



Livestock in a Changing Landscape: Social Consequences for Mixed Crop- Livestock Production Systems in Developing Countries

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Summary

Smallholders Predominate in Mixed Crop-Livestock Production Systems. Economic activities in livestock in mixed production systems in the developing world are predominantly undertaken by smallholders, making a living out of small farms <2 hectares per farm. These small farms account for a significantly larger share of meat and milk outputs in developing countries, and contribute significantly to rural (self-)employment given the labour intensity of smallholder production systems. Projections indicate that small farms will continue to be a prominent feature in rural areas in the next decades.

Informal market chains for are the main link between rural smallholder keepers of livestock and the growing demand for meat and dairy products, both in the major urban centres and smaller rural towns. Informal markets handle a far large share of market output than the formal market chains that linked with supermarkets and other outlets of higher-end meat and milk products. They generate more employment per unit of output as well as in the aggregate along the processing and distribution chain, as compared to their more capital-intensive formal market chain counterparts.

Formal and informal market chains are, however, accorded with unequal deference, with the perception of 'superiority' being attached to the formal mode of trading, while to the informal mode of transactions is attached the stigma of 'illegality' or 'inferiority' of products. The

negative attitude to informal market chains are a very unfavourable starting point in public policy and investments on how participants in these chains could be integrated into the whole scheme of the development of markets for rural smallholder livestock keepers.

The impact of the drivers changing the livestock landscape, including demand and supply factors as well as institutional and policy changes, will vary depending on country's resource endowments, role of agriculture and livestock sector in the economy, and the economic and institutional framework within which the livestock sector develops. Three distinct pathways are identified.

A positive livestock sector development occurs when the growth and transformation is supported by a strong interconnectedness between the demand for and supply of livestock products, benefiting the majority of rural producers and leading to a smallholder based rural development.

On the other hand, livestock sector stagnation or involution could occur when demand growth is confronted by a sluggish and even contracting livestock sector, where both the demand and supply sides are unable to respond to and lead any significant social transformation. This situation may happen in countries where governments have not designed policies which allow farmers to compete in the downstream markets for meat and dairy products, so that both small and large-scale producers end up with have few or no incentives to respond to market signals in rural areas

Finally, a positive but inequitable livestock sector growth could happen when the more 'traditional' and more 'modern' segments of the sector are not equally accorded relatively equal opportunities for growth in their respective markets. In this path, growth would be characterized by a dualistic pattern of development where few and large market-integrated producers appropriate the benefits derivable from the drivers of change in the livestock sector, while the majority of rural smallholder producers, processors and distributors are excluded from the market transactions through which they could share from the benefits of the 'changing livestock landscape'. At times, they are even forced out of the market without similarly remunerative livelihood or employment opportunities out side the sector.

There is thus certainly room for policies to turn the changing livestock landscape into an opportunity rather than a threat for smallholder livestock producers and stakeholders along the market chains they use. Under this perspective, two key elements deserve to be emphasized.

The first is that livestock production activities can be efficiently organized in a decentralized manner by exploiting the capital, physical labour and entrepreneurship of small rural producers. This smallholder based rural development strategy, if scaled up at the level of countries, would certainly contribute to broad-based agricultural growth, rural employment and poverty alleviation.

The second is that policy makers, international organizations and development practitioners should focus not only on technical issues, but also on the economic and institutional context in which these technologies are supposed to be used. Building this supporting context would significantly assist the less endowed livestock holders to benefit from the changing livestock landscape, and to contribute to agricultural and rural growth.

I. Introduction: The 'Changing Livestock Landscape'

Livestock systems¹ in many developing countries are rapidly evolving in response to changes in the economic and institutional environment in which livestock production, processing and distribution takes place. The demand for livestock products, notably for meat and dairy products, continues to expand rapidly in developing countries as a consequence of population growth, progressive urbanization and rising per capita incomes (Delgado *et al.* 1999). On the supply side, new and sophisticated technologies, building on economies of scale in production, processing and distribution, have evolved in response to increasing competition between suppliers for market share, particularly in the higher value-added market segments.

Significant changes are also taking place in the organization of production, procurement of supplies, processing, and distribution of products. On the one hand, large agri-food firms increasingly coordinate functions along the market chain for greater control of product quality and identity, mainly targeting domestic consumers in large urban markets. On the other hand, the global trend toward greater liberalization of both domestic and international markets is pressuring local livestock systems to operate without direct government support and to compete with imports from industrialized as well as other developing countries in the battle for domestic market share.

The above are the interlocking drivers of change in the livestock sector in LDCs. The way in which the livestock sector of individual countries will be affected by and respond to these

¹ For the purposes of this paper we define livestock systems to comprise all activities along the value chain, from the provision of inputs to livestock production, the production process itself, to the processing and distribution of livestock products.

trends will to a large extent be determined by the country's 'initial conditions', which comprise: 1) the role of the agricultural / livestock sector in the economy, 2) the basic resource endowments (land, labour, capital), and 3) the economic and institutional framework.

A broad characterization of 'initial conditions' is provided in the first column of Table 1 by Pingali (2006), where the changing characteristics of the agricultural sector, as reflected in the livestock sub-sector, are described according to particular facets of the economy. On one extreme, subsistence oriented, 'traditional agriculture' dominates while on the other extreme 'globalizing agriculture' and its processes are dominant, competing in international markets in with highly differentiated products. Between these extremes are agricultural production and distribution processes characterized by 'modernizing agriculture', where changes in the domestic demand are significant in shaping the output mix from a modernizing farming sector. Within countries, the development does not necessarily follow a linear path as these three characteristics may be present in one developing country at the same time, in different locations, with varying resource base and degree of linkage to markets.

Table 1: Changing characteristics of the agricultural sector in developing countries.

Characteristic	Traditional Agriculture	Modernizing Agriculture	Globalizing Agriculture
Share of agriculture in GDP	High	Moderate	Low
Share of labour in agriculture	High	Moderate	Low
Market orientation	Subsistence	National / Domestic	International
Output mix	Food staples	Food staples + Export crops	Highly differentiated
Scale economies in production	Not important	Not important	Important

Source: Pingali (2006)

Within countries, the consequences of the 'changing landscape' will be different for the various livestock production systems (extensive production systems, intensive production systems and mixed production systems) and for the different actors within the different livestock systems. In particular, while expanding markets provide opportunities for livestock producers and associated market agents in developing countries to increase their incomes, the increasing importance attributed to product quality and food safety by more affluent

consumers, particularly those in urban areas, bears the risk that some production systems are relegated to markets for low-value products or squeezed out of the markets altogether and participants will not necessarily find alternative jobs in other productive sectors.

The next section illustrates the role of mixed crop-livestock production systems in developing countries; section three presents possible alternative development paths for mixed livestock production systems; section four illustrates some country examples. Section five concludes.

II. Mixed Crop-livestock Production Systems

Human populations of developing countries are, in general, predominantly rural and a significant proportion of the economically active population is engaged in agriculture. From the FAOSTAT estimates from 1990 to projections to 2010, for most regions in the developing world, the agricultural population continues to increase in absolute terms, although its proportion in the total economically active population is on a decline. By 2010, some 209 million people will be active in agriculture in sub-Saharan Africa (SSA), 383 million in South Asia (SA), and 151 million in East and Southeast Asia (E&SEA). In these regions, agriculture will be providing about 60 percent of total employment in SSA, 53% in SA, and 43 percent in E&SEA.

Within agriculture, the great majority of (self-)employment is generated by small-sized farms, either irrigated or rain-fed, engaging in the production of crops and livestock. Of the over 450 million farms in the world, around 85% are less than 2 hectares in size (Table 2).

Table 2: Estimate of world farm size distribution in the late 1990s.

Farm Size Class (ha)	Number of Farms within Size Class (million)	Proportion of Farms within Size Class (%)
<1	334.0	73.2
1-2	53.3	11.7
2-5	40.3	8.8
5-10	13.8	3.0
> 10	14.8	3.3
Total	456.1	100.0

Source: Von Braun (2005)

The 'average' smallholder, however, differs among world developing regions. In Asia and sub-Saharan Africa, the average farm size is 1.6 hectares. Within Asia, the average farm size would be as low as half a hectare as in Bangladesh and China (Von Braun, 2005). In relatively land abundant or sparsely populated regions such as Latin America and the Caribbean, the average farm size is 67 hectares. In this region, however, the 'average' hides the extent of smallholder farms as this region has the highest inequality in landholding size (Von Braun, 2005). The differences in average farm sizes across regions, however, are also a function of land quality and water availability, where viable farm sizes in the more arid regions would tend to be relatively larger.

This picture is not going to significantly change in the next decade and small farms will continue to predominate well into 2015, particularly in sub-Saharan Africa, South Asia and SE Asia, despite the decline in numbers of farmers in the latter. With the continuing fragmentation of land, most farmers will have to make a (partial) living from smaller and smaller farms (Table 3).

