
Mozambique	1,779	216	--	--
Namibia	--	--	--	--
Rwanda	198	54	.93	.25
Rhodesia	1,369	258	--	--
South Africa	15,371	662	107.59	4.63
Swaziland	89	212	--	--
Tanzania	1,209	94	--	--
Uganda	1,242	127	11.42	1.16
Zaire	1,655	76	--	--
Zambia	1,526	365	--	--
NORTHEASTERN AFRICA				
Egypt	6,740	202	46.50	1.39
Ethiopia	1,670	68	10.02	.40
Somalia	242	87	--	--
Sudan	1,713	109	8.05	.51

Table A5 (Con.)

	National income total 1970 (millions U.S. $)	National income per capita 1970 (U.S. $)	Total national income derived from sheep and goats (millions U.S. $)	Per capita national income derived from sheep and goats (U.S. $)
CENTRAL AMERICA				
Costa Rica	909	525	--	--
Cuba	--	--	--	--
Dominican Republic	1,358	334	--	--
El Salvador	970	281	--	--
Guatemala	1,633	320	2.28	.44
Haiti	399	94	2.51	.59
Honduras	668	266	--	--
Jamaica	1,198	641	1.19	.64
Mexico	32,048	632	25.63	.50
Nicaragua	720	393	--	--
Panama	924	646	--	--
Puerto Rico	4,723	1,738	--	--
NORTHERN SOUTH AMERICA				
Bolivia	863	175	6.81	1.38
Brazil	43,278	468	47.60	.51
Columbia	6,357	310	4.44	.21
Ecuador	1,431	250	4.14	.72
Guyana	230	323	.11	.16
Peru	4,059	302	8.92	.66
Surinam	241	650	--	--
Venezuela	9,693	932	5.81	.55
SOUTHERN SOUTH AMERICA				
Argentina	23,366	984	51.40	2.16
Chile	6,174	659	13.58	1.44

Table A5 (Con.)

	National income total 1970 (millions U.S. $)	National income per capita 1970 (U.S. $)	Total national income derived from sheep and goats (millions U.S. $)	Per capita national income derived from sheep and goats (U.S. $)
SOUTHERN SOUTH AMERICA (con.)				
Paraguay	549	239	.54	.23
Uruguay	2,338	809	23.14	8.00
NEAR OR MIDDLE EAST				
Bahrain	195	888	--	--
Cyprus	537	873	--	--
Iraq	2,919	309	17.51	1.85
Israel	4,782	1,655	1.91	.66
Jordan	600	261	--	--
Kuwait	2,082	2,814	--	--
Lebanon	1,454	589	--	--
Qatar	259	1,837	--	--
Saudi Arabia	3,832	495	--	--
Syria Arab Republic	1,620	259	4.37	.69
Turkey	12,200	350	9.76	.28
Yemen Arab Republic	446	77	--	--
Yemen Dem.	135	92	--	--
SOUTHWESTERN ASIA				
Afghanistan	1,425	83	--	--
Iran	10,095	352	95.90	3.34
Pakistan	9,878	163	--	--

Table A5 (Con.)

	National income total 1970 (millions U.S. $)	National income per capita 1970 (U.S. $)	Total national income derived from sheep and goats (millions U.S. $)	Per capita national income derived from sheep and goats (U.S. $)
NORTHERN ASIA				
Japan	170,706	1,636	--	--
Korea Republic	7,825	250	--	--
Korea DPR	--	--	--	--
SOUTHERN ASIA				
Bangladesh	4,038	59	--	--
India	50,647	94	--	--
Nepal	825	73	--	--
Sri Lanka	2,080	166	.41	.03
EASTERN ASIA				
Burma	2,001	73	--	--
Hong Kong & Macao	2,958	747	--	--
Indonesia	8,414	70	--	--
Khmer Republic	--	--	--	--
Laos	210	71	--	--
Malaysia	3,582	345	--	--
Singapore	1,800	870	--	--
Thailand	6,065	167	--	--
Vietnam	--	--	--	--
Philippines	6,038	164	3.01	.08

Source: Table 7
United Nations. 1976 Statistical Yearbook, ST/ESA/STAT/SER/4. New York, 1977. Table 191.

Table A6. The Contribution of Sheep and Goats to Employment

	Economically active population in agriculture 1975 (000's)	Economically active population percent in agriculture 1975	Number of persons involved in sheep and goat production (000's)	Proportion of economically active population involved in sheep and goat production
NORTHWESTERN AFRICA				
Algeria	2,072	55.3	2.54	.06
Cameroon	2,553	82.7	.30	.01
Central African Republic	880	89.5	.08	.01
Chad	1,331	87.2	1.79	.11
Dahomey (Benin)	696	47.8	.23	.01
Equatorial Guinea	73	77.4	--	--
Gambia	205	80.0	--	--
Ghana	2,027	54.6	.11	.0
Guinn Bissau	141	84.8	--	--
Guinea	1,681	82.5	.22	.01
Ivory Coast	2,070	82.1	--	--
Liberia	476	72.8	.02	.0
Libyan Arab Republic	133	22.8	--	--
Mali	2,799	89.1	--	--
Mauritania	338	85.3	--	--
Morocco	2,469	54.0	2.21	.05
Niger	1,313	90.6	--	--
Nigeria	14,236	57.7	2.70	.01
Reunion	46	32.7	--	--
Senegal	1,459	77.1	.17	.01
Sierra Leone	789	68.4	.01	.0
Togo	673	70.7	--	--
Tunisia	616	45.1	.90	.07
Upper Volta	2,760	84.3	1.78	.05
SOUTHERN AFRICA				
Angola	1,049	60.8	.07	.0
Botswana	276	83.7	--	--

Table A6 (Con.)

