Chapter 4

Markets and Livestock in the Coming Decades: Implications for Smallholder Highland Producers

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Introduction

It is well recognised that people living in highland regions depend particularly on livestock for their livelihoods. Where crop production is feasible, livestock are an essential component of farming systems. They provide food, traction, manure, income, and fibre and perform other social and economic functions. Where extremes of climate and terrain make crop production especially difficult, livestock can often live and flourish on available resources and provide livelihoods. What is less well recognised is the importance of livestock markets, and also the special constraints that such markets face in highland and mountain areas to furthering the contribution of livestock to livelihoods.

This paper reviews recent research, first to present a picture of coming trends in livestock product consumption and production in developing countries, in general, and second to derive some of the market implications of these for smallholders in the highlands. Evidence is also presented concerning the linkages between livestock, agricultural intensification, and markets. Finally, several highland case studies are presented that show in detail some of the major market constraints facing highland livestock producers.

The Continuing Livestock Revolution

Clear evidence is now available that smallholder livestock producers in developing countries are being presented with growing market opportunities. A recent study by

Delgado et al. (1999) examined the trends for livestock demand and production to 2020, with a focus on developing countries. Based on a global food model, they predict where and to what degree demand for livestock products will grow, and simultaneously predict where the increased production needed to meet that demand will occur.[1]

The projected changes are dramatic. Particularly because of increases in per capita income in Asia and elsewhere in developing countries, but also as a result of growing human populations and urbanisation, consumption of animal products will increase significantly in all developing countries by 2020. Consumption of meat and milk is predicted to grow by about 50% in the period from 1993 to 2020 in developing countries, to some 30 kg/capita and 62 kg/capita annually, respectively (Table 4.1). Much of the growth in meat consumption will occur in pork and poultry, although beef consumption per capita is expected to grow by more than 30% as well.

Table 4.1: **Per capita consumption of livestock products in developing countries** (kg per capita per year)

Commodity	1993	2020 (projected)
Beef	5	7
Pork	9	13
Poultry	5	8
Meat	21	30
Milk	40	62

Source: Delgado et al. 1999

Further, significant growth in animal product consumption can be expected to occur in all regions of the developing world (Table 4.2). The largest volume increases are expected in China where total milk and meat consumption will more than double. Overall, milk and meat consumption in developing countries is projected to grow at a rate of about 3% annually, with the highest rate of growth in Sub-Saharan Africa (3.5%), although from a low base. In sharp contrast, consumption in developed countries is expected to change hardly at all. This phenomenon is centred entirely in the developing world.

These dramatic changes, which are already well on their way, have been described as the 'Livestock Revolution' (Delgado et al. 1999), which in value terms is larger than the Green Revolution of the 1960s and 70s. From the point of view of smallholder producers, however, the important questions remain: where will the increased production needed to meet this demand take place, and will smallholder livestock producers be able to participate in this market opportunity?

[1]The IMPACT model is a global food model of 18 commodities including 7 livestock commodities, covering 37 separate regions/countries, and with annual iterations to 2020. It incorporates expected growth in population and income and changes in productivity (Delgado et al. 1999).

Table 4.2: **Projected growth in total meat and milk consumption for selected regions, 1993 to 2020** (million tonnes)

Region	Meat			Milk		
	1993	2020	Annual growth rate (%)	1993	2020	Annual growth rate (%)
China	38	85	3.0	7	17	2.8
India	4	8	2.9	52	160	2.9
Latin America	21	39	2.3	46	77	2.3
Sub-Saharan Africa	5	12	3.5	14	31	3.5
World	184	303	1.8	412	654	1.7

Source:Delgado et al. 1999, p. 24

The answer is that increased production is expected to occur generally in the same areas where the increased demand is expressed, in other words the additional meat and milk will be locally produced not imported. This follows the current pattern: 10% or less of value of livestock production is traded internationally (FAOSTAT 1998). In spite of the public attention sometimes given to livestock product trade issues, livestock products are not easily traded, requiring extensive transformation or high cost to preserve and transport, after which they may not share the level of quality of local fresh products. Thus the model predicts that countries deficit in livestock products will generally import feed rather than meat and milk, leading to rapid increases in feed grain imports in some areas (Table 4.3).[2]