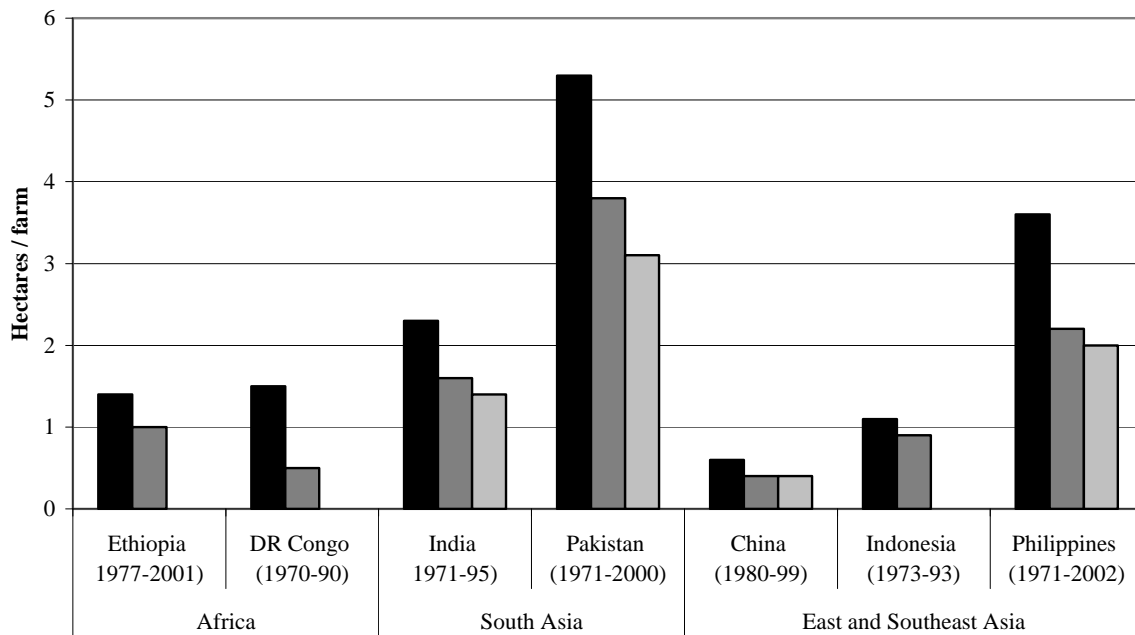
Table 3: Trends in agricultural land availability (ha) per economically active person in agriculture.

Region	1985	2000	2015
Sub-Saharan Africa	7.0	5.2	4.1
Near East / North Africa	12.2	10.4	9.3
South Asia	0.8	0.7	0.6
East & Southeast Asia	1.4	1.2	1.3
Latin America and Caribbean	15.9	16.5	18.1

Source: elaborated from FAOSTAT and FAO projections

The above general trend of agricultural land availability is borne out by country specific statistics on average farm size. From the 1970s to the 90s, average farm sizes continued to fall in Ethiopia, DR Congo, India, Pakistan, China, Indonesia and the Philippines (Figure 1). In these countries, except for Pakistan, the average farm sizes have fallen to two hectares or less.

Figure 1: Trends in average farm size for selected developing countries in sub-Saharan Africa and Asia.



Source: Nagayets, 2005

Livestock are an important source of income for small mixed farms. Despite comparable data being not available on a global scale, household surveys suggest that livestock contribute 5 to 20 % to household total income in mixed rainfed production systems, around 25 to 35 % in irrigated zones. In pastoral areas, livestock income share goes as high as 70 to 80 % (Davis *et al.*, 2007; Maltsoğlu and Taniguchi, 2004; Roxas *et al.*, 1997).

On a global scale, mixed farming systems account for close to 90% of milk and 70% of ruminant meat output (Table 4). Although globally intensive landless systems are dominant in the production of pig and poultry meat and of eggs, mixed farming systems still account for more than one third of world output in these commodities. Within the developing world, the contribution of mixed systems to pig and poultry meat and to eggs is estimated at 45% and 39%, respectively.

Table 4: Shares of major productions systems in volume of meat, milk and egg output by geographic regions, 2004.

Commodity / Production System	SSA	NENA	SA & SEA	LAC	OECD	Global Total
Ruminant meat						
Land based extensive	50%	6%	15%	49%	21%	25%
Mixed crop-livestock	50%	91%	85%	50%	68%	69%
Landless intensive	0%	3%	0%	1%	11%	5%
Total	100%	100%	100%	100%	100%	100%
Pig & poultry meat						
Land based extensive	19%	1%	0%	5%	0%	1%
Mixed crop-livestock	56%	26%	52%	23%	21%	36%
Landless Intensive	25%	73%	48%	72%	79%	62%
Total	100%	100%	100%	100%	100%	100%
Milk						
Land based extensive	62%	6%	3%	45%	10%	12%
Mixed crop-livestock	38%	94%	97%	55%	90%	88%
Landless intensive	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%
Eggs						
Land based extensive	14%	1%	0%	4%	0%	1%
Mixed crop-livestock	60%	28%	51%	15%	22%	38%
Landless intensive	26%	71%	49%	81%	78%	61%
Total	100%	100%	100%	100%	100%	100%

Source: Groenewold, 2004

There is a very close connection between mixed crop-livestock production units and smallholder farms in the developing world. Groenewold (2004) has shown that in the developing country regions of SSA, NENA, SA&SEA and LAC, across livestock production systems, 84% of the agricultural populations are found in mixed systems. The average size of the agricultural land resource base is small, computed at 0.33 ha / agricultural inhabitant, ranging from just 0.15 ha / inhabitant in SA&SEA to 1.15 ha / inhabitant in LAC. The larger proportion of the arable lands in these mixed systems are rain-fed (71%), with the small remaining portion being irrigated. In terms of the physical volume of output, measured in metric tons of milk, meat and eggs, although differences in physical product form are to be noted, milk accounted for the largest proportion (69%), followed by meat (24%). In the meat

category, the bulk of the output consists of monogastric meat (61%), with ruminant meat accounting for the remaining.

Whereas table 4 is likely to overestimate the contribution of smallholder crop-livestock producers to national production, note that also in countries with particularly skewed land distribution, smallholders largely contribute to agricultural production. For instance, in Kenya in East Africa, smallholder dairy farmers produce around 85% of milk output and account for about 80% of marketed milk. In Ethiopia, the contribution to total milk output by rural small-scale mixed farms in the highlands is around 63% as compared to 22% by the extensive pastoral/agro-pastoral producers in the lowlands (Staal *et al.*, 2006). In India in South Asia, the contribution of smallholders to total milk output is around 80%. The corresponding estimate for Pakistan ranges between 65 and 70% of output (Staal *et al.*, 2006). In Vietnam, where pigs generate the highest livestock income, smallholder households are estimated to produce 80% of total output (Tung *et al.*, 2005). In the Philippines, 'backyard producers', still hold around 77% of the national pig inventory (Costales *et al.*, 2007). Thus, even in rapidly growing economies of Southeast Asia, such as Thailand, the Philippines, and Vietnam, on the whole, small farms continue to constitute the majority of farms and hold a large share of the national livestock inventory despite the 'scaling-up' of the sector and the gradual exit of small scale producers (Table 5).

Table 5: Changes in relative shares of small-sized pig farms in Southeast Asia.

Thailand* (< 20 sows)		Philippines** (<20 pigs)		Vietnam* (<6 pigs)	
Year	Share (%)	Year	Share (%)	Year	Share (%)
1988	97	1990	83	1994	98
2003	88	2003	77	2001	92

Sources: Poapongsakorn (2003); Costales *et al.* (2007); Tung, D.X. *et al.* (2005)

* as proportion of total number of pig farms

** as proportion of total pig inventory

Small farms not only contribute significantly to total output but, being labour intensive, also to overall employment in rural areas. On the one hand, because of the restricted or even absence of alternative farm or non-farm employment opportunities, the market wage does not reflect the opportunity cost of labour (which would likely be approaching zero), and thus family members work beyond levels that wage-labourers would be willing to do. On the other hand, farmers, with little investment capital at their disposal, typically make use of

labour-intensive rather than capital-intensive technology and thus largely contribute to employment in rural areas.

Comparable examples are available for dairy production in India and Pakistan in South Asia, and Kenya and Ethiopia in East Africa. On the livelihood and employment dimension, small farms (1 to 3 head of dairy cattle) in these countries significantly generate more direct (and indirect full-time equivalent employment) than large farms per 1,000 litres of milk produced (Table 6). Projecting the relative shares of farm employment in dairy for Pakistan and Kenya to sector level on the basis of employment generation capacity per 1,000 litre of milk output indicates that large farms account for only 12 to 13 % of dairy farm employment, while the remainder is employed in the small and medium-sized farms (Staal *et al.*, 2006).