	Economically active population in agriculture 1975 (000's)	Economically active population percent in agriculture 1975	Number of persons involved in sheep and goat production (000's)	Proportion of economically active population involved in sheep and goat production
SOUTHERN AFRICA (con.)				
Burundi	1,590	85.2	.10	.01
Congo	179	37.9	--	--
Gabon	201	79.0	--	--
Kenya	4,154	79.9	1.09	.02
Lesotho	542	87.0	--	--
Madagascar	3,507	86.6	--	--
Malawi	1,948	86.6	--	--
Mauritius	93	31.0	--	--
Mozambique	2,522	69.1	--	--
Namibia	153	52.1	--	--
Rwanda	2,062	91.5	.16	.01
Rhodesia	1,311	61.3	.10	.0
South Africa	2,724	29.8	2.38	.03
Swaziland	170	77.1	--	--
Tanzania	5,427	83.7	1.66	.02
Uganda	4,010	83.6	.77	.02
Zaire	8,197	76.9	--	--
Zambia	1,314	69.8	--	--
NORTHEASTERN AFRICA				
Egypt	5,509	52.4	1.32	.01
Ethiopia	9,745	81.8	13.40	.11
Somalia	1,023	72,5	--	--
Sudan	4,581	79.5	3.33	.06

Table A6 (Con.)

	Economically active population in agriculture 1975 (000's)	Economically active population percent in agriculture 1975	Number of persons involved in sheep and goat production (000's)	Proportion of economically active population involved in sheep and goat production
CENTRAL AMERICA				
Costa Rica	244	38.5	--	--
Cuba	763	26.8	--	--
Dominican Republic	795	58.7	--	--
El Salvador	677	53.3	--	--
Guatemala	1,085	58.0	.05	.0
Haiti	1,622	70.5	.23	.01
Honduras	584	64.6	--	--
Jamaica	167	24.8	.02	.0
Mexico	6,908	40.5	.55	.0
Nicaragua	325	47.0	--	--
Panama	216	38.0	--	--
Puerto Rico	46	5.2	--	--
NORTHERN SOUTH AMERICA				
Bolivia	942	52.7	.49	.03
Brazil	14,525	42.0	1.30	.0
Columbia	2,471	32.2	.06	.0
Ecuador	1,069	47.7	.15	.01
Guyana	60	24.8	.0	.0
Peru	1,835	41.0	.26	.01
Surinam	21	19.9	--	--
Venezuela	773	21.5	.08	.0

Table A6 (Con.)

	Economically active population in agriculture 1975 (000's)	Economically active population percent in agriculture 1975	Number of persons involved in sheep and goat production (000's)	Proportion of economically active population involved in sheep and goat production
SOUTHERN SOUTH AMERICA				
Argentina	1,427	14.6	.26	.0
Chile	684	21.0	.24	.01
Paraguay	429	50.8	.01	.0
Uruguay	161	13.4	--	--
NEAR OR MIDDLE EAST				
Bahrain	--	--	--	--
Cyprus	105	36.4	--	--
Iraq	1,209	43.4	4.40	.16
Israel	99	8.2	.01	.0
Jordan	193	29.6	--	--
Kuwait	5	1.7	--	--
Lebanon	105	14.1	--	--
Qatar	--	--	--	--
Saudi Arabia	1,505	63.1	--	--
Syria Arab Republic	932	49.3	.14	.01
Turkey	10,455	61.3	8.35	.05
Yemen Arab Republic	1,457	77.2	--	--
Yemen Dem.	272	61.7	--	--
SOUTHWESTERN ASIA				
Afghanistan	5,256	79.8	--	--
Iran	3,948	42.2	8.57	.09
Pakistan	11,043	56.2	--	--

Table A6 (Con.)

	Economically active population in agriculture 1975 (000's)	Economically active population percent in agriculture 1975	Number of persons involved in sheep and goat production (000's)	Proportion of economically active population involved in sheep and goat production
NORTHERN ASIA				
Japan	8,443	14.8	--	--
Korea Republic	5,672	44.7	--	--
Korea DPR	3,492	50.3	.03	.0
SOUTHERN ASIA				
Bangladesh	21,559	85.1	--	--
India	159,939	66.6	--	--
Nepal	5,660	93.3	--	--
Sri Lanka	2,574	54.3	.01	.0
EASTERN ASIA				
Burma	7,154	55.5	--	--
Hong Kong & Macao	62	3.3	--	--
Indonesia	29,456	62.6	--	--
Khmer Republic	--	--	--	--
Laos	1,235	76.4	--	--
Malaysia	--	--	--	--
Singapore	23	2.7	--	--
Thailand	14,914	77.7	--	--
Vietnam	14,977	73.6	--	--
Philippines	7,789	49.6	.14	.0

Source: FAO Production Yearbook, Volume 30, 1976. Table 7.

TABLE A7. PRODUCTION TRENDS, 1961-76.

Country	Number of Sheep			Number of Goats		
	1961-65	1976	% change	1961-65	1976	% change
NORTHWESTERN AFRICA						
Algeria	6,180	8,886	44	1,950	2,400	23
Cameroon	1,663	2,105	27	1,053	1,633	55
Central African Republic	52	76	32	456	566	24
Chad	2,000	2,424	21	2,000	2,424	21
Dahomey (Benin)	346	850	146	466	840	80
Equatorial Guinea	27	31	15	5	7	40
Gambia	69	95	37	97	94	--
Ghana	952	1,800	89	988	2,000	102
Guinn Bissau	56	70	25	147	180	22
Guinea	364	420	15	374	385	3
Ivory Coast	511	1,000	96	627	1,000	59
Liberia	120	176	47	110	175	59
Libyan Arab Republic	1,378	3,360	144	1,281	1,125	-12
Mali	4,337	4,219	-3	4,735	3,929	-17
Mauritania	3,234	3,100	-4	2,654	2,500	-6
Morocco	10,957	16,800	53	6,488	7,200	11
Niger	1,980	2,300	16	5,186	5,100	-2
Nigeria	7,207	7,900	10	21,141	23,000	9
Reunion	3	2	-33	13	40	208
Senegal	968	1,740	80	1,180	873	-26
Sierra Leone	38	68	79	120	179	49
Togo	521	750	44	447	630	41
Tunisia	2,804	3,526	26	525	900	71
Upper Volta	1,140	1,300	14	1,920	2,300	18
SOUTHERN AFRICA						
Angola	145	205	41	521	910	75
Botswana	119	425	257	332	1,050	216
Burundi	146	311	113	405	653	61

TABLE A7 (CON.)