Table 4.3: **Projected growth in total cereal use as feed** (million tonnes)

Region	1993	2020	Annual growth rate (%)
China	84	178	3.4
India	3	14	5.0
Latin America	55	92	2.0
Sub-Saharan Africa	3	5	3.5
Developing World	194	409	2.8
Developed World	442	519	0.6

Source: Delgado et al. 1999, p. 26

As a result, livestock production in developing countries will increase approximately on a par with consumption. By 2020, developing countries will produce some 60% of all meat and 52% of all milk globally, up from some 47% and 32%, respectively, in 1993. This increased production is expected to place a new stress on extensive livestock production systems and those relying on peri-urban grazing, and to create the potential for concentration of production.

[2] In spite of increased use of grain for feed, the IMPACT model predicts that grain prices will not rise significantly, and would remain in real terms below the levels seen in the 1980s. This is because of expected continued productivity increases (Delgado et al.1999).

The Livestock Revolution also means new market opportunities for smallholder livestock producers. Important constraints remain, however, that will impede the ability of smallholders to participate. These include the following.

- Small scale of production and marketed output implies low bargaining power and inability to capture economies of scale in marketing
- Poor access to livestock services and credit
- Policies that favour capital-intensive livestock production
- The growing commercialisation of livestock production, particularly through the industrial production of poultry and pork

In the highlands, these constraints are likely to be even more severe. Will highland livestock producers and communities be able to participate in the Livestock Revolution?

The Link between Livestock and People

In considering the future of livestock markets and their likely impact on highland communities, it is useful to look at patterns of linkages between people and the livestock they keep. In short, not only will production growth occur in the same areas as demand growth at the global level, but locally market constraints and other factors will also lead to livestock living near to people.

An important indicator of potential market constraints to livestock products can be seen in the spatial link between human and livestock population densities. Historically, the evolution of agricultural production systems shows that there was a positive relationship between human and livestock population densities – areas with high human population densities also had high livestock population densities. A number of previous and recent studies at country, regional, and global levels have confirmed this historical pattern (Mukherjee 1938; Jabbar and Green 1983; Wint and Bourn 1994; Sere and Steinfeld 1996; Slingenbergh and Wint 1997; Lapar 2000). Wint and Bourn found that in Sub-Saharan Africa, in areas with less than 500 mm annual rainfall, 70-90% of the ruminants occur in rural systems.[3] The remaining animals are in villages or within settlements. However, as rainfall increases, the proportion of animals in rural areas falls, to 50-60% in areas of 500-2000 mm annual rainfall, and to 10-15% in the wettest areas. This seems to occur because, where rainfall is more plentiful, the availability of adequate feed resources allows the transport of feed and fodder into urban areas. Livestock are then kept as close as possible to the centres of demand in order to reduce the constraints in marketing livestock products. Given that many highland areas also experience relatively higher rainfall, these same trends could occur in those settings. Sere and Steinfeld found

[3] These figures refer to the percentage of ruminant biomass, not numbers of animals.

that among the different agroecological zones, highlands have the highest livestock population densities and sometimes very high human population densities. Slingenbergh and Wint found in their global study that, spatially, livestock population densities occur at a rate approximately double that of the human population density. Approximately the same results were found in Sub-Saharan Africa (SSA), and a slightly lower level of relationship in Asia.

This positive relationship between human and livestock population densities normally occurs until urbanisation and industrialisation lead to a steady decline in the rural population depending on agriculture. However, where urbanisation is not accompanied by adequate development of market infrastructure to connect rural producers and urban consumers, livestock production continues in urban/peri-urban areas. For example, in the mid-19th century, most European cities depended on urban/peri-urban dairies for much of their milk and beef. By the turn of the century, these urban/peri-urban dairies had disappeared because of health regulations, improved infrastructure, and economies of scale leading to larger production units, which in turn required more land (Phelan and Henriksen 1995). In the newly emerging economies of East and Southeast Asia, a combination of rapid income growth, urbanisation, and population growth led to a rapid increase in the demand for livestock products, particularly meat and meat products. Traditional rural livestock production systems were slow to respond to these demands, which led to an increase in imports and in the role of urban/peri-urban industrial production systems, particularly for non-ruminant livestock. Lack of adequate infrastructure, the high transport cost from distant areas, and lack of regulations on the one hand; and policies supporting trade, prices, and subsidies by different governments on the other, have led to the establishment of production enterprises in urban/peri-urban areas. A recent study has identified these concentrated livestock production systems in East and Southeast Asian countries as one of the ' hot spots of livestock-environment interactions' (de Haan et al. undated).