Table 6: Employment generated in dairy production by scale of operation in India, Pakistan, Kenya and Ethiopia (In full-time equivalent employed workers/1000 litre of milk offtake).

Country	Small farm (1 to 3 head)	Large farm (>3 head)	Small-to-Large farm employment ratio
India	230	25	9.2 : 1
Pakistan	242	73	3.3 : 1
Ethiopia	224	na	na
Kenya	105	49	2.1 : 1

Source: Staal *et al.* (2006)

Small crop-livestock producers are also invariably linked to informal markets in which the supply chains are in general more labour-intensive per unit of output (throughput) than more capital-intensive formal chains. Comparative estimates of dairy chain employment in India, Pakistan, Kenya and Ethiopia for formal and informal market chains are that on a 1000-litre throughput basis, various formal processing and distribution chains on average generate employment within the range of 1 to 17 regular workers, while different types of informal chains on average employ within the range of 3 to 26 workers on a full-time equivalent basis for the same throughput. While remuneration in the formal sector is much higher than in the informal sector, the returns to labour in the informal chains are still above rural non-farm wages (Staal *et al.*, 2006).

Table 7 presents estimates of employment generating capacity of the informal chains as a ratio to that of the formal enterprises. For India, the makers of traditional sweet dairy delicacies (*halwai*) are taken to represent the informal market processors, while creameries are taken as example of processors in the formal sector. For Pakistan, Kenya and Ethiopia, the informal

market chains involve the selling of raw milk and the processing and distribution of traditional milk products. In all countries, the final output of the formal market chains are highly processed products such as pasteurised milk, ultra-high temperature (UHT) processed milk, creamless milk, and other products. In general, the informal chains are more labour-intensive than the formal chains, though the differences are not extreme, ranging from 1.2 : 1 informal-to-formal chain employment ratio per unit of output in Kenya to a relatively high 2.5 : 1 ratio in Pakistan. Thus, on per volume throughput basis, employment generation at the level of the supply chains in the dairy sector is stronger along the informal chains relative to their formal counterparts.

Table 7: Ratio of informal-to-formal market chain employment generation per 1000-litre output in India, Pakistan, Kenya and Ethiopia.

Country	Informal-to-Formal chain employment ratio
India	1.5 : 1
Pakistan	2.5 : 1
Kenya	1.2 : 1
Ethiopia	1.5 : 1

Source: Staal *et al.* (2006)

While on a per volume output basis, the differences in employment-generation may not be large between formal and informal chain entities, in aggregate, total employment generation depends on the relative sizes of the informal and formal markets in terms of market shares of output. Table 8 shows that in important developing countries of SSA, S-Asia and SE-Asia, at least for dairy products, informal markets dominate, both in terms of production as well as in market chain employment.

Given the dominance of informal chains dominate in developing countries, these are expected to generate more employment than formal chains.

Table 8: Share (percent) of marketed milk sold through informal and formal markets and share of employment in the informal and formal dairy market chains in selected developing countries.

Country	GDP/person (2003 PPP USD)	Share of marketed milk		Share of employment	
		Informal	Formal	Informal	Formal
Pakistan	2,097	93	7	94	6
India	2,892	85	15	86	14
Bangladesh	1,770	97	3	n.a.	n.a.
Kenya	1,037	80	20	87	13
Tanzania	621	88	12	n.a.	n.a.
Ethiopia	711	89	11	98	2

Sources: Knips (2006), Staal (2006), WB (2006)

In conclusion, traditional/mixed crop-livestock production farms, dominantly consisting of small farms, significantly support the rural economy in developing countries, both because of their contribution to livestock production and to livestock-related downstream employment. This is in addition to their contribution to the non-livestock dimension of their economic activities mediated through consumption linkages. The potential social consequences of the changing environment on smallholder-based mixed crop-livestock production systems can therefore have profound impacts on societies in which agriculture (still) plays an important role, and where mixed systems contribute a significant proportion of livestock output. The consequences will depend on the impact of the changing environment on the livestock supply chains that traditional/mixed livestock producers dominantly use, i.e. the traditional informal supply chains, and on how these respond to the growth and reconfiguration of more modern formal supply chains within the domestic markets, and how they respond to the competition that these formal chains bring.

III. Stylized Livestock Sector Development Pathways

Countries worldwide present a variety of different agricultural and livestock development paths. For example, the livestock sector is growing fast in Brazil and India, but slowly in Zambia. Whereas in Thailand growth in poultry production is largely driven by large producers, in India small dairy farmers have been able to adapt to the changing livestock landscape and contribute to meeting the growing demand for livestock products of urban consumers. However, although each country follows its particular trajectory, it is possible to distinguish three potential development paths traditional crop-livestock production system

might take: (a) a positive and equitable development path, (b) livestock sector stagnation / involution, and (c) a positive but inequitable development path.

Positive livestock sector development path: The forces shaping livestock production can constitute a stimulus for growth of the rural livestock sector (and thereby improve rural incomes and reduce poverty) if the conditions are such that the increase in demand for livestock products translates into expanded markets and incentives for a majority of rural producers. The following investments in rural production and rural-to-urban distribution systems should result in increased productivity of rural labour, leading to increasing returns to own resources (labour and capital) and broad-based increases in household and per capita incomes, which in turn generate demand for non-farm goods and services (consumption linkages) and for production inputs and agricultural / livestock services (backward production linkages), and spur economic activities along the market chains for livestock products (forward production linkages in transport and commerce services).

This development path would only gradually change the structure of production. It is based on the assumption that industrialization and urbanization are not necessarily inseparable, as assumed in the traditional paradigm of economic development, but that there could be a movement of the modern production base into the rural sector. In this development pathway, livestock production activities could be organized in a 'de-concentrated' manner by exploiting both the physical labour and entrepreneurial ability of rural people and thus support a smallholder-based rural industrialization (Hayami, 1998). A number of studies have documented this development path in East Asia and some OECD countries (Hayami, 1998) which, if found to be feasible on a broad-scale, would alleviate the major difficulty in the tradeoffs between growth and equity that confronts developing countries.

Livestock sector stagnation / involution. In some developing countries responses to the changing environment may almost entirely by-pass the rural livestock sector and thereby induce its 'involution'. This pathway is likely to be followed when rural livestock production systems are largely disconnected from the growing urban markets for livestock products. Potential consumption and production growth linkages will not materialize and the continued growth of the agricultural population and rural labour force, coupled with the stagnation in their agricultural and livestock production activities, will lead to worsening agricultural land-to-man ratios, deterioration of the productivity of rural labour, a fall in their real wages, and ultimately to a decline in rural per capita incomes. The pressure to move to other low-income non-farm occupations and migration to town centres will reflect the lack of

opportunities in livestock and agriculture rather than growth in the others sectors of the economy.

Essentially, this 'development pathway' has been associated with indiscriminate liberalisation and privatisation policies which have not been accompanied by adequate transition policies allowing smallholders to be competitive in their proximate markets. This is not to say that liberalization and privatization generally lead to rural stagnation and involution as there are likewise a number of countries where successful liberalization and privatization had led to rural poverty reduction (Araujo *et al.* 2005; Besley and Cord, 2007). Where accompanying support policies were absent, the closure of agricultural state enterprises, which provided a secure output market for agricultural producers, and the privatization of animal health services, which provided cheap if not free services to smallholders, created a vacuum in rural areas which have rarely been filled by the private sector. Smallholders were thus largely unable to satisfy to the growing urban demand for livestock products, and in several cases imports of both dairy and meat products have substantially increased. It is only in recent years that policy makers in developing countries are experimenting with new market-friendly policies which aim to trigger the functioning of rural markets in low-income settings (De Janvry *et al.*, 1997). Examples are the institutionalisation of community animal health workers, market-smart subsidies to private animal health service providers, and legal reform in the financial sector which allow banks to accept movable properties, including livestock, as collaterals on loans.

Positive but inequitable development path. There may be variants to the two development pathways described above. On the one hand, the livestock sub-sector could be growing on aggregate, but this could be due to rapid growth of only the segment of the sector connected to the major urban consumption centres (as well as urban/peri-urban processors), but with weak production and consumption linkages with the rural economy. On the other hand, there could be an overall decline in the livestock sector, but within the sector, producers with good access to markets and services might in fact be experiencing growth in their own particular products, while for the remainder of producers there could be an even more rapid decline than the aggregate decline.