Country	Number of Sheep			Number of Goats		
	1961-65	1976	% change	1961-65	1976	% change
SOUTHERN AFRICA (Con.)						
Congo	38	52	37	53	101	91
Gabon	45	59	31	51	64	25
Kenya	4,026	3,611	-10	5,070	4,100	-19
Lesotho	1,394	1,640	18	748	915	22
Madagascar	266	700	163	309	1,300	321
Malawi	77	88	14	477	739	55
Mauritius	2	3	50	59	67	14
Mozambique	99	132	33	419	570	36
Namibia	3,394	5,000	47	1,503	2,000	33
Rwanda	231	252	9	448	570	27
Rhodesia	386	770	99	550	2,050	273
South Africa	39,128	31,001	-21	5,492	5,200	-5
Swaziland	40	35	-13	227	260	15
Tanzania	2,928	2,900	-1	4,365	4,602	5
Uganda	815	1,100	35	2,294	2,150	-6
Zaire	508	711	40	1,717	2,256	31
Zambia	36	50	39	156	283	81
NORTHEASTERN AFRICA						
Egypt	1,697	2,000	18	780	1,372	76
Ethiopia	24,242	23,065	-5	17,854	17,064	-4
Somalia	5,300	7,000	32	6,300	8,000	27
Sudan	8,255	15,262	85	6,579	10,105	54

TABLE A7 (CON.)

Country	Number of Sheep			Number of Goats		
	1961-65	1976	% change	1961-65	1976	% change
CENTRAL AMERICA						
Costa Rica	1	2	100	1	1	0
Cuba	229	340	48	72	92	28
Dominican Republic	38	51	34	240	355	48
El Salvador	3	4	33	14	11	-21
Guatemala	743	520	-30	86	76	-12
Haiti	58	81	40	990	1,384	40
Honduras	8	5	-38	45	58	29
Jamaica	11	5	-55	525	330	-37
Mexico	5,886	5,300	-10	9,165	8,800	-4
Nicaragua	1	2	100	7	6	-14
Panama	-	-	-	4	6	50
Puerto Rico	4	6	50	25	20	-20
NORTHERN SOUTH AMERICA						
Bolivia	6,136	7,767	27	1,881	2,848	51
Brazil	19,996	25,100	26	12,438	16,200	30
Colombia	1,506	2,036	35	656	632	-4
Ecuador	1,699	2,150	27	161	200	24
Guyana	56	108	93	28	62	121
Peru	14,311	17,300	21	3,920	1,970	-50
Surinam	5	4	-20	11	6	-45
Venezuela	88	103	17	1,342	1,467	9

TABLE A7 (CON.)

Country	Number of Sheep			Number of Goats		
	1961-65	1976	% change	1961-65	1976	% change
SOUTHERN SOUTH AMERICA						
Argentina	48,023	36,500	-24	5,009	5,600	12
Chile	6,536	5,607	-14	1,031	800	-22
Paraguay	413	355	-14	59	100	69
Uruguay	21,818	15,974	-27	18	12	-33
NEAR OR MIDDLE EAST						
Bahrain	3	4	33	8	8	0
Cyprus	418	420	0	164	320	95
Iraq	10,138	8,400	-17	2,209	2,584	17
Israel	190	202	6	156	140	-10
Jordan	752	818	9	592	474	-20
Kuwait	70	111	59	48	86	80
Lebanon	200	234	17	456	330	-28
Qatar	28	40	43	32	47	47
Saudi Arabia	834	1,379	65	650	779	20
Syria Arab Republic	4,035	6,200	54	668	750	12
Turkey	32,863	41,367	26	22,665	18,763	-17
Yemen Arab Republic	3,389	3,200	-6	7,993	7,400	-7
Yemen Dem.	730	930	27	1,150	1,200	7
SOUTHWESTERN ASIA						
Afghanistan	17,940	18,000	0	3,757	2,350	-37
Iran	30,410	35,300	16	13,006	14,300	10
Pakistan	11,210	19,186	71	7,786	14,109	81

TABLE A7 (CON.)

Country	Number of Sheep			Number of Goats		
	1961-65	1976	% change	1961-65	1976	% change
NORTHERN ASIA						
Japan	410	10	-98	502	94	-81
Korea Republic	1	6	500	242	250	3
Korea DPR	129	268	108	124	199	60
SOUTHERN ASIA						
Bangladesh	547	777	42	8,342	12,772	53
India	40,936	40,187	-2	62,334	70,394	13
Nepal	2,086	2,310	11	2,023	2,373	17
Sri Lanka	44	30	-32	530	562	6
EASTERN ASIA						
Burma	114	180	58	490	550	12
Hong Kong & Macao	-	-	-	-	-	-
Indonesia	3,540	3,188	-10	7,506	7,482	0
Laos	-	-		30	38	27
Singapore	-	-		2	2	0
Thailand	14	54	288	36	30	-17
Vietnam	4	12	200	36	38	6
Philippines	22	32	45	561	1,380	144

Source: FAO Production Yearbook Vol. 30 1976 Table 81.