Dairy is a major enterprise in highland areas because of the climate, which is more suitable for raising animals than is that in humid and arid/semi-arid areas. On a global basis, highlands produce 25 kg milk per ha compared to 17 kg in arid/semi-arid and 10 kg in humid/sub-humid areas. Milk output per capita is 34, 49, and 8 kg, respectively, in these ecozones (Sere and Steinfeld 1996). However, markets are particularly susceptible to infrastructure. In highland areas infrastructure is expensive to build and maintain and is liable to disruption, so that investment in it is often uneconomic even with moderate to high population densities. Yet, without a proper market infrastructure, highland livestock producers are unlikely to be able to benefit from the national and global market opportunities for their products.

Smallholder Access to Markets: the Example of Dairy

Dairy product consumption is expected to grow considerably in the developing world, for example in SSA by 3.5% annually between 1993 and 2020, and domestic production has the potential to meet this demand and generate additional income and employment. However, smallholders will only benefit if they can participate in the market, which will be globally related and influenced. Some producers sell home processed products as a result of lack of access to fluid milk markets in distant urban areas.

Several barriers remain to smallholder participation in dairy production. Prominent among them are the following.

Availability and cost of animals – Without better quality animals that offer potentially higher milk yields, the ability and probability of market participation is reduced significantly as the small quantities of milk from local cows are inadequate to justify the investment in time and labour necessary to reach the market. But better quality animals are not always easily available due to lack of breeding stock production programmes, and the cost may be beyond the reach of many smallholders. Credit can relax such constraints, but as a result of the criteria usually used for judging credit worthiness many smallholders are left out of the formal credit market. Identification of farmers with real credit constraint and extending credit to such farmers has a much greater effect on production and market participation than simply extending credit to those who meet traditional criteria such as the ability to provide collateral and apparent repayment capacity (Freeman et al. 1998).

Seasonal feed availability and quality – inadequacy and poor quality of feeds is a major constraint for livestock in the highlands, particularly for dairy animal production. Even when improved dairy animals are raised, lack of quality feed still limits the milk yield potential of the animals; thus the volume of milk entering the market is also less than the potential volume.

Market and spatial factors – Traditional smallholder livestock producers are generally scattered in rural areas that are often characterised by inadequate access to roads and transportation facilities. This raises transaction costs and limits market participation in two principal ways. First, milk is a bulky perishable commodity, so needs quick disposal. The distance, time, and effort required to reach the market and the associated risks of spoilage are thus important factors determining producer participation in the market. Second, inadequate access to inputs and services (such as veterinary services, drugs, artificial insemination, and feed) serves as a disincentive to the adoption of improved dairy cows, which also reduces dairy market participation (Staal et al. 1997).

Regulations restricting participation – In some countries governments have established a dairy processing and milk collection infrastructure to give small producers access to a stable market outlet for their products. While such parastatal organisations initially played a positive role in expanding smallholder dairy production, in time they became a principal disincentive to further expansion because of their monopoly behaviour and resulting inefficiency. The informal milk markets that emerge to bypass these inefficiencies offer less reliability, and are often limited in scale. Policies towards marketing, and institutional roles, thus affect smallholder livestock access to reliable, supportive markets (Staal et al. 1997).

