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The Role of Livestock in the Rural Economy

Ann Waters-Bayer & Wolfgang Bayer

Development of livestock production is seen within the context of improving the livelihood systems of smallholder families and communities, including nomadic and transhumant pastoralists. Examination of the multiple functions of animals in smallholder livelihood systems highlights the rationale of microeconomic decision-making in response to livestock development innovations and policies. It is shown that, in view of the close links between livestock and other farming activities not only in smallholder production systems but also in regional, national and global economies, livestock policy cannot be developed in isolation from policies for promoting cropping, tree-growing and agricultural processing.

Vision of Rural Development

Rural development should be a strategy which enables rural people to gain a secure and decent livelihood (cf. Chambers, 1983). Thus, livestock production in rural development does not involve improving livestock production for its own sake, but rather enabling rural people to use livestock as a source of survival and well-being, together with all the other activities which make up the livelihood systems of the men, women and children who keep these animals.

In strategies of "rural" development, the division between rural and urban is arbitrary. Even in towns and cities, many people grow some crops and keep some animals in order to meet their needs, including their need for cash. These people are often neglected because planners tend to assume that farming is done only in non-urban areas. Families practising backyard horticulture and animal-keeping can play a role in supplying urban consumers with agricultural products.

Perhaps the division between "urban" and "rural" would be more clear if urban people were regarded as those operating in an economy with a high degree of labour specialisation: the factory workers, merchants, civil servants etc.; whereas "rural" people are those operating in an economy with a

strong subsistence component: the producers are also consumers of part of their production. However, even this division is arbitrary, as many people are engaged simultaneously in "urban" and "rural" activities, e.g., factory workers who keep a few goats and chickens behind the house.

Livestock development planners tend to concentrate on how to raise production for the market—both home markets to feed the growing population, and international markets to gain foreign exchange. But this can be achieved only if the corresponding development measures and policies also help the livestock-keepers to meet their own aims—for they are the ones who make the actual production decisions. The past record of livestock development suggests that many policies were made and projects initiated which were based on false assumptions about livestock-keepers' aims and about how decisions are made within the production units: the livestock-keeping households.

Therefore, the main emphasis in this paper will be on aims and decision-making at the level of the livestock-keepers. Trying to see the situation from their viewpoint leads to a more holistic view than that of most

planners, who are generally operating within a particular government sector and therefore tend to look at only one part of a household's or community's total activities meant to ensure their survival and well-being.

Still with a focus on people-oriented development, some functions of livestock in rural and national economies will then be examined. Finally, moving to the global level, attention will be given to the role of livestock in maintaining (or destroying) the world's livelihood system. Taking this global view on livestock production draws attention to what can be learned from smallholder systems of animal-keeping: how to make optimal use of local renewable resources.

Focus on Small-scale Livestock-keepers

As the vast majority of rural people are small-scale farmers, the focus here is on development of these livelihood systems. In many tropical countries, a high proportion (in some cases, up to 90%) of the people live from small-scale "traditional" farming, which includes animal-keeping. The term "smallholder" refers to families which practise labour-intensive forms of farming with low levels of purchased inputs and with no more than a few acres of land for the more-or-less exclusive use of the household. The term thus also refers to a pastoral household of, say, 8 members with a herd of 80 head of cattle, if at least 10 head/person are needed to be able to survive from livestock-keeping.

By far the majority of livestock are kept by smallholders, yet most research and development efforts have been focused on "modern" systems such as ranching, feedlots and battery-keeping of chickens, and on only few species: cattle, sheep, chickens, pigs. Even buffaloes, which in terms of livestock biomass are second only to cattle worldwide, are still often called "nonconventional" animals. It is hardly surprising, then, that the majority of livestock-keepers have

benefited only marginally from formal research and development.

Another reason for focusing on smallholders is the potential for widespread improvement. Small increases within a large number of smallholdings can make a larger contribution to meeting national food needs than a large improvement in a small modern livestock sector. Furthermore, the benefits from livestock development are likely to be more widely spread if numerous smallholders are involved. In contrast, development of "modern", capital-intensive livestock production systems usually leads to a concentration of benefits in only a few hands.

In the long run, an even more important reason for focusing on smallholders is that their present modes of livestock production use mainly renewable resources, rather than fossil energy as in modern high-input systems. It will be from the "traditional" livestock-keepers who have developed efficient ways of using local natural resources that the so-called "developed" countries will have to learn, as external inputs become increasingly scarce and expensive. This will be the case, e.g., when the pollution-removal costs are added to the price of these inputs. And this is coming—even if much more slowly than it should be.

Taking a closer look at small-scale livestock-keepers and their aims, a differentiation can be made according to both mobility and main source of livelihood (see Table 1).

Fulltime livestock-keepers depend primarily on animals for their living. They may be nomadic, transhumant or sedentary. Most traditional systems of full-time livestock-keeping are more or less mobile: herders make opportunistic use of natural grazing and water when and where these are to be found. The term "pastoralists" refers to people who live mainly from herds of domesticated animals using primarily natural pasture. Pastoralism is practised not only in arid but also in semiarid and subhumid areas, and even into the humid forest belt of West Africa.