Appendix B

Guidelines for the Conduct of Collaborative Research

GUIDELINES FOR THE CONDUCT OF COLLABORATIVE RESEARCH SUPPORT ACTIVITY UNDER TITLE XII OF THE INTERNATIONAL DEVELOPMENT AND FOOD ASSISTANCE ACT OF 1975

A REPORT OF THE JOINT RESEARCH COMMITTEE

OF THE

BOARD FOR INTERNATIONAL FOOD AND AGRICULTURAL DEVELOPMENT

October 11, 1977

INTRODUCTION[1/]

Purpose of this Report

Title XII, Section 298(d) of the International Development and Food Assistance Act of 1975 states that "The President may authorize the Board to create such subordinate units as may be necessary for the performance of its duties, including, but not limited to, the following:

"A Joint Research Committee to participate in the administration and development of the collaborative activities described in Section 297(a), (3) of this Title."[2/]

Section 297(a) provides authority for a totally new type of research program. This program, of central concern to this report, is identified in the legislation as follows: "....to provide program support for long-term collaborative university research on food production, distribution, storage, marketing, and consumption."[3/ 4/]

[1/] The paper outlines general approaches and concepts to guide the development of the new research effort herein described. It is understood that all activities to be undertaken within these guidelines in the implementation of this research effort must be in accordance with applicable U.S. laws, regulations and policies. To the extent that new procedures are required for the implementation of these activities, they will be developed in conformance with these applicable laws.

[2/] A description of the Joint Research Committee (JRC) and its role under the Board for International Food and Agricultural Development has previously been approved by the Board. The Board has expanded the role of the JRC to cover all research activities encompassed under Title XII.

[3/] For the purpose of this report, the definition of a U.S. university is as described in the Act, Section 296(d).

[4/] Universities interested in potential involvement under Title XII research authorities may desire a criterion to distinguish "collaborative research" from "centrally funded research" contracts. The JRC suggests this be based on an evaluation by the university as to whether or not university resources are to be committed to the program, since this commitment is required of all "collaborative research" programs, but not required for "centrally funded research" projects. (See page 7).

This report outlines briefly and recommends for consideration by the Board for International Food and Agricultural Development and by the Agency for International Development the underlying concepts and general characteristics of desirable approaches for implementing this new research authority. Although this report describes the operational guidelines for implementation of the Collaborative Research Support programs, it is important to note there are other research program categories which function under Title XII authority. Centrally funded research contracts for programs with U.S. institutions and developing countries will be continued as in the past, with initial evaluation by the JRC. Also, it is expected that some research projects linking U.S. institutions and developing countries will be funded as parts of A.I.D. country programs and hence will fall under immediate cognizance of the JCAD.[1/]

Background

Concepts and recommendations presented here have evolved in part from an extended discussion process between A.I.D. and representatives of agricultural universities and the USDA, starting before and extending through the development of Title XII legislation, and culminating in an earlier report prepared by an ad hoc committee consisting primarily of university representatives (Hutchinson report).

These discussions were based on a mutual desire to explore possibilities of drawing upon the long experience of "Hatch Act" and other collaboration between the U.S. Department of Agriculture and state-supported research institutions, which feature federal support to state-funded research, justified by the complementarities of benefit to U.S. Government and individual state objectives.

The "Hatch Act" model does not provide a closely replicable analogy, however, as both U.S. Government research funds and those from the several states are all directed to the benefit of the U.S. public--albeit at a different level of governmental aggregation--and both USDA and the several state research institutions are mandated to serve those domestic U.S. interests. In contrast, U.S. funds for foreign assistance are to assist the peoples of developing countries and the Agency for International Development is mandated to use its resources to that purpose.

[1/] The "Joint Committee on Agricultural Development", a subordinate of the Board, comparable to JRC but focusing on country programs.

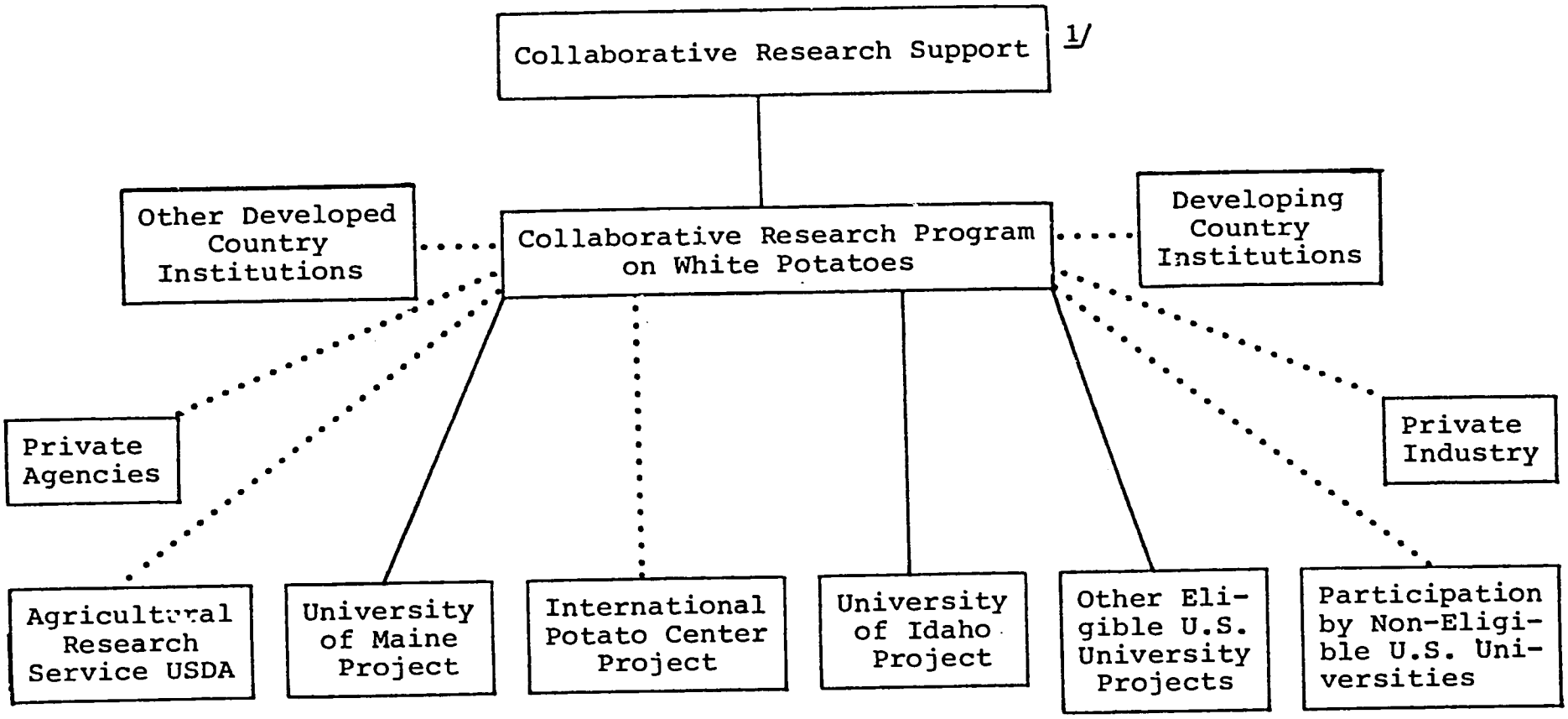
However, agricultural leaders concerned both with domestic and with developing country needs for research-based science and technology have come increasingly to see large areas of overlap of subject matter and the resulting substantial mutual advantage of joint research program efforts which cut across national boundaries and different levels of agricultural development. Most commercial crops and animals produced in the U.S. have origins in what are now the developing countries and most of the world's food is from crops and animals which are common to both the more and the less developed countries. Furthermore, such production-limiting factors as plant and animal disease, and climate (temperature, humidity, etc.) and soil constraints, are often best studied under the conditions of maximum stress which frequently occur in developing countries. Most important, solutions of specific, major technical problems often require critical masses of scientific talent and institutional resources not usually available to a single country.

