

FROM SUBSISTENCE TO SPECIALISED COMMODITY PRODUCTION: COMMERCIALISATION AND PASTORAL DAIRYING IN AFRICA ¹

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PASTORAL DAIRY SPECIALISATION

In this review we explore how pastoral dairying has changed as a consequence of commercialisation, defined as the total or partial shift in production goals from meeting subsistence needs to producing for the market. This shift occurs when monetary exchange becomes so regular and so generalised that pastoral products are no longer solely produced for *direct use* by the production unit, but acquire a *monetary value*, realizable through market exchange. When this happens, the character of pastoral products as marketable commodities is taken into account by producers *a priori*, during the process of production itself.

Faced with the need to produce most of what they consume, subsistence-oriented pastoralists extract a broad array of useful products from their herds. Commercially-oriented livestock producers, on the other hand, may purchase from the market most of what they need, and only produce those livestock products which are most profitable to sell. Market involvement therefore tends to narrow the range of products extracted from herds and to encourage specialization.

With regards to semi-arid Africa, development planners generally view live animals for slaughter as the commercial product par excellence, while milk and dairy products are conceived of as subsistence goods which decline in importance with commercialization. Accordingly, most examinations of commercialization analyze the problems and prospects for increased meat production. In this paper we will consider the same issue of pastoral commercialization, but from the opposite direction, looking the other way down the telescope. We are concerned with what has happened when milk itself

¹ This paper forms part of a research project in progress within the Pastoral Development Network at ODI, on commercial change in pastoral Africa. This review follows on from an earlier review published under this project, on the impact of commercialisation on the role of labour in African pastoral societies (Sikana and Kerven 1991), and from an historical study which stressed the importance of livestock marketing by African pastoralists (Kerven 1992). In this present review, sources from both anglophone and francophone Africa were consulted. The search for francophone literature was carried out in London and Paris by Nadia Lovell, whose contribution to this paper is acknowledged. The Pastoral Development Network's research programme on commercial change in pastoral Africa is supported by the British Government through a grant from the Overseas Development Administration.

becomes a commodity, and alternatively, what happens to dairy production by pastoralists when live animal sales become more prevalent.

The opening section of the paper offers a general model of the economic factors which influence a pastoral household to withdraw from or remain in dairy production, either for home consumption or sale. The model provides an overview of the process of commercial specialization as it affects dairy production. Subsequent sections examine four factors which are associated with variation in dairy specialisation and which have practical consequences for development planning:

- i) Scale of production: larger versus smaller herd owners
- ii) Production system: mobile versus settled livestock management
- iii) Labour and management: gender roles
- iv) Product and species variation.

THE USE AND EXCHANGE VALUE OF MILK IN PASTORAL DOMESTIC ECONOMIES

When deciding what to do with the milk produced by their livestock, pastoralists have several choices. Initially they must decide between:

- i) letting unweaned young animals consume all their dams' milk or
- ii) partially withdrawing for human consumption some of the milk from lactating female animals.²

If a pastoral household chooses to milk (which is frequently the case), then a further choice must be made between:

- iii) consuming within the household the dairy produce of the herd or
- iv) selling the dairy produce of the household herd.

The material summarised in this review suggests that most African pastoralists do all of the above, to various degrees on different occasions. The problem is therefore to disentangle the rationales for different allocation decisions.

To approach this problem, we propose a model based on the concept of use value. Individual pastoral households, may choose to produce variable quantities of goods for their own use; these directly consumed goods have a use, subsistence or in-kind value, as distinct from an exchange value realizable

² Other possibilities which exist but are very uncommon in pastoral Africa include feeding manufactured milk substitutes to young animals or slaughtering unweaned animals to retain their dam's milk for human consumption.

through trade. *If* there is no possibility of these goods being exchanged, *if* the goods are perishable and *if* the producing unit has a finite capacity to consume these goods, *then* the principle of diminishing returns will apply. The use value of such goods for producer households will decline very steeply after a saturation consumption point has been reached.

This principle is represented graphically in Fig 1., where the vertical axis represents the value of milk and the horizontal axis marks changes in the volume of milk (or any other perishable home-produced good where the above set of conditions apply). The value of milk is assessed from the viewpoint of the individual producing/consuming household; the volume of milk represents the potential milk output of all animals owned and operated by the household. The concave line in Fig. 1 suggests that, all else being equal, the use value of milk for a household declines with increasing milk output.

Figure 1. Use value of pastoral household milk production

Since all households are not equal in their size and composition, this will alter the value they ascribe to different quantities of milk. In Fig. 2 it is assumed that at very large quantities of milk, household size and composition are largely irrelevant in determining use value - too much is too much, and that is that. At lower output quantities, however, the variables of household size and

composition come into play. A greater number of consumers in a household raises the use value of each extra unit of milk. Conversely, since labour, particularly adult female labour, is required to obtain and process milk, fewer labourers in a household reduces the use value of each extra unit of milk by reducing the household's capacity to effectively capture that value. Households with an abundance of female labour capable of transforming fluid milk into less perishable forms can be expected to ascribe a higher use value to milk than labour-poor households.

Figure 2. Variable use value of pastoral milk production, by household size and composition

----- large/labour-abundant households
----- small/labour-scarce households

The hypothetical use value curves in Figs. 1 and 2 illustrate that the use value of milk may vary both by volume of production (Fig. 1) and according to the number and kind of personnel in the producing/consuming household (Fig. 2).

Thus far, we have assumed that milk has no alternative value apart from use value, but clearly this is not the case in reality since there often exists a market demand for pastoral dairy products. We now consider the consequences of providing a market outlet for 'surplus' domestically-produced milk. But when is a given volume of milk deemed by a pastoral household to be surplus to its consumption requirements? Fig. 3 points to an answer. In Fig. 3 the sale price of milk is assumed to be unaffected by the volume of milk produced by any particular household; the exchange value of milk at various household production levels is therefore represented by a horizontal straight line. The point at which particular households should in theory start to sell milk occurs at the point of intersection of the two curves representing exchange and use value, volume X in Fig. 3. Other factors being equal, within any household, volumes of milk less than X will tend to be consumed; those greater than X will tend to be sold.

Figure 3. Use and exchange value of pastoral milk production

In practice, all other factors are not equal, and we find instances in which pastoral households are selling rather than consuming milk when the use value still appears to be higher than the exchange value - that is, they have not reached the consumption saturation threshold predicted by Fig. 1. Therefore we must more closely examine the meaning of use value in this context. The

potential use value of milk to a pastoral household consists principally of its value as a food - but since households have other needs apart from food, we find that some households will sell milk as a means of obtaining other goods, even when their own food consumption requirements have not been met by milk. Pastoral households are able to do this because they can replace milk with other foodstuffs having a higher caloric value, through exchange.

Fig. 4 takes the principles depicted in Fig. 3 and adds a level of complexity which brings our still very simple model somewhat closer to depicting pastoral conditions. In Fig. 4 milk has three exchange values rather than one 'sale' price, as follows:

- i) The highest exchange value for milk is represented by its sale price in the dry season when supplies are low and prices are, accordingly, high.
- ii) An intermediate exchange value for milk occurs in the wet season when the supply of milk is plentiful and the price is depressed.
- iii) The lowest 'sale' price for milk does not, in fact, involve the direct selling of milk at all, but the deflection of milk production to live animal growth, increased meat production as a result of improved animal nutrition, and the realization of 'milk sales income' through the sale of increased numbers of more valuable live animals.

Figure 4: Use and exchange value of pastoral milk production in alternative markets

- a dry season exchange value
 b wet season exchange value
 c exchange value of milk converted to live-animal growth and sold as meat
 d use value

Exchange values (i) and (ii) above can be directly obtained by field research, whereas value (iii) requires calculation but can, at least in principle, be determined by a combination of biological and economic research.

Following the principles elucidated in Fig. 3, the three exchange values depicted in Fig. 4 suggest that a pastoral household producing a large quantity of milk will dispose of its production in at least four different ways, given in Table 1.

Table 1: The disposal of milk at different output levels

VOLUME*	ALLOCATION
0-1	milk livestock and family consume the milk
1-2	milk livestock and sell milk in dry season
2-3	milk and sell in dry/wet season
3+	do not milk

* See Figure 4

Complex and seasonally changing household milk sales patterns are noted in the case studies reviewed here. According to the above model, these variations will occur at the points of intersection between different use and exchange values. Where these points intersect is in practice highly variable, subject to many factors internal and external to the pastoral economy, as will become apparent in this review of case study material.

We have argued firstly that the scale of operation is a key variable setting use value (Fig. 1); as the volume of milk output increases, its use and exchange value to the producing household alters. Accordingly, we first consider the effects of scalar differences in the size of production unit on specialisation in commercial dairying. Other key determinants of use value are household size and composition - especially female labour (Fig. 2). The changing role of female labour in dairying is therefore one of the main issues examined later. Exchange value also varies, not only by season, which affects milk supply and price, as indicated in Fig. 4, but also according to the proximity of producers to the market. The factors of seasonality and market access are therefore reviewed, while lastly, the effect on exchange value of macro economic variables such as government pricing and importation policies for dairy products are very briefly considered.

DIFFERENCES IN SCALE AND THE DIVERGENCE OF PRODUCERS' GOALS

Re-orientation of pastoral production towards the market brings changes in the dairy output of different types of pastoral households. As important as the quantifiable changes in dairy product output are changes in the significance of that output - the proportional contribution to household income, the amount and type of family labour involved - for households having different herd sizes.