Livestock-keepers who also do some cropping, but livestock remain their main source of livelihood and identity, may be transhumant (growing some crops usually near their home base) or they may be more or less settled. Most can be called "agropastoralists", as their animals still depend mainly on natural grazing.

Crop farmers who also keep some animals usually stay in one place year-round, although some may move to other areas for activities such as dry-season gardening or fishing. Some may also combine the keeping of land-based livestock with fish culture in ponds or irrigated fields, particularly in Southeast Asia.

Finally, there are the landless who keep some livestock as a sideline to their various other means of making a living. They may have only a few animals in the backyard: a sheep or bull to fatten, a couple of goats to milk, some chickens or guinea pigs to eat and sell. Such people often live on the edge or in the midst of villages, towns or even cities.

gard themselves as, for example, Fulani, Maasai, Tuareg animal-keepers, even if they have only 2-3 animals being kept by their brothers while they themselves work as night guards or wage labourers. Moreover, one family may practise different types of livestock-keeping at the same time, e.g., one brother may be a transhumant herder while another lives in town and does some sheep fattening on the side.

In the past, traditional livestock-keepers—indeed, all traditional farmers—were often regarded as irrational in their economic behaviour and reluctant to accept new technology. Development planners therefore thought these traditional systems would have to be replaced by "modern" ones. In recent years, however, social anthropologists and economists have begun to re-assess smallholder economies. They have found that:

—Smallholders can be just as efficient in allocating resources as modern market-oriented producers, but their aims are more complex. Their main aim is not maximum

Table 1. Classification of livestock-keepers

| Mobility | No home base; year-round movement of animals | Home base; seasonal movement of animals | Home base; local movement or confinement of animals |
|---|--|---|---|
| Full-time livestock husbandry | Nomadic pastoralists | Transhumant pastoralists | Sedentary pastoralists |
| Livestock husbandry with subsidiary cropping | - | Transhumant agropastoralists | Sedentary agropastoralists |
| Cropping with subsidiary livestock husbandry | - | - | Livestock-keeping farmers |
| Livestock husbandry subsidiary to non-cropping activities | - | - | Landless livestock-keepers |

This is a very rough classification: there are numerous variants, including those people who would like to regard themselves as living primarily from livestock, but have too few animals to do so. They would still re-

production for the market but rather to provide for various household needs (to be explained in more detail below). They try to maximise the *use value* rather than the market value of their stock.

—Smallholders seek diversity rather than specialisation. They care for numerous different plants and animals, to provide for their various household needs and to ensure against production risks. Moreover, their agricultural output is often supplemented by off-farm activities, such as crafts, trade, wage labour.

—Smallholders also hedge risks by maintaining various social links with kin and nonkin, locally and further afield. These links involve mutual obligations to help each other in times of need.

—In smallholder agriculture, a resource is often used not just for one purpose but rather for many. Certain trees, for example, may produce fuel, edible fruits and leaves, timber, fodder, medicines, gums and resins, and may also be used for beekeeping. Cereals are grown not just to produce grain to eat; the residues may also be used as fodder, fuel, building material etc. Similarly, as will be discussed in the next section, their livestock serve multiple purposes.

—Smallholders are generally open to change. But because they operate under difficult ecological and economic conditions and consume a large part of the farm output, they are limited in their capacity to accumulate capital. They pursue risk-reducing production strategies with low capital investment. They favour innovations that require relatively few external inputs and that can be tested and adopted on a small scale.

—So-called "traditional" farming systems are constantly changing, even without the direct influence of development programmes. Smallholders develop new ideas through observation and discussions with neighbours and relatives. Many conduct small-scale informal experiments and deliberately select and exchange animal and plant genetic material (breeds, seeds) without any contact with development agents. For example, pastoralists who have moved into Nigeria's subhumid zone are crossbreeding their savanna cattle with trypanotolerant rainforest cattle (Salih, 1991). Such informal ways of experimenting and disseminating

information and inputs are usually more important to smallholders than the activities of formal research and extension services.

Functions of Livestock in Smallholder Livelihood Systems

The term "livestock production" suggests that the ultimate aim is to produce commodities such as meat or milk. However, smallholders keep animals as a means to achieve a variety of aims, of which food production is only one. The relative importance of each aim and the relative importance of livestock-keeping itself within the entire farming system will depend on the natural and economic conditions, market links, and the quantity and quality of production factors (land, labour etc.) available to the household—and these may change rapidly.

The rural economy rests on the viability of the economic actors, i.e., on the ability of rural households to survive and reproduce themselves and to use and maintain their resources. Livestock play important functions in ensuring this viability, in maintaining smallholder livelihood systems. These functions include:

Food production

Products such as milk, blood, eggs and meat are foods which are relatively high in protein but are also sources of energy, minerals and vitamins. Although the staple foods of most animal-keepers are cereals, they generally place high value on food from livestock. Milk may be a fairly regular part of the diet and a valued gift for guests; meat is usually reserved for special occasions. Livestock and their products are also exchanged or sold to obtain crop products. In this way, livestock foods become available on local markets, as well as on markets further afield.