These scenarios depict tendencies where changes in the 'landscape' surrounding the livestock sector create opportunities that benefit a few specialized strategically located producers in the modern segment of the sector, but exclude the majority of small livestock keepers in the rural areas who have poor access to input and output markets, credit and extension services, and information. This development path would create a dual livestock

economy structure: a ‘modern’ segment, restricted to a few capital-intensive large firms in livestock production and processing, generating limited employment per unit of output and in total, and a ‘traditional’ segment, consisting of many small livestock keepers in the rural areas. In the medium to long-term, industry growth will be accompanied by the exit of the small rural producers that face relatively higher costs of transporting and marketing livestock products per unit of output in the competition for supplying the larger mainstream market, apart from the cost of meeting standards of product quality.

The likelihood of a country following one pathway rather than another is influenced by the strength of linkages within the agricultural sub-sectors and between agriculture and the rest of the economy, whereby growth in one sub-sector is able to induce a corresponding growth in the others. Table 9 provides an overview of empirically derived relative strength of linkages for different regions / continents, where the ratios indicate the magnitude of additional income growth created elsewhere for any unit percentage growth in agricultural income. The sources of linkages are in consumption and production economic activities, with their relative shares adding up to the total (100%). As can be seen, agricultural growth linkages are strongest in Asia (0.64), and the relative share of the consumption linkages by far outweigh those in production. The results for Asia indicate that the farm and non-farm sectors are closely interrelated – by implication, growth (or decline) in one sector is likely to have repercussions on other sectors. By contrast, in Latin America agricultural growth linkages are weakest (0.26). This means that growth in agricultural income is mainly mediated within the sector, resulting in a relative ‘insulation’ of the sector (or sub-sector), and thus higher potential for ‘inequitable’ growth.

Table 9: Agricultural growth linkages in Asia, Africa and Latin America.

Region	Initial Agricultural Income Increment	Magnitudes of Additional Income Growth			Source of Linkages and Relative share	
		Other Agriculture	Rural Non-farm	Total	Consumption	Production
Asia	1.00	0.06	0.58	0.64	81%	19%
Africa	1.00	0.17	0.30	0.47	87%	13%
Latin America	1.00	0.05	0.21	0.26	42%	58%

Source: Haggblade, Hazell and Reardon (2005).

Two caveats are necessary in applying these ‘stylized’ livestock sector development paths to sample countries.

The first caveat is that the three development pathways are not necessarily exclusive routes as it is possible that within the same country, for example, smallholder dairy producers will be 'crowded out' as the dairy industry expands, whereas small pig farmers will be able to benefit from the opportunities offered by the growth in demand for pork, both of which may constitute aspects of livestock sector developments. It could also happen that within one country, some regions will be able to benefit from the 'changing landscape' (e.g. those better endowed with market infrastructure or governed by more efficient local governments), whereas some other areas won't.

The second caveat relates to the often presumed dichotomy between formal and informal supply chains, and the presumed 'superiority' of the formal over the informal chains. A first note is that formal and informal supply chains are not mutually exclusive and often exist side-by-side, catering for various types of consumers.

Secondly, the traditional informal supply chains are relatively well-established to maintain their market position in terms of serving consumer demand in their proximate market - households in rural communities and consumers in small towns, where average household incomes are relatively low, and consumer preferences lean toward fresh produce or traditional processed products (raw milk, live poultry, warm meat, traditional sausages), where further home processing can easily be undertaken (boiling milk, home slaughtering of poultry, preserving meat). In supplying this market, the presumed 'superiority' of formal market chains does not come into play. The size of this market in terms of market share of livestock products needs to be more firmly determined, and its growth path predicted. The size of this market can increase (in absolute terms) with the increase in rural populations. It can also decline as competing products of more modern formal supply chains make inroads to consumers in small towns. In the competition for market share in the more distant larger urban centres, however, where the more rapid growth in demand for livestock products is occurring, and where consumer demand for quality and food safety are becoming more significant, the traditional informal market chains are in a disadvantaged position vis-à-vis the more modern organized formal supply chains. In this context, the 'superior' position of the formal supply chains applies, as the market chains distinguish between products coming from formal and informal supply sources.

Thirdly, a movement from an informal towards a formal supply chain does not necessarily imply a significant reduction of employment. On a per unit throughput basis, the differences in employment generation capacity between formal and informal chains are in fact not necessarily very large and more dependent on scale than degree of 'formality'. It is rather the still relatively large share of the informal market chains in total marketed volume that makes the employment shares disproportionate. As the formal supply chains grow and gain in market share, the

employment levels in the formal chain will also grow in absolute terms in various value adding activities along the chain.

Finally, informal is not synonymous with illegal. Often informal small traders or processors would be willing to formalize their transactions – e.g. be registered as enterprises for tax purposes and thereby be able to obtain loans from formal credit institutions – but even when market opportunities exist, the presence of institutional bottlenecks can turn the act of formalization unprofitable. For instance, becoming a formal business entity might not only mean the obligation to pay proper licence fees and taxes, but also imply a greater vulnerability to be subjected to having to pay bribes to rent seekers who hold discretionary powers in making business transactions happen or not.

IV. Case Studies – Dairy Sector Development in India, Zambia and Brazil

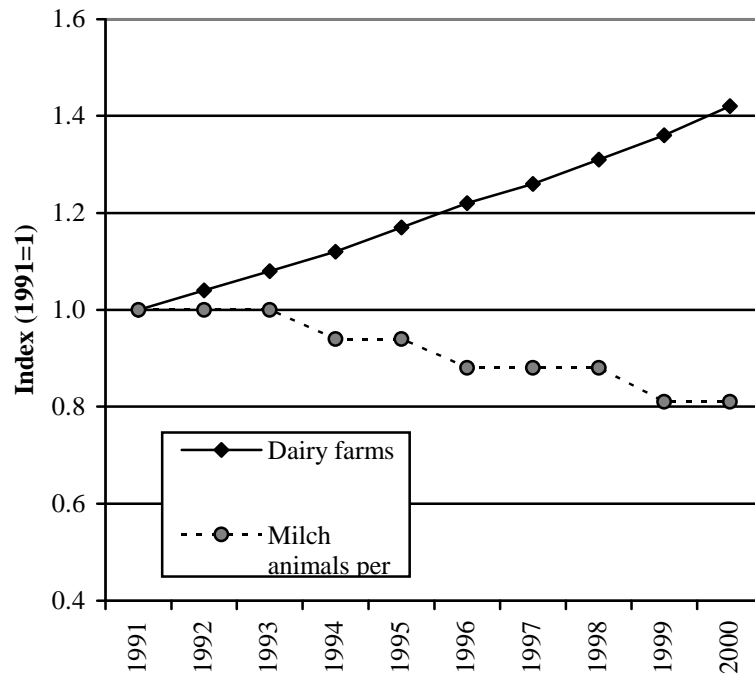
Positive Development: The Dairy Sector in India

India is a low income economy with a GDP per capita of International \$ 3,460 in 2005 (at purchasing power parity, PPP). Agriculture is a dominant sector of the Indian economy and accounts for over 18% of GDP (World Bank, 2006) and, according to the most recent figure (1995), for about 67% of employment. During the past five years the agriculture sector has witnessed advances in the production and productivity of food grains, oilseeds, commercial crops, fruits, vegetables, food grains, poultry and dairy. Today, India is the largest producer of milk in the world (91,940 million tons in 2005) (FAOSTAT, 2006)

The Indian agricultural sector is dominated by small to very small farms, with over 80% of farmers, or about 93 million farms, cropping less than 2 hectares. Average farm size has been constantly falling, from 1.6 ha in 1991 to 1.4 ha in 1995, while over the same period, the number of small farms (<2 ha) increased by almost 10% (Nagayets, 2005). With respect to the dairy sub-sector, the number of farmers engaged in dairy production has increased by around 40% between 1991 and 2000 (Figure 2) while average herd size is declining. Small and marginal farmers raising 1 to 3 head of cattle/buffalo continue to comprise close to 60% of all dairy farms (GOI, Basic Animal Industry Statistics, 2002, in Sharma *et al.*, 2003). Figure 3 shows, however, that qualitative changes are taking place in the composition of the dairy herd in Indian farms, with

the number of buffalos and of crossbred cattle² increasing rapidly while numbers of animals of local cattle breeds³ are in absolute decline.