Constraints to Livestock Market Participation: Two Case Studies

Case 1: Smallholder dairy in highland Kenya (1500-2500m)

Kenya is one of the few success stories for smallholder dairy development in the African continent, particularly in the highland region. European settlers originally started medium to large-scale dairy farms with exotic and cross breeds to meet the growing urban markets and the rapidly expanding tourist industry. Beginning in the 1950s, crossbred dairy cattle began to be acquired by indigenous smallholder farmers. These were eventually supported by government-established milk processing facilities, milk collection centres, and a federation of dairy cooperatives of producers called Kenya Cooperative Creameries (KCC). These cooperatives played an important role in smallholder dairy development during the 1970s and 1980s, such that smallholders now supply about 80% of the milk marketed nationally. However, the KCC had a monopoly on the purchase of fluid milk from local cooperatives and on all urban milk sales, using prices set by the government. By the early 1990s, these policies resulted in a high producer-consumer price spread, leading to declines in milk deliveries to KCC as producers diverted milk to private informal traders at higher prices. The 1992 deregulation of the milk market followed a similar liberalisation in veterinary and artificial insemination (AI) services. These led to a dramatic change in the nature and extent of market participation (Table 4.4). There has been a large increase in the rate of the unregulated raw milk market and a decrease in the relative share of sales to KCC outlets; furthermore rural dairy co-operatives have started providing veterinary and AI services alongside the private sector. A significant rise was also observed in the real prices received by producers, with emergence of a price gradient by distance from urban centres: the further away the milk producing farm, the lower the price they receive.

In order to verify more systematically how spatial, household resource, and agro-ecological factors in the highlands affect market access (measured as the farm-gate milk price) and the ability to take up dairy technology (measured as the probability

Table 4.4: Pre and post-reform status of dairy farmers' cooperatives (DFCS) in three districts in highland Kenya

	1990	1995	% Change
Registered members	58,428	83,751	43
Active members	22,078	35,248	60
Milk sales ('000 litres)			
Retail outlets	8,702	17,785	104
KCC	17,712	15,295	-14
Middlemen	4,848	5,972	23
Private processors	486	1,499	208
Total	*31,748*	*40,551*	*28*
Numbers of DFCs providing service			
Milk marketing	27	30	11
Sale of veterinary drugs	9	13	44
AI service	1	22	2,200
Sale of feed	13	23	77

Source: Owango et al. 1998

of having a dairy cow), a detailed study was conducted combining farm survey and GIS-derived variables in an econometric analysis (Staal et al. 1999). A random survey was conducted among 1,389 households in the central highlands of Kenya, about half of which were small dairy farms that depend on both formal and informal markets. In the latter the farm-gate milk price is 10% higher, but more risky as seasonal demands vary and informal market agents sometimes fail to pay. Each household was geo-referenced using global positioning system (GPS) units. GIS tools were then used to derive least-travel-time distances from each farm by road to urban areas and milk market points, by road type. Additional GIS data on rainfall, temperature, and human population density were also included to determine the factors influencing the adoption potential for improved dairy cows.

The results of this analysis confirmed that there is a milk price gradient by distance from urban centres: the further the distance, the lower the price in both formal and informal markets, although the effect is much more marked in the latter (Table 4.5 and Figure 4.1). The negative effect on farm-gate milk price of a kilometre of tarmac from the largest city is about double in the informal market. This difference does not necessarily suggest, however, that informal markets operate less efficiently per kilometre than formal markets, only that the informal market prices paid to farmers more explicitly reflect the actual transport costs and associated risks. This is because the formal market tends to offer uniform prices at the main collection centres, regardless of distance.

The other important difference between the formal and informal market results was seen in the effect of the size of the dairy herd on the farm-gate price (Table 4.5). In the formal market a larger herd (and so more milk delivered) leads to higher prices;

Table 4.5: **Effects of selected variables on farm-gate milk price in the Kenyan highlands: estimated OLS model for farm-gate milk price formation**

Variable	Formal milk market price	Informal milk market price
Household transaction characteristics		
Dairy herd size (number of cows)	0.17[1]	-0.36[2]
Market infrastructure		
Distance to largest city by tarmac (km)	-0.07[1]	-0.14[2]
Distance to largest city by all weather loose surface roads (km)	NS	-0.28[2]
Distance to largest city by dry weather only roads (km)	NS	-0.37[2]
Distance to nearest milk collection centre by tarmac (km)	-0.41[2]	NS

[1]significant at 0.05 level, [2]significant at 0.01 level, NS= not significant
Source: adapted from Staal et al: 1999

in the informal market the price effect is significantly negative and large. This can be seen as a clear indication of the inability of the informal market to capture economies of scale in milk transport as a result of the technology used, but is also a result of existing government policies. Currently, if traders increase their scale of operation from bicycles to pickups they face increased risk of harassment and fines from law enforcement, because the informal milk trade for sale of raw milk in urban areas is illegal.