As pastoral products are redefined as commodities, producers develop new goals in organising production. These goals begin to diverge according to the increasing specialisation of producers under commercialisation.

In subsistence-oriented pastoral systems, the most important output from livestock is milk for human sustenance. Not only does milk constitute the greatest part of pastoral diet but it can also be exchanged for grains and other non-pastoral products. Here we would say that production goals were relatively unspecialised within a particular pastoral society - all aim to produce milk and some live animals for consumption and exchange.

While all pastoral households may share similar production goals, the ability of a household to achieve these goals varies according to the size of the production unit. Pastoral societies are internally differentiated in terms of access to the main factors of production, particularly livestock holdings and labour resources (Sikana and Kerven 1991). As we noted in that earlier review, in subsistence-oriented pastoral societies, inter-dependencies exist between stock-poor/labour-sufficient households and stock-rich/labour-deficient households. These inter-dependencies often revolve around access to and redistribution of milk, with the transfer of milk animals from self-sufficient households to deficit households being one widely-used strategy to balance stock and labour. Thus,

households with insufficient livestock to provide for their food requirements could, by supplying herding labour to stock-rich but labour-deficient households, obtain milk in the short term and, in some cases, acquire livestock in the long term.

Alternately, differential endowments in the factors of production mean that bigger subsistence-oriented herd owners, whose herds produce more milk than required by the family, could acquire labour in exchange for milk, while using their surplus animals to acquire non-pastoral goods through simple exchange (i.e. barter). Wealthier households are also in a position to expand their network of social relationships which not only assures them of a dependable supply of labour but also enables them to accumulate 'symbolic capital' (cf. Bourdieu 1977) in the form of social prestige and power.

As subsistence production shifts to commodity production, our model suggests that the exchange value of live animals and milk alters radically in relation to use value for some producers. The goals of engaging in market exchange begin to diverge for bigger and smaller herd owners, who increasingly become distinct categories.

One effect of the increase in commodity production is that the role of milk in maintaining household viability tends to change, in very different ways depending on household scale of operation. One of the main changes is a tendency for households to substitute milk with cereals as the main staple (Grandin 1988, Ensminger 1987, Waters-Bayer 1984, Sutter 1982, Horowitz and Jowkar 1992, Holden et al. 1991). But the reasons for the switch from dependence on milk to dependence on cereals are different for richer and poorer households. With commercialisation the significance of milk in terms of forging labour networks also declines because stock-rich/labour deficient households prefer to substitute contractual labour remunerated in cash for kinship and client labour remunerated in kind (see review by Sikana and Kerven 1991).

Below we review cases of this divergence in production goals between poorer and richer pastoral households.

Richer households

Bigger herd owners who have disposable stock can take advantage of new opportunities in livestock marketing. These opportunities for market exchange enable owners to convert surplus stock into monetary value. This secures for them unprecedented material advantage in terms of capital accumulation and expanded production. Often, capital accumulated from livestock sales is invested into other spheres of production such as retail trading (Solway 1986, Hogg 1980, Ensminger 1984) and agriculture (Barth 1961, Little 1985). Thus bigger herd owners can become richer herd owners.

Bigger owners may therefore switch from reliance on milk as a staple to reliance on grains, as a deliberate strategy to maximise herd productivity (and thus live animal sales) by minimising the competition between calves and humans. Such owners tend to forego some of their animals' potential milk output in order to maximise animal offspring growth and weight gain (as suggested in Fig. 4). To them, this option is unproblematic, since they can easily purchase grain with income from live animal trade. In addition, the greater capital resources of richer households allow them the flexibility of temporary withdrawal from market exchange when live animal prices are low and the market value of animals is lower than their use value and reproductive value (Kerven 1993, Herren 1990).

The propensity of richer herders to forego some of their potential milk output in favour of the calf is best illustrated in a study of Kenyan Maasai by Grandin (1988) who observed that more prosperous households milked a lower proportion of lactating cows than poor households. Whereas poorer households milk 100% of their lactating cows, richer households milk only 40% of their lactating cows. In addition, when a cow gives birth, richer households tend to delay the onset of first milking as well as stopping sooner than poorer households. Furthermore, richer households tend to milk their animals only once per day while poorer households milk twice. The study concludes that richer Maasai pastoralists could obtain large amounts of milk beyond their normal household consumption requirements, if they utilised all their lactating cows to the same degree as do poor households. However, in the area where the study was undertaken, market demand for milk and other dairy products is very limited and is restricted to a few eating places along the road. Thus richer households are more inclined to divert the potential extra milk towards the maximisation of returns from the beef enterprise. It is noted that in this study area, only 5% of the total milk off-take is sold by both rich and poor households.

The tendency to reduce the frequency of milking with increased commercial beef production has also been observed among the Fulani of the semi-humid zone of central Nigeria (Waters-Bayer 1984) and among the Baggara of South Darfur in the Sudan (Behnke 1985, Kerven 1987b). The two studies on the Baggara cited above identified a strategy termed *matruuka*, whereby male calves are specifically selected for their potential as beef animals, and allowed to nurse all their dam's milk.

Richer herd owners whose priorities turn to the live animal trade may split their herds, which involves the separation of the milk or 'domestic' herd from the beef or 'investment' herd. Herd splitting is sometimes associated with settlement, discussed later in this review. Here we note cases in which richer herd owners who settle in permanent villages and trading centres to maximise

access to trading information networks as well as to enjoy the amenities offered by urban life, maintain the bulk of their herds at distant herding camps in order to maximise live-weight gain and thus increase market value (Ensminger 1984, Kelly 1985, Solway 1986). The household dairy enterprise is obviously affected when settlement accompanied by increased live animal marketing results in the separation of the herd from the domestic unit, especially from women who are traditionally responsible for dairying. A decline in the significance of dairying among richer households occurs, as for example, Kelly (1984) observed, that although richer households among the Galole Orma of Kenya may decide to maintain a small milk herd near the settled village or trading centre, the choice of which dams to keep in the domestic herd has become more influenced by the priority given by male household heads to the live animal enterprise. A good milker with a male calf will be sent away to the distant herding post because male calves are more valued for their beef than the milk foregone. Furthermore, richer Orma herders have also changed their breeding decisions in favour of animals which gain weight rapidly, instead of those which produce more milk.

The declining significance of pastoral dairying among the richer Orma herders must also be interpreted against the wider background of the supply/demand factors which have significant implications for traditional dairying. In Kenya, the pastoral dairy sector faces strong competition from the formal sector, which enjoys government support in terms of price controls. Kelly (1986) reports an incident between 1980 and 1981 when pastoral Orma women responded to increased grain prices by raising the price of their milk to the same level as that fetched by formal dairy milk. This sparked a protest by local non-Orma residents, and the government intervened by imposing a lower price for local Orma milk. Against this background, it makes sense that richer households, who are less dependent on milk income, should decide to withdraw from the milk market and concentrate on the live animal enterprise.

Market demand for pastoral products is not limited to meat; where external demand for dairy products exists, richer herders will utilise certain strategies to exploit the milk market without necessarily compromising the beef enterprise. One of the strategies used is again that of herd splitting, but with a different purpose than noted above. Herd splitting is a traditional management strategy which was, and is still being used by many pastoral groups to allow the larger portion of the herd to take advantage of better grazing in migratory camps while at the same time ensuring the supply of milk to humans resident in the more permanent settlements. This is reported for example by Niamir (1982) in the case of Ngok Dinka of Sudan, by Hama (1981) reporting on the Kal Tamacheq of the Niger Bend in Mali, and by Upton (1986) on the Borana of Ethiopia. With increased commercialisation, there are indications that this strategy is being re-worked to allow herd owners to simultaneously exploit distant superior ranges

for the main investment herd in migratory camps, on the one hand, and market opportunities for dairy products in settled villages and trading centres, on the other hand. Examples are given by Kelly (1985) and Ensminger (1987) on the Galole Orma in Kenya, Waters-Bayer (1985) on the settled Fulani of Nigeria, and Kanoute et al. (1987) reporting on some southern Malian pastoral groups.

Another example of how richer pastoral households can exploit market opportunities for dairy products without neglecting the beef enterprise is provided by Herren (1990). In his study of pastoralists in the Mogadishu hinterlands of Somalia, it was found that richer households tend to be more involved in the marketing of milk and other dairy products during the dry season when demand is high and the price of milk is high. Also at this time, the price for live animals is lowest while demand for purchased grain is very high. In the wet season, when milk prices are deflated by increased supply, richer households tend to withdraw from the milk market and depend more on sales of live animals which fetch premium prices during this time of the year because of better grazing. The wet season is also associated with decreased demand for purchased sorghum due to abundant milk supplies and also due to the fact that richer households will often have their own sorghum fields. Furthermore, as will be discussed later, the priority for richer households is to secure access to the more abundant distant pastures, rather than maintaining access to urban milk markets.

The above case studies show that for richer households, marketing of milk can be a strategy to keep live animals from the depressed livestock market during the dry season by depending on milk income to purchase the required grains. This strategy, of withdrawing live animals from the beef market during the dry season and depending more on milk to obtain grain, was earlier observed by Dupire in the 1950s, in the case of Fulani (Dupire 1963). Provided they have sufficient livestock resources, by balancing the relative advantages of dairying and live animal sales at different times of the year, households can maximise returns from both enterprises without compromising the efficiency of one or the other.

However, as we discuss next, poorer households tend to use entirely different milking and marketing strategies, because their capital base does not allow them the freedom of tactical withdrawal when market conditions are not favourable for milk products.