THE PROGRAM

Some Definitions

"Collaborative Research Support" is the generic term given to the activities carried out primarily under Section 297(a), (3) of Title XII. This is research jointly supported by A.I.D. and collaborating institutions. Specific multi-institutional collaborative programs addressed to specific problems of food production, distribution, storage, marketing, or consumption are designated as "Collaborative Research Support Programs". Formally organized individual components of a given Collaborative Research Support Program may be designated as projects. One example of this approach is given on the following page.

The term "Collaborative Research Support Program" denotes an arrangement which facilitates collaboration among U.S. universities, U.S. Department of Commerce, USDA, International Agricultural Research Centers, other research institutions, private agencies and industry, and developing country university and other research institutions on a problem-oriented basis in a common research and development program to solve a priority food and nutrition problem. (See Program Planning section on pages 9-11). This may require fundamental research. The diagram shown on the following page is for the purpose of illustration and it should be recognized that there are many other variations which could be developed. Participation by small and less experienced, eligible universities and other interested institutions (public and private) will be encouraged.



1/ By definition in the Title XII legislation, support funds for Collaborative Research Support Programs may be granted only to eligible institutions as defined in that Title. In the diagram this means the linkages with solid lines indicate potential support funding of eligible institutions, through the management entity (Page 9), while dotted lines indicate funding can occur only through a contract or sub-contract for prescribed services from the management entity or one of the participating eligible institutions. As indicated on Page 10, only in the special case where the management entity itself is an eligible university can it receive support funds; in other cases its services may be obtained through appropriate contract arrangements.

The Concept

The amelioration of world food, nutrition, and poverty problems will require considerable expansion in a comprehensive body of relevant scientific knowledge. While expanding, the research capacity extant in the developing nations is insufficient to the task of providing such in an acceptable time frame. The special purpose international agricultural research centers have considerable capacity to contribute to certain of these knowledge needs; however, this also is insufficient. The agricultural research establishment of the American higher education community, the USDA, U.S. Department of Commerce, and other federal research organizations, has extensive capacity to work effectively on this set of problems. For a variety of reasons, this capacity has not been brought to bear in sufficiently comprehensive fashion on these issues. If progress is to be made, and the U.S. foreign assistance commitment effectively discharged, this latter capacity must be mobilized to work in collaborative fashion with the international agricultural research centers and, even more important, the agricultural research institutions in the developing nations. Conceptually, it is the creation of an instrumentality capable of mobilizing this talent and permitting it to play a significant role in high-payoff, problem-oriented, research programs that is of principal concern.

This instrumentality and the collaborative research programs which it generates must also be capable of assuming effective interaction and complementarity with national, bi-national, and multi-national agricultural development programs in developing nations.

Research programs of U.S. agricultural research institutions have, to a degree, become specialized in response to the specific characteristics of agriculture within their respective state. Since the late 1940's the U.S. state agricultural experiment stations have collaborated in research planning and implementation on a regional basis through a formal process entitled "Regional Research" which is funded by Congress for that specific purpose. Regional research projects have enabled state agricultural experiment stations to contribute specialized research competence to the solution of comprhensive problems. The rising relative and absolute costs of scientific research will inevitably force more such specialization because it is becoming increasingly more difficult for a U.S. state agricultural research institution to cover the research needs of all components of agriculture in that state.

Similarly, developing country institutions cannot be all things to all people. Certain basic minimal response capabilities to major agricultural needs must be developed and maintained in each country; but such institutions will have to make priority decisions and choices among competing needs in order to devote enough attention to any one problem to make significant contributions and thereby earn their constituents' support.

In some subject matter areas, International Agricultural Research Centers have been established, and in some subject matter areas these address problems confronted by developing country and U.S. agriculture alike. These Centers are supported by some thirty donor members of the Consultative Group on International Agricultural Research (CGIAR) of which the U.S. is one of the major donors. The Centers focus their research and training programs on the major food sources of the developing countries. Their successful operation is dependent upon establishment of effective linkages, on the one hand with the client developing country research systems, and on the other, for supportive research with appropriate institutions in the developed countries.

Program Approach

The "Collaborative Research Support Program" approach will link institutions having common interests in organized programs of research on selected problems. Such a collaborative research program on a single problem of common interest to the U.S. and several of the developing nations might involve a single U.S. institution as the U.S. leader, an international center, and several developing nation agricultural universities or research centers. More commonly, two or more U.S. universities with exceptional competence and interest in the problem would work as a team with the collaborating foreign institutions either under a special consortium or under prime grantee/sub-grantee or subcontractor arrangement. Under any organizational model, certain specialized competencies required for effective solution of a given problem might not be available in the principal participating institutions and would need to be drawn from whichever source, U.S. or foreign, most capable of providing them.