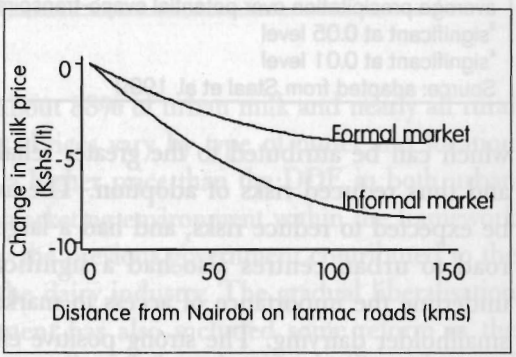

Figure 4.1: **Estimated distance decay functions for change in farm-gate milk price with distance from Nairobi (the largest city) by all-weather road in formal and informal milk markets in the Kenyan highlands**

A profit analysis was made for the adoption of dairy cattle. The results are shown in Table 4.6. The variables with a significant and positive effect on the probability of dairy cattle adoption were years of education, total household land, availability of a veterinarian and formal market locally, and agro-climate. The human capital parameters were highly significant and indicate about a one per cent increase in the probability of adoption with one additional year of formal education. The total land parameter was weakly significant whereas rainfall and temperature were strongly positive, indicating that land size is less important than agro-climatic potential. The local market and services' access parameters were very significant and large. An increase of one per cent of the proportion of local sales to formal markets was associated with a more than three per cent increase in the probability of adoption,

Table 4.6: Effects of selected variables on the probability of dairy cow ownership in the Kenyan highlands: estimated probit model for the adoption of dairy cattle technology

Variable	Marginal effects[1] (%)
Household characteristics	
Years of education of household head	1.1[4]
Total land owned (acres)	1.0[3]
Local area characteristics	
Availability of veterinarian locally	2.2[3]
Availability of formal market locally	3.4[3]
Rainfall and temperature[2] (PPE)	2099[3]
Market infrastructure (GIS)	
Distance to nearest urban areas by tarmac (km)	-1.0[3]
Distance to nearest urban areas by all-weather loose surface road (km)	-1.0[3]

[1]marginal effect is the % change in the dependent variable (probability of dairy cow ownership) of a 1% change in the explanatory variable
[2]rainfall and temperature were represented by a combined index, PPE, which is the annual average precipitation over potential evapo-transpiration
[3]significant at 0.05 level
[4]significant at 0.01 level
Source: adapted from Staal et al. 1999

which can be attributed to the greater reliability and lower risks in milk marketing and thus reduced risks of adoption. The availability of a veterinarian can similarly be expected to reduce risks, and had a large positive effect. Finally, the distances by road to urban centres also had a significant impact. These last three variables underline the importance of access to markets and services in this case of highland smallholder dairying. The strong positive effect of agro-climate has implications for highland systems, which generally have relatively higher levels of rainfall and lower temperatures, and underlines the significant comparative technical advantage of production in these areas for major types of livestock products, including dairy.

Case study 2: Smallholder dairy farming in highland Ethiopia (~2000 m)

Mixed smallholder farms predominate in the highlands of Ethiopia. The large cattle population, mostly indigenous Zebu, perform many functions including providing traction, manure, and milk and milk products. However, sale of fluid milk is insignificant in the rural areas outside the Addis Ababa milk shed, which covers a 120 km radius principally along the main roads. Dairy is a major activity in Addis Ababa city and its surrounding areas and most of the country's crossbred dairy animals are located here. The government has established a Dairy Development Enterprise (DDE) to provide market and other physical and service facilities to promote dairy development. The DDE has established a processing plant in Addis Ababa and milk collection points along the main roads to provide a stable market outlet for producers, and veterinary and AI services and other inputs. There are also

milk producers' cooperatives, which provide selected services to their members, but their activities are concentrated primarily in Addis Ababa city. The DDE collects milk at fixed prices. These have not changed for several years although prices in the informal market vary both between seasons and between years. The nature and extent of market participation by urban/peri-urban and rural producers are limited by distance and road infrastructure (Table 4.7).