The actions of one group within a system - richer herd owners - has a reaction on another group, the poorer herd owners. As the market value of live animals rises and bigger herd owners tend to withdraw their surplus animals from internal circulation to the market, this removes poorer households' access to milk as well as other outputs such as draught power (as in cases by Graham 1984, Ensminger 1984, Livingstone 1984, Little 1985, Solway 1986, Sutter 1987, Grandin 1988, Bennett 1988, Herren 1988, Abdullahi 1990, reviewed in

Sikana and Kerven 1991). We examine these implications below, in terms of poorer herd owners' specialisation in dairying.

Poor households

For stock-poor households, when market exchange becomes dominant, involvement in sales is done as a matter of survival. The shrinking of traditional redistributive networks under commercialisation denies poor households access to milk from animals formerly obtained from richer households in exchange for labour and clientage (Solway 1986). When this happens, the livestock:human ratio for poor households drops below the minimum threshold required to adequately subsist on the produce of the herd. But since stock-poor households do not have enough animals to profitably engage in routine live animal sales, they remain with the options of selling their labour or selling the replenishable livestock products (of which milk assumes a great importance), while holding onto their herd capital (Kerven 1987b, Herren 1990, Holland 1989).

Thus the inability to subsist on small herds leads some poor households to engage in market exchange, as a strategy to convert their below-subsistence livestock products (e.g. milk and live animals) to a higher quantity of calories in the form of grains (Sutter 1982, Kerven 1987b, Herren 1990, Behnke 1987, Holden et al. 1991). For these households, the switch from dependence on milk as a staple to dependence on grain staples is done under duress (Sutter 1982, Salih 1985, Ensminger 1984, Grandin 1988, Herren 1990, Holden et al. 1991).

Fig. 5 models the phenomena of forced milk sales by poor pastoral producers operating small herds. These poor producers sell very small quantities of milk which, in a more prosperous household, would be consumed by the household. The income from milk sales is then devoted to the purchase of grain for household consumption. The characteristic sales/consumption patterns of poor households are explicable in terms of the distinctive consumption of use value of milk within households which are calorically deficient in their diets. For these households, milk must be seen as a source of caloric energy, and since milk has fewer calories compared to grain, sale or barter routinely takes place.

Figure 5: The different values of milk to calorically-deficient and sufficient households

- - - calorically sufficient households
- - - calorically deficient households
- a dry season exchange value
- b wet season exchange value

Better-off households with a calorically sufficient diet can afford to view milk as a source of protein (however this value may be expressed locally - in terms of taste, dietary variety, effect on child health and growth, etc). Since milk is an excellent source of protein relative to available alternatives, the estimation by these households of the consumption value of milk is considerably higher than that by poor households. Fig. 5 displays graphically the alternative use-value curves for low quantities of milk production in calorically deficient and sufficient households, relative to hypothetical dry and wet season exchange values for milk. As diagrammed in Fig. 5, calorically insufficient households with small herds would be unlikely to consume much of their own milk in any season, given the inverse seasonal movement of price and volume of household production.

One of the survival strategies of poor households is therefore based on the manipulation of the terms of trade between milk and cereals, which always favour milk producers in terms of calories. Because of this greater dependence on milk income, the management strategies and milking practices of poorer pastoralists differ from those for richer households. For example, it has been suggested that poor pastoralists in the Kenyan Maasai group ranches tend to have a higher proportion of cows in their small herds (Kituyi 1985). The earlier-cited case study on the Kenyan Maasai (Grandin 1988) indicates that poorer households also tend to milk all of their lactating cows more frequently and stripping much harder, leaving less milk for the calf. Another study carried out in the same area (Talle 1981) observed that poor Maasai households tend to live near watering points and water their animals more frequently as a strategy to maximise milk output. Although the range near the watering points is generally

inferior, it is adequate to support the limited number of animals owned by poor households (Grandin 1988).

A study carried out among the Borana of southern Ethiopia (Holden et al. 1991) also shows the interaction between household wealth and milk off-take. Poorer households (owning 0.5 Tropical Livestock Units per Referent African Adult) took relatively more milk from their cows than richer households (owning 2 TLU's per Referent African Adult). The tendency for poorer household to take more milk from their cows increases with decreasing distance to the market. The study goes on to suggest that high milk off-take may explain high calf mortality and morbidity rates observed among herds belonging to poorer households living closer to the market. On the contrary, calf mortality and morbidity among richer herders is attributed to labour shortage, because given their large herds, labour input per unit animal is lower.

In the Mogadishu hinterlands of Somalia, Herren (1990) found that unlike the richer pastoralists who withdraw from the milk market at certain periods of the year to take advantage of seasonal price differentials, poor herders continue to market milk throughout the year, even during the wet season when milk prices are low. Another pertinent observation made is that whereas richer households consume more milk and sell less during the wet season, poor households tend to maintain a constant level of milk consumption throughout the year, which means that the extra milk yields in the wet seasons are being diverted towards the market, instead of being consumed directly by the household. The probable explanation for this is that even in the wet season, total milk yields for poor households are rarely sufficient to cover consumption requirements, and hence there is a need to convert available milk supplies into higher calorie grains. This is what is predicted by Fig. 5.

The tendency for poor households to sell their milk under duress has also been observed by Zimmerman (1982) in the Nile Delta region of Egypt, and by El Tayeb (1986) in the White Nile province of the Sudan. In both these cases, poor herders sell their raw milk to cheese factories at below-market prices, in contrast to richer households who either consume their fresh milk or else process it into cheese and butter, which not only fetch a higher price on the open market but which can also be used as non-perishable reserves of animal protein and energy during periods of food scarcity. In both these case studies, the poor households were often indebted to specific factory owners, from whom they obtained credit in the form of consumer goods, animal fodder or cash, in return for a commitment to regularly supply milk to the factory, irrespective of the price offered for their milk by the patron factory owners.

The greater dependence of poorer households on dairying income may also reduce their herd mobility, which as discussed in more detail later, is linked to milk output. This is shown in the case of poorer households among the Kenya

Orma (Ensminger 1984). In the first place, poor households need to maintain access to the little milk that their small herds can provide for them to be able to earn the required income to purchase grains. Therefore, they cannot herd their milking animals separately, in the herd splitting option often pursued by richer herd owners. Secondly, poor households do not have sufficient income with which to hire herding labour required for the highly mobile grazing camps. Furthermore, poorer Orma households are less able to retain their young male members of the age category required in the herding camps, because the latter often hire themselves out as herders to the richer households in order to earn a living, as well as to relieve pressure on the limited resources of the parental household. Therefore, through a series of interlocked causes and effects, poorer households having limited ability to profitably market live animals, become by default more dependent upon dairying income.

Rich versus poor households and dairy specialisation

This section has examined the relative significance that dairying assumes for richer and poorer households when, in the process of commercialisation, pastoralists reduce their reliance on milk and milk products for household subsistence, either by choice or by necessity. By replacing a product which they produce themselves with a product they have to buy on the market, both richer and poorer herders become more dependent on the market. But we have noted that for the richer households, participation in the market is voluntary and strategic, and is often geared towards enhancing the efficiency of the live animal enterprise. In instances where market opportunities allow, richer households may sell large quantities of milk, but overall the milk enterprise remains secondary in significance, as compared to the live animal enterprise. For poorer herding households on the other hand, participation in milk marketing is not negotiable. With commercialisation, their inability to subsist on milk from their small herds requires them to exchange the little milk they produce for grains via the market. For poor households therefore, even though they may sell smaller quantities of milk as compared to richer households, dairying assumes greater significance under commercialisation and has become a specialisation.

Lastly, it must be pointed out that in instances where market demand for pastoral dairy products is low, the option to engage in milk trading does not exist even for poor households. For example, in countries such as Kenya, where pastoral dairy products face stiff competition from a relatively efficient formal dairy sector (Kelly 1985), poor herders may abandon pastoralism altogether.

DAIRY SPECIALISATION AND SETTLEMENT

Productivity versus profit: mobility and distance from market

The process of commercialisation may be a cause or a consequence of sedentarisation; the two processes are often so intertwined that it is difficult to distinguish cause and effect. Nevertheless, changes in herd mobility have biological consequences upon milk production, and economic consequences upon the use and exchange value of milk.

Whereas settling down may have the advantage of opening up opportunities for trade, this can be at the expense of herd productivity, and in particular, milk yields. The increasing concentration of people and stock near settled villages or trading centres brings considerable pressure to bear on the range and water resources available around settlements (Salih 1985, Ensminger 1984, Herren 1990, Simpson and El Hadari 1970). Pastoralists themselves often cite higher herd productivity as the main advantage of nomadic life over sedentary life (see for example Waters-Bayer 1983, Michael 1990). A comparative study of milk yields carried out among the Ngok Dinka of Sudan (Niamir 1982) indicates that milk production in migratory herds is about 50% higher than in sedentary herds during both the wet season and the dry season (Table 2).

Table 2: Milk output from mobile and sedentary herds, Southern Sudan

Location of herd	Average yield per cow per day
Dry season camp (mobile)	0.73
Dry season homestead (sedentary)	0.34
Wet season camp (mobile)	1.50
Wet season homestead (sedentary)	0.83

Source: Niamir 1982

Another study (Wilson and Clarke 1976) carried out in South Darfur, Sudan, using different productivity indices, also established the superiority of mobile herds over sedentary herds (Table 3).