The management entity will assume overall responsibility for managing the program and will fund sub-grantees or sub-contractors according to criteria approved by A.I.D. All such

funds would be used to support research by eligible universities, or to fund research by other participating entities, in a Collaborative Research Support Program, as agreed upon and approved.[1/]

These funds could be used for such purposes as:

- financing those components of appropriately reoriented U.S. based research programs having identifiable utility in solution of developing country problems;

- financing planning and organizational costs which are necessary to carry out the research programs;

- financing overseas research activities of U.S. faculty and graduate students working on approved collaborative research programs;

- financing research arrangements of management entities and eligible universities with collaborating developing country institutions or individuals, and for conducting research in practical developing country farm situations to test validity, relevance and applicability of findings;

- financing developing country and U.S. graduate students and other junior U.S. scientists on research necessary to prosecution of the problem-solving activity;

- Financing development of research information exchange systems including conferences, data storage and retrieval system publications, materials exchanges, professional exchange arrangements and any other arrangements necessary to prosecution of the problem-solving activity;

- financing special activities specific to the participation of International Agricultural Research Centers on approved research not covered by their budgets; and

- financing such other functions as are essential to effective conduct of approved collaborative research programs.

[1/] Statutory authority to fund research activities of foreign institutions in collaboration with U.S. universities may be technically contained in provisions of the Foreign Assistance Act other than section 297(a) (3)--for instance, section 297(a) (2) and (5). All potential aspects of Collaborative Research Programs, whether or not carried out by U.S. universities, are collected in the guidelines' discussion of collaborative research activities.

The bulk of the contribution to the total program would come, of course, from the U.S. and foreign institutions' own resources devoted to their research efforts; however, the new international component of most programs would be paid primarily by A.I.D. funding for Title XII programs. Collaborating U.S. institutions would likely be those with a high performance potential as judged by commitment or willingness to become committed (and not exclusively by experience in the field), professional research capability and related factors. It is expected that collaborating institutions would elect to participate in programs which would be complementary to their own domestic responsibilities.

Collaborating developing country institutions would participate out of their sense of the priority research needs of the constituencies they serve and their capability to contribute to solution of the identified priority research problems.

Division of effort would be worked out in large part by the collaborating researchers themselves. It would not necessarily follow a standard pattern. In some cases, U.S. scientists might do the major portion of the more basic research, because of access to costly laboratory facilities and specific expertise; in other instances, because of special aptitudes or interest, this might be a primary contribution of developing country researchers. Interest, capability and, above all, design requirements of an effective research program would be the ultimate considerations.

Characteristics of an Administrative Entity

For each Collaborative Research Support Program, an administrative "Management Entity", with appropriate legal status, not necessarily a corporation, will be required for administering the resources contributed by A.I.D. and for overseeing the individual projects comprising the program. This management entity would receive and administer A.I.D. grant funds for the Collaborative Research Support Program, sub-allocating them to the participating U.S. and developing country institutions for their respective projects. The management entity should have the capacity to coordinate the effective implementation of the program and be responsible for implementation of the budgetary plans including the contributions to the projects of the participating institutions.

The management entity might be a lead U.S. university, or other institution, an administrative unit within a lead university, a special consortium of universities or other body representing the participating institutions. An entity, or a combination

(such as a joint venture) of entities, eligible to receive grant support under Title XII are the preferred types of management entities. Although in some limited number of problem areas it may be possible for a single university to conduct a Collaborative Research Support Program without involving other U.S. institutions, this approach would not be typical. Selection of management entities and their relations with grantees would, as appropriate, be in accordance with the collaborative assistance approach provided in Appendix H, Subpart 7-4.58, Collaborative Assistance.

Only in the case where the management entity is an eligible university, or a group of eligible universities organized as a joint venture, could the management entity be eligible to receive, by grant, support funds as defined in Title XII. In all other cases, the services provided to A.I.D. by the management entity for execution of the Collaborative Research Support Program would be financed through appropriate contract arrangements.

In this concept, funds for a grant for a given Collaborative Research Support Program would flow from A.I.D. to the management entity and from that entity to each institution participating through projects in a Collaborative Research Support Program. A.I.D. would hold the management entity responsible, through established A.I.D. management procedures, for performance of the Collaborative Research Support Program. A.I.D. would assure that the management entity would manage the program in accordance with the overall plan and budget agreed to by A.I.D and the management entity. The JRC will, through the Board, assist A.I.D. in execution of all these activities by such continuing evaluational and other program development and monitoring mechanisms as may be evolved. Similarly, A.I.D. would hold the management entity accountable for the funds and for their appropriate use in all aspects of the Collaborative Research Support Program, and this entity would, in turn, hold the participating institutions accountable for the funds and for their use in the projects according to budgetary plans. A suitable system of accountability would be developed between the management entity, the contributing universities and A.I.D. for holding participating institutions accountable for use of A.I.D. funds in their projects. Such a management system is essential for efficient management of a number of participating university projects comprising a Collaborative Research Support Program. It is hoped that this will facilitate participation of a wide range of institutions, make available a diversity of scientific talent, and assure that all necessary disciplinary and institutional components of a Collaborative Research Support Program will be integrated into a comprehensive effort.

Program Planning

The Joint Research Committee (JRC) will be responsible for preparing a prioritized list of programs suitable for addressing world food problems, with specific areas identified with each program. After this list is prepared and approved by BIFAD and A.I.D., the JRC will assist BIFAD, and ultimately A.I.D., in doing the necessary planning preparatory to the establishment of a Collaborative Research Support Program. For this purpose the JRC will identify a roster of possible planning entities. A.I.D. may award a contract or contracts to one or more qualified entities for providing assistance in the planning process. A.I.D., in consultation with the BIFAD and JRC, will design the planning contract in a manner calculated to insure maximum participation in planning and research by all qualified institutions and to avoid organizational conflicts of interest. The purpose of the planning contract would be to provide a delineation of the problem, an outline of a research program to address the problem (in detail or in general terms, as may be appropriate), and identification of institutions which might become actively engaged in the research program.

