

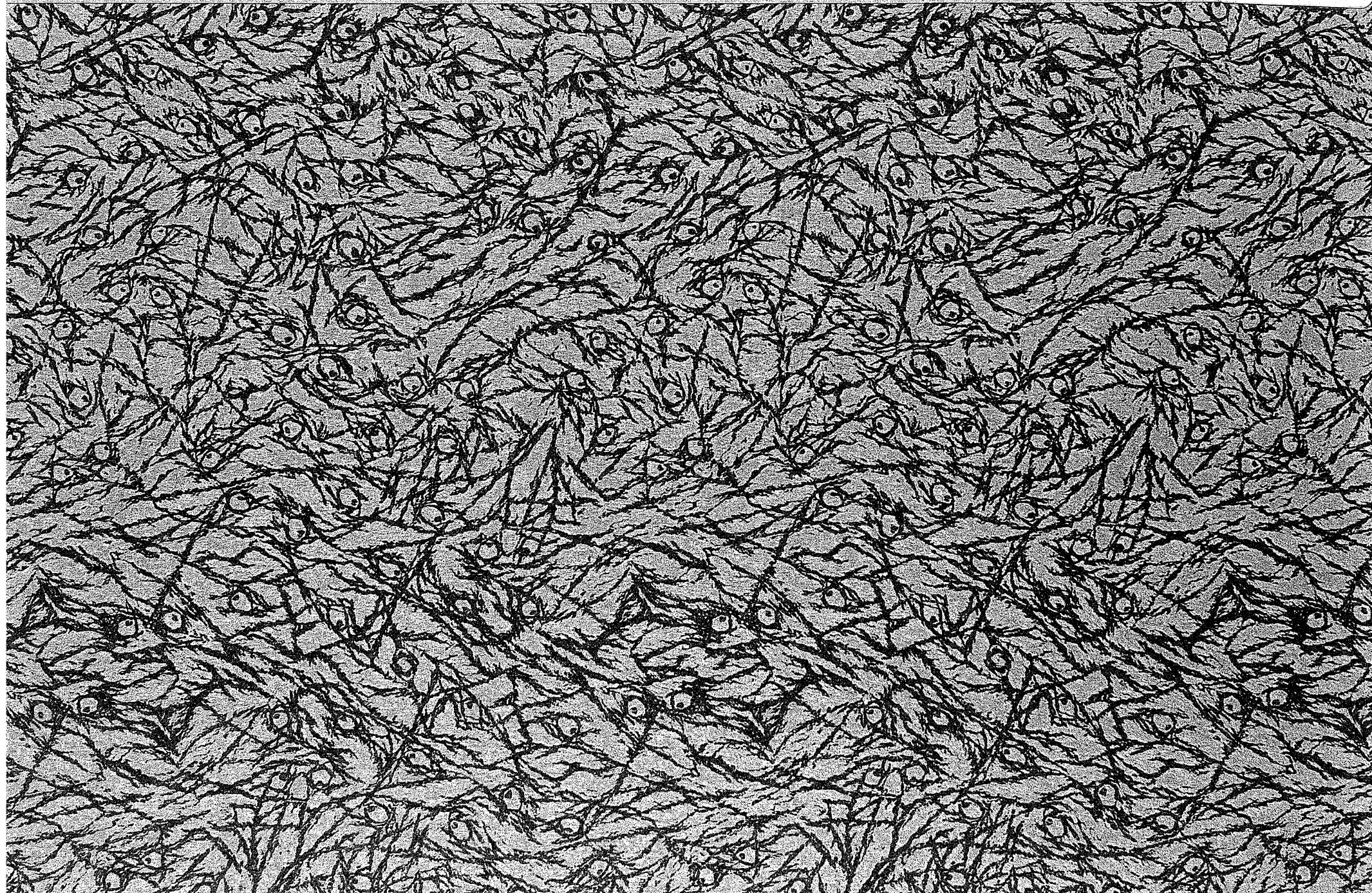
CRFD

Michu

Centred

D

105





SMALL STOCK, LARGE DIVIDENDS:  
SHEEP AND GOATS IN SUB-SAHARAN AFRICA

by  
Henri P. Josserand



---

CENTER FOR RESEARCH ON ECONOMIC DEVELOPMENT  
The University of Michigan  
Ann Arbor, Michigan 48109

---

Discussion Paper No. 105

October 1983

SMALL STOCK, LARGE DIVIDENDS:  
SHEEP AND GOATS IN SUB-SAHARAN AFRICA

by  
Henri P. Josserand\*

An earlier version of this paper appeared as part of a study entitled "Market Forces and Livestock Development in Africa," prepared for the World Bank, September 1982.

\* \* \*

Discussion Papers are preliminary materials circulated to stimulate discussion and critical comment. References in publications to Discussion Papers should be cleared with the author to protect the tentative character of these papers.

\* \* \*

\*Senior Research Associate, Center for Research on Economic Development,  
University of Michigan.

Discussion Paper No. 105, October 1983.  
Published by the Center for Research on Economic Development,  
University of Michigan, Ann Arbor, MI 48109, U.S.A.

## ABSTRACT

1. Over the last fifteen years, the Gross Domestic Product (GDP) of African nations has risen overall, but agricultural and food production per capita have declined.
2. Most of the progress in agricultural output has been due to increased cultivated acreage and higher herd numbers. Very little progress (20 percent) can be attributed to productivity gains.
3. In the aggregate, small ruminants (sheep and goats) make sizeable contributions to African economies -- in terms of meat, milk and skins, and through international trade. The consumption of mutton and goat meat in Africa, however, is still an overwhelmingly rural phenomenon.
4. Among pastoral groups, small ruminants insure complementarity in resource use and other benefits to herding families: risk spreading, flexibility in stock holding, dry season milk supply, etc.
5. Agropastoral groups and agriculturalists keep smaller herds overall, which are less carefully managed, and have a higher small to large ruminant ratio, and different objectives. Sheep and goats are treated as a readily convertible cash crop and as an occasional source of meat.
6. Key population, income and demand indicators show that African agriculture will have to undergo some basic restructuring if the food gap trend is to be reversed. At the same time, most African nations will not be able to afford an investment in agricultural productivity based uniquely on imported heavy equipment and fertilizers. There is little choice but increased reliance upon animal power for cultivation, processing, transport, and on manure for the maintenance or enhancement of soil fertility.
7. This will require a restructuring of the primary sector towards a much greater integration of livestock into agriculture, but this may itself create a gap in beef supplies, which could be filled by increased mutton and goat meat supplies.
8. The demonstrated great reproductive potential of small ruminants may be tapped with technically simple methods: deworming, controlled mating and selection, and wider use of traditional supplementary feed practices. Because sheep and goats are widely diffused throughout the countryside and span several production systems, a development strategy, even at the country level, should follow a decentralized, basic field-level approach rather than a concentrated, highly technical project-oriented one.
9. Small ruminants are part of a larger production system and should be treated as such in research programs. Research -- and development interventions -- should be diffuse, systemic, and take place at the producers' rather than the station level.

10. Finally, the demonstrated superiority of private marketing channels over public attempts to "rationalize" livestock marketing should be further recognized. Such channels should be treated as an asset and an active component of such a strategy.

#### RESUME

1. D'une manière générale, le Intérieur domestique Brut (PIB) des nations africaines a augmenté au cours des quinze années les plus récentes. Inversement, la production agricole et vivrière par habitant a diminué.
2. La plupart du progrès concernant la production agricole est attribuable à l'extension de la superficie cultivée et au croît des troupeaux. Très peu de progrès (20 pour cent) est imputable à l'accroissement de la productivité.
3. En somme, les petits ruminants (ovins et caprins) apportent des contributions importantes aux économies africaines - en termes de viande, lait et peaux, et à travers le commerce international. Néanmoins, la consommation de viande ovine et caprine en Afrique reste surtout un phénomène rural.
4. Parmi les groupes d'éleveurs, les petits ruminants assurent aux familles des éleveurs la complémentarité dans l'utilisation des ressources, aussi bien que d'autres avantages: atténuation des risques, flexibilité dans la structure du troupeau, alimentation en lait pendant la saison sèche, etc.
5. Par rapport aux éleveurs, les groupes agro-pastoraux et les agriculteurs détiennent des troupeaux plus petits, moins bien gérés, et dont la proportion de petits ruminants est plus élevée. Leurs objectifs diffèrent également. Ils considèrent leurs ovins et caprins comme des produits facilement convertibles en argent comptant et parfois une source de viande.
6. Les indicateurs clé sur la population, le revenu et la demande montrent que l'agriculture africaine devra subir une réorganisation fondamentale pour contrecarrer cette insuffisance en production vivrière. D'autre part, la plupart des pays africains ne pourront pas financer un investissement dans la productivité agricole qui s'axe uniquement sur le machinisme et les engrais importés. Il reste peu de choix sauf une plus forte dépendance de la traction animale pour le binage, la transformation, et le transport, et du fumier pour préserver ou améliorer la fertilité des sols.
7. Pour ce faire, il faudrait orienter le secteur primaire vers une intégration bien plus extensive de l'élevage et l'agriculture. Pourtant, ceci même pourrait entraîner une diminution de l'approvisionnement en viande bovine qui pourrait être compensée par une augmentation de l'approvisionnement en viande ovine et caprine.

8. L'on peut tirer profit d'une grande capacité de reproduction, avantage démontré des petits ruminants, par des méthodes techniquement simples: utilisation d'helminthiques, reproduction et sélection contrôlées, mise en pratique plus extensive des procédés traditionnels d'alimentation supplémentaire. Comme les ovins et les caprins sont dispersés à travers la campagne et comme le système de production diffère d'une région à une autre, une stratégie de développement, même au niveau d'un seul pays, serait décentralisée plutôt que concentrée et s'orienterait vers une approche sur le terrain plutôt que vers des projets d'une haute technicité.
9. Les petits ruminants font partie d'un plus grand système de production, un fait dont les programmes de recherche devraient tenir compte. Il faudrait que la recherche -- et les actions de développement -- soient diffuses, systémiques, et réalisées au niveau du producteur plutôt qu'au niveau de la station.
10. Finalement, serait plus reconnue la supériorité démontrée des réseaux commerciaux privés sur les tentatives gouvernementales de "rationaliser" la commercialisation de bétail. Il faudrait considérer ces réseaux comme des avantages et comme une partie active d'une telle stratégie.



TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT. . . . .	iii
LIST OF TABLES. . . . .	ix
INTRODUCTION. . . . .	1
I. THE AGRICULTURAL AND FOOD SITUATION IN AFRICA . . . . .	1
II. THE CONTRIBUTION OF SMALL RUMINANTS TO AFRICAN ECONOMIES. . . . .	3
III. MAIN SYSTEMS IN THE LIVESTOCK SUBSECTOR . . . . .	8
A. Primarily Pastoral Societies. . . . .	8
B. Agropastoral and Agricultural Societies . . . . .	11
IV. KEY TRENDS. . . . .	13
A. Population and Demand . . . . .	13
B. Agricultural Systems. . . . .	14
V. STRATEGIES FOR SMALL RUMINANTS' DEVELOPMENT . . . . .	15
A. Institutions and Infrastructure . . . . .	16
B. Genetic and Biological Potential and Health . . . . .	19
C. Research and Training . . . . .	21
APPENDIX. . . . .	23
REFERENCES. . . . .	29

LIST OF TABLES

	<u>Page</u>
1. Relative Distribution of Ruminants. . . . .	4
2. Meat Production of Livestock. . . . .	5
3. Fluid Milk Production of Livestock. . . . .	5
4. Regional Average Income Elasticities of Demand. . . . .	14
A1. 1979 Production of Meats for Africa . . . . .	25
A2. 1979 Fluid Milk Production for Africa . . . . .	26
A3. 1979 Production of Wool, Hides and Skins for Africa . . . . .	27
A4. 1979 Exports of Livestock and Meat Products for Africa. . . . .	28

## INTRODUCTION

This paper first seeks to place sheep and goat raising and their use within the context of the current agricultural and food situation in Africa. The contribution of small ruminants to African economies -- in terms of meat and meat products, milk, wool and skins, as well as their place in international trade -- are also examined. Our attention is then focused on past and current patterns of ownership and use, both among herding societies, and agropastoralists and agricultural societies. Key trends in population, demand and agricultural systems are examined, with the conclusion that by and large, African nations will have little choice but to make serious efforts to further integrate livestock into their crop production systems. The implications for the demand for mutton and goat meat are also examined. A proposed type of strategy based on past project experiences and on our understanding of current systems and the influence of market forces, follows.

### I. AFRICAN AGRICULTURE AND FOOD SITUATION

The Gross Domestic Product (GDP) of tropical African nations rose by an average 4.3 percent annually from 1970 to 1977, but agricultural production between 1970 and 1975 increased by only 1.2 percent per annum. Agricultural food imports for the 1963-1975 period, on the other hand, rose by 6 to 7 percent annually in real terms. A recent USDA report (1981) much in agreement with similar studies from the World Bank, International Livestock Centre for Africa (ILCA), and others, states that:

Sub-Saharan Africa is the only region in the world where per capita food production declined over the past two decades. In most Sub-Saharan countries, per capita calorie intake is below minimal nutritional standards. Demand for food imports is increasing at a time when grain prices are rising, and many African governments face acute balance of payments and foreign exchange problems.

This and other reports stress that much of the problem lies on the supply side and that production and supply systems have continued to display the traditional emphasis on cash crops produced for external markets:

Even in countries where production did grow more rapidly, progress in both crop and animal production appears to have resulted primarily from an expansion of the area under cultivation and from higher livestock numbers, with very little progress resulting from improved productivity, with the possible exception of some cash crops and the poultry sector. Despite a few high growth rates, fertilizer consumption remains at levels which are still too low to allow any substantial improvement in crop yields, while in several regions the land use pressure often appears to have risen above the threshold dictated by the low technological level of African agriculture (ILCA, 1981).

In general, African agriculture is constrained much more by limits on labor, and labor's low productivity, than by lack of arable land. The overall R-factor (or ratio of land actually cultivated to total potential arable land) is low for Africa as a whole, but it varies considerably -- from 0.003 to 0.6 (in Nigeria alone) to 0.9 (in the East African highlands). The approach chosen in many cases has been to expand the amount of land cultivated, and displace labor from higher to lower population density areas. This has been done under a variety of guises: new settlements, land reclamation, river basin development, etc. Since Africa is the continent with the highest endowment of permanent grazing land, one might think that increases in land put under cultivation would have little or no effect upon livestock raising. Actually, all the available evidence, sketchy as it may be, points to the contrary: there are virtually no instances in Africa where significant land development schemes did not have some impact on livestock production, even in nations like Mali, where the ratio of grazing to arable land is 15 to 1 (Winrock, 1981). In some cases, the mobility of herders has been reduced, not so much because of the extra land tilled, but because newly developed land is, more often than not, strategically located with respect to bodies of water or in the thoroughfare of traditional transhumance patterns.

The overall impact of increased tillage cannot be observed directly; too many changes take place simultaneously. Whether "new lands" consist of marginal areas suitable for low productivity dryland cereal cropping or for highly developed river basin schemes, herders' mobility becomes impaired, and the productivity of the affected traditional herds drops. The patterns of herder-farmer interaction (milk-millet barter, management of farmers' cattle, grazing stubble in exchange for manure on the fields, etc.) are disturbed. A new equilibrium in the system of herder-farmer interactions may eventually be

reached, but not without time, effort, and possible changes in economic or social status. The impact of such changes is felt in herd management, size, and composition; new groups may become livestock raisers, in ways differing from established customs. The point here is obviously not to lament the disappearance of an "old" system, nor to denigrate prima facie the dynamics of change in the primary sector, but to stress the close linkages between agriculture and livestock and to be aware of the consequences which interventions in one subsector may have on the other.

## II. THE CONTRIBUTION OF SMALL RUMINANTS TO AFRICAN ECONOMIES

Small ruminants are found in most subregions of the African continent, but their distribution and the sheep-goat mix are not naturally even. Half of all sheep and goats are estimated to be in northern Africa and the Sahel, with the next highest concentration being, not unlike the case of cattle, in Ethiopia, Somalia, Kenya, Sudan and Tanzania (close to one-third of all sheep and goats, cf. ILCA, 1981; Winrock, 1977). Although the proportion of small ruminants to total livestock is high on the west coast and in Central Africa, absolute numbers are low -- the only notable exception being Nigeria. One may lend some credence to estimates of relative distribution over the continent, while admitting that absolute numbers quoted are more often than not wide of the mark. The accepted fact that data on agricultural production are -- imperfect as they may be -- more accurate than estimates of livestock numbers applies with a vengeance in the case of small ruminants. Because of their wide distribution, high flock dynamism, and the greater extent to which they may be transported by nonspecialized means and channels, it is much more difficult to assess both the status and change of small ruminant flocks than to make similar estimates for cattle herds. Official estimates of sheep and goat numbers are not uncommonly revised upwards by a factor of 1.5 or 2 after careful sampling.

The various breeds of sheep and goats found in Africa have adapted to different environments. For sheep, they range from the northern African fat-tailed, coarse wool variety to the leaner, tall Red Masai or Fulani. Similarly, goat types vary from the long-legged Nubian and Jamnupari in the north, and the Galla of East Africa, to the west coast dwarf variety, hardly larger by adult age than an oversized cat. The ethnology of small ruminants is relevant for considering environmental constraints to growth and

management, and the animals' contribution to the herding family or other economic agents.

Small ruminants play a large -- and by some accounts increasing -- role in African economies. The following data on herd sizes, production, and trade relate to twenty-six selected African nations, including Sahelian states and such other major livestock-producing countries as Ethiopia, Sudan, Tanzania, Kenya, Somalia, and Botswana. (See also the more detailed tables in the Appendix.)

Small ruminants are significant in absolute numbers, and relative to cattle: against the standing cattle herds of some 104 millions in these countries, there are 84.6 million sheep, and 87.4 million goats (Winrock, 1981). The relative distribution of ruminant livestock by agroclimatic zones over Africa in general is given below:

TABLE 1  
RELATIVE DISTRIBUTION OF RUMINANTS

Agroclimatic Zones	Small/Large Ruminants Ratio	Goats/Sheep Ratio
Arid	2.7	1.4
Semiarid	1.2	1.4
Subhumid	1.0	1.4
Humid	2.6	1.4
Highlands	1.1	0.6
TOTAL	1.5	1.2

SOURCE: ILCA, 1981.

In terms of meat production, the contribution of the various livestock species in the 26 selected countries may be summarized as follows:

TABLE 2  
MEAT PRODUCTION OF LIVESTOCK  
(000 MT)

Beef	Mutton & Goat Meat	Pig Meat	Poultry Meat	TOTAL
1,246 (56%)	598 (27%)	122 (5%)	274 (12%)	2,240 (100%)

SOURCE: Winrock, 1981. On the other hand, ILCA (1980) citing FAO estimates, contends that small ruminants contribute as much meat as cattle in tropical Africa, on the basis of a 29 percent offtake rate for sheep and 30 percent for goats, with yields per flock unit of about 4 Kg carcass weight for sheep and 3 Kg for goats.

As for meat, small ruminants contribute a great deal to total fluid milk production among the same group of nations, with goats having a clear and well-documented advantage over sheep (i.e. Dahl and Hjort, 1976), in this respect:

TABLE 3  
FLUID MILK PRODUCTION OF LIVESTOCK  
(000 MT)

Cow Milk	Sheep Milk	Goat Milk	TOTAL
4,185 (73%)	398 (7%)	1,127 (20%)	5,710 (100%)

SOURCE: Winrock, 1981.

Most African countries export live animals rather than fresh, chilled, frozen or otherwise processed meats. Notable exceptions are Botswana (\$76 million in meat exports in 1979), Kenya (\$10 million), Swaziland (\$5.7 million), Cameroon (\$2.6 million) and Ethiopia (\$1.3 million); these meat

exports primarily consisted of beef. The total value (in exports of live animals from these twenty-six countries) in 1979 reached \$100.7 million for cattle exports; the comparable figure was \$118.8 million for live sheep and goats (Winrock, 1981). Naturally, these figures include both inter-African trade and exports to the Middle East and other regions.

The importance of small ruminants to African economies may be further appreciated through a brief survey of overall demand and consumption patterns. Considering small ruminants as sources of meat and meat products, there is ample evidence from several African regions that meat demand has been, and remains, strong (Delgado, 1980; Eddy, 1979; Josserand, 1980; Staatz, 1979; ILCA, 1981). This is due to (i) a combination of increased urbanization and higher urban incomes in parts of Africa, leading to large domestic and international trade movements (i.e. from Sahelian nations to the west coast), and (ii) the sharp rise in incomes among oil-producing Near East and Arabian Peninsula states.

Within the continent itself, the patterns of demand and consumption in cities and rural areas are quite different and must be examined in turn, but first an estimate of the extent to which town and country share the various meat products will be made. Given the general paucity of data and disparities between regions, only an order of magnitude can be derived, but the exercise is still worth doing. The basic assumptions are that African populations are roughly divided in a 3 to 1 proportion between rural and urban areas, and that beef, which provides about 56 percent overall of meat consumption on the continent, is almost exclusively consumed in towns and cities (using 80 percent as an approximation). Poultry and pig meat together contribute 17 percent overall to domestic meat supplies, and may be divided equally between town and country, implying that per capita consumption of poultry and pork is three times higher in urban than in rural areas. The question then becomes to find what proportion of domestic sheep and goat production is absorbed by urban and rural households. Several studies on domestic meat consumption in Africa (Delgado, 1980; Josserand, 1980; Staatz, 1979) have found the ratio of total meat consumption per capita in urban versus rural areas to be in the vicinity of 4 to 1. On that basis, rural families would be relying on sheep and goats for meat consumption to such an extent that 80 to 90 percent of small ruminant domestic production must be absorbed by rural areas. (Delgado, 1980, quotes estimates of 90 percent for Mali, a Sahelian exporter of sheep



and goats to Ivory Coast, Senegal and Algeria.) For Africa as a whole, mutton and goat meat are estimated to make up roughly 50 percent of total rural meat consumption, excluding game. Along the west coast and in Central Africa, however, game constitutes a major -- although declining -- rural source of animal protein (see ILCA, 1981). One must realize that this overall pattern applies equally well to nations in a surplus situation with respect to small ruminants and to those in an equilibrium situation. In the case of large importers like Algeria, Ivory Coast, and Libya, major cities tend to absorb sheep and goat imports, while small towns and rural areas take up most of the domestic output.