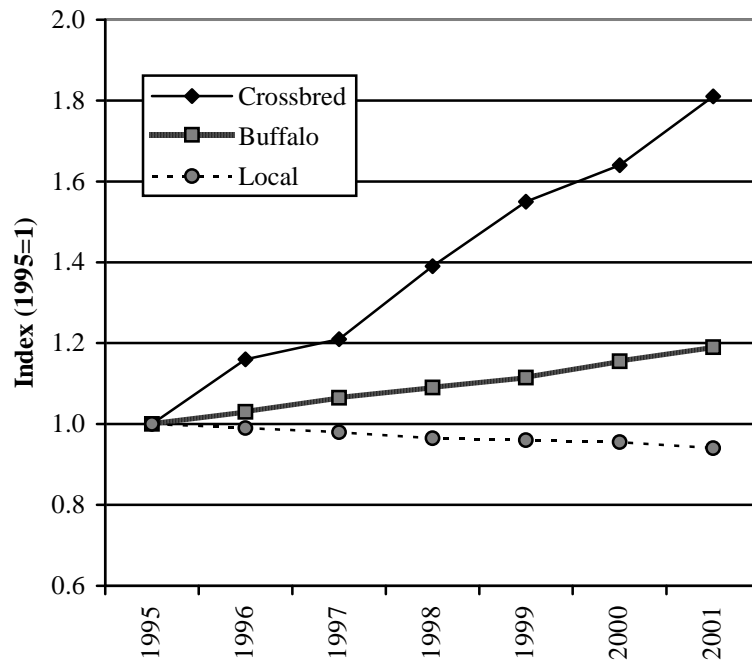
Figure 2: Growth in dairy farm numbers and average herd size in India (1991 = 1).



Source: Hemme, Garcia and Saha (2003)

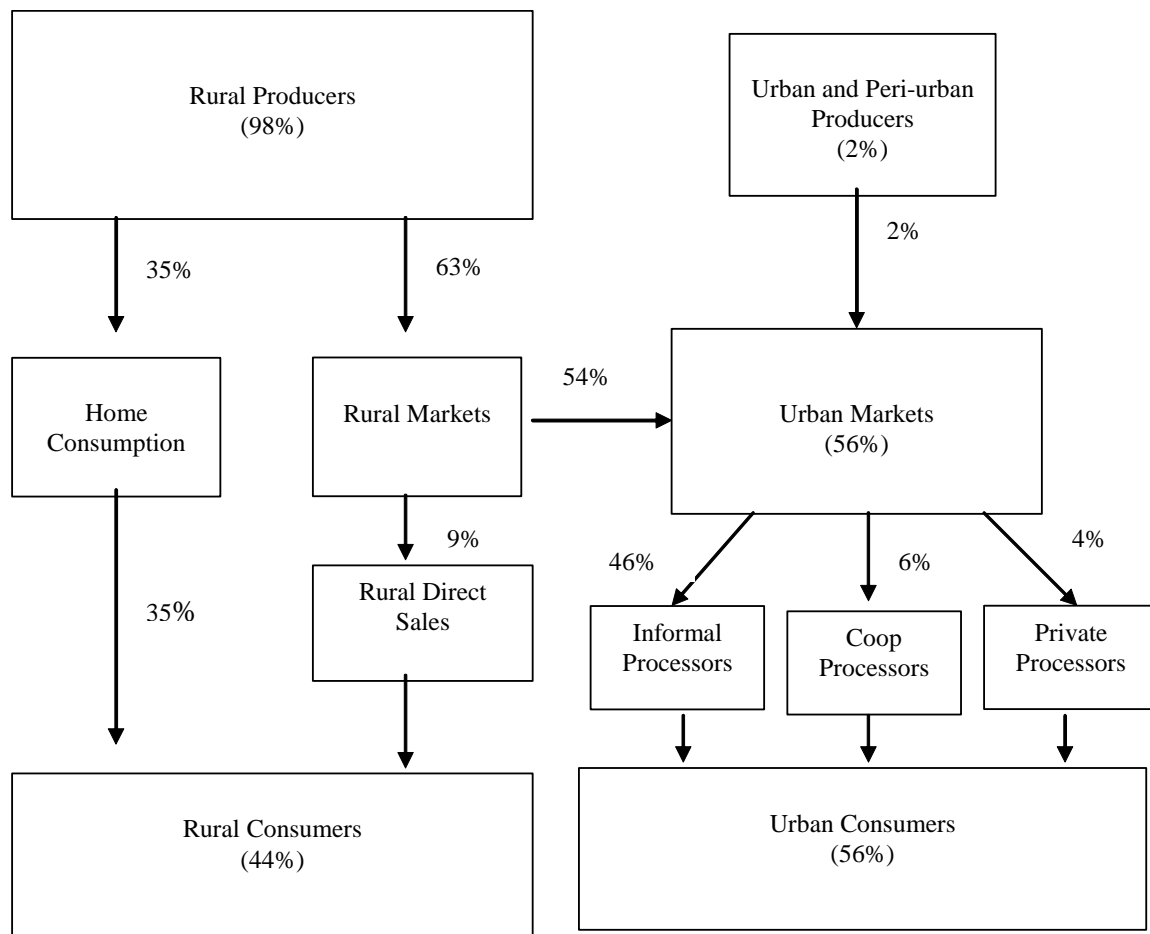
² Crossbreeds refer to animals with varying degrees of a high potential dairy genes (*Bos taurus*; usually Holstein and Brown Swiss) and one of the many Indian breeds

³ Local breeds refer to the original Indian cattle, mostly *Bos indicus*, which have a relatively low milk yield potential but are well adapted to local conditions.

Figure 3: Differential growth of different types of dairy animals in India (1995 = 1).

Source: Hemme, Garcia and Saha (2003)

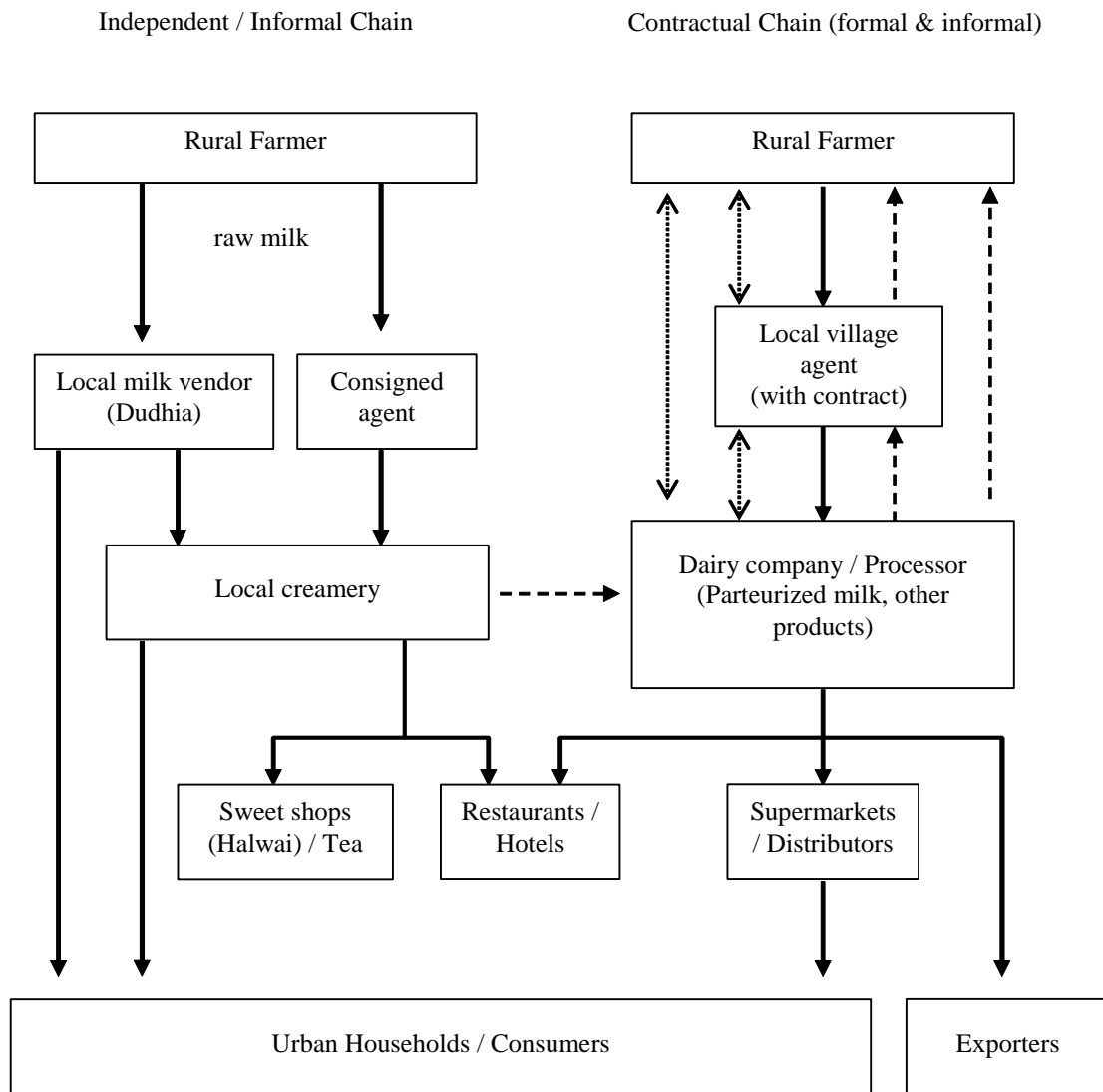
On the marketing side of the dairy industry, Figure 4 shows that while the bulk of marketed dairy output comes from rural producers, the greater part of marketed output find their way to urban market destinations (86% of marketed milk). Milk sold to urban markets flows largely through informal chains (82%). However, formal chains for the supply of milk are emerging through processing cooperatives (11%) and private companies (7%).