As the initial step of the planning process the planning entity will be required to identify all other eligible institutions and individuals who should be brought into the planning or research process. As part of this process a meeting, or a series of meetings if necessary, could be arranged for a larger group than would ultimately be involved in a Collaborative Research Support Program. This could include representation from eligible universities having an interest and capability in the subject and representatives from developing countries, International Agricultural Research Centers, A.I.D. Missions, and other research agencies. Out of this meeting would come a preliminary delineation of the problem and the identification of institutions which might become actively engaged in the program. Steps will be taken to assure that all eligible institutions, including the smaller and less-experienced, and other public and private entities having interest and scientific capacity in the problem area have an opportunity to participate in this early phase of the planning process.

A variety of techniques and instrumentalities may be used for this process of getting a proper plan developed for the Collaborative Research Support Program. These techniques will vary according to the nature of each specific situation, and they will range from those where the planning entity will not be allowed to be a participant in the CRSP to those where the

planning entity will be encouraged to be a participant in the CRSP. When the latter technique is utilized, it will be necessary to provide adequate safeguards against "organizational conflicts". Such instances would include cases where adequate exploratory work had been done in advance of the planning contract so that the state of the art of the subject is well known, and the universe of university capability and interests in participation has been clearly defined, and/or where competency is otherwise lacking to assist in the planning process. Needed safeguards would include but not be limited to arrangements to assure that eligible institutions other than those involved directly in the planning contract, and having scientific capacity in the problem areas and interest in collaborating in the program, would have an opportunity to participate in this early phase of the planning process and to be considered for participation in the Collaborative Research Support Program.

In some instances, the responsibility for coordinating the planning function might be given to a single university (one which does not have a primary interest in participating in the research program), or a consortium of such universities. In other instances, it might be given to an organization such as the Sea Grant Association which could coordinate the efforts of all interested and eligible universities.

When the planning process for a Collaborative Research Support Program has been completed, a proposal or proposals would be submitted to the JRC for consideration as basis for its recommendations to the Board.

At an appropriate stage in the planning process, the JRC would make recommendations to the Board for its consideration and possible recommendations to A.I.D.

The decision whether to make a grant or contract, the choice of the grantee or contractor and the terms of the grant or contract are matters to be decided by A.I.D. with the advice of the BIFAD.

University representatives of the JRC or BIFAD will disqualify themselves from participation in decisions or recommendations of those bodies that directly affect the interests of their universities.

When the entity for a Collaborative Research Support Program grant has completed the process, a proposal will be submitted to the JRC for consideration and approval before being recommended to the Board. Essential features of a grant proposal are as follows:

(1) A master plan for the entire Collaborative Research Support Program Grant. This should include a state-of-the-arts review.

(2) Project statements from each participating entity, including a description of collaborative relationships with developing country and other institutions.

(3) A plan to show how the Collaborative Research Program will be coordinated, including the management of the funds provided by the grant, as an integral part of the total research effort.

   (a) The involved universities will unite in a legally defined corporation or special consortium, or

   (b) One institution will be designated as the lead institution which will accept a Support Grant that will be subdivided by sub-grants and/or contracts to the cooperating institutions.

(4) Program and fiscal accountability:

   (a) Individual project contributions by collaborating institutions to the program as well as program progress will be evaluated periodically by the PPC for recommendation to the management entity.

   (b) Annual project summaries will be submitted by the cooperating universities for review by the PRC.

   (c) Evaluation plans laying out critical steps in the research process and appropriate progress measuring devices will be developed.

   (d) Expenditures will be subject to audit in accordance with FMC-73-8 entitled "Cost Principles for Educational Institutions" and other applicable regulations.

   (e) Forward funding decisions will be made by A.I.D., keeping in mind the need for a two-year lead time.

(f) A.I.D. may monitor all aspects of a Collaborative Research Program and may require such reports as are deemed necessary.

Characteristics of Collaborative Research Support Program Grants

(1) Collaborative Research Support Grants will be approved for periods of up to five years with forward funding assured for three and more years. These grants will be reviewed annually with regard to a rolling five-year plan and budget, subject to the statutory requirements for "termination for the convenience of the government".

(2) The principle of "jointness" between the U.S. universities and A.I.D. in conceptualization and management of each Collaborative Research Support Program should be the standard test in evaluating the proposal. "Jointness" should be demonstrable through specific indication in the proposal of commitment by each U.S. university. Commitment will be tested by whether the A.I.D. component is additive to on-going university research programs and whether the total university effort toward the solution of international food problems exceeds the amount funded by A.I.D.

(3) All grants, sub-grants and contracts entered into by the management entity shall be in accordance with criteria to be developed jointly by the Board and A.I.D

Appendix C

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Appendix D

Letters Sent to United States Universities and Foreign Institutions

RESEARCH TRIANGLE INSTITUTE
POST OFFICE BOX 12194
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

October 25, 1977

Dear Sir:

This letter is sent by the Research Triangle Institute (RTI) on behalf of the U.S. Agency for International Development (AID) to inform you of collaborative research opportunities in improving small ruminant production that will be developing under AID's Title XII program. RTI has begun a 6-month planning project that will result in a recommended Collaborative Research Support Program on Small Ruminants to be funded under Title XII of the International Development and Food Assistance Act of October 1975.

The planning project when completed, will include recommendations for research projects; identification of participating institutions in the United States and developing countries which evidence interest in research on small ruminants; determination of personnel who will be involved; establishment of budget requirements; and recommendations for a legal entity which will be responsible for administering the project.