As an urban phenomenon, the mutton and goat meat trade displays several interesting features, some being linked to consumers' preference for mutton and goat meat over available substitutes. First, and with the admittedly notable exception of Nigeria, mutton and goat meat prices have consistently remained above the price of beef (25 to 30 percent premia being common) and at least on a par with the weight-equivalent cost of poultry (Delgado, 1980; Eddy, 1979; Josserand, 1980; Staatz, 1979; ILCA, 1981). In addition to considerations of taste and variety in diet, consumers' preference often stem from cultural or religious factors. The ceremonial use of sheep to celebrate the Tabaski and other Moslem holidays is the example most frequently cited in the literature. Tabaski induces such a sharp increase in demand for sheep (solid white rams at a premium) that live small ruminant prices can double as the holiday approaches. People commonly purchase animals a month or two in advance, either to avoid, or take advantage of, the price rise which never fails to take place a few days before the feast. Most people also buy rams and wethers in advance to properly fatten the animals; naturally the prestige derived from having a suitable sheep pegged and finished in one's courtyard for some weeks is also quite significant.

Another factor contributes to demand for small ruminant meat: the partly countercyclical supplies of mutton and goat meat with respect to beef. Because mating and births are more evenly spread throughout the year for small than for large ruminants, offtake from sheep and goat flocks is more even than is the case for cattle herds; it may actually increase during the dry season, a time during which herders are reluctant to put cattle on the market but need to purchase grain. In that sense, sheep and goats usually "take up the slack" in domestic beef supply (cf. Delgado, 1980; Niamir, 1982).

The question is sometimes posed, what differences exist between preferences for sheep and for goats? There can be no general and definitive answer. Sheep are preferred by Moslems for ceremonial purposes, some groups prize the leaner goat meat over mutton while others do the opposite, and in many cases local sheep and goats are morphologically so similar that buyers of small cuts are not certain of what they are getting at the market.

### III. MAIN SYSTEMS IN THE LIVESTOCK SUBSECTOR

#### A. Primarily Pastoral Societies

The role of small ruminants among groups with a primarily pastoral vocation is examined in this section. Sheep and goats appear as an essential component of such herd management tactics as flexibility, risk spreading, diversification, and complementarity in resource use.

Among primarily pastoral societies (i.e., organized herding groups deriving most of their sustenance directly from livestock use, sales, or exchanges), few raise small ruminants exclusively. Dahl and Hjort (1976) cite only a few nomadic groups in Iran and East Africa as those being involved solely in sheep or goats. By the same token, one is rather hard-pressed to give examples of pastoral groups relying only upon large ruminants; even a camel and cattle association rarely excludes sheep and goats. In fact, camel-goat combinations often dominate in very arid environments. Primarily pastoral groups make extensive use of rangeland located in arid and semiarid areas. Given the constant uncertainty they face in the timing and distribution of rainfall, and availability of water and forage, they follow a herd management approach based on flexibility and adaptation to changing conditions. This approach itself requires two tactical components: (i) mobility of the herds, including separating animals of the same species in several mobile groups, and (ii) a diversified "stock portfolio". Mobility, dictated by the changing environment, constitutes a response to physical and biological considerations. Stock diversification is a more complex matter, achieving both physical and economic objectives. (In the relevant literature, Dahl and Hjort, 1976; Eddy, 1979; Sandford, 1981; Sutter, 1982; Swift, 1979, readily come to mind.) Herds are mixed partly to insure complementarity among species in range utilization. Although sheep compete to some extent with cattle for graze, goats browse on forage not normally used by other animals

(see McCannon et al., 1981). Goats also make the herding of a flock of sheep much easier (Dahl and Hjort, 1976; Swift, 1979). Herds are further mixed because the differences between large and small ruminants in patterns of weight change and breeding throughout the year are all-important. For instance, cattle lose a lot of weight during the dry season, and do not gain it back until well into the rainy season. Herders, therefore, find it more advantageous to keep a head of cattle intended for sale until the rainy season, even though the price per pound of cattle on the hoof rises during the dry season. Small ruminants, however, do not lose as much weight (particularly hardier, leaner goats), so that small ruminants, as noted above, take up a great deal of slack in dry season meat supply. The effect is advantageous both to herders, by providing an alternative source of dry season income, and to consumers, by dampening the overall dry season increase in meat prices. Naturally, the better the traditional marketing system works, the more beneficial to all this characteristic of small ruminants becomes.

In addition to cash from dry season sales of sheep and goats, the family keeping small as well as large ruminants insures for itself a more constant supply of milk over the year than if it had followed a single-species herding strategy. Several authors have shown (e.g. Dahl and Hjort, 1976; Eddy, 1979) that a herding family might well derive more milk in toto from the exploitation of a cattle herd, but that availability of fresh goat milk to the family during the dry season is worth the loss in aggregate quantity over the year. Swift (1979) ably summarizes the various advantages derived through proper management of goats as a pastoral herd component in Niger:

The breeding cycles of Illabakan and Kel Adrar goats are regulated differently from sheep, reflecting the different ecological requirements and economic utility of goats. In a normal year the does naturally come into oestrus early in the rainy season, and the kids are born from September to January. For ewes and lambs, which particularly need grass at the period of maximum stress during lactation and at weaning, there is an ecological advantage for births to take place during the rainy season, when grasses grow rapidly. But goats browse by preference on the shoots, seedpods and fruits of bushes and trees, which are most abundant in the cold season. Thus goats do well to produce kids in the dry season, since there is plenty of the goats' preferred food during lactation, and the kids have the right food at weaning. This timing also provides goat milk for pastoral households during the cold and hot seasons, when milk from other animals is scarcest."

In this respect, one should keep in mind that the amount of grain pastoralists are able to grow during the rainy season often provides no more than three months' supply for the family. During the rest of the year, herding groups: (i) trade grain for milk, or (ii) buy grain and other food items (two-thirds of annual money income is commonly spent on food; Sutter, 1982), or (iii) subsist chiefly on milk and other animal products. The importance of securing a goat milk supply for the family during the dry season, when grain supplies are critically low among farmers as well as pastoralists, is quite clear.

Much has been made in the literature (Brandstrom et al., 1979; Dahl and Hjort, 1976; Eddy, 1979) of the extent to which people rely on small ruminants to build up a family herd, starting from a very small investment, or reconstitute household wealth after livestock losses provoked by a drought or epizooties. Indeed, small ruminants require a modest initial investment, multiply much faster than cattle, and although disease can decimate a flock, the risk may be reduced through dispersion as soon as flock size becomes large enough. But small ruminants are not, among pastoralists, necessarily "just the small herder's stock". Studies of pastoral groups in East Africa and the Sahel have shown that species diversification is a strategy followed by small and large herd owners alike, especially in more recent times, where social interdicts on the ownership of certain species by certain groups have virtually disappeared (cf. ILCA, 1981; Sutter, 1982; on the first point; Sabry, 1972; Swift, 1979; on the second). For small stockowners, sheep and goats provide the means for later adding cattle or other species to their flocks. For both large and small herd owners, the importance of a dry season milk supply has been emphasized.

Finally, small ruminants allow large herd owners to put part of their stock into "risky" investments, and thus follow in Sandford's words (1981), an "opportunistic" strategy. A conservative strategy aims to limit the size of the herd raised in a given region, to the level this region can support even in very bad years; this approach implies risk avoidance and stability both for the range and herds, finding favor among some planners. Individual stockmen, however, are less interested in herd management at a "safe, stable, level" than in deriving as much benefit as possible from their own animals. This does not necessarily mean they adopt shortsighted strategies leading to large stock buildups, overgrazing and system collapse. Herders are acutely aware of environmental change and uncertainty, but they want to be able to take full

advantage of favorable conditions when they do occur. At the same time, they realize that favorable conditions do not usually persist, and that unless they can adjust herd location, size, and composition in time, the benefits accrued under favorable circumstances will be more than offset by losses once the conditions have changed. Just like investors in a booming market, they seek high-yielding investments, but they can do so without serious risk to themselves and the whole market only if they have a varied portfolio, and can get in and out of certain stocks tolerably quickly. It is clear that the success of the herders' opportunistic strategy requires asset mobility and access to efficient marketing or exchange channels (among pastoral groups, and between pastoral and other groups).

Even with mobility and access to efficient marketing exchange channels, it ought to be recognized that "accidents" will occur. Just as occasional "crashes" in a commodity market can be attributed to imperfect foresight on the part of investors, occasional crashes do, and will, occur in the traditional African livestock subsector. At the same time, however, two points should be underscored: (i) individual herders (just like individual farmers or fishermen) strive to improve their own lot rather than pursuing a social objective of risk avoidance and stability, and (ii) given their preference for an "opportunistic" strategy, limits on their mobility, diversification efforts, and access to efficient marketing and exchange channels will heighten the probability of "accidents" in their subsector. Because small ruminants provide diversification in investment, high (though usually risky) returns, and high liquidity or convertibility, these animals constitute a very practical instrument of "opportunistic" herd management among pastoral groups.

#### B. Agropastoral and Agricultural Societies

This section highlights basic differences between pastoral and agropastoral groups, in terms of their livestock strategies, the relative importance of animal husbandry in the production system, and the species mix dictated by local conditions.

The distinction between primarily pastoral, and agropastoral and agricultural societies is no sharper in Africa than elsewhere. However, it is known that agropastoralists occupy less arid lands than do "pure" pastoralists, and that in fact, the stock kept by agropastoralists in many of the northeastern, eastern and southern African countries makes up the bulk of

the total livestock population (Brandstrom et al., 1979). Because of their environment and more sedentarized character, agropastoral groups also display a much higher density of both human and livestock populations than is observed among pastoral societies, and the average agropastoral herd is much smaller than its equivalent among pastoral people.

There does not seem to be much difference overall in species mix between pastoral and agropastoral groups. Admittedly, pastoral groups living in arid areas have a very high small to large ruminant ratio (due to the importance of goats), but most pastoral and agropastoral groups are found in the semiarid and subhumid zones, where the respective herd mixes are similar. The difference in basic strategies is much more significant. For pastoral groups, livestock constitutes a factor of production, a source of food, and a medium of investment and saving. Agropastoral people further see it as a useful medium for the conversion of agricultural surplus, and an indirect factor of production for agriculture (manure, draft, labor through bride acquisition). To a lesser extent, livestock may be also considered as an insurance against crop failure (see Brandstrom et al., 1979, on East Africa). Agropastoral groups keep small ruminants essentially for the same reasons as do pastoral groups: e.g., diversification for risk spreading; ready source of cash; complementarity in resource use and supply of food to the family.

