J. Soc. Sci., 3(3): 117-126 (1999)

Livestock as Capital and a Tool for Ex-Ante and Ex-Post Management of Food Insecurity in Semi-Traditional Agropastoral Societies: An Example from South-East Kenya

Dickson M. Nyariki[1] and Steve Wiggins[2]

[1]Department of Range Management, University of Nairobi, P.O. Box 29053, Nairobi, Kenya
email: farah@net2000ke.com
[2]Department of Agricultural and Food Economics, University of Reading, P.O. Box 237, Reading RG6 6AR, UK

KEY WORDS Food security; livestock capital; risk management; coping; agro-pastoralists.

ABSTRACT Discussions of the roles of livestock in many societies are not something new. They have been done in anthropological, sociological and, to some extent, economic literature. However, most of these discussions are normally not based on statistical evidence. In this article, there is an attempt to evaluate using simple statistical analysis the role of livestock in a household economy in sub-Saharan African rural setting. It is shown that livestock keeping in agro-pastoral systems is multi-faceted. Households possessing livestock till more land and realise greater yields of grain during the wet season. During the dry season, livestock are commodities, which are sold and or exchanged for grain. Ex-ante or risk management and ex-post (coping) strategies against food scarcity are also enhanced by the possession of livestock.

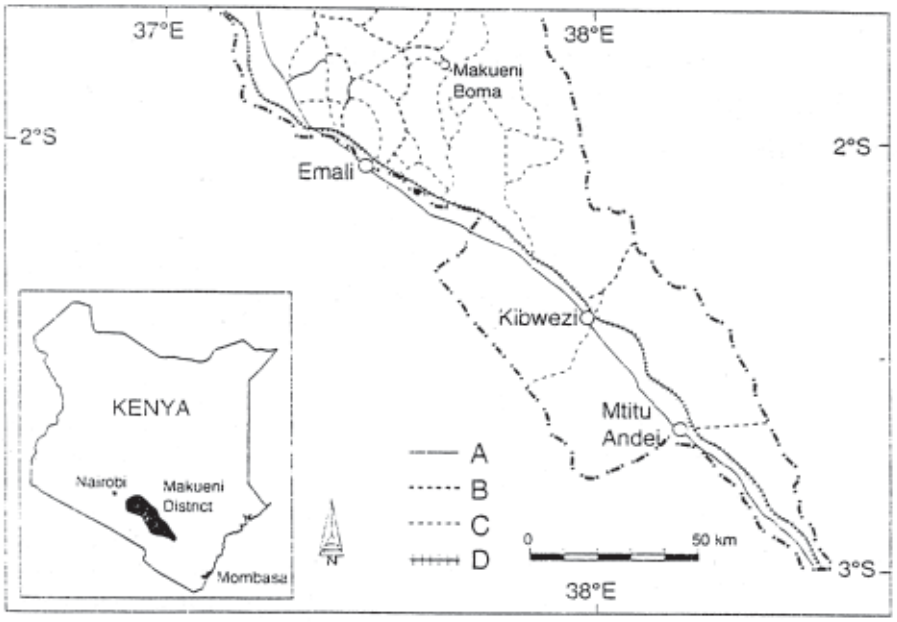
INTRODUCTION

In some empirical literature, food security is defined with reference to food grains alone. This may be misleading for households where livestock may form a substantial component of farm production, and hence a major source of food and income. For example, foods other than cereals provide about 40 per cent of total food energy for half the population in the sub-Saharan region with highest risk of food insecurity (Sansoucy *et al.*, 1995). The potential contribution of livestock to food security and economic development in these areas is great. Thus, exclusion of livestock in analyses of food security would be inappropriate in such circumstances, because individual and household food security depends on access to assets, work and assured income (Nyariki and Wiggins, 1997). Livestock may contribute to food security through increased output of livestock and non-livestock products and by employment and income generation that may assure access to food.