Provision of other raw materials

Livestock provide not only foodstuffs but also various other raw materials such as wool, hair, hides, feathers and bones which can be used for clothing, furnishings, im-

plements etc., both for household use and for sale. The added value of processing such raw materials can be a further source of income for both men and women within rural communities.

Provision of labour (energy for work)

Animal traction is used in some areas for ploughing, weeding and pulling loads. More widespread is the use of animals for riding and transporting loads on their backs. Household goods, water, but also farm inputs and products are often carried in this way. Animals are sometimes used to operate irrigation or threshing equipment, or are used directly to thresh grains with their hooves. The action of animal's hooves is also used to prepare a soil surface for sowing. Experienced lead animals in a herd are also useful for reducing the herders' labour inputs in controlling the animals.

Manure production

Particularly as population and cultivation densities increase, manure plays an important role in supplying the nutrients and organic matter needed to maintain soil fertility and structure on cropland. Even where chemical fertilisers are available, organic matter such as that provided by manure is a key to the sustainability of cropping. Animal-keepers may use manure to fertilise their own household gardens and cultivated fields, as well as those of other farmers who do not have the appropriate number or breed of stock. The easiest way to deposit manure on fields is to keep animals there overnight. More laborious methods include collecting manure from animal enclosures and transporting it to fields, transporting the even bulkier barnyard manure (mixed with straw and feed residues), or preparing and transporting compost.

Not only large but also small animals provide manure for cropping. For example, in central Nigeria, goats are kept overnight in huts during the wet season. Their dung is mixed with wood ash and used to fertilise millet nurseries. Even cattle-keeping Fulani obtain goat manure from their non-Fulani

neighbours for this purpose. In Kenya, manure from commercial poultry production is sometimes used by smallholders to fertilise Napier grass (*Pennisetum purpureum*) for dairy animals (Bayer, 1990a).

In addition to its use as fertiliser, manure has many other (often conflicting) uses, such as to plaster house walls and floors or to burn as fuel for cooking or heating. Particularly in Asia, the use of manure to produce biogas is widely propagated.

Means of savings and investment

Livestock serve an important function as a savings account, producing offspring as interest. Income from cropping or other enterprises is often invested in livestock. In many countries, this form of investment is more reliable and lucrative than putting money in the bank. A 6-year study in Lesotho found that investing in cattle earned farmers the equivalent of a 10% interest rate, while a bank account lost 10% because of inflation (Swallow & Brokken, 1987). It is therefore not surprising that farmers—and many non-farmers—put their money in livestock rather than banks.

When smallholders keep livestock as a means of savings and investment, they are often satisfied simply if the animals survive and reproduce, i.e., bring interest, with very few inputs. The animals eat kitchen scraps, weeds and anything else they can find for themselves and, when cash is needed, an animal can be caught and sold. With few inputs of scarce resources such as labour or cash, these livestock give value to waste. They make use of byproducts within the farming system which are not eaten directly by humans: not just kitchen scraps but also plants thinned from cereal plots, lower leaves stripped from standing crops, crop residues after harvest or threshing, or a crop which failed to mature because the rains stopped.

A special form of using livestock as investment is the use of more prolific animals, such as small ruminants, to rebuild herds after disasters, the offspring being sold to buy cattle or camels (Talle, 1990).

Source of cash

Daily offtake from living animals, such as milk or eggs, provides a more or less regular flow of cash income, even if only part of the offtake is sold and the absolute income per day is low. At least it is enough to pay for small regular purchases of salt, sugar, soap, kerosene etc. Larger sums of money to pay, for example, for a sack of grain, medical care, house repairs, fertiliser or supplementary feed can be obtained by occasional sales of animals. For this purpose, it is important to have animals of different values, for a goat and not a bull would be sold to obtain enough cash for, say, school uniforms.

As cropping is intensified and particularly when supplies of chemical fertiliser are unreliable or not available at all, manure can also be a source of income. In parts of West Africa, farmers pay cattle-keepers in the form of cereals, fodder (crop residues), traditional mineral supplements or cash, and grant pastoralists rights to land use and water in return for manure. In addition, the hiring out of animals for ploughing can be a source of income for livestock-keepers.

Animals can be an important source of cash not only for full-time live-stock-keepers, but also for crop farmers who keep only a few animals. Crops make up the larger part of total farm output, but may be used more for home consumption, while the animals bring in the cash. For example, in Nigeria, researchers from the International Livestock Centre for Africa initially paid little attention to the crop farmers, as they kept only a few goats, pigs and chickens, whereas the Fulani kept herds of 50–60 head of cattle. However, household economic studies revealed that the farmers derived more than half of their cash income from animal sales. According to FAO (1991), the sale of livestock products can account for up to 80% of the regular cash income of small-scale farmers.

Source of security

The importance of keeping livestock grows as the risks of cropping increase, for instance, in drier areas. Livestock serve as a buffer for

the variations in crop yield: when crop harvest is not enough to meet family needs, animals can be sold to buy food or slaughtered to eat. As long as the animals remain alive, they have a food storage function.