Primarily agricultural groups derive most of their food and money income from cultivation. In subhumid zones, the amount of livestock they manage is usually limited by the local availability of grazing land and farm labor requirements, so that the livestock to man ratio is quite low. Agriculturalists hold some cattle for draft, occasionally fatten steers over the dry season, and may possess small ruminant and other small stock, mostly as a readily convertible cash crop. Often, when agricultural families do decide to own cattle as a form of saving or investment, these are entrusted to nearby pastoral or agropastoral groups for management. There is commonly a fair amount of interaction between agriculturalists, pastoralists and agropastoralists; e.g., millet-milk exchange, manuring fields, use of stubble, and herding services.

In humid zones, such as the west coast or Central Africa, a great deal of farming is done as shifting cultivation, so that there is apparently more land and forage available per family than in drier areas. Actually, humid zones do not currently support much livestock. Trypanosomiasis, parasites, infectious and respiratory diseases account for part of this; forage, although abundant,

is low in quality (especially for large ruminants), and the labor requirements of herding animals rather than following the current "free-roaming" practice can be substantial. For these reasons, the current species mix for the humid zone livestock displays a very high degree of small ruminant specialization (see Table 1), e.g., the unsupervised "Guinean" and "dwarf" goat, and a fair proportion of pigs raised in tropical Africa.

As one shifts from subhumid to humid zones, the role of livestock among farming groups becomes less and less integrated into the crop production system, and less important overall. In both cases, small ruminants are considered only as readily convertible savings, and as an occasional source of meat. Contrary to agropastoral and pastoral groups, small ruminants are not herded, no breeding control or selection is carried out, and little veterinary care (admittedly less common than in the case of large ruminants, even under pastoral conditions) is extended.

#### IV. KEY TRENDS

##### A. Population and Demand

A general continuation of current population trends over the next twenty years or more is expected:

According to estimates by the United Nations Economic Commission for Africa (ECA), the average rate of population growth in tropical African countries has increased from 2.6 percent to 2.62 percent between 1970-75 and 1975-80, and will rise to 2.86 percent in 1980-85 and 3 percent in 1985-90. It may thus be assumed that the population growth of the region will be close to 3 percent for the coming 20 years. On this basis the population of tropical Africa will be over 600 million in the year 2000, as against 335 million today. Population increases will be highest in Sudan and Nigeria, but lower in the Sahel countries. Population growth will tend to accelerate in Central Africa. On the other hand the increase in urban population, which is at present from 1.7 to 2 times faster than in the population as a whole, will continue at a pace similar to that of the past (ILCA, 1981).

Demand for food products is, therefore, likely to remain quite strong, especially for livestock and livestock products, which have relatively very high demand elasticities with respect to income, as indicated below:

TABLE 4

REGIONAL AVERAGE INCOME ELASTICITIES OF DEMAND  
FOR SELECTED PRODUCTS, 1975-2000

Region	Cereals	Meat	Milk	Eggs
Sahel	0.23	0.92	0.75	1.4
West Africa	0.21	1.08	1.20	1.2
Nigeria	0.16	1.08	1.20	1.2
Other	0.33	1.08	1.23	1.1
Central Africa	0.51	0.97	1.09	0.9
Eastern Africa	0.29	1.01	0.77	1.1
Southern Africa	<u>0.14</u>	<u>0.84</u>	<u>0.95</u>	<u>1.0</u>
TROPICAL AFRICA	0.22	0.98	0.82	1.1

SOURCE: Adapted from ILCA, 1981, Table 26.

According to a conservative scenario, the yearly rates of growth in per capita demand over the 1975-2000 period are: (i) 1.2 percent for meat; (ii) 0.8 percent for milk; (iii) 2.2 percent for eggs; the growth in demand being highest in non-Sahelian West Africa and Central Africa (see ILCA, 1981, Table 28).

#### B. Agricultural Systems

Given growth trends in population and demand, the production patterns followed over the past fifteen to twenty years will not be adequate to meet requirements. Increases in productivity must be achieved, but these imply -- in addition to economic incentives -- a great deal of technological change: improved seed varieties, better on- and off-farm storage, increased mechanization, and greater use of fertilizer or other methods to conserve and enhance soil fertility and moisture retention, etc. It is increasingly obvious and widely recognized that African nations cannot afford to make an investment in heavy agricultural equipment and chemical fertilizer of the size required to do the job, nor should they when the alternative of further integrating livestock into agriculture is available -- not without cost, but at a cost lower than for any other option.



The costs attendant on such an integration policy, when and where it can practically be implemented, arise from the reorganization of both cropping and animal husbandry systems. In agriculture it will necessitate: new cultivation methods, light draft equipment, fences, reallocation of family or communal labor to herding, sometimes even provisions for dry season forage, and last but not least, substantial changes in attitudes, both at the institutional and individual levels.

In the livestock subsector, integration may involve shifting an increasing proportion of cattle herds to the development of animal traction. While certain authors (e.g. Sleeper, 1979) believe increased use of draft oxen, perhaps combined with on-farm fattening, should have no impact on herd composition and offtake, a comparison of sedentary and pastoral herds in Ethiopia (which has almost 60 percent of the draft oxen used in tropical Africa) suggests otherwise:

Using the cattle herd to promote animal traction for example, would require a sharp increase in the number of adult males (draught oxen), and would therefore involve a drop in the number of breeding females, leading to a potential fall in milk and meat output. Thus herd offtake was estimated at 6.5 percent in the highlands of Ethiopia, where animal traction is highly developed, as against almost 10 percent in pastoral production areas while the percentage of breeding females was estimated at 28 percent and 39 percent, respectively (ILCA, 1981).

Under current conditions, and for the medium term, a greater use of large ruminants in agriculture would induce African populations to further rely on sheep and goats as a source of meat. The development of larger and more productive flocks of small ruminants thus does not appear merely as a laudable goal in itself, but also possibly as a requirement for an overall expansion in agricultural output.

#### V. STRATEGIES FOR SMALL RUMINANT DEVELOPMENT

This section addresses: institutional and infrastructural issues; questions of genetic and biological potential and animal health; and issues of research and training. In each case, a brief review of the experience of development efforts to date will be included; from this, our understanding of the systems and our view of expected trends, a set of objectives will be

derived. Finally, recommendations on how to overcome constraints perceived as lying in the way of these objectives will be offered.

#### A. Institutions and Infrastructure

Critical evaluations of livestock projects in Africa now make up an increasingly voluminous body of literature (see Gall, 1981; Hoben, 1979; Honadle and McGarr, 1979; Sandford, 1981, etc.). This literature points out that problems for both host countries and donors have stemmed from:

- i) incorrect assumptions about the workings of livestock systems and their links to the rest of the primary sector and the economy at large;
- ii) a misperception of and a lack of reconciliation between the diverse interests existing among the various groups involved;
- iii) the consequent use of inappropriate inputs and outputs [related to (i) above];
- iv) a rather narrowly technical orientation;
- v) a lack of reliance upon the inherently positive factors of systems targeted for intervention; i.e., the knowledge and experience of herding groups, the leverage available in local sociopolitical structures, etc.

Hoben (1979) emphasizes that problems stem from basic misconceptions at the design stage rather than shortcomings in implementation. Even with due regard to the great difficulties commonly encountered in project execution, one can agree with him that: "...livestock projects appear to suffer similar difficulties in regard to effectiveness, regardless of the quality of their management."

There has been, both on the part of African and outside institutions, a pronounced bias both in favor of large ruminants versus other domesticated animals, and meat as an output of economic value large ruminants, rather than other benefits derived from the herds. There has also been a lack of concern for existing and potential interactions between animal husbandry and cropping. The chasm between agriculture and livestock raising in institutional, administrative and project logic remains wide. Some of the reasons for this are obscure, but many are readily apparent. The emphasis on cattle springs from the fact that they represent a more concentrated and "obvious" target than small ruminants. Beef also constitutes a larger share of urban meat consumption. Many African governments have considered that they

had a fair chance of controlling cattle movements across borders, for political or economic reasons; small ruminants have been another matter altogether. Finally, sheep and goats are spatially less concentrated than cattle and thus much harder to reach for censuses, animal health and other extension services. The end result has been a situation where domestic and foreign resources in research, project activities and infrastructure went mostly to cattle. (African governments allocate an average of only ten percent of total livestock budgets to small ruminants; Winrock, 1977.)

Small ruminants are scattered all over African countries, and the size of individual flocks is quite small, making the task of "reaching the target population" even more difficult than for cattle. Whereas a heavy administrative and physical infrastructure is hardly justifiable on economic grounds in the case of cattle, it becomes patently impossible when sheep and goats are concerned. The type of activity carried out in parts of Kenya, for instance, where bomas (simple buildings) have been built expressly for goats belonging to women's associations, is impractical on any but the smallest scale. Aside from particular instances of organized fattening near large urban areas, the thrust of activities will have to go very much counter to established tendencies; it will have to include a major decentralization of activities.

Even if one assumes some budgetary reallocation to small ruminant development, the limited resources available will force this diffuse approach to be quite basic, and to rely as much as possible on existing local resources and talents (public and private). In addition, the diffuseness of small ruminants throughout each nation will imply that no single decentralized master plan is going to work, because activities will have to span a number of production systems, from primarily pastoral groups managing mixed herds and flocks, to sedentarized farmers in humid zones owning only a few sheep or goats.

On the positive side of the issue, one should recognize that investment in small ruminants will show much quicker payoffs than in the case of cattle. Payoffs will be quicker because of biological parameters, such as fertility, prolificity, etc. (See the next section on "genetic and biological potential and health".) The payoffs may also be larger than in the case of cattle because there has been so little previous investment in sheep and goat husbandry that returns to expenditures (if suitably basic and diffuse) will be much superior, at the margin, to similar expenditures on large ruminants.

A typical "institutional" strategy for small ruminants development should thus include the following six points:

1. African governments must assess the current and potential role of small ruminants, in the light of needed restructuring in the primary sector.
2. Although the infrastructure in livestock development projects is invariably too heavy, institutions themselves are weak, and are primarily geared to address specific, concentrated and technical tasks. Some attitudinal change must be encouraged and promoted.
3. Given the diffuseness of small ruminants, and thus the diversity of suitable approaches, a development strategy for sheep and goats cannot be based on a "project approach". With a few exceptions (see point 5 below), decentralized interventions will be required.
4. In view of resource constraints, decentralized and flexible interventions will have to: (i) be basic, (ii) involve local resources and talent, and (iii) rely partly on existing outreach structures. An example of "basic", is the simplest health interventions (deworming, vaccination, and deticking) provided at cost, on a voluntary basis, and advice on the elementary control of mating and breeding cycles. The specifics should be worked out in the various cases in the way described below in the "research and training" section. In many cases, the agricultural extension service is better organized and has had more experience with village-level extension work than have livestock services or agencies. Given that most small ruminant owners are at least partially involved in agriculture, and given the basic character of needed interventions and the greater integration sought of agriculture and animal husbandry, a much greater cooperation between the two types of agency, at the field-level, will be required.
5. In addition to the general, diffuse strategy outlined above, there are a few specific areas with great development potential, more amenable to a "project approach". These consist of short-term fattening near urban areas, and increased marketing of sheep and goat skins. Demand for mutton and goat meat is expected to increase sharply in urban areas, because of population and income trends, and a possible reallocation of some cattle to nonbeef uses. As mentioned, demand for mutton is also extremely strong in connection

with Moslem ceremonies. There are already a few private enterprises profitably fattening sheep and goats for urban markets. In our view, small ruminant fattening offers two major advantages over cattle: (i) the initial investment required is much smaller, and (ii) the supply of animals is a lot more constant throughout the year. The encouragement of small- and medium-scale private sheep and goat fattening near large urban areas should therefore be a valid component of a livestock strategy.