Table 3: Herd productivity in mobile and sedentary herds, South Darfur, Sudan

Productivity indices	Mobile herd	Sedentary herd
Calving rate	65%	40%

Heifers calving under 4 years of age	65%	29%
Calf mortality	11%	40%
Total mortality	15%	35%

Adapted from: Wilson and Clarke 1976

In the case of dairy marketing, there is clearly a trade-off between increased herd productivity achieved by mobility and decreased market opportunities with greater distance from markets. Some studies (e.g. Holden et al. 1991, Hashi 1988, Niamir 1982) have highlighted the tendency by pastoralists who live closer to the market to be more involved in the commercial sale of dairy products. It is noted that the level of milk off-take among Peul herders in Burkina Faso tends to increase with decreased distance from the market (Toure et al. 1985, cited in Lovell 1992). The relationship between market access and milk off-take is hardly surprising, as it should be expected that as distance to markets decreases, the opportunity costs of time spent travelling to markets are also lower. Thus proximity to markets, should, all other factors being equal, encourage dairy sales by pastoralists. But all other factors not being equal, we need to look more closely at some of the relationships between mobility, settlement and dairy specialisation which are recorded in the literature.

Mobility and commercial dairying

Given the costs of settlement in terms of productivity, pastoralists have shown preference for continued nomadism in instances *where pastoral products can be marketed without the need to settle down*. In relation to dairying, flexible marketing systems have spontaneously evolved in cases where demand for dairy products is high. For example, in Somalia, the opening up of road networks linking pastoral hinterlands with major milk consumption centres such as Mogadishu and Kismayo, has enabled specialised professional milk traders called *abakaar* to purchase milk from the nomadic settlements using motorised transport (Herren 1990, Little 1989). Due to the perennial demand for milk (especially camel milk) in Mogadishu and other urban centres, these professional milk traders, who are all women, have established milk trading centres along the main migratory routes used by nomads.

There are, however, economic costs to continued nomadism when it comes to marketing dairy produce. In the case of the *abaakar* traders, it has been noted that milk is bought at a lower price as the nomads move further and further away from the main consumption centres (Samantar 1987). It is expected that

as distance from the trading centres and main motorable routes increases, the number of nomadic producers and their total milk output will exceed the buying capacity of the few *abaakar* traders who are able to reach such locations. Therefore, the milk market in such situations effectively becomes a buyer's market, and consequently, the *abaakar* traders are apt to fix low prices to take advantage of abundant supply and also to recoup their transport expenses. As is discussed below, the variable price of milk with distance from the main consumption centres may partly influence the migratory strategies of different kinds of pastoral producers.

Somali pastoralists also make some strategic adjustments to their migratory patterns to take advantage of market opportunities along the routes where the *abaakar* traders operate. This fact has also been observed by Hashi (1988) who reports that nomadic Somali herders now tend to pass through well-established 'milk catchment areas' to market their produce during their seasonal migration. In West Africa, Hama (1981) reports the same phenomenon; in this case Kal Tamacheq shepherds of Mali establish their wintering camps around urban centres where milk and other dairy products are in high demand.

Another well-documented instance of how pastoralists can combine commercialised dairy production with continued nomadism is drawn from the Baggara in northern Sudan (Michael 1987) where increased urban demand for milk and cheese has led to the creation of mobile cheese factories which ensure an all-year-round supply of cheese to urban centres by following the nomads along their main migratory routes. The Baggara nomads themselves also change their migratory routes and locate their camps near cheese factories. In the White Nile province of the Sudan, permanent cheese factories are sometimes strategically located in known dry season retreats for pastoral nomads (El Tayeb 1986).

The introduction of motorised transport (as in the case of the Somali *abaakar* and the mobile cheese factories in northern Sudan), means that even when nomadic pastoralists retreat further and further into the hinterlands it is still possible for traders to reach them and purchase their perishable produce. In such cases, the market has in a sense sought out the pastoralists. But mobile producers can supply an urban market in other ways as well. An instance of specialised peri-urban milk trade was observed by Kanoute et al. (1987), in which pastoral women take milk animals from their domestic herds to be kept near Bamako, the capital city of Mali. These women then hire herdsmen to look after the animals in their peri-urban 'farms'. The women collect milk from the farms on a regular basis and sell it in the city. In Somalia, Little (1988) describes a similar situation in Somalia where some pastoral households maintain cattle herds on the outskirts of big towns such as Kismayo, in order to supply milk to the town. The number of animals kept is usually small (10-15),

which can be adequately managed under new feeding regimes, since purchased fodder is required to supplement scarce natural ranges around the towns.

Reduction in herd mobility has implications for herd productivity and thus management in terms of feed supply. But specialised dairy production can be maintained without compromising herd mobility. This point is exemplified by the information presented by Hashi (1984,1988) on a herd management system called *aono-teel* which was common in some parts of Somalia. This system was based on the establishment of range reserves called *seere* in close proximity to towns with markets for pastoral dairy products; pastoralists would keep a few milk camels for a fee, on these reserves. The milk camels were often taken from the mobile herd and kept in these superior ranges to maximise milk production. However, the influx of squatters due to unplanned settlement, led to appropriation of these range reserves and the system collapsed as a result.

The *aono-teel* system differs from the peri-urban or urban sedentary milk trading described below, which mainly involves impoverished pastoralists who are forced to settle down and sell milk because they do not have sufficient stock. The *aono-teel* system, on the contrary, was utilised by well-to-do herders, who made strategic investments into the milk enterprise in the same manner that, in the case of the Galole Orma of Kenya, the more beef-oriented richer herders utilise herding camps to maximise beef production. Whereas the production goals behind the concept of Orma herding camps is to provide superior ranges to some animals for optimum live weight gain, the emphasis in the *aono-teel* system is optimum milk production.

Settlement and commercial dairying

Market opportunities for dairy products, and the availability of infrastructure beneficial to the livestock industry (such as boreholes and veterinary services), has often brought pastoralists to centralised markets, leading to the relocation and sedentarisation of pastoral populations. An example of this process earlier in this century was the establishment of milk collection points and small scale dairy plants around Jos, Zaria, and Kano districts of Nigeria in the 1940s, which contributed significantly to the concentration of cattle-breeding Fulani on the central plateau since the end of World War II (Fricke 1979). Likewise, recently in one area of Somalia the construction of a tarmac road and drilling of boreholes and development of large water catchment ponds along the tarmac road, has not only opened new livestock trade routes and changed herd movement patterns but has also led to the influx of a considerable number of pastoralists into this new production corridor (Herren 1990). Permanent villages and service centres soon developed along the tarmac road, and such centres

facilitated the operation of an efficient milk collection system by the *abaakar* traders.

But as noted, the attraction of settlements, in the form of infrastructure, higher prices for dairy products, accessibility to markets, etc., is offset by reduced herd productivity. In the Somali case study (Herren 1990), the richer households, who are less dependent on milk income, can afford to sell their milk at lower prices offered by the *abaakar* traders in the more productive but more distant grazing camps, located far from the main consumption centres. Richer households therefore choose to remain more mobile. Poorer households, whose subsistence is more dependent on year-round involvement in the milk trade, tend to curtail their seasonal movements altogether, and choose to remain in the vicinity of the newly-developed trading centres. As poorer households are more involved in dairying rather than raising live animals for sale, the immediate goal of securing a reliable market and obtaining higher milk prices in the trading centres may outweigh the longer-term advantages of improved herd productivity gained through mobility. In effect, mobility becomes a luxury which poorer households can no longer afford.

Herders with insufficient stock to maintain their families on the rangelands, either through consumption or exchange of pastoral products, often turn to peri-urban dairying. By keeping milk animals in and around large settlements where there is a high demand and therefore good price for dairy products, pastoralists are able to enhance the market value of their herd output.

One of the immediate effects of peri-urban dairying is a reduction of pasture in the immediate vicinity of the settlement. Herders who are heavily reliant upon this form of income have to devise new strategies to maximise milk output. A commonly-used strategy is to purchase supplementary fodder for the animals to compensate for the shortfall resulting from the inadequate natural grazing (see for example, Salih 1985, Little 1989, Simpson and El Hadari 1970). Other cases where peri-urban pastoralists have adopted supplementary feeding regimes have been reported by Salzman (1988), Hashi (1988), and Zimmerman (1982).

Poor herders, being particularly dependent upon dairy income, have to invest some income into the herd, as well as increasing the labour input per unit animal, in order to maintain milk output under peri-urban conditions. The fact that poor herders are able to commit these extra resources to the dairy enterprise clearly shows the central role dairying plays in their survival strategies. A study of poor peri-urban producers near Khartoum in the Sudan (Simpson and El Hadari 1970) demonstrates the willingness of these producers to invest extra resources into their production system even when doing so may mean operating at a loss during certain times of the year. It is noted that animal fodder constitutes the major production expense under this system, which results in seasonal fluctuation of production costs during the annual cycle. During the dry

season, production costs are very high, and producers operate at a loss. The losses incurred during the dry season are recouped during the wet season when production costs are lowered by the availability of natural grazing. Thus, these small producers only manage to survive by averaging out costs and returns across seasons, and by employing certain marketing strategies such as adulterating the milk or charging higher prices during the dry season, when demand for milk is high. In sum, the necessity to invest these extra resources often leads to reduced returns, to such an extent that most producers are only able to operate at basic subsistence levels (Simpson and El Hadari 1970). In some cases, pastoral productivity in trading centres and peri-urban settings becomes so marginal that some of the producers are forced to take up wage employment, or engage in other occupations such as charcoal burning and petty commodity trade (Hjort and Ornäs 1990).