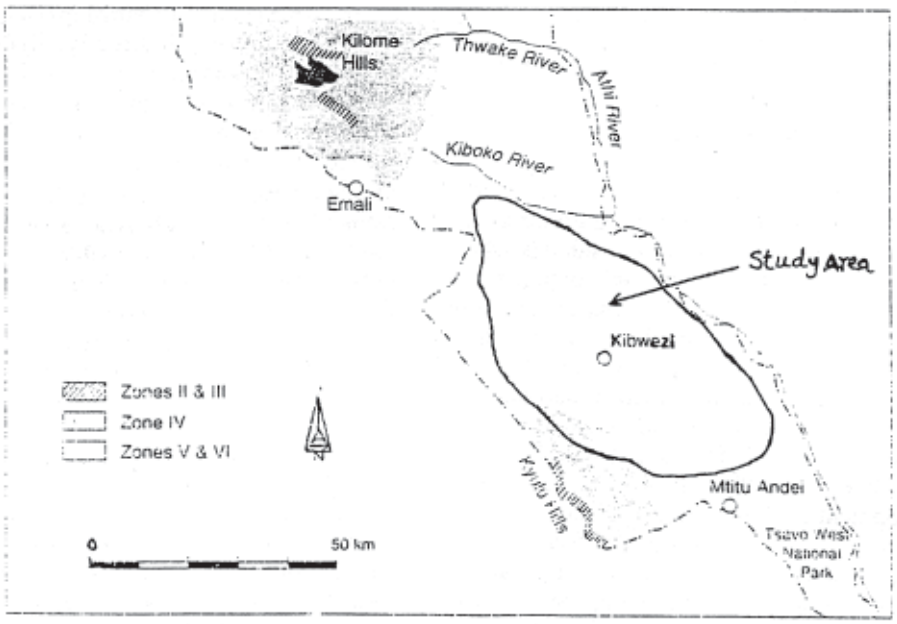
In most communities in Kenya, livestock, especially cattle and goats, have over the years mainly played a dual role as a means of social value by being a source of bride price and as a measure of wealth and social status; the higher the number of livestock, the higher the social status of the head of the household. In addition, livestock had value as investment that could be converted into cash to purchase food or could be directly exchanged for food or slaughtered for the same in times of hardship (Dahl and Hjort, 1976). Therefore, indirectly, livestock also played an important role in the food security cycle. As farming became more crop-oriented, livestock acquired an extra value by being a source of manure and traction. In some areas, this latter role of livestock as a capital good (rather than a final product) which produces intermediate goods to be used in the production process, has become increasingly dominant over the former roles. With empirical examples, some of these roles among agro-pastoral households in South-east Kenya are discussed.

AREA OF STUDY AND DATA

The present work involves the analysis of household data collected from Makueni district situated in the South-east of Kenya (Figure 1). This district was chosen as a representative case of arid and semi-arid areas. Areas of this type collectively form about 80 per cent of the country's landmass. Except in the north and some eastern parts of the country, a large number of semi-arid districts are inhabited by households involved in small-scale agropastoralism. And it



(a)



(b)

Figure 1. (a) Location of and infrastructure in study area; (b) Agro-climatic zones*
***A: Tarmac roads; B: Loose all-weather roads; C: Other roads; D: Railway line**
Source: **Adapted from Jaetzold and Schmidt (1983); Tiffen et al. (1994)**

is in such areas where households are most prone to food insecurity.

Most of the population of Makueni District of about one million live in the rural areas with only about 8% urban dwellers, living mainly in townships (ROK, 1994; Tiffen et al., 1994). The district is classified into several agro-ecological zones (AEZ) or agro-climatic zones (ACZ) (Jaetzold and Schmidt, 1983; Sombroek and Braun, 1980). Makueni District has six agro-climatic zones (I - VI), the most dominant of which are ACZs IV and V. Except for small areas under large-scale livestock production (ranching), most of the land is under small-scale mixed farming (agropastoralism). In the lower areas (Kibwezi Division), livestock keeping - cattle, sheep, goats, rabbits and poultry - is the major occupation, but crop production is also important. The main food crops include maize, pigeon peas, cow peas, beans and sorghum.

A sample of 50 households was drawn from villages in Kibwezi in zone IV/V. Except for the main Nairobi-Mombasa road, most roads are poor and usually impassable during wet periods. The division was fairly recently settled, the earliest settlements having been between the late 1960s and early 1970s. The 50 households were selected through cluster or area sampling by considering each administrative location under a chief as a cluster. This is normal practice in a country like Kenya because of poor infrastructure and difficult terrain (Casley and Lury, 1987). The clusters were randomly selected after which a sampling frame was prepared and systematic sampling applied to the frame.

Households were visited three times to obtain cross-section data for the three different seasons - the rain season ending December, 1994 (second season), the harvest season in July/August, 1995 (first season) and the harvest season of February/March, 1995/96 (second season). The visits at different seasons were helpful in tracking down livestock inventories mainly through purchases and sales, plus crop harvests and sales. They also provided time-series based on season.