The same is true for the processing of skins, especially in East Africa, the Sahel, and coastal West Africa. Although the basic infrastructure for the treating and tanning of skins is available in many countries where sheep and goat skins are not consumed as food, there are serious problems with the quantity and quality of skins delivered to and coming out of tanneries. The difference between what African nations now receive for skins and what they could obtain on the world market with a better product, appears well worth an incentive-based change in handling between the butcher and the tannery. (Export earnings could increase by a factor of 2.36 for hides and of 3 for skins according to UNCTAD, 1974 as cited in ILCA, 1981.)

6. Finally, government should refrain from trying to control or "rationalize" marketing channels. In spite of occasional imperfections in the traditional private livestock marketing system, it functions and adapts to change quite well, given existing constraints (see Delgado, 1980; Eddy, 1979; Gall, 1981; Josserand, 1980; Sandford, 1981; Staatz, 1979).. In the field of livestock marketing, it is hard to find a single instance in Africa where the public sector has consistently demonstrated greater efficiency than private agents.

#### B. Genetic and Biological Potential and Health

Fragmentary information from independent studies throughout Africa (e.g., as compiled by Dahl and Hjort, 1976), as well as more systematic comparative work done by ILCA over the last few years, clearly attests to the great reproductive potential of small ruminants (see also Wilson, 1982). African sheep and goats display considerable precocity, and their year-round breeding

season allows high fertility rates. For instance, average age at first parturition is about twelve months, and

unlike cows, in which maturity is traditionally retarded by difficult environments, does and ewes in tropical Africa thus reveal sexual maturity at about the same age as, or even earlier than, exotic breeds (ILCA, 1980).

The average number of young per parturition, or prolificacy rate, is also quite high, even under traditional conditions; it varies from 1.1 to 1.4 for ewes, and is higher yet among goats (1.5 to 1.8 for the West African dwarf), so that prolificacy rates observed for African goats "compare favorably with those currently achieved by different breeds of small ruminants raised in other parts of the world" (ILCA, 1980).

Most of the benefits of this reproductive potential are, however, lost through mortality among the young. This is due to three main factors: (i) exceedingly short parturition intervals, (ii) lack of basic health care, and (iii) feed insufficiency. Nothing very surprising there -- what is more significant is the extent to which a minimal improvement in each area is likely to translate into very large changes in survival and total flock numbers. For example, an ILCA study (1980) showed that with a lambing interval of under seven months, only seven percent of all lambs born survived to six months of age, while forty percent did so with lambing intervals above seven months. In terms of disease control, it is generally estimated that a simple deworming program prevents about one-half of kid and lamb deaths. Finally, ILCA research (1980) in the Nigerian forest zone showed that "...animals left to fend for themselves showed mortality rates up to four times greater than those of animals receiving supplementation in the form of crop residues or maize by-products".

One can hardly tell in advance just how receptive small ruminant owners would be to basic disease control, breeding management or feed supplementation ideas. There are, however, some very encouraging signs. ILCA (1980) reports on supplemental feeding in Upper Volta and Nigeria in these terms:

Some fattening practices are found in sedentary systems; usually these involve wethers, which are tethered in the family compound and fed intensively on forages and crop residues (moutons de case). According to a survey in Upper Volta, which took place in an intermediate zone and thus involved both Sahel breeds (notably Fulani) and those of the south (Mossi), fattening practices sometimes assume a substantial role, involving nearly 90 percent of males under one year, and virtually 100 percent of those in higher age classes.

In Nigeria:

It also emerges that in many cases animals receive supplementary feeding. This consists of household residues in rural areas and purchased feeds in towns. In contrast to what is generally believed, animals also received a certain amount of veterinary care: 60 percent of farmers in the forest area said that they had bought drugs during the past year. Producers consider disease to be the major constraint to the development of their flocks, leading as it does to high mortality.

There are also reports of private efforts to improve the existing system; animals are permanently tethered and fed according to a cut-and-carry system. Manure is collected and spread on fields to maintain soil fertility. Larger-scale commercial operations have also developed in Ghana and Ivory Coast, usually raising sheep with rotational grazing, supplementary feeding, and other improved methods. Most farmers, however, will have to perceive clearly the potential economic advantages of improved health and management before they make relatively large cash and labor investments into sheep or goat production. But although labor bottlenecks induced by extensive cut-and-carry, fencing of grazing areas, etc., will eventually appear, there is enough "slack" in feed availability and labor to allow a strong demonstration effect to take place.

### C. Research and Training

The type of research and training consistent with the strategy outlined in this paper will require a definite shift in institutional views, from highly technical, insular, station-based research to more basic, decentralized, field-level studies. There are two compelling reasons for this: (i) in virtually every nation, small ruminants are raised under diverse ecological conditions and within different production systems; and (ii) sheep or goat raising does not constitute an independent production activity; it is almost invariably part of a farming system and should research-wise be treated as such.

Research will have to be systemic and take place at the producers' level; the following would apply to this case: using local people as data gatherers or researchers; direct observation in farming communities; reliance on a combination of key informants, guided interviews and group interviews.

The first phase of field-level research should provide a basic understanding of the various components in the local production system, and of how small ruminants fit into it. A second phase would look at the effects of

promoting or introducing simple changes in the small ruminants component of the system, and making a simple assessment of overall impact. Research should include a number of topics, and their relative emphasis would naturally depend on the specific farming system studied. They would include:

- forage-feed use and effect on the local environment;
- use of crop stubble and agricultural by-products;
- use of manure on fields and gardens;
- individual and communal herding practices;
- existence of cut-and-carry or grazing areas;
- impact of basic health care (e.g. deworming);
- effect of controlled breeding and selection.

Under certain conditions other specific issues may be examined: examples would be brush control on tree crop plantations, or grazing on steep slopes not suitable for cultivation.

Training for field-level researchers should involve people from the general research area, with a few years of schooling, and be carried out jointly by the livestock service and the agricultural extension agency, at some basic level. The first point would facilitate local acceptance (e.g. language), and help weaken the prejudice that farmers and herders are ignorant and inefficient. The second point would help insure that small ruminant activities are seen as part of a greater production system, even in apparently simple cases.

Finally, training should emphasize the fact that at the second phase of research, proposed interventions should be viewed as rational hypotheses to be tested rather than certain, proven steps to be carried out.



**APPENDIX**

TABLE A1.

## 1979 PRODUCTION OF MEATS FOR AFRICA

	Beef and Buffalo Meat (000 MT)	Mutton and Goat Meat (000 MT)	Pig Meat (000 MT)	Poultry Meat (000 MT)	Total Meat (000 MT)
Botswana	45	5	1	0	51
Cameroon	44	17	19	11	91
Ethiopia	218	131	1	59	409
Ghana	13	10	7	16	46
Kenya	196	36	4	39	275
Lesotho	7	5	3	1	16
Liberia	1	1	3	3	8
Mali	47	46	1	10	104
Mauritania	28	20	0	3	51
Niger	41	26	1	5	75
Senegal	42	10	7	9	68
Somalia	56	86	0	3	145
Sudan	197	125	0	16	338
Swaziland	14	3	1	1	19
Tanzania	129	30	0	24	183
Upper Volta	33	16	3	12	64
Zaire	24	9	30	16	79
Benin	11	5	12	4	32
Burundi	16	3	3	3	25
Gambia	4	1	0	0	5
Guinea	19	2	1	7	29
Malawi	10	4	7	8	29
Rwanda	14	2	2	1	19
Sierra Leone	4	1	2	5	12
Togo	4	3	5	4	16
Zambia	29	1	9	12	51

SOURCE: Winrock, 1981.

TABLE A2.

## 1979 FLUID MILK PRODUCTION FOR AFRICA

	Cow Milk (000 MT)	Buffalo Milk (000 MT)	Sheep Milk (000 MT)	Goat Milk (000 MT)	Total Fluid Milk (000 MT)
Botswana	88	0	0	3	91
Cameroon	62	0	0	0	62
Ethiopia	630	0	58	95	783
Ghana	8	0	0	0	8
Kenya	850	0	15	43	908
Lesotho	19	0	0	0	19
Liberia	1	0	1	1	3
Mali	86	0	30	35	151
Mauritania	68	0	53	68	189
Niger	96	0	12	124	232
Senegal	100	0	8	9	117
Somalia	166	0	96	276	538
Sudan	925	0	122	380	1,427
Swaziland	36	0	0	0	36
Tanzania	732	0	0	51	783
Upper Volta	77	0	0	21	98
Zaire	6	0	0	0	6
Benin	12	0	0	5	17
Burundi	54	0	1	6	61
Gambia	5	0	0	0	5
Guinea	39	0	1	3	43
Malawi	34	0	0	0	34
Rwanda	26	0	1	7	34
Sierra Leone	14	0	0	0	14
Togo	3	0	0	0	3
Zambia	48	0	0	0	48

SOURCE: Winrock, 1981.

TABLE A3.

1979 PRODUCTION OF WOOL, HIDES AND SKINS  
FOR AFRICA

	Wool, Greasy (MT)	Wool, Scoured (MT)	Buffalo, Cattle Hides (MT)	Sheep Skins (MT)	Goat Skins (MT)	Total (MT)
Botswana	0	0	5,250	176	620	6,046
Cameroon	0	0	9,764	2,114	1,359	13,237
Ethiopia	12,200	6,300	40,793	13,590	11,655	84,538
Ghana	0	0	1,624	778	1,089	3,491
Kenya	12,200	600	29,400	3,840	3,825	38,865
Lesotho	2,600	1,400	1,320	680	352	6,352
Liberia	0	0	532	189	124	845
Mali	320	210	7,772	4,919	3,028	16,249
Mauritania	0	0	2,520	1,440	900	4,860
Niger	0	0	4,370	1,200	4,200	9,770
Senegal	0	0	7,700	1,785	1,000	10,485
Somalia	0	0	8,740	2,325	8,284	19,349
Sudan	15,000	6,200	27,300	11,000	8,000	67,500
Swaziland	0	0	1,650	45	280	1,975
Tanzania	0	0	29,560	2,310	3,125	34,995
Upper Volta	0	0	4,230	814	1,491	6,535
Zaire	0	0	2,981	691	1,788	5,460
Benin	0	0	1,872	441	522	2,835
Burundi	0	0	3,805	352	753	4,910
Gambia	0	0	469	35	48	552
Guinea	0	0	2,682	180	149	3,011
Malawi	0	0	1,448	74	542	2,064
Rwanda	0	0	2,166	140	400	2,706
Sierra Leone	0	0	1,419	126	154	1,699
Togo	0	0	810	340	151	1,301
Zambia	0	0	3,751	31	198	3,980

SOURCE: Winrock, 1981.