Security is increased by keeping various kinds of stock with different susceptibilities to drought and disease. Loaning animals to other households is also a way of spreading risks of loss (e.g., to outbreaks of contagious animal disease) and ensuring rights to borrow animals when a household is itself in need. Conversion of livestock into networks of social relationships also secures access to extra-household labour (Sikana & Kerven, 1991). Livestock are thus used to ensure the survival of the household.

Source of identity

These mutual loans are closely connected with the function of livestock in giving meaning to social relationships and gaining political status. Among many traditional livestock-keepers, social relations are continuously affirmed by exchanges and transfers of animals, by cooperation in herding and by sharing meat from slaughtered animals (Talle, 1990). Preoccupation with livestock gives these people their social and cultural identity. This is a phenomenon found throughout the world, particularly among smallholders who have managed to survive under harsh conditions, such as the mountain dairy farmers in Switzerland and Austria.

Implications for measuring productivity

Recognition of the various benefits derived from livestock demands redefinition of the concept "productivity". Conventional measurements are based on products marketed in a formal "modern" economy, such as meat, eggs, milk. The formulae express livestock production in terms of liveweight gain, milk yield, reproductive performance etc., ignoring many of the other use values of animals in the rural economy. Even if productivity is confined to measuring food output per unit of input over time, conventional measurements are inadequate. In

"modern" livestock marketing, carcass weight and dressing percentage are important parameters, yet so-called "offal" such as intestines and skins may be highly valued foods in some societies.

If productivity were to be defined as the rate at which the *sum of benefits* is generated per unit of scarce resource (e.g., per unit land, labour, water, cash), then calculation of livestock productivity would have to be expanded to include other outputs such as manure or draught power. Many smallholders derive a wider range of benefits from animals than "modern" specialised enterprises, which concentrate on only one or few products. It is therefore not surprising that, when all benefits are included in the calculations, "traditional" systems can be more productive than "modern" ones—particularly if calculated per animal or per unit of land (cf. de Ridder & Waagenar, 1984).

Yet even if productivity calculations include only food output, it has been found that traditional livestock systems in semiarid Africa can yield up to ten times more protein per hectare than ranching in comparable regions of the United States or Australia (Breman & de Wit, 1983; Table 2).

focus on increasing meat or milk output may, for example, be relatively unimportant if farmers give high priority to manure production for cropping. Then, it may be better to keep two animals with low weight gains than one with high gains. Or if the savings function is particularly important, a smallholder may be more interested in survival feeding than in feeding for high weight gains or high milk yield.

Household Decision-making in Meeting Multiple Aims

In drawing up appropriate development programmes and policies, awareness is needed not only of the multiple functions of livestock in rural households, but also of the complex nature of household decision-making to meet the aims of the various household members. In agricultural development in general, but particularly in livestock development, planners have tended to regard the male household head as the one who controls the resources and makes the decisions about production. Not enough recognition was given to the rights, interests and influences of other household

Table 2. *Livestock production in the Sahel and two comparable regions (semiarid tropics with less than 500mm annual rainfall)*

| Region | Livestock-keeping system | Protein production (kg/ha/year) |
|---------------|--------------------------|---------------------------------|
| Sahel | Nomadism | 0.4 |
| Sahel | Transhumance | 0.6 to 3.2 |
| Sahel | Sedentary | 0.3 |
| United States | "Modern" ranching | 0.4 |
| Australia | "Modern" ranching | 0.3 to 0.5 |

Source: after Breman and de Wit, 1983.

Thus far, livestock development programmes with a narrow concept of productivity have achieved little in strengthening the many different functions of livestock in rural households. The conventional development

members. In recent years, however, numerous studies have been made of the division of labour and responsibilities within households, and the substantial role of women has been documented.

Many women own livestock, are involved in decisions about animal sales and, for example, in Somalia, are even engaged in the butcher trade (Oxby, 1983; Broch-Due et al., 1981; Reusse, 1982). Particularly smaller animals such as sheep, goats and poultry are often owned and managed by women and girls. But even in societies where the men traditionally pride themselves on owning the large animals, women may actually control a surprisingly large number. For example, among the Fulani agropastoralists in central Nigeria, one quarter of the cattle belonged to women and girls (Waters-Bayer, 1988). Even where animals are owned by men, the women and children are often involved in daily tasks such as feeding, watering, cleaning enclosures, and tending young and sick animals. In many cases, women are responsible for milking and, even if the men do the milking, the women decide how the milk will be used: whether consumed at home, given to friends, exchanged for food or labour, or sold.

As a result of external influences, roles within smallholder households change over time. Women's role in pastoral systems becomes even more important in societies under pressure as a result of commercialisation of production and changes in land use, such as among the Turkana in north Kenya, where women are increasingly taking over herd management responsibilities while men seek wage labour in other parts of the country (Hogg, 1985). The same phenomenon was observed among impoverished pastoralists who had settled on the edge of towns in Sudan and Nigeria: women not only sell the milk from the few cows and goats, they have also taken over the herd management, while the men seek other sources of income in the towns (Salih, 1991).