RESULTS AND DISCUSSION

Livestock Production in Kibwezi

The main livestock breeds kept in Kibwezi are the local Small East African Zebu (SEAZ) cattle, the Small East African Goat (SEAG) and local sheep. Table 1 gives a breakdown of ownership of cattle, sheep and goats. The breeds are well adapted to the harsh local environment, plagued by lack of sufficient water, tsetse infestation and tick-borne diseases (Musimba and Nyariki, 1997). During the dry season, the animals have to be moved over long distances to the water points, which are provided by the Kibwezi River - the only non-seasonal river in the area. Sheep are kept in small numbers and by few households. The zebu cattle produce milk which is mainly used for home consumption. However, selling milk in small quantities locally is common. Milk is consumed fresh in tea or sour as a relish along with *ugali* (maize porridge). Cattle are also on occasion sold for cash, especially during drought, or slaughtered. Goats are rarely milked but their meat is preferred. Sheep and goats are also good for quick sale to provide ready cash. However, the production of cattle in Kibwezi is as much judged by their milk, meat and cash (through direct sales) as by their manure and traction. Traction and manure are both valued and saleable outputs. They are, probably, increasingly one of the main reasons why agropastoralists in this area still continue to keep cattle. Suffice it to say that, in addition to this, taking into account that, generally, most livestock are sold during the dry season (Table 2), they reduce the vulnerability of households to severe food scarcity. When dry season sales are compared with wet season sales, it becomes apparent that in times of food scarcities livestock play an important role in household food security (Nyariki, 1997).

Table 1: Livestock ownership in Kibwezi

Type of livestock	*Number of livestock*	*Number of households owning*	*% households owning*
Cattle	0	12	24
	>0<5	29	58
	>5	9	18
Small stock	0	4	8
	>0<5	46	92
	>5	0	0
Both cattle and small stock			
	0	3	6
	>0<5	33	66
	>5	14	28

Table 2: Household livestock access and sales in Kibwezi

Season/year	*Animal species*	*No. of households with access*	*Average no. of animals/ household*	*No. of animals sold/ household*	*% sales (offtake rate)*	*No. of households selling*	*% households selling*
2nd season 1994	Cattle	40	5.3	1.8	34.0	12	40.0
1st season 1995		24	4.9	1.7	34.7	3	12.5
2nd season 1995		31	4.4	1.3	29.5	15	48.4
2nd season 1994	Sheep	13	3.8	2.8	73.7	26	30.8
1st season 1995		12	3.6	2.7	75.0	3	23.1
2nd season 1995		12	4.7	2.2	46.8	6	50.0
2nd season 1994	Goats	48	10.1	1.1	10.9	4	54.2
1st season 1995		46	7.7	3.2	41.6	6	13.0
2nd season 1995		45	10.1	1.1	10.9	28	53.3
2nd season 1994	Chicken	49	17.7	8.4	47.5	30	61.2
1st season 1995		49	17.0	3.8	22.4	13	26.5
2nd season 1995		45	18.7	7.8	41.7	23	51.1

Livestock in Kibwezi are managed by herding or tethering. At night the cows are kept in a separate *boma* (cow shed) from the calves and milked in the morning and at times in the evening. Milk output per cow is low - approximately 1 litre per day. This is because, generally, the Zebu is a low milk producer. The advantage of the zebu cow is, however, that it requires low feed intake in addition to being tolerant to harsh climatic conditions.

Poultry, especially the local chicken breed, is another type of animal commonly kept by the Kibwezi households. The birds are kept under a free range system, feeding around the homestead on seed, grass, food waste and insects. Chicken meat is well liked and is frequently consumed at homes. Eggs are also commonly used at home. Chicken and the eggs are sold in local markets for quick cash (Table 2). To a small extent, beekeeping is also practised.

Livestock as capital in Kibwezi

Capital by definition is all those goods that are produced for the purpose of producing other goods. These are normally not natural resources but are material goods (other than land and labour). Generally speaking, however, anything - living or non-living - produced in the past for the purpose of contributing to production in the future can be classified as capital (Upton, 1987). Indeed, in livestock production, agricultural economists argue that livestock that are produced for the purpose of breeding or providing draught power and other intermediate products may be regarded as capital (Jarvis, 1974; Crotty, 1980; Nyariki and Munei, 1993). In this case, therefore, cattle that are devoted to the production of crops or final livestock products through the provision of manure, traction, calves and milk may be regarded as capital insofar as they have the physiological capacity to do so.