Figure 4: Rural and urban/peri-urban formal and informal market flows for dairy in India.

Source: Staal *et al.*, 2006

A close look at the rural dairy market chains in India shows that segments in the informal sector connect with formal market chains where controls are in place for smallholder milk producers to conform to the standards of private processors. Figure 5 shows that in the state of Rajasthan, independent smallholders selling their output through the dominant traditional informal market chain exist side by side with smallholders whose milk flows through the formal channel through informal agreements with collecting agents who have formal supply contracts with milk companies or private processors. These agreements involve commitments in the supply of output by smallholders and the direct provision of inputs and livestock services by the formal dairy processors, or indirect provision through their contracted village agents.

Figure 5: Independent and contractual market linkages for rural smallholder dairy producers in Rajasthan, 2005.



Legend:

- flow of product
- - - -> flow of services and inputs
- ← - - - -> flow of information

Source: Hemme *et al.* (2003); BIRTHAL *et al.* (2006)

In conclusion, rapid growth in the livestock industry could coincide with the continued proliferation of small farms with small livestock holdings. It is imperative, however, that there be a technological transformation in these small farms themselves (e.g., improved breeds, higher quality feeds) to significantly improve productivity and increase income per unit of land, per head

of livestock and per unit of labour input. Furthermore, the growth and development of the livestock industry could well coincide with a still large segment of the urban market being served by informal supply chains supplying differentiated products particularly demanded by the greater bulk of consuming public, but as consumers become more discriminating and formal organizations become more convenient and credible suppliers of high quality and food-safe livestock products, then vertical coordination along formal lines in supplying processing firms will obtain increasing importance, and organization of production of groups of smallholders at the farm level (through formal contracts or informal agreements) with their main market links will more likely become a necessity for smallholders to link up with formal market chains.

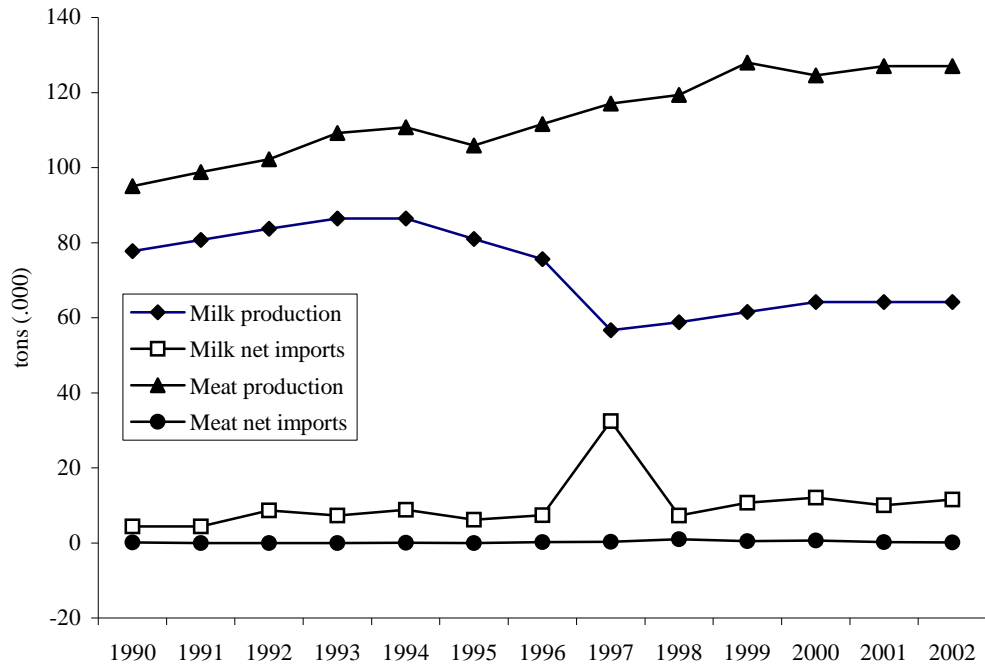
Stagnation and Involution Pathway: The Dairy Sector in Zambia

Zambia is a low income rural economy, with a GDP per capita of International \$ 950 in 2005 (at PPP). The country has gone through three decades of declining living standards (per capita income in 2000 was just 60 % of its level in the late 1960s) and today over 83 % of the rural and 56 % of the urban population live below the national poverty line (World Bank, 2006). Agriculture contributes about 22 % to national GDP and about 75 % to overall employment (World Bank, 2006). In value terms, livestock accounts for about 39 % of national agricultural output (FAO, 2006). The agricultural sector comprises about 450,000 small rain-fed mixed crop-livestock farms with less than 10 ha of land, using basic production technologies and largely relying on family labour. Some 145,000 emergent, medium-scale farmers crop between 10 and 60 hectares making use of draught power and some purchased inputs; less than 750 large-scale farmers have holdings of 60 ha or more and use mechanized farming techniques; there are only a dozen large corporate farms (Government of Zambia, 2002; FAO and WFP, 2005).

The radical liberalization and privatization programs carried out in the first half of the 1990s transformed Zambia into one of the most liberalized and deregulated economies in Africa. These reforms had negative impacts on agriculture. In the livestock sector, following the government's withdrawal from the provision of livestock services, animal diseases spread and livestock mortality increased significantly (IFAD, 2006). The resulting loss of livestock negatively affected overall agricultural production, as animals had been used for land preparation and manure was used for soil fertilization. The adverse impacts were more strongly felt in the dairy sector, which is dominated by smallholders, and less in cattle production where almost 40 % of producers are commercial and semi-commercial and, therefore, able to rapidly adapt to changing market dynamics (McLeod and Chilonda, 2004).

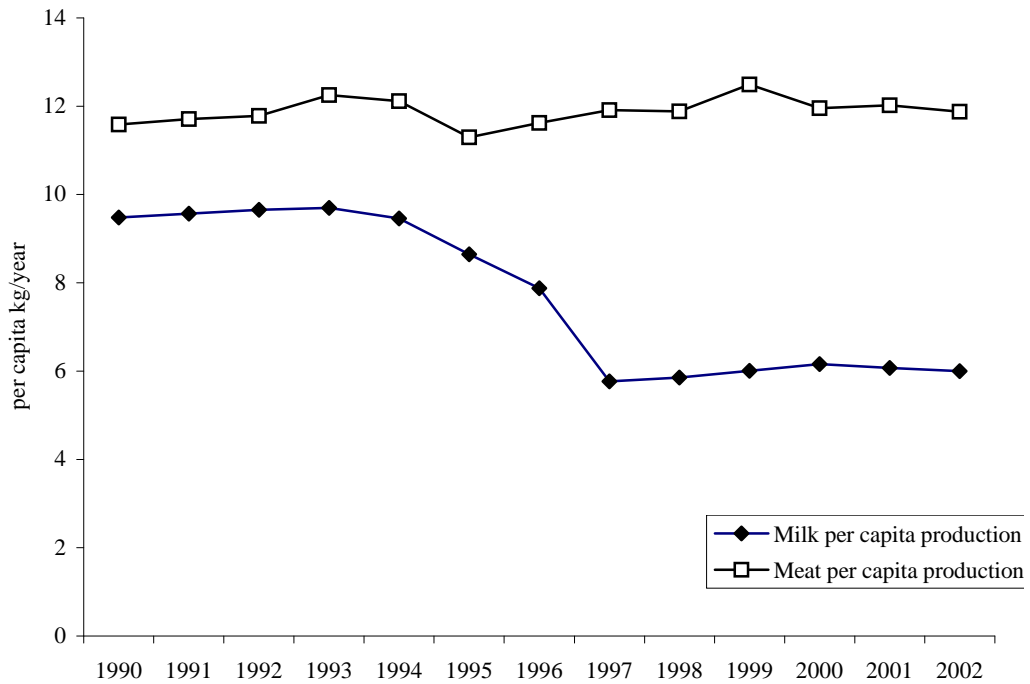
Figure 6 illustrates the trends in the aggregate production and net imports of milk and meat, while Figure 7 shows the trend in per capita production for the 1990 to 2002 period.

Figure 6: Milk production and net imports in Zambia, 1990-2002.



Source: FAOSTAT (2006)

Figure 7: Per –capita milk and meat production in Zambia, 1990-2002.