Settlement and decreased dairying

As we have commented above, whether or not settlement has a bearing on dairy commercialisation is, to a large extent, dependent on the market demand for pastoral dairy products. Relocation by pastoralists settling into new areas where there is no demand for pastoral dairy products can reduce the importance of dairying. This point is illustrated in a case where Peul pastoralists in Cameroon migrated southwards and became more sedentary (Boutrais 1981-82, cited in Lovell 1992). In moving southwards, the Peul came to settle near sedentary groups of Baya, who were mainly growing cash crops; this meant that the Peul could not rely on the Baya for the supply of cereal food crops. Moreover, the Baya do not consume milk or other dairy products, and were considerably reluctant to incorporate these into their diets. The newly-settled Peul no longer had an outlet for their dairy products, which they were accustomed to exchange for grains, with agriculturalists. Given the lack of a market for their dairy products, the Peul compensated by increasing their sale of live animals, as well as by taking up agriculture themselves. Local demand for meat was also boosted as a consequence of Peul in-migration; the Baya, who formerly hunted wild animals, lost this source of meat due to environmental competition from Peul cattle, and began instead to purchase meat, supplied by the Peul, from local butchers' shops.

Dairying, settlement and mobility: Some findings

The range of situations which have been summarised in the case examples examined strongly implies that there is no causal relationship between settlement and commercialisation of dairying. Other factors are involved than settlement or nomadism, in whether a pastoral group increases or decreases the specialisation in dairy marketing. This point is illustrated by the contrasting cases of pastoral groups in the three neighbouring countries of Kenya, Sudan and Somalia. In Kenya, changes in pastoral mobility have had little effect on the supply of pastoral dairy products, as demand for dairy products is adequately met by non-pastoralists operating within the formal sector. In northern Sudan and in Somalia, quite a different pattern has emerged, where pastoral dairy products have had little competition from cheap imports or from non-pastoral dairy producers. In these two countries, specialised commodity production of dairy products by pastoralists has proceeded both with and without their settlement.

CHANGES IN THE SPECIALISATION OF LABOUR AND MANAGEMENT

As the goals of pastoral production shift towards more commercial ends, there are accompanying adjustments in the division of labour, as dairying becomes more or less significant for different household members. For the majority of cases in subsistence-oriented pastoralism, women are responsible for, among other things, milking and disposal of milk products, while men are mainly (but not solely) responsible for herding and disposal of live animals (Niamir 1990). Below, we consider the extent to which gender roles have been transformed or retained under commercialisation, as the traditional role of women in pastoral dairying changes in the following spheres:

- (i) changes in the nature of dairying tasks performed as well as in the volume of work carried out by women or men.
- (ii) changes in the degree of women's control over milk and milk products.

Change in the nature of tasks and volume of work

As milk and dairy products acquire more commercial value, there is greater demand for labour required to process and take the products to market. Where markets are distant, women who traditionally were responsible for selling dairy products may travel longer distances in order to sell their dairy produce (Herren 1990, Michael 1990, Talle 1992). In the Mogadishu hinterlands of Somalia, lack

of a suitable person to carry milk to the market may affect the ability of a given household to fully exploit the milk trading opportunities (Herren 1990).

The greater the distance from market, the greater the potential conflict of labour demands on those who are responsible for marketing. Shorter distances to markets means that women are still able to undertake other commitments in their busy labour schedule. For women living far from markets, frequent travel would lead to distraction from child care and other domestic responsibilities. Women who live far from markets have therefore developed certain strategies to lessen the opportunity costs of time spent marketing dairy products. One strategy is to establish a rota system at the village or camp level, whereby one or two women are sent to the market to sell milk on behalf of other women in the village or camp. The personal transportation costs for the women travelling to the market are spread amongst all the women cooperating. Meanwhile, the women remaining in the camp undertake to take care of some of the domestic responsibilities of the marketeer, such as looking after her small children. This strategy has been reported among the Somalis (Herren 1990, Talle 1992) and among the Baggara of Sudan (Michael 1990).

Women in Central Somalia have developed another innovation to cope with the labour burden resulting from commercial sale of milk (Talle 1992). Due to the importance of the milk trade, Central Somali women have started to rear donkeys, often purchased from their dairy earnings, as beasts of burden. Women prefer donkeys to camels for milk transportation because the former are more docile and more accustomed to crowds than the 'wild' camels. Thus donkeys are found to be easier to control and more suitable for market situations.

In another example of how women strive to reduce the labour burden associated with commercial dairying, Zimmerman (1982) describes how in the Nile Delta villages, a number of women have acquired milk separators for cheese preparation. Apart from reducing the drudgery associated with traditional methods of cheese preparation, the separators are also hired out for a fee to other women and thus representing another source of income for those women who can afford to make the necessary investment.

The cases cited above indicate that where remuneration from the milk trade are sufficiently attractive, pastoral women are willing to re-invest their cash earnings into labour-saving devices to improve the efficiency of their dairy operation and to earn extra income.

In addition to the extra labour demands occasioned by more dairy market opportunities, commercialisation of dairying may also result in greater labour required in the production process. This is the case as we discussed earlier, when peri-urban dairying develops, as supplementary fodder has to be provided. It has been observed that where commercialisation of milk production is

associated with hand-feeding, the extra labour burden disproportionately falls on women (Chavangi and Hansen 1983, Salih 1985, Whalen 1984, Zimmerman 1982).

The diminished role of milk in pastoral diets under commercialisation also entails new tasks and responsibilities for pastoral women. The switch from reliance on milk to reliance on grain staples brings additional pressure to bear on pastoral women because grains take longer to process and prepare into a meal (Horowitz and Jowkar 1992), and also because grain staples require more wood fuel than the traditional milk-based recipes. According to Ensminger (1987) women in richer households among the Galole Orma of Kenya are more likely to bear the brunt of this additional workload because their wealth enables them to more regularly entertain visitors.

Changes in women's control over milk

Commercialisation has not resulted in uniform changes to women's control and responsibility over dairying (Chavangi and Hansen 1985). In some cases, women's control over dairying has been shown to diminish (Ndagala 1982, Lilljequist 1983, Waters-Bayer 1988, Horowitz and Jowkar 1992, Lovell 1992) whereas in other cases, women's role over milking is not only retained but also enhanced by their involvement in external marketing (Zimmerman 1982, Michael 1987, Herren 1990, Talle 1992).

The issue therefore is to explain why women's control varies. It is suggested here that such variations may be explained in terms of demand factors which are in turn influenced by other variables such as the cultural value of pastoral dairy products, the availability or otherwise of alternative non-pastoral dairy products, as well as government policy and prices. Where consumers place a premium value on pastoral dairy products (as in Somalia) or where alternative dairy products are not widely available at competitive prices, then demand for pastoral dairy products is buoyant, and women's participation in commercial dairying tends to be enhanced. Alternatively, where demand for pastoral dairy products diminishes, for example due to increased competition from substitute products, changes in official pricing or increased market value of live animals, then women often lose their control over dairying.

Apart from the demand factors cited above, a woman's social status under Islam can have an influence on women's participation in dairy marketing (Lovell 1992). A further influencing factor in changing women's control over milk has been the failure by some development projects to take traditional gender roles and responsibilities into account, particularly women's usufructuary rights over animals and animal products. This has often led to women's diminished role in

pastoral dairying (Lovell 1992, Chavangi and Hansen 1985). We will now explore these transformations in more detail.

Specialisation in meat production: Women's diminished control over dairying

In the earlier discussion of the changing role of milk when herd owners turn their attention to the live animal trade, it was noted that lack of market demand for pastoral dairy products combined with a good market for live animals had led to a general decline in the importance of dairying among Galole Orma of Kenya. Although women remained in charge of milk production and milk marketing their participation had been reduced (Ensminger 1987, Kelly 1985). With the increasing market value of live animals, (sold by men), women's rights of stock ownership, and therefore their access to milk animals, were diminishing. For example, whereas a girl was traditionally entitled to at least four animals allocated to her on different occasions leading to her circumcision, the practice has been abandoned, and the most a girl can expect these days is only one heifer. Girls from poor families do not get anything at all. It has also been noted that cash is increasingly replacing live animals in most of the ceremonies which previously involved stock transfer to women (Ensminger 1987). Women's control over animals is further marginalised by the fact that the previously ambiguous and fluid rights of ownership of animals has given way to more rigid and precise ownership rights (Kelly 1985). Furthermore, poor women no longer have access to milk animals from richer households which were formally available through traditional redistributive networks. This means that women's *de facto* access to and *de jure* rights over animals have both declined.

Another example of how commercialisation of the live animal trade leads to diminished control of women over pastoral dairying is drawn from the settled Fulani around a town called Zonkwa in Nigeria (Waters-Bayer 1984, 1985). These studies found that unlike among the nomadic Fulani where women are still in charge of milking, settled Fulani men have taken over milking, in order to have direct control over the levels of milk off-take. Whereas nomadic Fulani cattle were milked twice a day and women were in control of the milk output, men among the settled Fulani have reduced the frequency of milking to only once a day (Waters-Bayer 1984). The usurpation of milking by settled Fulani men is attributed to their greater orientation towards the beef market, although dairying still continued to play a significant role in household economies. This re-orientation meant that women's participation in herd management decisions was reduced, and they were disinclined to invest part of the income they earned from dairy sales into herd maintenance, including investments which could

improve milk output such as purchase of supplementary feed. All such expenses were being borne by the male heads of households. As it will be shown in due course, this is contrary to situations in which women still retain control over milking and milk distribution.