Capital items may be classified in many ways. For a number of economic analyses, capital is categorised as fixed or working capital, depending on the length of its productive life. As capital, livestock (especially cattle) would therefore be in the group of farm buildings, tractors, ploughs, sprays, irrigation equipment, etc.; items for which cash expenditure is required on the basis of a medium or long-term production period.

The role of cattle as capital in developing agriculture, especially in agro-pastoral systems, cannot be overemphasised. Capital is indeed needed for any kind of production process. Implementation of new agricultural techniques depends on capital availability. The share of traditional techniques in production will tend to go down as capital accumulation in agriculture takes place. This is mainly because capital accumulation results in the employment of capital intensive techniques. In many developing countries, including Kenya, for example, capital tends to save scarce land resources (substitute effect) and use rural labour (complementary effect) (Haley, 1991). Thus, in cases where the use of some livestock-related capital, such as the ox-plough, does not replace labour, increasing use of this type of capital may be quite beneficial, and may contribute significantly to household

food security. And even though labour may be replaced at some stages of production such as tilling the land, the use of cattle in ploughing might lead to larger pieces of land under cultivation and higher crop harvests leading to increased requirement for labour in weeding, harvesting and even threshing of certain crops.

Table 3 shows the relationship between cattle ownership and crop harvests - maize and maize equivalents compared to other categories of inputs. (Maize equivalents are obtained by converting all crop and livestock products into maize by weighting using local market prices). The table also shows the annual outputs of maize and maize equivalents among groups of

Table 3: Availability and use of various inputs and annual average yields in Kibwezi

Household category	*Maize (kg/ha)*		*Maize-equivalents (kg/ha)*	
	Use	*Non-use*	*Use*	*Non-use*
Hybrid seed	757	794	963	825
Fertiliser	821	772	907	872
Pesticide	862	770	1399	820
Access to irrigation	811	546	896	746
Ownership of cattle	783	767	1012	835
Handhoe	456	933	841	1587
Ox-plough	932	315	2937	1902

households who had access to two different means of cultivation - handhoe and ox-plough. Households using the handhoe as their main tool in land preparation had a lower harvest per unit area. This was likely because, compared to those using the ox-plough, households using handhoes spent more time in tilling and had less time to carry out other agricultural activities, resulting in delays in planting. Also, even though it may not be true for all soils, it has been argued by Oosten (1989), who has studied household farming systems in Kwale (a semi-arid coastal district in Kenya), that tillage by a handhoe is irregular and superficial and thus produces a rough seedbed, which leads to an early growth of weeds and even germination, in addition to reducing the root space. Further, the same weathered topsoil is used every season, leaving nutrients in deeper layers unutilised. These arguments may, however, not universally apply with regard to soils in semi-arid areas, where minimum tillage might be the more suitable method of land preparation, assuming cultivation is environmentally suitable in the first place.

Crop-Livestock Complementarities

The analysis of interaction consists of measuring complementary or competition between crops and livestock. Complimentary is defined as one sector's supply of inputs to another, such as using draught power and manure in crop production or crop residue as feed (McIntire et al., 1992). This relationship can be measured by comparing the outputs of mixed farms with those of specialised ones using average output for each category. Alternatively, outputs of crops and livestock within mixed farms can be analysed. If outputs from both production activities move in the same direction, that is to say, if one increases with an increase of the other or vice versa, complementary could be said to occur. Conversely, competition would be thought to be taking place if the outputs move in opposite directions.

In agropastoral systems, the interlinkage between livestock and crop production is not something new. Livestock production is an integral part of agricultural production and is not separate and apart from crop production. Both livestock and crop production have been shown to intensify alongside each other (Bourn and Wint, 1994). The linkages between crop production and cattle possession are principally through increased area under crop and yields per area cropped. A strong relationship between cattle ownership and crop production has been observed in some parts of Kenya and other areas of Africa, like Ethiopia, Zambia and Zimbabwe (see, for example, Francis (1998), Mukhebi et al. (1991), Barrett (1992) and Omiti (1995)). It is argued that the link between livestock biomass and land use intensity is associated with livestock access to marginal fodder (such as crop residues) as a result of cultivation and fallow land, proximity to markets and services, and particularly in more arid areas, the availability of water (Nyariki, 1997). Whatever the causal relationships, which may change in time and space, it has been demonstrated in several studies that, to some extent more animals tend to be found where there is more cultivation or vice versa in agropastoral systems (see, for example, Pingali et al. (1987), McIntire et al. (1992)).