Collaborative Research Support Programs (CRSP) refer to research jointly supported by AID and collaborating institutions. CRSP's generally will involve several U.S. institutions, and would be organized around the resolution of a priority food and nutrition problem. Formally organized components of a given CRSP may be designated as projects. CRSP's must contribute to producing or adapting technology to support agricultural development in developing countries. This will require the establishment of firm links with developing country institutions, beginning with the planning process and followed by the implementation of field research programs through and with appropriate developing country institutions. While some research might be conducted in the U.S. independent of developing country institutions, the majority will require research in developing country locations. Work conducted in developing country locations is expected to include basic research (especially where location in critical) as well as applied research, field testing, and in-service training.

(919) 541-6000 FROM RALEIGH, DURHAM AND CHAPEL HILL

The Joint Research Committee (JRC) of the Board for International Food and Agricultural Development (BIFAD) selected small ruminants as a priority area because of the potential for using these animals to improve the nutritional and economic status of very poor people in the developing countries. AID contracted with Research Triangle Institute to accelerate progress in developing the program.

The purpose of this letter is to inform you of procedures and the schedule to be followed in the preparation of recommendations for a CRSP on Small Ruminants and to solicit information from you to assist in this planning activity.

1. Program of Work

a. RTI has already convened an ad hoc planning committee meeting charged with establishing detailed procedural plans to be followed in developing a CRSP on small ruminants. Completion date - October 13, 1974.

b. RTI will prepare and distribute to eligible institutions an Integrated Report on the status of production and utilization of meat, milk, fiber/hides produced by small ruminants; an inventory of research underway in developed and developing countries; the identification of potentials, constraints and most urgent research needs for small ruminant systems in developing countries. Completion date - December 20, 1977.

c. Interested institutions will submit to RTI brief conceptual proposals, with budgets, of activities to be included in a Small Ruminants CRSP. The Integrated Report as described in (B) will provide the basis for the preparation of these proposals. Completion date - January 31, 1978.

d. RTI will convene a panel including RTI staff (4), livestock production staff consultants (4), invited livestock production specialists from the United States, developing countries and international centers (4-6), AID livestock production specialists (2), JRC and BIFAD representatives (2) to evaluate proposals and make recommendations on the technical program including participating institutions and developing country(s) where research will be carried out; and a legal administrative entity for the Small Ruminants CRSP. Completion date - February 15, 1978.

e. RTI will submit a final report to the JRC including a State of the Arts report, recommended program and legal administrative entity for a Small Ruminants CRSP. Completion date - March 31, 1978.

2. Information Required

We need a number of items of information from you in order to facilitate the preparation of the Integrated Report which will be distributed to all eligible institutions by December 20, 1977. We will need this information by November 15, in order to use it effectively in our report.

a. Graduates (advanced degree) of your institution who specialized in some aspect of sheep and goal production and who now are living in less developed countries. We would like their names, addresses, and institutional affiliation.

b. The names and addresses of institutions in the less developed countries with which you have existing linkages. For the purpose of this activity we are interested only in those institutions that have some research capability in the area of sheep and goats.

c. Your ideas on production potentials and problems related to sheep and goats in developing countries, and the research needed to overcome production problems.

3. Information Attached

A copy of the State of the Arts Study on the Role of Sheep and Goats in Agricultural Development by the Winrock International Livestock Research and Training Center is included for your use. A letter of transmittal from the Agency for International Development is inserted in the study. Please note that the first paragraph mentions the Proceedings of a Workshop on the Role of Sheep and Goats in Agricultural Development. This report is not included because Winrock International previously sent copies to your library and the Chairman of your Animal Science Department.

This letter probably will be the only communication that you will receive from RTI before December 20, 1977, when the request for proposals is sent to you along with the Integrated Report. The short time (6 weeks) allowed for preparation of the proposal means that you will need to start thinking about it now. No time extensions will be granted beyond the January 31 deadline.

I look forward to receiving your suggestions in the near future and a proposal in January 1978, if your institution should be interested.

Sincerely,

Paul F. Mulligan

Paul F. Mulligan, Ph.D.
Project Leader

PFM:dt

RESEARCH TRIANGLE INSTITUTE
POST OFFICE BOX 12194
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27709

Office for International Programs

November 21, 1977

Dear Sir:

The Research Triangle Institute, on behalf of the U.S. Agency for International Development, has begun a six-month planning project that will result in a recommended collaborative research support program on small ruminants (specifically sheep and goats).

The thrust of the planning effort is twofold:

1. To identify problem areas where further research could be applied in improving the quality of life of very poor people in less developed countries. Since the overall interest in small ruminants focuses on their utilization in improving human nutrition, employment opportunities and income, relevant research spans all aspects from the production and management of sheep and goats to the demand for and cost of milk, meat and fiber.

2. To identify institutions in the U.S. and developing countries with the capabilities and interest in research involving sheep and goats. As presently conceived, the program will involve a consortium of U.S. institutions with linkages to LDC institutions.

While some research might be conducted in the U.S. independent of developing country institutions, the majority will require research in developing country locations. Work conducted in developing countries is expected to include basic as well as applied research (especially where location is critical), field testing, and in-service training.

This letter is to request your assistance in meeting the objectives of the planning project. More specifically, our questions are as follows: What research has been done/is being done in the management, production, nutrition, marketing, demand for, health of, etc. sheep and goats in your area of responsibility? Who is doing these projects? What are the

most pressing problem areas which need further attention? How do we assess what problems take priority? What are some of the locale-specific problems, with respect to specific environmental, cultural, or economic situations?

Reports of the State of the Art Study and conferences held at the International Livestock Research and Training Center in Winrock, Arkansas (1976 and 1977) on sheep and goats are being used extensively in determining the state of the art and locating institutions and individuals with expertise in this field. If you feel you would like to up-date or elaborate upon information included in these reports, especially in terms of new research underway and/or specific problem areas where you see a need for more research, this would assist us greatly. In addition, any linkages you or your institution have with U.S. institutions or other LDC institutions which might be relevant to planning future collaboration would be helpful.

As this planning phase is a short and intensive effort, all of this information needs to be gathered together no later than January 21. Your responsiveness will be greatly appreciated.

Sincerely,

Paul F. Mulligan

Paul F. Mulligan, Ph.D.
Economist

PFM/mja

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