The reduced levels of milk off-take among the settled Fulani of Zonkwa suggests that at least for the menfolk among these pastoralists, the returns from raising beef cattle were perceived to be higher than from processing and selling milk. According to Waters-Bayer (1985) access to markets is not a limiting factor in this instance because of the high demand for pastoral dairy products in the nearby town of Zonkwa and among neighbouring agricultural communities. In fact, income from milk sales constitute a significant proportion of annual household income (33%) for many households. This is in contrast to the evidence obtained among other groups of Fulani who settled in the more southern states of Nigeria such as Anambra, where the decreased significance of dairying is attributed to low demand resulting from the unfamiliarity of traditional dairy products to non-pastoral ethnic groups of southern Nigeria (Di-Domenico 1989).

Indeed, one of the common explanations given by researchers for the reduction in women's control over dairying under commercialisation is that of conjugal conflict between men and their wives over the allocation of milk to calves and people (as in the case studies by Waters-Bayer (1985) and Kelly (1985)). While conflicting production priorities may well exist between spouses, caution must be taken not to over-exaggerate the extent of this conflict. Elsewhere, Waters-Bayer (1983) notes that many women also appreciate the greater material gains to be realised from live animal sales. On the other hand, men also appreciate the contribution of the smaller but regular milk income, which ensures a steady supply of cash for daily expenses and consequently delays the need to sell a live animal (see also Grandin 1988, making the same point about the Maasai of Kenya). Thus, reduced milk off-takes observed by Waters-Bayer among the settled Fulani may have to do with declined milk yields under semi-sedentary conditions (as discussed later in this paper) rather than wanton desire by husbands to deny their wives' access to sufficient milk.

Specialised dairy production: Women's diminished control

When pastoral households become specialised commercial dairy producers, it does not necessarily follow that women retain their pre-commercial control over milk. Particularly when the commercialisation is based on formal dairy schemes for purchasing pastoral milk, men tend to take over the milking and marketing of milk. This situation sometimes occurs when incorrect assumptions about male ownership and control of resources within pastoral households are applied to

dairy schemes and milk collection centres; the milk animals are registered in the name of the male household head, who also receives payment for the milk delivered at the dairy scheme or milk collection point. This is reported for a case in Tanzania (Ndagala 1982) and recently, in the case of a Nestle dairy plant set up among the Peul pastoralists in the Ferlo region of Senegal (Madieng Seck 1992). In the latter case, women seem to have tried counteracting the loss of control which they had previously had over milk production within the pastoral unit (Lovell 1992). The Peul women purchase cheaper dried milk which they reconstitute, process and resell, to compensate for their loss of control over fresh milk, which was being sold by the men to the dairy schemes.

These and other cases noted (Lilljequist 1983, Dahl 1987, Zimmerman 1982, Horowitz and Jowkar 1992) indicate that women's usufructuary rights over animals and women's traditional role in the allocation and distribution of milk may be overlooked by gender-insensitive dairy development schemes. In sum, once pastoral dairying and marketing is transferred to formal institutional channels, it ceases to belong to the domestic domain and men tend to take over, because of their greater familiarity with workings of the male-dominated public sphere.

There are also cultural factors associated with changes in women's control over milk. Islam has been associated with diminished women's control over pastoral dairying in two cases; one among the Mbororo of the Central African Republic (Boutrais 1988 cited in Lovell 1992), and the other among Peul and Bella in Niger (Bellot 1980 cited in Lovell 1992). In the Mbororo case, where market exchange of milk and dairy products used to constitute an important source of income, in which women played a pivotal role, Boutrais (1988) found that commercial dairying had declined over the past two decades. He attributed this to the rapid Islamisation of the region, and the partial settlement of the Mbororo. Whereas milk formerly provided a primary source of income, it had become only a supplementary source. As Islam was gradually adopted, pastoralists became settled and the wealthier households adopted the ideal of women's seclusion. Women, particularly higher-status women, withdrew from the trade in dairy products, as this public activity became imbued with concepts of shame as well as religious prohibition. However, a contributing factor in the decline of commercial dairying is that when these Mbororo settled, they also took up farming, and so the need to exchange milk for grains was lessened.

As it will be shown below, the stigma associated with the sale of milk among Mbororo society does not seem to be manifest in other Muslim societies in Africa. This being the case, we conclude that religious influences are important, but the overriding significance of market forces, in particular, market demand for pastoral dairy products, may provide the ultimate explanation for the

different modes of adaptation by women found in different Muslim societies.

Increased women's control over milk

Commercialisation does not always lead to women's labour being substituted by men, nor in diminished control by women over pastoral dairying. In some cases, the very process of market articulation may enhance and strengthen women's control over dairying and consequently ensure them more economic and social independence. This occurred among all but the very poorest Muslim women of the Nile Delta region of Egypt, in a case earlier summarised (Zimmerman 1982). Many women had managed to retain control over milk output under commercialisation, enjoying a high degree of economic independence and social esteem based on the value of their substantial economic contribution, amounting to a sum equivalent to the monthly wage of a low-ranking government employee, and constituting about a third of the total cash income of an average farm family.

A well-documented example in this regard is that of the Baggara, a Muslim group in Northern Sudan (Michael 1987). The Baggara case underscores continuity rather than transformation in the gender-based allocation of labour and responsibilities. Regionally within Sudan, urban demand for milk and milk products and the existence of an efficient and flexible marketing system (such as the mobile cheese factories) has expanded the significance of dairying in the household economies of the Baggara households. It is estimated that total revenue from the sale of dairy products accounts for at least a third of average household incomes.

Baggara women have assumed the responsibility of milk and dairy product marketing, a role resulting from their traditional right of allocating and distributing milk within family and kinship units. This new role gives them the opportunity to participate in the 'public' or external sphere, rather than being confined to the 'private' or domestic domain, as has been the case in pre-commercial settings. However, women's participation in the public sphere is still, in the main, oriented towards fulfilment of their traditional obligations in the domestic sphere. For example, a big part of the income earned from dairying is spent on domestic-related expenses such as food, child-care and socialisation of young children. Thus men and women have apparently negotiated a satisfactory arrangement for exploiting traditionally male-controlled and female-controlled domains under commercialisation.

According to Michael (1984, 1987), Baggara women's access to and control of income has increased their social and economic autonomy, as well as enhancing their participation in decision-making. Nomadic Baggara women can

also influence migratory routes by pressuring men to locate camping sites near a cheese factory, water source or a trading centre, in order to maximise returns from their dairy enterprise.

Most intriguing is the fact that unlike in the case of the settled Fulani women in Nigeria (Waters Bayer 1988), Baggara women do take part in management decisions related to improving milk output. For example, they use their income to purchase supplementary feed such as sesame cakes and determine which animals should be fed on the cake and in what quantities. In contrast, as was noted among the settled Fulani, husbands or male household members had taken over the responsibility for milking and allocating a share of the milk to each wife and other female members of the household. However, among the Baggara, women remained responsible for milking and hence directly able to determine the level of milk off-take.

These differences in investment patterns between the Baggara and settled Fulani cases illustrate that under a new set of economic conditions, men have assumed control of milk off-take levels, diverting more milk towards the calves, to maximise live animal production. Having lost much of their former control over milk, individual women are not guaranteed a return to any individual investment in supplementary feeding of their milk cows, because the resultant increase in milk output may be redistributed by the male household head to other female members of the household and/or diverted to calf growth. Where live animal sales have gained precedence, the propensity for men to divert the benefit of supplementary feed towards herd productivity rather than milk productivity was noted by the International Livestock Center for Africa (ILCA), which carried out on-farm experiments among the settled Fulani in Nigeria. Although the experiment was aimed at improving milk output by subjecting specific cows to improved feeding regimes, the Fulani herders included other animals in the feeding schedules, in order to improve overall herd productivity (Waters-Bayer 1985).

MARKET SPECIALISATION BY DAIRY PRODUCT AND LIVESTOCK SPECIES

Traditional dairy marketing begins as very small-scale petty trading operations run by individual producers locally selling household surpluses. As market demand for pastoral products increases, the traditional dairy sub-sector tends to grow in both volume and sophistication. Increased commercialisation has in many cases led to the development of specialised production and marketing systems, as different categories of producers and traders try to establish niches in the traditional dairy sub-sector. We now consider some of these forms of specialisation.

Specialisation by dairy product

Some of the examples we have presented earlier have already indicated the extent to which pastoralists have specialised in producing particular dairy products for a market. In a further example, we see how special economic niches can be exploited. In central Somalia, one of the clans (Caafi) specialises in producing and marketing camel milk; Talle (1992) observes that trade in camel milk is an economic niche that the Caafi have monopolised for a long time because they are the only camel rearing group in their area. Other pastoral clans in the area have taken advantage of the small stock trade, but the Caafi who live in the least developed part of the district in terms of infrastructure such as boreholes and motorable roads are less able to engage in small stock rearing, which is more dependent on the availability of water and roads. The Caafi instead concentrate on raising camels which are hardier and more suited for remote conditions. The problem of transporting their camel milk products to the town, in the absence of motorable roads, has been solved by the introduction of the donkey, as discussed earlier.

Groups of marketeers can occupy specialised niches, in time or space, for trading particular dairy products. This process is well-documented for the case of Somalia, where a number of studies focusing on milk were carried out in the 1980s. Little (1989) describes a situation in Somali in which different producers and traders specialise in the marketing of different dairy products. The town-based *abaakar* traders described earlier in this paper mainly specialise in marketing sour camel milk year-round in the major towns of Somalia, using motorised transport to collect sour milk from the nomadic producers. A second category of milk traders are the nomadic women themselves, who mainly specialise in selling fresh camel milk and fresh cow milk. When the nomadic producers move too away to be able to sell fresh products in towns, the gap left is filled by a third category of milk trader, the peri-urban dairy producers described earlier, who mainly specialise in selling fresh cow's milk. This degree of market specialisation is only found in the main urban centres, where consumers are willing to pay high prices for dairy products all year round. Despite fluctuations in supply, demand is high enough that a series of specialised traders or producer/traders is prepared to meet demand. Milk supply from nomadic herds fluctuates according to season and to distance of the herds from centres, but peri-urban dairy herders can step in and meet the constant high demand for dairy products. Also, high urban prices for milk mean that the *abakaar* traders also have an economic incentive to venture further out into the rangelands to buy milk from nomadic producers. But outside of the large centres of demand, there is less opportunity, and thus the seasonal fluctuations in milk supply are not compensated by specialised market activities.