Figure 2 shows a plot of the average number

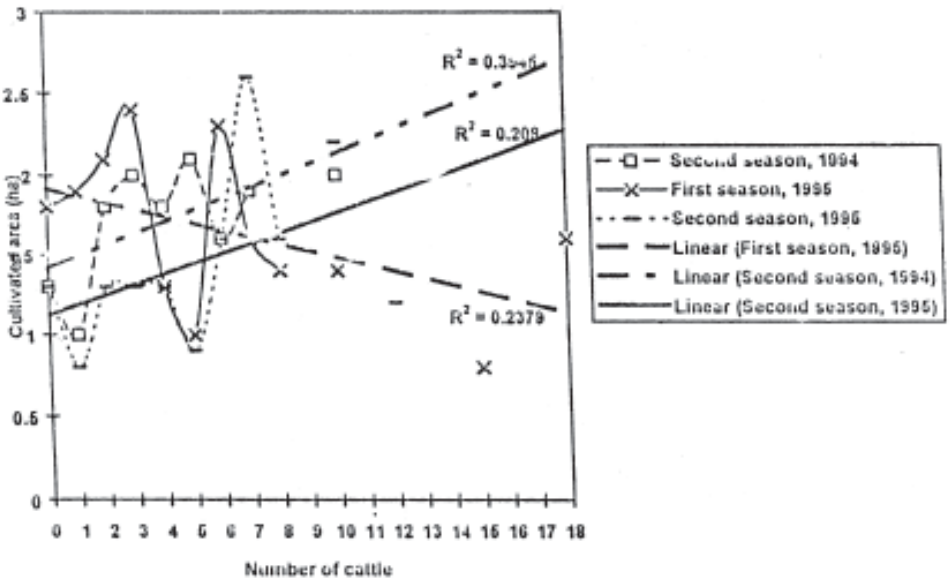


Figure 2. Cattle numbers and cultivated land area

f cattle owned by households against the average land area under cultivation. The straight (trend) lines depict the tendency of average cultivated area as average cattle numbers increase. Two of them - that represent normal seasons - show an upward tendency while one indicates a downward trend. The latter represents a drought season. Their goodness of fit (shown by the respective R^2 values) is, however, low indicating that the relationship is not strong. This, nevertheless, seems to confirm the held contention that numbers of cattle influence agricultural land that is cultivated (see also Table 4). It is clear from Figure 2 that cultivated area in Kibwezi increased with the number of cattle kept by households adopting a mixed farming system. We should be careful, though, when analysing complementary relationships. For example, it might be the case that those households with a greater number of cattle are richer and thus can afford to own and cultivate larger pieces of land. This latter scenario may be common among certain households and may, therefore, render the arguments of higher cultivation owing to greater cattle numbers inaccurate.

Whilst the plots in Figures 2 indicate that the average cultivated area increases with cattle numbers during 'normal seasons', as shown by the trend lines, swings are observed which may suggest that some households may actually be able to cultivate large areas of land not because they own cattle but because they are wealthy and cattle is just part of that wealth. However, at low levels of animal numbers, households may be experiencing the benefits of crop-livestock interaction, which increases cultivation with numbers up to a point. This occurs mainly because household labour is released as a result of the availability of animal draught taking the place of hand tillage (which consumes more labour). Beyond a certain level, it is no longer possible to increase cultivation as extra animals added begin to compete with crops for resources leading to reduced cultivation, and thus exhibiting the universal economic principle of diminishing marginal returns. In an environment such as Kibwezi, where farmers have small farm holdings, it is not possible to hold many large animals like cattle without causing competition with crops. Probably then the recommendation in such areas is to keep less cattle and more small ruminants.

Where households keep large numbers of cattle and simultaneously till large pieces of land, we may be observing what could be happening to a subset of farmers - the richer - who have acquired a large number of animals through, for

example, off-farm income, rather than by virtue of the contribution made by animals to farm benefits. These households are also capable of increasing the land tilled through the same means by either hiring more permanent or casual labour or sustaining big families with large amounts of labour available for the fields. Therefore the possession of cattle in such households would be a result of wealth rather than wealth being a result of cattle possession.