The following example illustrates how gender differences in responsibilities affect decision-making within the household and, thus, lead to results other than those expected by livestock policymakers.

In Nigeria, dairy development plans involved promoting supplementary feeding and pasture improvement. The inputs were

to be sold on credit to cattle-keepers, who would then feed their cows, extract more milk, sell this to milk collection centres, and use part of the income to pay back the credit. This assumed that decisions about buying inputs, feeding, milking, selling milk and using milk income were made by the same person: the household head. However, over 90% of cattle in Nigeria are kept by Fulani and, in most cases, the men are responsible for buying inputs, making feeding decisions and milking; while the women process and sell milk products and decide how this income will be spent. The men have no control over milk income, which the women usually spend on food and goods needed daily by their families. The men obtain cash income, which is used among other things for buying herd inputs, by selling animals.

The men therefore used the supplements primarily for survival feeding and, if they did feed milk cows, they left more milk for the calf. In this way, they managed to cut calf mortality in half (from 28% to 14%), but the women did not receive more milk from the herds. Meanwhile, the women continued to process and sell their small daily quantities of milk in villages and towns, earning more than four times as much per litre of milk than was offered by the collection centres.

Thus, the Fulani households indeed benefited from the innovations in cattle feeding: higher rates of livestock survival mean greater livelihood security. Moreover, the milk which was still produced remained in rural areas, where local people could continue to buy local milk products more cheaply than products from modern processing plants (which were using mainly imported milk powder at the time). If the milk from the Fulani herds had been bought up by the collection centres, it probably would never have found its way back to the rural areas. But policy-makers did not achieve their aim of producing more milk for the cities (Waters-Bayer, 1988).

Perhaps it is just as well that the planners were so thoroughly ignorant of what the Fulani women were doing: the dairy devel-

opment scheme was so "outlandish" that it did not have a detrimental effect on the women's income-generating activities. If changes in gender-specific control over household resources are brought about by outside interventions, serious negative consequences for women's ability to provide for their families could result. For example, commercial dairy development in parts of Tanzania and the Middle East has led to male control of milk and, thus, of the cash income (Ndagala, 1982; Dahl, 1987).

The control exercised by different household members over animals or their products can mean that decisions to use animals for commercial gain must be preceded by considerable discussion within the family, until an agreement can be reached. This may slow down marketing decisions and uptake of new technology, but helps to safeguard the interests and needs of the entire household.

Livestock-keeping and the Rural Economy

Seen on a regional scale within a country, livestock-keeping can make productive use of areas which could not otherwise be used. In ecological terms, animal-based systems are particularly suitable for making use of dryland resources (Hjort af Ornäs, 1990). But livestock can also give value to otherwise wasted resources in more humid areas. Forage is derived from land which is not suitable for cropping (wayside edges, waterlogged areas, rocky land, scrub areas) and from land which is temporarily not being cropped (via grazing of crop residues and fallow fields).

Livestock can also play a role in rural areas in manipulating vegetation to the benefit of human life. In subhumid areas, grasses grow tall and dry off quickly after the end of the wet season. Grazing around villages during the wet season reduces the combustible standing biomass and lowers the risk of uncontrollable fires during the dry season. Browsing animals can be used to control the growth of bushes and thorny shrubs; for

example, the Maasai reportedly herd their goats in such a way as to reduce bush encroachment (Jacobs, 1980). This permits a better grass growth for cattle. It may also destroy the habitat for biting and disease-transmitting flies and thus improve animal and human well-being.

Livestock-keeping permits intensification of land use with low levels of external inputs. Indeed, it has been observed in many parts of the tropics that, as the percentage of land cultivated increases, so does the number of livestock (cf. Bourn et al., 1986). If arable production is to be sustained in areas with low external inputs, ruminant populations must be kept high for manuring the cropland (Scoones, 1989). A striking feature of indigenous intensification of land use, e.g. on Ukara Island in Tanzania (Ludwig, 1967), in Nigerian hill farming (Netting, 1968) and in other indigenous systems described by Allan (1965) and Ruthenberg (1980) is the development of close links between crops and livestock. This is because, wherever cropping is possible, crop-livestock interactions permit optimal use of local natural resources and represent the most efficient form of production in terms of nutritional returns per unit area (Hjort af Ornäs, 1990). Thus, integration of livestock and crops raises the "human support capacity" measured in terms of the number of people who can be supported per unit area of land.

Integration is also possible when crops and animals are raised by different groups operating close to each other. A spatial integration of crops and livestock is achieved, for example, when animals are grazed by herders on fallow fields between plots cultivated by farmers. This complementary land use *alone* results in higher food production per unit area than if cropping and livestock were spatially segregated. And the beneficial links via manure for fertilising crops and crop residues for feeding animals permit still greater increases in production per unit area.

Interactions between livestock husbandry and cropping can involve both transfer of

nutrients and energy from grazing areas to cropland and intensification of the nutrient and energy cycles. On Kenyan smallholdings, for instance, 35–45% of annual forage energy is derived from crop residues, mainly maize stover (Stotz, 1983). By passing through the ruminant stomach, plant material is broken down more quickly than through natural decay of vegetation. Thus, although production of manure cannot create additional nutrients, it can speed up the nutrient cycling process (cf. Powell & Ikpe, 1992).