A more complex specialised marketing system of traditional dairy products is described by Di-Domenico (1989) who carried out a study of formal and informal dairy marketing in the city of Ibadan in Nigeria's central region, as well as in other cities in the southern states of Oyo and Anambra. Most of the population of the cities studied come from non-pastoral backgrounds and are therefore not familiar with traditional pastoral products. However, there are a good number of northerners with pastoral backgrounds, such as the Hausa and the Fulbe (Fulani). These northerners, most of whom are successful retail and cattle traders, tend to live in exclusive ethnic enclaves of the large cities of Ibadan and Oyo. The Hausa enclaves, locally known as Sabo (i.e. Sabo-Ibadan or Sabo-Oyo) are centres of Hausa culture and traditions which function as ideological expressions of identity and exclusiveness, and are also the main outlets of traditional dairy products from the north.

The trans-regional trade in traditional dairy products is mainly operated by Fulbe women, who transport their products by train or truck to Sabo areas, where they have established 'milk depots', as central points for receiving northern dairy products. The main products are *nono* (sour milk) and *man shanu* (butter) which can last for several days without refrigeration. Fulbe women deposit their dairy products at the depot for storage and marketing, and come back to collect their receipts afterwards. A Fulbe market leader organises the sales, supplying the Sabo areas first and then other markets frequented by northern consumers.

Despite the fact that most Sabo residents are affluent enough to regularly afford 'modern' dairy products, they tend to prefer domestic dairy products on the grounds of taste, nutrition and cultural habit. It is interesting to note that during the dry season, sales of industrially-manufactured yoghurt rise considerably in the Sabo areas, because of the scarcity of *nono*, the traditional equivalent from the north. The only traditional product which is preferred by a non-pastoral ethnic group is *wara* (cheese) which is highly popular among the Yoruba. Because of this wider appeal, *wara* trade is in the hands of both Yoruba women and nomadic Fulbe women, who recently settled in the semi-humid zone of southern Nigeria. Fulbe women make the *wara* and urban Yoruba women do the marketing. The Yoruba women collect the *wara* from the Fulbe homesteads on a daily basis, and sell it in urban centres, again using a well-organised trading association which regulates prices.

In this case, as in the case of Somalia, we can see how seasonal, cultural and locational factors intersect in the supply and demand for dairy products. This has led to the development of a specialised marketing system. Pastoral dairy products have a cultural value among more affluent urbanites, who are prepared to pay a premium price for these preferred foods. When seasonally in short supply, in the case of Nigeria, there are apparently acceptable substitutes

presumably at a cheaper price, but not in the case of Somalia, where seasonal shortages from pastoral herds simply encourages other sets of producers or traders (the peri-urban dairy women and the *abakaar*) to try and supply the high demand.

Specialisation by species

Whether pastoralists specialise in dairying or live animal sales often reflects relative market advantages for different animal species and their products, at national and regional levels. Again, this can be seen in the case of Somalia where, environmentally and culturally, the camel remains the most important species for milk production (Hashi 1988, Samantar 1987, Little 1988, Herren 1990), accounting for 80% of all the marketed milk in major towns (Little 1988). Cattle, on the other hand, are more important for beef and for export on the hoof. Foreign exchange earnings from cattle exports rank second in importance to sheep, accounting for 22% of livestock earnings while camels account for only 3% of live animal export earnings (Little 1989).

Thus in Somalia particular livestock species tend to predominate in areas where there is greatest demand for those animal species or for products from those species. Camel herding is more prevalent around larger urban centres such as Mogadishu and Kismayo, important for camel milk trade, while herders around small towns near the Kenyan border, for example, have a disproportionately high number of cattle, which are marketed across the border, but few or no milk camels (Clark University 1988, Little 1989).

Given domestic and international demand patterns, pastoral commercialisation in Somalia has been based on both milk and live animal off-takes, with a different species dominating in each case. With strong market demand for both pastoral meat and milk products, the Somalis have developed differentiated commercial strategies which avoid the usual competition between extraction of milk for humans and calves which is characteristic of commercialisation based on a single species, as we have reviewed in other cases.

INTERACTION BETWEEN THE FORMAL AND INFORMAL DAIRY SUB-SECTORS

Any analysis of the process of commercialisation must ultimately deal with the question of markets. In the African context, the generalised dichotomy between a formal and informal sector applies also to the dairy sub-sector (Simpson and El Hadari 1970, Mbogoh 1984, Walshe et al. 1991, Di-Domenico 1989). This dichotomy is characterised by the co-existence of two production and marketing

systems. On the one hand, there is the modern dairying sector, catering for a relatively small luxury market using Western-style production, distribution and retail systems. On the other hand we have the traditional market, catering for a large mass market, using relatively informal production and marketing networks operated by small-scale independent producers and entrepreneurs. Pastoralists are the main suppliers of milk to this traditional market (Lovell 1992, for Sahelian and North African countries).

Within sub-Saharan Africa, only a small proportion of milk production enters formal marketing channels. This proportion is as low as 10% in the case of Nigeria, the Sudan and Tanzania (Walshe et al. 1991). This means that the largest proportion of milk produced in these countries is either consumed by the producers themselves or marketed on the informal dairy market. The formal dairy sub-sector on the other hand relies heavily on imported milk products such as skimmed powdered milk, butter oil and condensed milk, which are recombined locally and processed into various products such as fresh milk, ice-cream, yoghurt etc. (Massow 1984, Di-Domenico 1989, Lovell 1992, Mbogoh 1984, Walshe et al. 1991).

There are several reasons why the formal dairy sub-sector in many sub-Saharan African countries has relied more on imported dairy products for local reconstitution, rather than using local milk sources. In the first place, imported dairy products are very cheap because of heavy subsidies in the major exporting countries of the EC and the USA and also because most sub-Saharan African currencies were over-valued (Walshe et al. 1991, Mbogoh 1984, Di-Domenico 1989). Secondly, local sources from pastoral and small-scale milk producers are highly seasonal, irregular and unpredictable. As a result, a dairy plant would not be in a position to plan beforehand the quantity of goods it would produce (Mbogoh 1984). Thirdly, given the fact that most local producers are rural-based, reliance on local milk sources would entail logistical problems of transportation and cooling. Therefore, milk collection may only be feasible in instances where producers are less dispersed and well-served by motorable roads (see for example Chikaka and Foote 1978).

However, with the escalating economic problems most sub-Saharan African countries face, coupled with the gradual removal of subsidies envisaged by the EC, dependence on imported dairy products for recombination in local dairy plants is decreasing (Walshe et al. 1991, Di-Domenico 1989). In many countries undertaking Structural Adjustment Programmes, import-based dairy products are now seen as luxury items and most governments are deliberately pricing these goods out of reach of the majority of their citizens (Di-Domenico 1989).

The question now is whether traditional pastoral dairy products can fill the gap left by the inaccessibility of import-based products to the majority of consumers. It is noted that despite the fact that import-based products have now become a luxury, a taste for dairy products may still remain, and in theory the

opportunity is provided for traditional dairy products to fill the gap without much competition from import-based products (Di-Domenico 1989).

One obstacle to the direct substitution of dairy imports by traditional dairy products is the fact that often, the quality of traditional dairy products is poor and inconsistent and prone to adulteration by vendors and middlemen (Di-Domenico 1989). Consumers who are habitually used to high quality import-based goods may find it extremely hard to make do with low quality traditional products. This conclusion was reached by Di-Domenico (1989) who established that in the Nigerian context, consumers of Southern origin would rather do without dairy products than purchase traditional ones if they are unable to afford import-based products.

A solution might be to raise the standards of local products to the level of import-based products for wider appeal. However, in the past attempts to modernise the traditional dairy sub-sector have often been associated with the emergence of centralised bureaucratic structures and price controls. For example, according to Simpson and El Hadari (1970), a dairy development scheme in the Sudan involving former pastoralists who were resettled on irrigated plots could not perform as envisaged because the prices offered by the dairy scheme were not competitive and flexible enough to take into account seasonal costs of production. Thus many producers were more inclined to sell their milk on the informal market, which offered higher variable prices according to season (see also review by Kerven 1987a).

The formal and informal (pastoral) dairy sectors are not necessarily incompatible. This has been shown in the past, when colonial veterinary departments were able to set up and successfully run dairies using milk sold by pastoral women (for a summary in the case of Nigeria see Kerven 1992). A recent development in Senegal, set up by the commercial giant of Nestle, also aims to integrate pastoralists into a production chain (Lovell 1992, citing Madieng Seck 1992). Five milk collection centres have been opened in the Ferlo region, which screen and collect milk from nomadic Fulani herds, for later transferal to Dakar for processing. Significantly, although the price offered to producers is only slightly below the prevailing local market price, it is three times higher than the price for imported dried milk. However, for the reasons outlined above, Nestle anticipates a decline in national milk importation, and is attempting to secure the local market for the future (Lovell 1992).