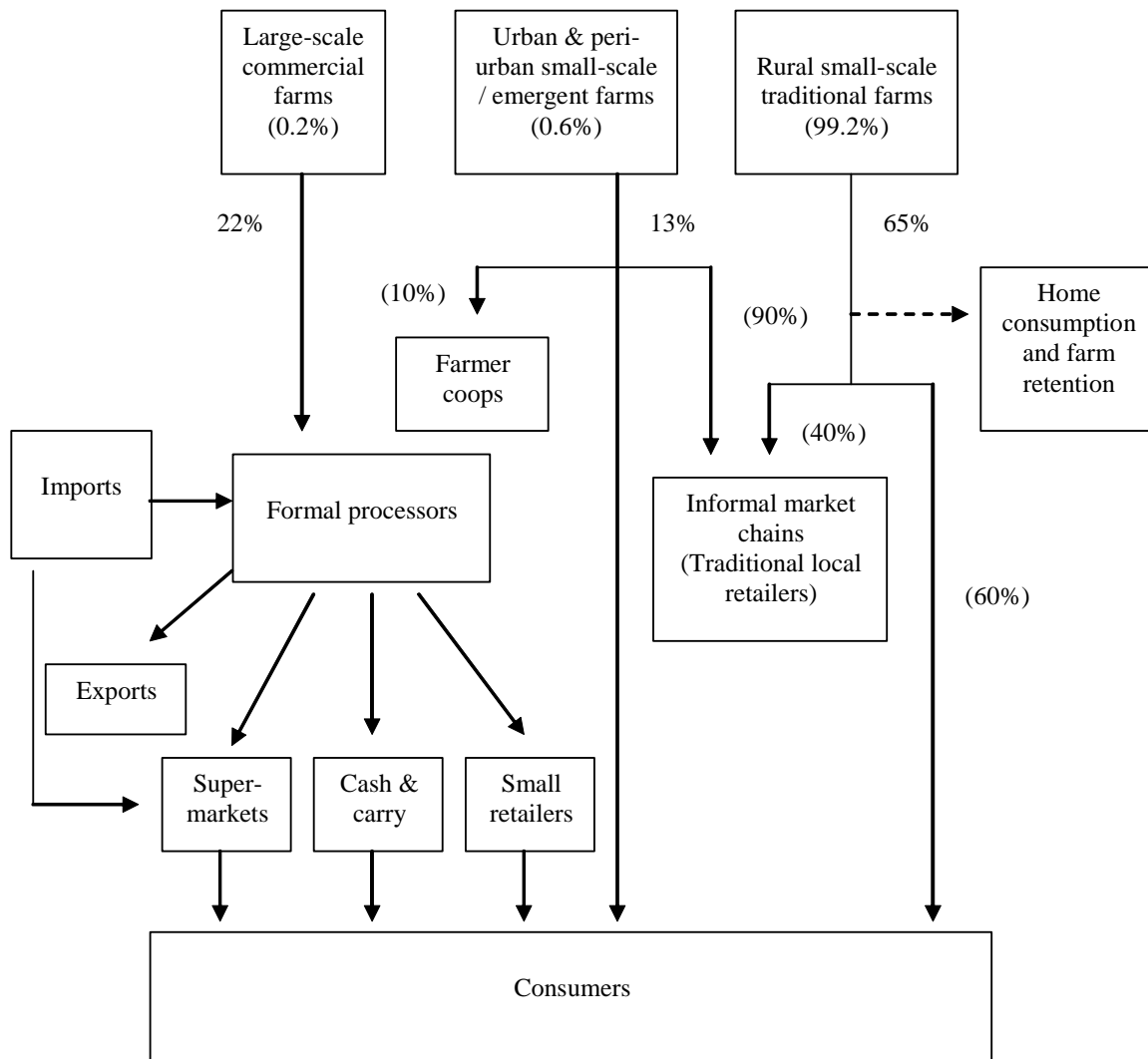
Source: FAOSTAT (2006)

During the 1990-2002 period, per capita milk production in Zambia declined from 9.5 to 6.0 litres per year while net imports of milk steadily increased (FAO, 2006). At present about 25 % of the milk consumed in the country is imported as milk powder from New Zealand and as long life (UHT) milk from South Africa and other countries (Emongor *et al.*, 2004).

Dairy production has been, and still is, largely dominated by traditional smallholder producers, which represent 99 % of all milk producers, own over 90 % of Zambia's dairy cattle and account for about 65 % of all milk produced in the country. Large commercial producers account for 22%, and small- and medium-scale peri-urban producers account for 13% of total milk production (Emongor *et al.*, 2004; Mukumbuta and Sherchand, 2006).

Between 70 and 75 % of national milk production flows through informal channels. Smallholder producers either produce for home-consumption or informally sell milk to neighbours, traditional small traders and hawkers. Small peri-urban producers, which are more market-oriented than rural livestock keepers, tend to sell milk directly to consumers and, in some cases, to small informal vendors. Those few that are members of cooperatives sell part of their surplus milk at collection points, but only about 3 % of production is marketed through this channel. About 70 large scale commercial farms provide milk to the 19 milk processors existing in the country, which are mainly of small to medium size. Some of the largest processing firms, including Parmalat, process milk into yoghurt, cheese and butter (Emongor *et al.*, 2004; Mukumbuta and Sherchand, 2006).

Given an inadequate supply of raw liquid milk, processing companies make up the deficit by recombining imported powder milk. They market milk through supermarkets (50%), 'cash and carry' stores (23%), and small formal retailers (22%). Overall, this formal system handles less than 25 % of all sales of domestic milk output (Emongor *et al.*, 2004). Figure 8 displays the dairy production and marketing chain in Zambia, which is dominated by small mixed crop-livestock producers producing milk for home-consumption and marketing surplus milk through informal market transactions.

Figure 8: Informal and formal market chains for milk in Zambia.

Source: elaborated from Emongor *et al.* (2004) and Mukumbuta and Scherchand (2004)

Thus, in the face of liberalization and privatization, the livestock sector in Zambia has not undergone any significant structural change over the last fifteen years; the dairy sector has even shown signs of involution with decreased aggregate and per capita production, leading to increased net imports. The decline in the production of milk in Zambia coincides with the deterioration in the overall economy, where real per capita incomes underwent a downward spiral until 1995. Nevertheless, the adverse infrastructural and market environment of the rural smallholder dairy sector presented constraints to more rapidly recover as per capita incomes improved afterwards. Whereas part of the involution of the dairy sector might be explained by the policy reforms carried out in the 1990s, the negative growth rates of milk production and consumption are particularly glaring as on the one hand, there is a demand for milk, which is not

met by domestic production, while, on the other hand, Zambia's resources for agricultural production are largely idle with only about 14 % of the cultivable land currently being exploited and only nine percent of the irrigation potential being used (McLeod and Chilonda, 2004).

The World Bank (2007) reports that one of the main challenges of rural farming households in Zambia, of which 71% own livestock, relate to low and declining levels of smallholder production systems. Low productivity and low returns to labour and other resources bring about chronically low levels of farm income. Among the main constraints relating to low productivity were (i) poor public rural market infrastructure (e.g., roads) and support mechanisms, which impedes the private provision of goods and services to rural farmers, and (ii) incomplete implementation of policies that lead to under-provision of public goods (e.g., rural irrigation) and services (e.g., extension and research). While public funds had been allocated for agricultural development and commercialization programmes, the government has traditionally chosen the route of making the interventions in the supply of inputs and in crop marketing arrangements – activities which are primarily driven by short-term political interests (World Bank, 2007).

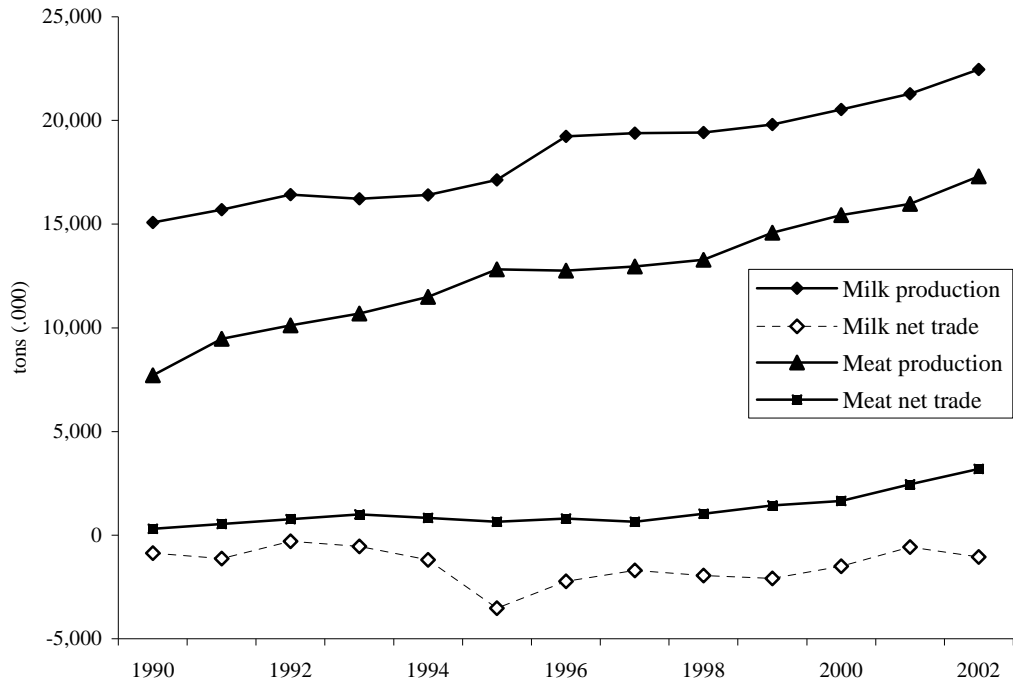
Inequitable Development: The Brazilian Dairy Sector

Brazil is a middle income economy with an annual per capita GDP of about International \$ 8,230 in 2005 (at PPP). The services and industry sector account for about 90 % of national GDP and for 80 % of total employment, with agriculture contributing 10 % to national value added and 20% to overall employment (World Bank, 2006).