In cases of increasing landuse intensity, the role of trees also becomes more important. In traditional systems of intensive land use with few external inputs, the livestock, field crops and woody species are closely linked. When new land is cleared for farming by traditional means, i.e., without mechanised clearing equipment, important economic trees are left standing. Seedlings close to the homestead may be protected, for example, by surrounding them with thorny plants, and some seedlings may even be transplanted. In central Nigeria, the trees valued as sources of forage were found to be more frequent on cropland than in the natural forest, in relative and sometimes also in absolute terms (Bayer, 1990b). Even though it is often not the prime reason for protecting trees, they are used to provide forage, particularly in the late dry season when other green feed is not available. Thus, livestock make additional use of resources such as woody vegetation, already being used for various other purposes within a very complex landuse system.

In view of the rapid population growth and the resulting necessity for increased food production, crop-livestock integration gains particular significance. The ways in which some farmers have already forged such links indicate interesting possibilities. For example, Bambara farmers in Mali have recently managed to expand production of fast-growing varieties of millet, without any chemical fertiliser, by having wells dug in their fields to attract transhumant herders to camp there during the dry season. The

increased manure deposits brought additional millet yields worth up to seven times the cost of the well-digging (Toulmin, 1983).

Such types of landuse systems which have been developed and are being further developed by smallholders under difficult conditions are resources for development (cf. Richards, 1985). It is important that planners and development agents understand and learn from them—rather than replacing or destroying them.

Livestock-keeping and the National Economy

But, one may argue, even if the many benefits of smallholder livestock-keeping are recognised, production must still be increased to meet urban needs for food. Foods derived from animals provide proteins to complement staple carbohydrate foods and to supplement the diet of vulnerable groups like children and nursing mothers. However, development of a modern, market-oriented livestock sector has been promoted in many countries not so much to meet these nutritional *needs* but rather to meet the *demand* for livestock-derived foods by richer urban dwellers.

A large number of very expensive attempts to develop the modern livestock sector have failed. Even where modern ranches or dairy schemes have “succeeded” in terms of supplying urban markets, they often compete strongly with the smallholder sector for land, particularly for better-quality land and key seasonal grazing and water resources. These limitations in flexibility and movement in smallholder livestock systems can bring about their collapse, for example, through overgrazing in areas of animal concentration. And what then happens to the people who once derived a livelihood from these livestock systems?

If the costs and benefits of different livestock-keeping systems were calculated to include the benefits of rural employment and, thus, less migration to urban slums, the profits to the nation of supporting the smallholder sector would become more

apparent. Widespread, small-scale livestock husbandry provides a source of productive employment and livelihood for a large number of people—not only in production but also in local processing of livestock products, like the above-mentioned Fulani women who process and sell milk.

Promoting smallholder livestock-keeping can also make use of indigenous knowledge and skills in livestock production with low levels of external inputs. This existing knowledge and the traditional ways of conveying it to younger generations are resources which are in danger of being eroded by introducing foreign and inappropriate forms of livestock production (and education). This is a strong argument in favour of helping pastoral families restock after a major disaster, to avoid the loss of productive skills and attitudes which can occur when people remain dependent on food aid for a long time (Moris, 1988).

Likewise, if use of external inputs is strongly promoted, for example, by means of subsidies and credit programmes, farmers are encouraged to make high capital investments and to adopt production methods which make them dependent on maintaining or even increasing their use of external inputs—many of which are based on fossil fuels or cause environmental pollution. But, when the prices of these inputs rise—because of scarcity, because of their environmental costs, or because subsidies are reduced or withdrawn—these farmers will be in very serious trouble. And it may be very difficult to salvage the valuable knowledge they or their parents once had about using renewable resources in livestock production.

Finally, livestock indeed have an important function in supplying rural, urban and international markets. The argument for promoting modern commercial livestock enterprises often equates "smallholder" with "subsistence", as though smallholders sold none or very little of their produce. As was shown above, not only nomadic herders but also crop farmers with only a few animals sell livestock or their produce. More-

over, this is increasing, even without deliberate projects to "integrate livestock-keepers into the market system".

The contribution of existing modes of livestock production to national economies should not be underestimated—measuring productivity in a more encompassing sense as outlined above. For example, it was calculated for Africa that the annual output from livestock (meat, milk, fibre, skins, manure, traction and transport) was more than the value of Africa's annual cereal output (McDowell, 1984). Part of the offtake is already supplying rural, urban and international markets. But the offtake for market from some of these smallholder systems may already be at the upper limit of what is possible with the available resources, if household viability is to be maintained.

Livestock-keeping and the Global Economy

If economics is concerned with the use of scarce resources to produce goods and services to satisfy human needs and wants, what role do livestock play in the use of resources on a global scale and in their continued use to satisfy human needs, i.e. in terms of sustainability?