TABLE A4.  
 1979 EXPORTS OF LIVESTOCK AND MEAT PRODUCTS  
 FOR AFRICA  
 (Thousands of Dollars)

	Live Animals		Meats			Total
	Cattle	Sheep and Goats	Fresh, Chilled or Frozen	Salted, Dried or Smoked	Canned Meats	
Botswana	\$ 0	\$ 230	\$76,300	\$ 0	\$ 0	\$76,530
Cameroon	1,350	80	2,640	0	0	4,070
Ethiopia	979	1,021	180	0	1,200	3,380
Ghana	0	0	0	0	0	0
Kenya	390	0	4,585	1,182	4,263	10,420
Lesotho	4,500	0	0	0	0	4,500
Liberia	0	0	0	0	0	0
Mali	22,000	10,400	0	0	0	32,400
Mauritania	13,000	14,000	0	0	0	27,000
Niger	13,000	2,650	130	50	0	15,830
Senegal	0	260	0	0	0	260
Somalia	12,000	53,000	0	0	0	65,000
Sudan	3,600	27,000	0	0	0	30,600
Swaziland	0	610	5,000	0	700	6,310
Tanzania	0	0	0	0	450	450
Upper Volta	9,000	8,400	0	0	0	17,400
Zaire	0	0	0	0	0	0
Benin	0	0	0	0	0	0
Burundi	5,000	125	0	0	0	5,125
Gambia	0	0	0	0	0	0
Guinea	8,400	910	0	0	0	9,310
Malawi	0	0	0	0	0	0
Rwanda	7,500	85	0	0	0	7,585
Sierra Leone	0	0	0	0	0	0
Togo	0	0	0	0	0	0
Zambia	0	0	0	0	0	0

SOURCE: Winrock, 1981.

## REFERENCES

- Brandstrom, Per; Hultin, Jan; and Lindstrom, Jan. Aspects of Agropastoralism in East Africa. Uppsala (Sweden): Scandinavian Institute of African Studies, 1979.
- Crotty, Raymond. Cattle, Economics, and Development. Farnham Royal (Slough, England): Commonwealth Agricultural Bureau, 1980.
- Dahl, Gudrun and Hjort, Anders. Having Herds: Pastoral Herd Growth and Household Economy. Stockholm: Department of Sociology, University of Stockholm, 1976.
- Delgado, Christopher. Mali, Vol. III - Livestock and Meat Marketing in West Africa. Ann Arbor: University of Michigan, Center for Research on Economic Development (CRED), 1980.
- Eddy, Edward. Labor and Land Use on Mixed Farms in the Pastoral Zones and Niger, Monograph III - Livestock Production and Marketing in the Entente States of West Africa Project. Ann Arbor: CRED, 1979.
- Gall, Pirie. Range Management and Livestock Development in the Sahel. Washington, D.C.: Chemonics International Consulting Division, 1981.
- Hoben, Allan. "Lessons from a Critical Examination of Livestock Projects in Africa," Agency for International Development Working Paper No. 26. Washington, D.C.: PPC, Office of Evaluation, June 1979.
- Honadle, George and McGarr, Peter. Organizing and Managing Technical Assistance: Lessons from the Masai Range Management Project. Washington, D.C.: Development Alternatives, Inc., 1979.
- International Livestock Centre for Africa (ILCA). "Small Ruminant Production in Tropical Africa," and "The ILCA Research Programme on Small Ruminants", ILCA Bulletin No. 7. Addis Ababa (Ethiopia): March 1980.
- \_\_\_\_\_. Trends and Prospects for Livestock and Crop Production in Tropical Africa, Working Document No. 5. Addis Ababa: 1981.
- Josserand, Henri. Benin, Liberia, Togo, Vol. II - Livestock and Meat Marketing in West Africa. Ann Arbor: CRED, 1979.
- \_\_\_\_\_. "The Marketing of Small Ruminants in West Africa," Presented at the Third International Conference on Goat Production and Disease. Tucson (Arizona): 1982.
- McCannon-Feldman, B.; Van Soest, P.; Horvath, P.; and McDowell, R.E. "Feeding Strategy of the Goat," Cornell International Agriculture Mimeo 88. Ithaca (New York): Cornell University, 1981.
- Niamir, Maryam. Report on Animal Husbandry Among the Ngok Dinka of the Sudan. New Haven (Connecticut): Harvard Institute for International Development, 1982.

Sabry, Omar. "Evolution in the Social and Economic Conditions of the Pastoralists in Central and West Africa," Land Reform: Land Settlement and Cooperatives. Rome: FAO, 1972.

Sandford, Stephen. Review of World Bank Livestock Activities in Dry Tropical Africa. Washington, D.C.: World Bank, Agriculture and Rural Development Department, 1982.

Santoir, Christian. Les Societes Pastorales du Sénégal Face à la Sécheresse (1972-1973). Dakar: ORSTOM, 1976.

Sleeper, Jonathan. "An Economic Analysis of the Role of Ox-Plowing and Cattle-Feeding in the Stratification of West African Livestock Production," ELP Working Paper No. 4. Ann Arbor: CRED, 1979.

Staatz, John. The Economics of Cattle and Meat Marketing in Ivory Coast, Monograph II - Livestock Production and Marketing in the Entente States of West Africa Project. Ann Arbor: CRED, 1979.

Stryker, Dirck. Livestock Development and the Role of Government. Medford (Massachusetts): Tufts University, The Fletcher School of Law and Diplomacy, 1979.

Sutter, John. Etude Socio-Economique de la Zone de Naissance de Guèye-Kadar. Dakar: SODESP, 1982.

Swift, Jeremy. "West African Pastoral Production Systems," ELP Working Paper No. 3. Ann Arbor: CRED, 1979.

United States Department of Agriculture (USDA). Food Problems and Prospects for Sub-Saharan Africa. Washington, D.C.: 1981.

Wilson, Trevor. Productivity of Indigenous Goats in the Traditional Livestock Systems of Semi-Arid Africa. Bamako (Mali): ILCA, 1982.

Winrock International. The Role of Sheep and Goats in Agricultural Development. Morrilton (Arkansas): 1977.

\_\_\_\_\_. The Role of Ruminants in Support of Man. Morrilton: 1978.

\_\_\_\_\_. Livestock Program Priorities and Strategy, USAID Draft Position Paper. Morrilton: 1981.

## PUBLICATIONS

CRED publications can be obtained by writing to the Publications Coordinator. A check or money order (payable to: The University of Michigan) should accompany your request, unless otherwise indicated on this listing.

### NEWSLETTER

CRED publishes a periodic newsletter entitled "CREDITS" which is available free of charge. Write to the Publications Coordinator if you wish to be placed on this mailing list.

### PROJECT REPORTS

1. Berg, Elliot J. The Economic Evolution of the Sahel. 1975. 258 p. \$7.50
2. Berg, Elliot J., et al. Marketing, Price Policy and Storage of Food Grains in the Sahel: A Survey - Volume I. Synthesis with Statistical Compilation and Annotated Bibliography. 1977. 152 p. \$8.00.
3. Berg, Elliot J., et al. Marketing, Price Policy and Storage of Food Grains in the Sahel: A Survey - Volume II. Country Studies. 1977. 105 p. \$10.00.
4. Berg, Elliot J., et al. Commercialisation, Politique des Prix et Stockage des Céréales au Sahel: Etude Diagnostique - Tome I. Synthèse avec Compilation Statistique et Bibliographie Annotée. 1977. 164 p. Tome II. Etudes des Pays. 1977. 129 p. [Tome II - Out of Print.]
5. Shapiro, Kenneth H. Livestock Production and Marketing in the Entente States of West Africa: Summary Report. 1979. 528 p. \$12.50.
6. Delgado, Christopher L. Livestock versus Foodgrain Production in Southeastern Upper Volta: A Resource Allocation Analysis (Monograph I - Livestock Production and Marketing in the Entente States of West Africa Project). 1979. 427 p. [Out of Print.]
7. Staatz, John M. The Economics of Cattle and Meat Marketing in Ivory Coast (Monograph II - Livestock Production and Marketing in the Entente States of West Africa Project). 1979. 589 p. \$15.00.
8. Eddy, Edward D. Labor and Land Use on Mixed Farms in the Pastoral Zones of Niger (Monograph III - Livestock Production and Marketing in the Entente States of West Africa Project). 1979. 493 p. [Out of Print.]
9. Herman, Larry A. The Livestock and Meat Marketing System in Upper Volta: An Evaluation of Economic Efficiency (Monograph IV - Livestock Production and Marketing in the Entente States of West Africa Project). 1983. 266 p. \$10.00.
10. Shapiro, Kenneth H. La Production et la Commercialisation du Bétail dans les Pays du Conseil de l'Entente: Rapport de Synthèse. 1980. 445 p. \$15.00.
11. Delgado, Christopher K. L'Elevage oar Rapproch: à l'Agriculture au Sud-Est de la Haute-Volta: Analyse de l'Allocation des Ressources au Niveau de l'Exploitation (Monographie I - La Production et la Commercialisation du Bétail dans les Pays du Conseil de l'Entente). 1980. 405 p. [Out of Print.]
12. Staatz, John M. L'Economie de la Commercialisation du Bétail et la Viande en Côte d'Ivoire (Monographie II - La Production et la Commercialisation du Bétail dans les Pays du Conseil de l'Entente). 1980. 536 p. \$15.00.
13. Eddy, Edward D. L'Utilisation de la Terre et de la Main-d'Oeuvre à l'Interieur des Exploitations Agricoles Intégrées de la Zone Pastorale Nigérienne (Monographie III - La Production et la Commercialisation du Bétail dans les Pays du Conseil de l'Entente). 1980. 406 p. [Out of Print.]
14. Ariza-Niño, Edgar J.; Herman, Larry A.; Makinen, Marty; and Steedman, Charles. Synthesis: Upper Volta (Volume I - Livestock and Meat Marketing in West Africa Project). 1980. 204 p. \$15.00.
15. Jossierand, Henri P., and Sullivan, Gregory. Benin, Ghana, Liberia, Togo (Volume II - Livestock and Meat Marketing in West Africa Project). 1980. 446 p. \$15.00.
16. Delgado, Christopher L., and Staatz, John M. Ivory Coast and Mali (Volume III - Livestock and Meat Marketing in West Africa Project). 1980. 439 p. \$15.00.
17. Ariza-Niño, Edgar J., and Griffith, J.L.P. Suppliers: Argentina, Australia and New Zealand (Volume IV - Livestock and Meat Marketing in West Africa Project). 1979. 239 p. [Out of Print.]
18. Ariza-Niño, Edgar J.; Manly, D.W.; and Shapiro, Kenneth H. The World Meat Economy: Other Supplier and Consumer Countries (Volume V - Livestock and Meat Marketing in West Africa Project). 1980. 183 p. [Out of Print.]
19. Ariza-Niño, Edgar J.; Herman, Larry A.; Makinen, Marty; et Steedman, Charles. Rapport de Synthèse: Haute-Volta (Tome I - La Commercialisation du Bétail et de la Viande en Afrique de l'Ouest). 1981. 258 p. \$15.00.
20. Jossierand, Henri P., et Sullivan, Gregory. Bénin, Ghana, Libéria, Togo (Tome II - La Commercialisation du Bétail et de la Viande en Afrique de l'Ouest). 1980. 441 p. \$15.00.
21. Delgado, Christopher L., et Staatz, John M. Côte d'Ivoire et Mali (Tome III - La Commercialisation du Bétail et de la Viande en Afrique de l'Ouest). 1981. 567 p. \$15.00.
22. Ariza-Niño, Edgar J. et Griffith, J.L.P. Les Fournisseurs - Argentine, Australie, Nouvelle-Zélande; et Ariza-Niño, Edgar J.; Manly, D.W. et Shapiro, Kenneth H. L'Economie Mondiale de la Viande: Autres Pays - Fournisseurs et Consommateurs (Tome IV/V - La Comm. cialisation du Bétail et de la Viande en Afrique de l'Ouest). 1981. 476 p. \$15.00.
23. Makinen, Marty and Ariza-Niño, Edgar J. The Market for Livestock from the Central Niger Zone (Niger Range and Livestock Project). 1982. 55 p. \$7.50.