Livestock Keeping as a Risk Management and Coping Strategy

By definition, a decision is said to be risky when its precise outcome is not known at the time when the decision is taken (Webster, 1977). Risk can also be said to be a measure of the effect of uncertainty on the decision-maker (Upton, 1987). A predominant objective of agropastoralists in dryland areas, characterised by difficult and highly unpredictable weather conditions, is to minimise the risk of failure in crop or livestock production. Uncertainty is caused among other things by climatic variations, price variation, and lack of information.

Risk management is interpreted as a deliberate household strategy to anticipate failure in individual income streams by maintaining a variety of activities. It is a before-the-event (ex-ante) management strategy. On the other hand, coping is the involuntary response to anticipated failure in major sources of survival; it is thus an after-the-event (ex-post) management strategy. For example, ex-ante income management is viewed as a risk response, while ex-post consumption management in the wake of crop failure is interpreted as coping (Walker and Jodha, 1996; Carter, 1997). Coping includes strategies for maintaining consumption such as using up food stores, falling back on savings, selling of livestock, soliciting gifts and remittances from neighbours, relatives and friends and liquidating assets. Thus livestock alone can fall under the category of savings, produce to be sold, or liquidated assets. Unplanned responses to or coping with crises may initially involve looking for new income sources, and disposing of assets may be seen as a last effort to try and cope. This then implies that households that have more assets (in other words, more capital), which in agropastoral households are mainly composed of livestock, may find it less difficult to cope with the effects of drought. Thus, in these environments, farmers who diversify are less vulnerable to livelihood collapse in the wake of disaster such a drought resulting in crop failure. The focus here is therefore mainly on how people interact with the natural resource systems and on ways of describing the instability of livelihoods in the face of deteriorating natural resource base or sudden shocks (Campbell, 1990). Vulnerability is therefore a high degree of exposure to risk, shocks and stress and proneness to food insecurity (Swift, 1989; Chambers, 1983; Davies, 1996). The concept of vulnerability may also refer to the resilience (ability to withstand change) and sensitivity of livelihood systems following human interference (Davies, 1996).

The primary issues considered when farmers make decisions on whether or not to produce certain products are the availability of labour and capital, the expected return - physical, monetary and even non-material - and the perceived risk involved. The methods of production should be 'affordable', consistent with available labour and farmers' attitudes to risk, and acceptable on

Table 4: Crop-livestock interaction in Kibwezi : Cattle ownership, area of cultivated land and crop harvests

Households with	*Season/year*	*Number of households*	*Average number of animals*	*Average cultivated area (acres)*	*Average crop harvest (kg of maize)*
Cattle	2 nd season 1994	30	5.3	4.1	3777
No cattle		20	0.0	2.4	2475
Cattle	1st season 1995	24	4.9	4.3	614
No cattle		26	0.0	2.7	35
Cattle	2nd season 1995	31	4.4	4.2	3217
No cattle		19	0.0	2.7	1658

socio-economic grounds (Deuson and Day, 1990). Thus, scarcity of labour, capital assets and weather variability determine the appropriateness of certain productive processes and the inherent production risks.

By implication, risk factors are considered to be some of the principal factors that influence the survival of poor households as found in pastoral or agropastoral communities. Risk factors play a major role in agricultural production and productivity and hence food security in semi-arid areas. These factors are important in African agriculture, and especially so in the highly variable climatic conditions in semi-arid areas. Unreliable rain and pest and disease outbreaks cause wide variation in resource availability and in crop and livestock production. Generally, there are wide seasonal and unpredictable fluctuations in market prices, while information on alternative methods of production or the market situation outside the immediate locality is often lacking. Hence the producer cannot plan with certainty; his decisions are subject to risk (Upton, 1987).

Uncertainty is said to result in sub-optimal economic decisions at the farm level (absence of profit maximisation), unwillingness or resistance to change (conservatism of subsistence farmers), various production practices such as mixed cropping or farming as an adaptation to uncertainty, and a reinforcement of social differentiation by impacting the poor and the rich differently (Ellis, 1993).