It is necessary to examine livestock development trends, to assess which ones render the soil-plant-animal-human livelihood system less sustainable, and to establish ways in which it can be made more sustainable. A number of issues related to this have already been mentioned, for example:

- smallholder livestock-keeping contributes to household economic viability, rural income and welfare and, thus, to social and economic stability in rural areas;
- integration of livestock-keeping and crop farming maintains or increases the human support capacity per unit of land, particularly with a view to maintaining soil fertility on cultivated land.

There are also trends which are to the detriment of the natural resource base and the rural economy, for example:

-increasing animal numbers to support increasing numbers of people who derive their living from animals, as well as concentration of animals with limited mobility, are leading to overgrazing in some areas, particularly when the stock-keepers no longer have access to seasonal pastures, when water development creates imbalances in water and pasture availability, and when nomads are settling in dry areas;

-increasing commercialisation of livestock production is squeezing out many of the rural poor, as profits are concentrated in fewer hands.

But the disturbing nature of these trends pales almost to insignificance against the grotesque forms that commercial livestock development has taken in some parts of the world. Take the example of the Netherlands: Large areas overseas, for example, in Brazil, are now being monocropped with soyabean—on land from which smallholders were ousted, pushed into urban slums or into rainforest areas as squatters. While Brazil now has to import some of its basic foods, the exported crops are fed to livestock in the Netherlands. Here, they permit concentrated animal production on an industrial scale, which causes pollution of soil, water and air, while the gases (e.g., carbon dioxide and methane) from the fire-clearing of the rainforest in Brazil and from the well-fed Dutch livestock contribute to global warming.

The intensive livestock feeding also contributes to overproduction in Europe and mountains of butter, pork, beef etc., which are dumped on the world market and limit the marketing possibilities for livestock-keepers in the "Third World".

In other words, policies of industrialised countries, as well as export policies of many developing countries, are distorting markets and hindering sustainable livestock development. As much as it is necessary for governments in the South to ensure that their policies do not contribute to destroying their own resources, it is equally important that pressure is exerted on the governments in the North not to destroy the world's resources.

This is also connected to the issue of energy efficiency. High-external-input livestock "factories" are depleting nonrenewable sources of energy. In traditional smallholder systems, livestock are produced with little use of fossil energy, for instance, few chemical-based drugs are used, little or no chemical fertiliser is applied to grow feeds, and little or no fuel is used to process and transport feeds and products. In view of the long-term economic and environmental costs of using fossil energy, it would make sense in terms of global resource management to minimise the use of such external inputs. This would mean trying to at least maintain and, if possible, increase the efficiency of resource use in present systems of smallholder livestock-keeping, rather than promoting "modern" systems using high levels of non-renewable resources.

In terms of producing food for the growing world population, the energy input-output ratios for livestock products are less favourable than for crop products. The ratios are particularly unfavourable when livestock are fed with crop products which can be consumed directly by humans. However, in calculating energy balances, consideration should also be given to the energy needed to prepare foods for human consumption: for example, milk can be consumed directly or processed into fermented products with very low energy inputs, whereas meat requires cooking and a plant protein source such as beans requires even longer cooking and correspondingly more fuel.

Livestock Policy Implications

Policy must be guided by knowledge of the role of livestock in the household, rural and national economies. As an example at the household level: if livestock are kept as a buffer against poor harvests or large herds are kept as insurance against drought, then livestock marketing can be encouraged only if grain is available for these livestock-keepers to buy. If they cannot use their cash earnings from livestock to buy the grain they

need, they will be more inclined to eat their animals than sell them (O'Leary, 1990).

At the level of the rural economy, promoting commercialisation of livestock production, i.e. production for the market, means promoting specialisation in terms of animal species and products, for example, in beef production. In many cases, as already discussed above, this results in lower total output per unit area and, thus, lower human support capacity of livestock-keeping within a country. Studies in Somalia and Botswana revealed that increased commercialisation of cattle-keeping led to increased offtake of stock for slaughter but also to a weakening of traditional insurance systems (e.g., animal loans), lower milk offtake, less intensive herd management, and social stratification with a few rich, often urban-based herd owners and many impoverished herders (Behnke, 1983). Thus, increased commercialisation may serve urban and export markets, but can erode the subsistence base of many rural people. Increased commercialisation cannot be prevented; it is already long underway. However, the inherent dangers must be recognised and efforts made to minimise the risks to the poorer rural inhabitants, and to minimise the decrease in total (not just cash-generating) offtake from the national livestock resources.

On a national level, human nutrition strategies must be clarified, particularly when it comes to the issue of intensifying livestock production by feeding grains. Tropical forage is low in quality compared with temperate forage, and animal production can undoubtedly be improved by feeding concentrates. This can be attractive to market-oriented producers, if the costs justify the gains made in, for example, animal fattening or milk offtake. Concentrates can be bought and fed immediately; they do not require longer-term investments of land, labour and capital as does fodder cropping. However, feeding grains competes with human nutrition. If a nation wants to use its resources to meet the basic needs of its people, then giving grain to livestock cannot be considered an efficient way of doing so. Yet exactly this is encouraged by subsidising

grain prices, such as in Egypt, where it is suspected that even bread is fed to livestock. In terms of resource use, feeding of agroindustrial byproducts and straw/hay would be more efficient, particularly to bridge gaps in animal nutrition (e.g., survival feeding during the dry season), and as a source of fodder for livestock kept by the landless.