24. Makinen, Marty et Ariza-Niño, Edgar J. Le Marché du Bétail dans la Zone Nigérienne Centrale (Le Projet de Gestion des Pasturages et de l'Élevage). 1982. 63 p. \$7.50.

25. Barlow, Robin (editor). Case Studies in the Demographic Impact of Asian Development Projects. (Contributors: J. Anderson, H. Barnum, J. Bauer, P. Gosling, A. Jain, H. Mohtadi, and E. Mueller). 1982. 204 p. \$10.00.

26. Ariza-Niño, Edgar J. et al. Consumption Effects of Agricultural Policies: Cameroon and Senegal - Part I: Country Reports; Part II: Methodology. 1982. 465 p. \$15.00.

27. Ariza-Niño, Edgar J. et al. Effets nutritifs de politiques agricoles: Cameroun et Sénégal - Partie I: Rapport de Pays. 1982. 369 p. \$8.00. Partie II: Méthodologies d'Analyse et Modalités d'Enquête. 1982. 284 p. \$7.00.

These prices include postage and handling charges. Please refer to the Project Report Number (PR #) when placing an order.

#### DISCUSSION PAPERS

CRED normally publishes 5-8 discussion papers annually, which provide preliminary reports on the research (institutional or personal) of its senior staff. In many cases, revised versions of these papers are later published in academic journals or elsewhere. Individual discussion papers can be purchased for \$3.00 each; an annual subscription (based on a July 1 - June 30 subscription year) is available for \$15.00. Subscriptions are also available on an exchange basis for publications from other institutions.

1. Berg, Elliot J. "Wage Structure in Less-Developed Countries," January 1963. 51 p. (Republished in Wage Policy Issues in Economic Development, edited by Anthony D. Smith, International Institute for Labour Studies, Geneva, 1969.)

2. Eckstein, Peter C. "Accounting Prices as a Tool of Development Planning," February 1963. 34 p.

3. Stolper, Wolfgang F. "Economic Growth and Political Instability in Nigeria: On Growing Together Again," November 1963. 38 p. (Republished in Growth and Development of the Nigerian Economy, edited by Carl K. Eicher and Carl E. Liedholm, Michigan State University Press, East Lansing, 1970.)

4. Berg, Elliot J. "Industrial Relations Systems in Colonial West Africa: A Comparative Analysis of French West Africa and the Gold Coast," December 1963. 50 p. (Republished in African Dimensions: Essays in Honor of William O. Brown, edited by Mark Karp, Boston University, Boston, 1975.)

5. Berg, Elliot J. "Trade Unions and Wage Levels - The Nigerian Case," January 1969. 19 p. (Republished in Economic Development and Cultural Change, Volume 17, No. 4, July 1969.)

6. Porter, Richard C. "Some Implications of Post-War Primary Product Trends," February 1969. 17 p. (Republished in Journal of Political Economy, Vol. 73, No. 3, May - June 1970.)

7. Eckstein, Peter C. "Quantitative Measurements of Development Performance: A Critique by Peter Eckstein and a Reply by Irma Adelman and Cynthia Taft Morris," April 1969. 37 p. (Republished in American Economic Review, Vol. 60, No. 1, March 1970.)

8. Porter, Richard C. "The Effectiveness of Tax Exemption in Colombia," July 1969. 41 p. (Republished in Weitschaftliches Archiv/Review of World Economics, Vol. 103, No. 3, September 1972.)

9. Eckstein, Peter C. "Toward an Integrated Theory of Tariffs," August 1969. 41 p.

10. Stolper, Wolfgang F. "Limitations of Comprehensive Planning in the Face of Comprehensive Uncertainty: Crisis of Planning or Crisis of Planners," October 1969. 44 p. (Republished in Weitschaftliches Archiv, Vol. 107, No. 1, March 1971.)

11. Porter, Richard C. "Birth of a Bill Market," August 1970. 20 p. (Republished in Journal of Development Studies, Vol. 9, No. 3, April 1973.)

12. Adalemo, Isaac Ayilinde. "Distribution of Market Centers, Market Periodicities and Marketing in Northwestern Nigeria," August 1970. 57 p. (Republished in African Urban Notes, Vol. 5, No. 2, Winter 1970.)

13. Berg, Elliot J. "Wages and Employment in Less-Developed Countries," December 1970. 23 p. (Republished in The Challenge of Unemployment to Development and the Role of Training and Research Institutes of Development, O.E.C.D., Paris, 1971.)

14. Hutcheson, Thomas L. and Porter, Richard C. "The Cost of Tying Aids: A Method and Some Colombian Estimates," January 1971. 58 p. (Republished in Princeton Studies in International Finance, No. 30, March 1972.)

\* 15. Andriamananjara, Rajaona. "Labor Mobilization: The Moroccan Experience," April 1974. 119 p.

16. Aho, C. Michael. "The Use of Export Projects in Allocating Foreign Aid Among and Domestic Resources Within Developing Countries," July 1971. 59 p. (Republished in Journal of Development Studies, Vol. 10, No. 3/4, April/July 1974.)

17. Kennedy, Michael. "An Empirical Evaluation of the Two-Gap Model of Development," November 1971. 29 p.

18. Naranjo, John and Porter, Richard C. "The Impact of the Commonwealth Preference System on the Exports of Latin America to the United Kingdom," March 1972. 37 p. (Republished in Journal of Development Studies, Vol. 9, No. 4, July 1973.)

19. Fields, Gary S. "Private Returns to Investments in Higher Levels of Education in Kenya," April 1972. 16 p. (Republished in Education, Society and Development: New Perspectives from Kenya, edited by David Court and Dharam P. Ghai. Oxford University Press, Nairobi, 1974.)

\* Available in French and English.

20. Osayimese, Izevbuwa G. "An Application of Control Theory to Rural-Urban Migration and Urban Unemployment," May 1972. 19 p. (Republished in Geographical Analysis, Vol. 4, No. 2, April 1974.)
21. Johnson, George E. "The Determinants of Hourly Earnings in Urban Kenya," May 1972. 36 p.
22. Staelin, Charles P. "The Cost and Composition of Indian Exports," May 1972. 41 p. (Republished in Journal of Development Economics, Vol. 1, No. 2, June 1974.)
23. Heller, Peter S. "A Model of Public Sector Expenditure Dynamics in Less-Developed Countries: The Kenyan Case," May 1972. 50 p. (Republished in Quarterly Journal of Economics, Vol. 88, No. 2, May 1974.)
24. Heller, Peter S. "The Strategy of Health-Sector Planning in the People's Republic of China," July 1972. 62 p. (Republished in Medicine and Public Health in China, edited by M. Wegman and T. Lin, Josiah Macy Foundation, New York, 1973.)
25. Winegarden, Calman R. "Determinants of International Differences in Educational Effort," September 1972. 31 p. (Republished in Eastern Economic Journal, Vol. 2, No. 1, January 1975.)
26. Staelin, Charles P. "A General Equilibrium Model of Tariffs in a Non-Competitive Economy," March 1973. 29 p. (Republished in Journal of International Economics, Vol. 6, No. 1, February 1976.)
- \* 27. Barlow, Robin. "Planning Public Health Expenditures with Special Reference to Morocco," April 1973. 68 p. (Republished in International Journal of Health Services, Vol. 6, No. 1, February 1976.)
28. Dia Bondo, Theophil Lukusa and Porter, Richard C. "A Constant Market-Share Look at African Exports in the 1960s," June 1973. 25 p.
29. Porter, Richard C. "Labor Migration and Urban Unemployment in Less-Developed Countries: Comment," July 1973. 19 p.
30. Heller, Peter S. "An Econometric Analysis of the Fiscal Behavior of the Public Sector in Developing Countries: Aid, Investment and Taxation," October 1973. 39 p. (Republished in American Economic Review, Vol. 65, No. 3, June 1975.)
31. Porter, Richard C. "Some Doubts About Kenya's Future as an Exporter of Manufactures," October 1973. 30 p. (Republished in Eastern Africa Economic Review, Vol. 6, No. 1, June 1974.)
32. Weisskopf, Thomas E. "Sources of American Imperialism: A Contribution to the Debate between Orthodox and Radical Theories," November 1973. 46 p. (Republished in Review of Radical Political Economics, Vol. 6, No. 4, Fall 1974.)
33. Hoopengardner, Thomas. "Rural-Urban Migration: A Dynamic View," January 1974. 15 p.
34. Porter, Richard C. and Staelin, Charles P. "On the Rationality of 'Cascaded' Export Subsidies and Taxes," March 1974. 9 p.
35. Weisskopf, Thomas E. "American Economic Interests in Foreign Countries: An Empirical Survey," April 1974. 56 p.
36. Shapiro, Kenneth H. and Muller, Jurgen. "Sources of Technical Efficiency: The Roles of Modernization and Information," April 1974. 40 p. (Republished in Economic Development and Cultural Change, Vol. 25, No. 2, January 1977.)
- \* 37. Stolper, Wolfgang F. "Investments, Employment and Output per Man in the Tunisian Economy, 1961-1971," September 1974. 112 p. (Republished in Weirtschaftliches Archiv, Vol. 114, No. 3, September 1978, and in Annales Economiques, No. 14, 1980, in French.)
38. Porter, Richard C. "Measuring the Cost of Granting Tariff Preferences," September 1974. 44 p.
39. Herman, Barry M. "Multinational Oligopoly in Poor Countries: How East Africa Got its Petroleum Refineries," September 1974. 32 p. (Republished in Journal of Development Economics, Vol. 2, 1975 and in Readings on the Multinational Corporation in Kenya, edited by Rapnael Kaplinsky, Oxford University Press, Nairobi, 1978.)
40. Elliott, Howard J.C. "Animation Rurale and Encadrement Technique in the Ivory Coast," September 1974. 33 p.
41. Weisskopf, Thomas E. "China and India: A Comparative Survey of Economic Performance," October 1974. 43 p. (Republished in Economic and Political Weekly, Vol. 10, Nos. 5-7, February 1975.)
42. Heller, Peter S. "Factor Endowment Change and the Structure of Comparative Advantages: The Case of Japan, 1956-1969," January 1975. 23 p. (Republished in Review of Economics and Statistics, Vol. 58, No. 3, August 1976.)
43. Heller, Peter S. "An Analysis of the Structure, Equity and Effectiveness of Public Sector Health Systems in Developing Countries: The Case of Tunisia, 1960-1972," February 1975. 105 p.
44. Blake, Robert. "Import Controls and Production in Tunisia During the 1960s," March 1975. 41 p.
45. Kieve, Jacob G. and Stolper, Wolfgang F. "Changes in Income Distribution, 1961-1971 (Tunisia)," March 1975. 30 p.
46. Kieve, Jacob G. "The Financing of Investments in Tunisia, 1961-1971," March 1975. 41 p.
47. Ketkar, Suhas L. "Economics of Education in Sierra Leone," April 1975. 37 p. (Republished in Manpower Planning and Utilization in West Africa, International Labor Organization, 1979.)
48. Berg, Elliot J. "Some Problems in the Analysis of Urban Proletarian Politics in the Third World," March 1976. 17 p. (Republished in Comparative Urban Research, Vol. 4, No. 1, April 1976.)