CONCLUSIONS

It is now widely appreciated that dairying, either for direct consumption or barter, has been the mainstay of subsistence-oriented pastoralists. But the role of dairy production when pastoralists become commercially-oriented is less clear. Herders can choose to consume milk from their animals, to sell it, or to

deflect it to live animal growth. Although many herders continue with all three practices, commercialisation has meant a shift in emphasis between these allocations, under certain circumstances, and for particular types of pastoralists. Pastoral dairying is in decline in many places as herders turn their attention to raising animals primarily for the slaughter market. It is also evident that, for other pastoralists in other places, the economic importance of dairying has intensified. It was the need to explain these apparently disparate trends that led us into a review of the material, and to propose the model presented at the outset.

Under conditions of commercialisation, we find that significant differences in the patterns of allocating milk from livestock emerge between types of producers within a single pastoral group, and that these differences extend to the level of how individual animals are managed by different pastoral households. In an attempt to generalize from individual cases, we proposed a simple model based on a three-way distinction between the use value of milk, its exchange or sale value, and finally, its value as an input into a further production process (meat production). It was the relative value of milk deployed for household consumption, sale or animal growth which, we argued, determined the emphasis on commercial versus subsistence strategies for any pastoral household.

The simplicity of this model proved to be deceptive, on several grounds. The most problematic aspect of the model is our current inability to quantify the relationships it depicts. While information on the sale price of milk is sometimes available, research on the input value of milk for calf growth has just begun (Holden et al.), and use values are, by their very nature, shadow prices (Behnke 1985). We are left with a model which proves exceedingly difficult to test. Especially with respect to the determination of use value, we run the risk of logical circularity if we try to deduce use values from patterns of producer behaviour, which are precisely the phenomena our imputed values purport to explain.

Rather than attempt a spurious quantification of our model, we have instead reviewed the variety of factors which could, in practice, cause a shift in the exchange, use or input values of milk. We have seen that the use value of milk is sensitive to alterations in, among other variables:

- volume of milk output (as a function of herd size)
- household size (and hence the number of milk consumers)
- gender composition of household (and hence the labour available for dairying)
- seasonal fluctuation in milk supply from the domestic herd.

Likewise, the exchange value of milk can be affected by:

- cultural taste preferences for dairy products among non-producing consumers
- price controls on dairy products
- dairy importation policies and the availability of substitutes for local products
- the market price of grain and other food staples, which alters the effective 'purchasing power' of milk which is sold
- producers' access to centres of demand (markets).

Finally, the value of milk as an input to intensify meat production varies according to two broad categories of factors:

- economic (e.g. the market price for live animals)
- biological (the effect of increased milk intake on offspring growth and survival, for example).

The number and complexity of the interactions between these factors is such that the preceding review yields few elegant generalizations. We note instead those findings which should have a bearing on the design and management of pastoral development policy and programmes.

1. The review has shown how commercialisation leads to specialisation, as generalised production for subsistence gives way to production by special groups, of specialised commodities for special markets. One of the features of this process is the growing distinction between poorer and more wealthy producers, as the size of the livestock holding induces herd owners to pursue diverse goals, using distinct husbandry techniques. Under certain market conditions quite common in Africa, poorer pastoralists can become more intensively involved in and dependent upon dairying marketing at an informal level. We therefore conclude that development efforts concerned with marketing of pastoral products should be directed firstly at members of this group, as those most likely to be interested in dairying as a means of increasing household incomes.

2. Our examination of cases has shown that that pastoral mobility is not incompatible with specialised dairy marketing by pastoralists, *provided there is a strong demand for pastoral dairy products*. The corollary of this is that pastoral settlement is not a pre-condition to development of dairying. When demand is sufficient, pastoralists will bring their dairy produce to sell in town, or else traders will seek out pastoralists. Likewise, market demand for their dairy products has encouraged pastoralists to find ways of overcoming labour and feed supply problems that arise with dairy specialisation in peri-urban areas. The

principal effect of pastoral mobility is on dairy product prices, as producer prices are generally lower the greater the distance from the consumer market, due to the perishable nature of the products and the transportation costs involved for traders.

The conclusion which can be drawn is that effective demand and market access are among the most important factors influencing the level of pastoral dairying under commercial conditions. To some extent, strong demand compensates for producer inaccessibility, in that entrepreneurs are prepared to seek out mobile producers and pay premium prices, when there is sufficient urban demand for pastoral dairy products. However, where demand is weaker, the question of market access becomes more important in whether dairying can be commercialised, given the perishable nature of many dairy products.

Where it becomes economically viable, one advantage of the flexible dairying marketing systems noted in some of the cases is that they enable some pastoral producers to simultaneously market their dairy products and exploit superior range and water resources through continued herd mobility. It is therefore suggested that, wherever firm demand exists, development interventions aimed at enhancing pastoral dairying consider marketing programmes which can co-exist with continued herd mobility.

Pastoralists, either under pressure or seeking marketing opportunities, are attracted to the 'development corridors' or settled centres where population, infrastructure, employment opportunities and services tend to be concentrated. One of the perceived advantages of these corridors are dairy marketing opportunities, but the resulting higher animal populations causes pressure around the settlements. This being the case, development programmes should consider the predicament of the poorer category of pastoral producer, who may be forced through lack of other viable alternatives, to remain in the vicinity of these settlements to maintain all-year-round access to milk market outlets. In particular, development efforts could focus on ways to sustain sufficient levels of milk production under peri-urban conditions, especially during the dry season. Where possible, alternatives such as silage projects, concentrates and small-scale irrigation projects, as well as fodder bank programmes should be considered.

3. Informal dairying marketing continues to be carried out mainly by women, according to most of the case studies examined here. This is contrary to the conclusion reached in a recent major review by Horowitz and Jowkar (1992). They argue that women are not likely to benefit from the commercialisation of pastoral dairying because men tend to take over when, among other things, the volume of dairy marketing increases beyond a certain point.

However, we find that, *provided* demand for pastoral products is not exceeded by the input value of milk for live animal growth (based on increased market values for live animals), women's participation in dairy marketing is not

threatened and under certain market conditions, may in fact be expanding. Certainly, it is reported that in some cases pastoral women's involvement in dairying has declined, but closer examination finds that this decline is correlated to the differences in commercial orientation linked with the size of herd - that is, with wealth rather than gender differentiation. Larger herd owners who become more involved in live animal marketing when prices are attractive start to deflect milk to animal growth, away from domestic milk consumption or sale. One result is that the milk formerly available for women to process and sell is no longer available. Higher cash returns from live animal sales, and often higher social status for women whose husbands have bigger herds, means that wealthier pastoral women no longer need to depend on dairy income. On the other hand, women whose families have few animals often find themselves becoming *more* dependent on dairy income, as the social and economic effects of commercialisation begin to take effect.

Promotion of income-earning dairying opportunities for pastoral women must therefore be based on ensured, proven market demand and should be carefully targeted at those women who have the need, ability and interest in continuing to be involved in dairy marketing. Provided these preconditions are met, it is likely that promotion of pastoral dairy marketing for women will improve food security at the household level, since women tend to spend their income on food and other day-to-day household expenses (Michael 1984, 1990, Waters-Bayer 1988, Little 1989, Zimmerman 1982, Whalen 1984, Kelly 1985). Higher incomes accruing to women will also solve labour bottlenecks through reinvestment in labour-saving devices as illustrated in the case studies by Talle (1992) and Zimmerman (1982). Finally, it must be emphasised that development efforts to formalise pastoral dairying need to avoid repeating past mistakes, in which women's participation was reduced.

4. Clearly, from the cases noted, pastoral dairying can be commercialised without any external assistance such as industrial dairy processing plants, or direct interventions in the form of projects. Although the marketing of pastoral dairy products may *look* traditional, closer inspection reveals that this is often a specialised economic activity, sensitive to consumer demand, adaptive to new challenges and competitive with industrially-processed alternative products. Pastoral dairy products have a great advantage over industrial dairy schemes, as the former tend to be cheaper for the consumer, unless the dairy schemes rely on subsidised milk imports. Local taste preferences may also favour pastoral products over industrially-processed milk products. Furthermore, the flexibility of the informal dairy sector in determining market prices has been widely reported, and can thus be considered as more characteristic of a 'free market system' than the formal sector (Mbogoh 1984). We therefore conclude that any successful dairy development strategy should incorporate lessons from the way

the informal dairy sub-sector operates. In particular, local participation and collective responsibility should be emphasised over bureaucratic control. Above all, the high profile of women in informal pastoral dairy marketing should be noted.

5. To sum up, we have proposed in this paper that one way of understanding the process of pastoral commercialisation which is occurring across Africa is to focus on the primary output of milk, to see under what conditions this becomes a commodity or by contrast, ceases to be a commodity. We have argued that these conditions centre on the shift in the value of milk, and that this shift is influenced by a number of discrete and identifiable variables. However, we note that the abstract model is deceptively simple, and that at present, neither researchers nor producers have the means to precisely estimate use, exchange and input milk values. Nonetheless, the literature reviewed here suggests that these values have significantly changed in the wake of market penetration, that producers have somehow taken account of these shifts, and that they have subsequently instituted new husbandry techniques which adjust amounts and types of output to reflect new opportunities or constraints.

Further field research is required to specify empirically the various quantifiable elements in the model, and test it. Any practical attempt to pinpoint the intersection of curves between the values in any particular time and place would require locally-specific data on the key variables. Such an attempt would be justified either when planning macro policies and programmes on live animal marketing or dairying involving pastoralists, or when planning local projects with pastoralists on issues which affect marketing of their products.

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