The policies concerned with processing and marketing of livestock products can also have important implications for the rural economy. If the food strategy of a government is to produce animal protein primarily for a rich elite, it might be appropriate, for example, to collect as much milk as possible from rural areas, process and package it in modern dairy plants, and sell it in urban supermarkets at many times the price that women could have sold it to a much larger number of rural customers. However, if the strategy is to make additional protein available to a wide segment of the population, it might be more appropriate to promote small-scale, possibly even home-based milk processing units in rural and peri-urban areas. This example is also related to issues of employment and income distribution (numerous decentralised processing units as opposed to few centralised units), gender aspects (income generation for women by adding value to livestock products through home or village processing), and sustainability (forms of processing and marketing which involve high levels of inputs based on fossil fuels, versus promoting low-external-input processing).

As animals constitute but one component within complex rural economies, policies in other sectors can also have considerable implications for livestock-keeping. Policies which promote the use of external inputs in cropping can weaken crop-livestock linkages. For example, subsidies for mineral fertilisers can lead farmers to abandon their traditional manuring practices, with serious consequences for soil structure and fertility and, thus, for sustainability of farming. Similarly, the introduction of herbicides may eliminate a source of fodder, if weeds are customarily fed to animals during the growing season or grazed after harvest.

Likewise, large-scale mechanised cropping may reduce availability of pasture, and the land-clearing methods may also reduce the number of fodder trees. Introduction of irrigation techniques which permit cropping throughout the dry season may deprive livestock of vital seasonal grazing grounds. Smallholder livestock-keeping systems typically depend on different resources used at different times of the year, and the exclusion of one seasonal grazing resource may cause the entire system to break down, meaning that the other resources can no longer be used gainfully for livestock-keeping and, thus, to sustain human livelihoods. To ensure that these resources can still be used by livestock, another source of fodder would have to be made available to replace the loss of lowland dry-season pastures.

Forestry policies may have similar effects, for instance, they may block women's access to grazing areas for their sheep and goats, which are kept to provide security and food for the family. If women are not consulted during the planning of tree-growing and forest-reservation measures, and alternative grazing and fodder supplies are not included in the programme, family welfare is likely to suffer (Angstreich, 1991).

On the other hand, because of the many ways in which smallholders use productive resources, including livestock, it is also possible that innovations not directed exclusively at improving animal production nevertheless make an important contribution to this. Some examples:

- Trees and bushes can be incorporated into farming systems or watersheds in such a way that they provide food or fuel for household and market, and protection against erosion, but also fodder for animals.
- In multiple-cropping systems, legume plants can be promoted which produce food for consumption and sale, improve soil fertility and also provide fodder for livestock.
- If cropping is promoted in such a way that it does not exclude livestock, for example, so that it still allows them access to water sources and to grazing on harvested fields, increased cropping can also contribute to improving livestock production.

-Appropriate techniques can also be used in the threshing and processing of crop products, to ensure that byproducts relatively rich in protein are made available as feed supplements. For example, in a rice project in Niger, using a machine that removed the husks from the paddy before it was polished, rather than dehusking and polishing in one operation, produced a bran which was more palatable and valuable as animal feed than a mixture of husks and bran (Wardle, 1979).

Thus, in view of the close links between livestock and other farming activities—particularly with increased intensification of land use—livestock policies will be virtually inseparable from policies for promoting cropping, tree-growing and agricultural processing. This has important implications for livestock research policies, in that increased attention will have to be paid to the role that crops can play in livestock husbandry and that livestock can play in cropping. This may range from relatively simple questions such as how many maize leaves can be stripped from the standing plant to feed animals without reducing the grain harvest, to complex questions of nutrient transfer and nutrient cycling by letting livestock feed on natural vegetation (by either grazing or cut-and-carry) and using the manure to maintain soil fertility on cropland.

Questions for Policymakers

Policies pursued in livestock development have important implications for income generation and distribution, nutrition strategies, gender issues and sustainability—all of which are closely interrelated. Policymakers in developing countries may find it useful to ask themselves the following questions related to these issues:

Income generation and distribution. Which systems of livestock-keeping and of processing and marketing animal products can be identified in the country which give a large percentage of the population a source of livelihood and income? What policies already exist to support these systems of live-

stock-keeping, and what policies are still needed to support them?

Nutrition strategies. Are there really only the two extremes: "starve the city dwellers and they riot" or "starve the peasants and they die"—or move to the cities? What balance is presently sought between meeting urban and rural needs through livestock development, and how is this being done?

Gender issues. What roles do women in different parts of the country play in keeping livestock and processing animal products? What measures are being taken to allow women to participate in livestock development in both the planning and the production?

Sustainability. Are increased livestock productivity and sustainable use of natural resources diametrically opposed to each other? Or are there possibilities in the nation to pursue both goals at the same time? What livestock policies have already been formulated to achieve the most efficient use of the nation's resources, including human resources?

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