49. Monson, Terry D. and Pursell, Garry G. "An Evaluation of Expatriate Labor Replacement in the Ivory Coast," April 1976. 75 p. (Republished in Actualité Economique, Vol. 53, No. 2, April - June 1977, in French, and in Journal of Development Economics, Vol. 6, No. 1, March 1979.)
50. Kendrick, Robin, J. "A Survey of Labor Relations in Cameroon," May 1976. 39 p. (Republished in Industrial Relations in Africa, edited by Ukandi G. Damachi, International Institute for Labor Studies, Geneva, 1979.)
51. Berg, Elliot J. "The Economic Impact of Drought and Inflation in the Sahel," May 1976. 35 p.
52. Shapiro, Kenneth H. "Efficiency Differentials in Peasant Agriculture and Their Implications for Development Policies," June 1976. 13 p. (Republished in International Association of Agricultural Economics Occasional Paper No. 1, November 1977.)
53. Saulniers, Alfred H. "Unit Equivalent Scales for Specific Food Commodities: Kinshasa, Zaire," August 1976. 22 p.
54. Saulniers, Alfred H. "The Economics of Prestation Systems: A Consumer Analysis of Extended Family Obligations with Application to Zaire," August 1976. 27 p.
55. Elliott, James A.M. "Will Rising Wages in the Controlled Sector Increase Total Employment in Less-Developed Countries?," August 1976. 37 p. (Republished in Journal of Development Studies, Vol 16, No. 1, October 1979.)
56. Barlow, Robin. "A Test of Alternative Methods of Making International Product Comparisons," September 1976. 15 p. (Republished in Economic Journal, Vol. 87, September 1977.)
57. Heller, Peter S. "Interactions of Childhood Mortality and Fertility in West Malaysia: 1947-1970," September 1976. 33 p.
58. Heller, Peter S. and Drake, William D. "Malnutrition, Child Morbidity and the Family Decision Process," September 1976. 43 p. (Republished in Journal of Development Economics, Vol. 6, No. 2, June 1979.)
59. Staelin, Charles P. and Jurado, Gonzalo M. "The Impact of Export Incentives and Export-Related Policies on the Firms of the Less-Developed Countries: A Case Study of the Philippines," September 1976. 29 p.
60. Porter, Richard C. "A Model of a South African-type Economy," October 1976. 42 p. (Republished in American Economic Review, Vol. 68, No. 5, December 1978.)
61. Montgomery, Barbara B. "The Economic Role of the Ivorian Woman," February 1977. 49 p.
62. Heller, Peter S. "A Model of the Demand for Medical and Health Services in West Malaysia," October 1976. 52 p. (Republished in Social Science and Medicine, Vol. 16, 1982.)
63. Monson, Terry D. "A Note on Measuring Educational Returns in LDCs," February 1977. 12 p. (Republished in Journal of Developing Areas, Vol. 13, No. 4, July 1979.)
64. Lopez, Michael. "The Determinants of Income and its Distribution in Four Villages in India," February 1977. 76 p.
65. Cross, John G. "A Stochastic Learning Model of Migration," February 1977. 17 p. (Republished in Journal of Development Economics, Vol. 5, No. 2, June 1978.)
66. Weisskopf, Thomas E. "Dependence as an Explanation of Underdevelopment," February 1977. 32 p.
67. Heller, Peter S. "Issues in the Allocation of Resources in the Health Sector of Developing Countries," February 1977. 33 p. (Republished in Economic Development and Cultural Change, Vol. 27, No. 1, October 1978.)
68. Porter, Richard C. "Economic Sanctions: The Theory and Evidence from Rhodesia," March 1977. 19 p. (Republished in Journal of Peace Science, Vol. 3, No.2, Fall 1978.)
69. Henning, Peter H. "The Urban Popular Economy and Informal Sector Production," March 1977. 66 p.
70. Nziramasanga, Mudziviri T. "Production from an Exhaustible Resource Under Government Control in LDCs," December 1977. 17 p.
71. Barnum, Howard N. and Squire, Lyn. "Labor Heterogeneity and Rice Production in Malaysia," December 1977. 11 p.
72. Bloch, Peter C. "Labor Relations in Senegal - History, Institutions and Perspectives," January 1978. 41 p.
73. Barnum, Howard N. and Squire, Lyn. "Consistent Aggregation of Family and Hired Labor in Agricultural Production Functions," January 1978. 12 p.
74. Delgado, Christopher L. "An Investigation of the Lack of Mixed Farming in the West African Savannas: A Farming Systems Approach for Tenkodogo, Upper Volta," November 1978. 71 p.
75. Pinckney, Annette M. "An Analysis of Grain Storage in Three Interior Sahel Countries," January 1979. 75-p.
76. Berg, Nancy and Elliot J. "Graduate Training of LDC Economists in U.K. Universities - A Statistical Note," January 1979. 35 p.
77. Porter, Richard C. "The Potential Impact of International Trade and Investment Sanctions on the South African Economy," February 1979. 30 p. (Republished in Journal of Conflict Resolution, December 1979.)
78. Barnum, Howard N. and Barlow, Robin. "Reducing Mortality When Diseases are Interdependent," August 1978. 25 p.

79. Berg, Elliot J. "Reforming Grain Marketing Systems in West Africa," June 1979. 50 p.

\* 80. Ross, Clark G. "Grain Demand and Consumer Preferences: Dakar, Senegal," June 1979. 26 p. (Republished in Food Policy, Vol. 5, No. 4, November 1980.)

\* 81. Ross, Clark G. "A Village Level Study of Producer Grain Transactions in Rural Senegal," June 1979. 51 p. (Republished in African Studies Review, FORTHCOMING ISSUE 1983.)

82. Barlow, Robin. "Economic Growth in the Middle East, 1950-1972," June 1980. 41 p. (Republished in International Journal of Middle East Studies, Vol. 14, 1982.)

83. Eddy, Edward D. "Prospects for the Development of Cattle Production on Mixed Farms in the Pastoral Zone of Niger: A Summary," June 1980. 91 p.

84. Berg, Elliot J. "Alternative Strategies for Zimbabwe's Growth," June 1980. 27 p.

85. Ross, Clark G. "A Modeling of the Demand and Supply of Food Grains in Senegal," June 1980. 68 p.

86. Staatz, John M. "The Economics of Cattle and Meat Marketing in Ivory Coast: A Summary," June 1980. 84 p.

87. Ranney, Susan I. "The Open Door Policy and Industrialization in Egypt: A Preliminary Investigation," August 1980. 47 p.

88. Ranney, Susan I. "A Note on the Proletarianization of the African Peasantry in Rhodesia," August 1980. 18 p.

89. Barnum, Howard N. "The Economic Cost and Benefits of an Immunization Program in Indonesia," January 1981. 37 p.

90. Makinen, Marty; Herman, Larry A.; Staatz, John M. "A Model of Meat Versus Live-Animal Exports from Upper Volta," February 1981. 27 p.

91. Grosse, Scott D. "A Skeptical Perspective on Income Redistribution and Poverty Reduction in Sri Lanka," May 1981. 27 p.

92. Kemal, A.R. and Porter, Richard C. "Learning by Doing While Remembering Forgetting, With Reminders From Pakistan Manufacturing Data," May 1981. 21 p.

93. Berg, Elliot J. "Intergovernmental Health Assistance in Francophone West Africa," June 1981. 46 p.

94. Ranney, Susan I. "Terms of Trade and Domestic Distribution: A Comment," July 1981. 11 p.

95. Porter, Richard C. "Apartheid, the Job Ladder, and the Evolutionary Hypothesis: Empirical Evidence from South African Manufacturing, 1960-1977," September 1981. 34 p.

96. Makinen, Marty. "A Benefit-Cost Analysis of Measles Vaccinations in Yaounde, Cameroon," November 1981. 20 p. (Republished in Social Science and Medicine, FORTHCOMING ISSUE 1983.)

\* 97. Thomas-Peterhans, Randall. "The Stratification of Livestock Production and Marketing in the Zinder Department of Niger," September 1982. 39 p.

\* 98. Berg, Elliot J. and Ainsworth, Martha. "A Strategy for Health Care in West Africa," November 1982. 35 p.

99. Josserand, Henri P. and Brazee, Richard J. "Domestic and Foreign Effort Applied to a Fish Stock: Getting the Most over Time, for a Change," May 1983. 14 p.

100. Ranney, Susan I. "Time Allocation and Remittance Flows: The Case of Temporary Mexican Migration to the U.S.," June 1983.

101. Ranney, Susan I. "International Capital Transfers and the Choice of Production Technique: A Simple Two-Country Model," June 1983.

102. Ranney, Susan I. "Economic Models of Planned Temporary Migration," June 1983.

103. Grosse, Scott D. "Rural Development and Rural-Urban Migration: The Elusive Relationship," June 1983.

## FORTHCOMING

104. Gordon, David F. "Which Way for Zimbabwe: Development Dilemmas and Prospects," August 1983.

105. Josserand, Henri P. "Small Stock, Large Dividends: Sheep and Goats in Sub-Saharan Africa," October 1983.

106. Chambas, Gerard. "Rural Income Distribution in Senegal: Changes and Indicators," December 1983.

107. Ranney, Susan I. "Historical Migration Patterns and Current Temporary Migration: The Case of Mexican Migration to the U.S.," December 1983.

Please refer to the Discussion Paper Number (DP#) when requesting one of these titles. Postage and handling charges are included in the individual and subscription prices.

Publications Coordinator  
Center for Research on Economic Development  
307 Lorch Hall  
The University of Michigan  
Ann Arbor, MI 48109 USA