Table 4.7: **Dairy sales pattern and distance to markets in highland Ethiopia**

Sales (per household per day)	Distance to milk collection centre	
	0-3 km	3-10 km
Milk (l)	3.2	0.1
Butter (g)	7.0	97.0
Cheese (g)	0.0	11.3
Total milk equivalent (l)	*3.2*	*2.4*

Source: Debrah and Anteneh 1991

In spite of the support from the DDE, about 88% of urban milk and nearly all rural milk is handled by the informal market. Prices vary by type of outlet and location (Table 4.8). In general, all outlets paid a higher price than the DDE in both urban and peri-urban areas. This rather rigid marketing environment within the framework of the overall command economy run by the previous government contributed to the slow and less than expected growth in the dairy industry. The gradual liberalisation of the economy by the present government has also included some reform in the dairy sector. Recent reform measures have allowed formal private milk traders and cooperative farmer milk groups to appear alongside the DDE. It is too early, however, to assess the full impact of these reform measures and emerging institutions on the dairy industry and the extent of farmer participation in market.

Policy reform may not be enough to improve market access for smallholder highland dairy farmers. A study among a stratified sample of 144 farms, in an area where milk groups have emerged after the introduction of the new regulations, showed that transaction costs are a major determinant of the probability of market participation

Table 4.8: **Pre-reform sales outlets and price received by producers in and around Addis Ababa, Ethiopia (in Ethiopian birr per litre)**

Sales outlets	Peri-urban		Urban	
	Large	Small	Large	Small
Individuals	0.95	1.05	1.63	1.65
Hotels and restaurants	2.00	1.30	1.60	1.35
Other retailers, traders	NA	1.22	1.54	1.21
DDE	1.00	NA	1.00	NA

Source: Staal et al. 1997

by dairy farmers. Only 15% of the sample had sold milk to the milk groups at any time during the five-month survey period, and market participation (i.e., sales of milk to milk groups) was determined significantly by marketable surplus and distance. Distance was measured by the time to transport milk to the group's purchase point, and thus served as a proxy for an important component of transaction costs. It was estimated that current non-participants in the milk market are likely to participate if, other things being equal, they can increase their daily marketable surplus by 9.8 litres, and have either 2-3 crossbred cows or 6 local cows, or have about 10 extension visits per year, or if their return journey to the market could be reduced by about 2 hours (Holloway et al. 2000). Therefore, the transaction costs determined by the market infrastructure seem to be a major constraint to smallholder participation in dairy marketing and the adoption of improved cows to produce more milk.

Conclusions

Global trends in livestock demand and production point clearly to a strong growth potential, especially in the developing countries. The questions are whether smallholder mixed farmers will be able to compete with growing industrial systems and participate in the domestic and global market, and what the particular constraints are facing those in the highlands. The constraints that policy-makers will need to address include small scale of production and marketed output, poor access to livestock services and credit, policies that favour capital-intensive livestock production, and the growing commercialisation of livestock production. One means of addressing these constraints may be through farmer organisations that allow better bargaining power and vertical integration of activities. Other factors favour smallholder livestock production, particularly the greater nutrient cycling possibilities in mixed farms and consequent increased returns to livestock production.

Broad regional studies and case studies show that livestock production is particularly constrained by market and spatial factors. In highland and mountain regions these constraints are likely to be relatively greater as a result of the high costs of infrastructure and risks of disruption. On the other hand, in some cases, highlands offer a lot of potential because of the existence of mature mixed farming systems, high human and livestock population densities, and the climatic advantages for raising more productive dairy animals like crossbred cows. The selected case studies show that the primary constraints to the participation of highland smallholders in dairy farming are the remnants of restrictive policies and regulations, high transaction costs due to poor infrastructure and information systems, and poorly developed markets for inputs and outputs. These case studies also show that recent reforms

have eased some of these constraints with good results for both producers and consumers. Further reform and investment in supporting infrastructure, including farmer group development, can help provide good growing opportunities for smallholder livestock producers in highland systems.

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