Agropastoralists in unstable production conditions are likely to be risk averse. They try to avoid risk by adopting those production and or marketing strategies that assure an adequate food supply for the household throughout the season or year. Farmers base their judgement not only on the financial costs of production activities. They also consider those activities that take account of the risk minimising behaviour and food security objectives in difficult circumstances as found in dryland areas. Thus, output - increasing activities or methods that also result in reduced stability of output and incomes are undesirable and are likely to be avoided by producers.

As a result of unpredictable circumstances under which agropastoralists operate, they have, as already alluded to, developed various risk management strategies and coping mechanisms. One of the major strategies is to keep a variety of livestock in addition to cultivation (Table 4). Livestock enhance risk management and coping capacity as sales are increased during drought (Table 2) to purchase grains. Risk is also usually cited as one of the primary motives for income diversification. When definite outcomes in relation to income streams, for example, are replaced by probabilities of occurrences (risk), the social unit diversifies its portfolio of activities in order to anticipate and mitigate the threat to its welfare or failure in individual activities. Income diversification as a risk strategy is usually taken to mean a trade-off between higher total incomes involving higher probabilities of income failure and lower total incomes involving smaller probabilities of income fortune.

Crop-livestock mixing as a risk management strategy, from the point of view of the agropastoralist, has been condemned by extension workers and 'experts' in the past as an inappropriate system of production mainly on the assumption that it increases the incidence of disease and pest infestation. It has been documented, however, that in many countries where the system of mixed crops and livestock is practised, this has not been the case. The system is widely practised by most households in many areas in Africa including Kenya (McIntire et al., 1992; Deuson and day, 1990). However, in the semi-arid areas, there is a need for careful analysis of plant and or animal densities so as to reduce competition for limited moisture and nutrients, and to avoid the possibility of ecological disintegration.

As was observed earlier, it should be clear that diversity in cropping or livestock systems does not necessarily imply risk aversion. This action may be an effort to take advantage of complementary relationships between crops and livestock, variations in soil types and differences in micro-climates that ensure risk spreading with little loss in total income (Walker and Jodha, 1990). Farmers generally strive to achieve all these simultaneously (Roummasset, 1976).

One of the critical features of income diversification for risk reasons is the achievement of a portfolio with low covariate risk between its components. A characteristic of rural livelihoods

in sub-Saharan Africa is that most of the income earning opportunities for farm households (own farm production and agricultural wage labour) show a high relationship between risks attached to alternative income streams. However, in agropastoralism, especially in dryland areas, livestock production provides a means of reducing these risks, as it is less affected by adverse weather conditions than does crop production.

LIVESTOCK POLICY IMPLICATIONS

With limited physical capital and as a result little irrigation, livestock production still remains the principal viable means of livelihood for households in much of the arid or semi-arid regions of sub-Saharan Africa. The main means of alleviating poverty and mainutrition among smallholder agropastoralists in these areas is to encourage, through support and development, sustainable indigenous and or new livestock (production) technologies and management practices, suited to subsistence-oriented farmers and the environment. Any indigenous or new and sustainable technologies will depend mainly on the ability of animals to utilise low-quality roughages as found in the rangelands, enabling continuous production without interfering with environmental stability. More resources should be allocated to this sector for livestock research and extension to boost production, leading to increased production from existing or reduced area under grazing. Improved efficiency of meat and milk products would then mean that fewer animals would be required to produce the same amounts of products, thus conserving scarce animal and plant resources. Institutions charged with research on the best management and production methods should direct more efforts towards developing appropriate technologies for increased crop and livestock production.

Since one of the key ways to increase livestock production lies in giving producers, agropastoralists in this case, adequate incentives through increased rewards to their labour and management, careful policy frameworks are required to ensure that pricing and marketing are properly co-ordinated. This could be by ensuring timely and prompt payments for produce, where government and the private sector could facilitate this. Access to cash through employment and exchange in markets are the chief means by which households in rural areas survive times of crisis precipitated by drought, and by which they achieve food security under such circumstances. The two are the main modes (including livestock) by which capital accumulation can take place in the absence of credit facilities. Thus, some of the areas for policy intervention should not only be in supporting livestock output of smallholder households but also in increasing the access of households to a diversified portfolio of economic activities and improved public services to stimulate private activity in, say, livestock marketing. In fact, the most important way to improve food security in a livestock/crop based economy in semi-arid areas is by increasing market access, since production levels are low and crop failures are common. Livestock ownership in the form of both capital and food, however, improves market access and can be a provision against risk as it is an essential addition to crop production in agropastoral systems.

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