Since the structural reforms of the early 1990s, the Brazilian economy has shown unstable growth, averaging about 2 % per annum. Agriculture has been the fastest growing sector in the economy, growing at about 3 % per year, with industry and services growing at 1.2 and 2.2 % per annum respectively (World Bank, 2006).

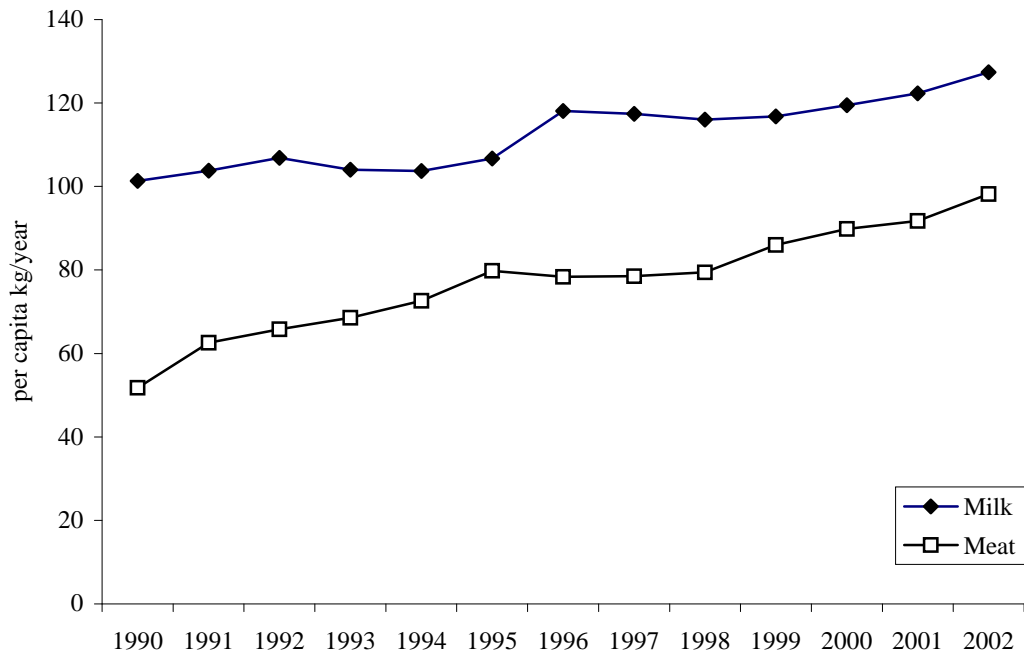
Within agriculture, the livestock sector has been performing particularly well. According to FAO (2006), livestock accounted for about 39 % of agricultural value added in 1990 and for 45 % in 2002. While per capita cereal availability slightly decreased between 1990 and 2002, meat and milk per-capita availability increased by 71 and 27 % respectively (Figures 9 and 10).

Figure 9: Meat / milk production and net trade in Brazil, 1990-2003.



Source: elaborated from FAOSTAT (2006)

Figure 10: Per-capita meat and milk production in Brazil, 1990-2002.



Source: elaborated from FAOSTAT (2006)

Currently, Brazil is the eighth largest milk producer in the world (23.5 million tons in 2005) and is expected to become the world's second largest producer within 5 years. While in the second half of the 1990s Brazil was an importer of dairy products, the country has moved close to self sufficiency and export sales are steadily increasing. Presently, milk is the sixth most important agricultural product in Brazil (FAO, 2006; Phillips, 2006).

These changes in the dairy sector have been driven, on the one hand, by the growing demand for dairy products in the country and, on the other, by the liberalization program carried out by the government since the late 1980s. Between 1989 and 1995, after four decades of market regulation, Brazil liberalized the domestic dairy sector, including retail and farm gate prices, and opened to international competition when joined MERCOSUR in 1991 and WTO in 1995 (Farina, 2002; WTO, 1994). The local milk supply chains were thus forced to compete with industrial firms and multinationals entering the Brazilian markets.

The new policy regime severely affected small farmers: the last ten to twenty years have seen a general decline in the number of small dairy farms in the order of 3 to 4 % per year. In 2003 there were about 1.4 million dairy farms, down from 1.8 million in 1996, and average herd size has grown from 9 to 14 dairy cows (IFCN 2005). 'Between 1997 and 2001, more than 75,000 Brazilian dairy farmers (around 5%) were 'delisted' by the 12 largest milk processors. Most presumably went out of business' (FAO, 2003). Milk supply data to the 12 major dairy industries indicate that 'only between 1996 and 1998, the number of suppliers fell by 28 % and supply by farm increased by 37 %' (FAO, 2003). Barros *et al.* (2004) report that suppliers to the major twelve processing firms – which account for about 50% of inspected milk processed – declined from 152,500 in 1998 to 89,300 in 2002, a net reduction of almost 71 %, with the average supplier providing 117 litre/day in 1998 and 207.2 litre/day in 2002.

Despite the above, still 80 % of dairy farmers keep ten or less dairy cows and manage 50 % of the national dairy herd. Only around 10 % of dairy farmers keep more than 30 dairy cows, but overall these farmers manage 30 to 35 % of the national dairy herd and contribute about 30 to 40 % to national milk production. Matthey *et al.* (2004) state that more than 30 % of Brazil's milk is produced by small farmers and marketed through local markets and stores; Phillips (2006) contends that around 40 % of milk is produced on small, non-specialised farms; Costa *et al.* (2004) state that about 41 % of total milk production is informally sold to consumers and Leite Brasil estimates that in 1997-2000 43 % of production was channelled through informal markets (Ostrowski and Deblitz, 2001).

Liberalization and the ensuing competition in milk production are certainly among the root-causes of the reduction in number of small dairy farms in Brazil, which at the same time has led to structural changes in the processing industry. Since market has been liberalized, milk producer price has decreased by 44 %, forcing the more inefficient (typically small) producers out of the formal market. Many of the latter diverted sales into the informal market and between 1990 and 1998 the informally marketed milk increased by about 4 million litres (a gain of about 10-percentage points of market share) while the amount of formally marketed milk increased by less than 2 million litres (Table 10). Barros *et al.* (2003) argue that since the regional markets are the outlets of the informal sector, and that milk marketed through these chains could pass without the inspection of the federal agency, smallholders find less restrictions in selling their milk than through the large companies of the formal sector. The existence of the informal market also reduced the power that large companies exercised on the prices of milk.

Table 10: Market shares of the formal and informal dairy chains in Brazil, 1990-1998.

Market Segment	Volume (million litres equivalent)			Market Share (%)	
	1990	1998	% Change	1990	1998
Formal	9,609	11,345	18.1	66.3	56.5
Informal	4,875	8,732	79.1	33.7	43.5
Total	14,484	20,077	38.6	100.0	100.0

Source: Barros *et al.* (2003)

Competition among processors has become stiffer since the introduction of UHT technology in the late 1980s. UHT milk can be transported over long distances and inefficient cooperatives, previously protected from competition because pasteurized milk required a cold chain, left the market or were acquired by large private firms. In the late 1980s almost all formally marketed milk was collected and processed by strong national cooperatives. In the second half of the 1990s this share had dropped to 60 %, and today cooperatives collect about 40 % of all milk processed in the country⁴ (Costa *et al.*, 2004; Farina, 2002).

Increasing competition among processors has led many to develop new, more efficient chain management requiring the adoption of refrigeration tanks at farm level. Since the smallest tank in Brazil holds 200 litres while average farm production is 50 litres, most small farmers cannot comply with the new system and are forced out of the formal market (Farina, 2002).

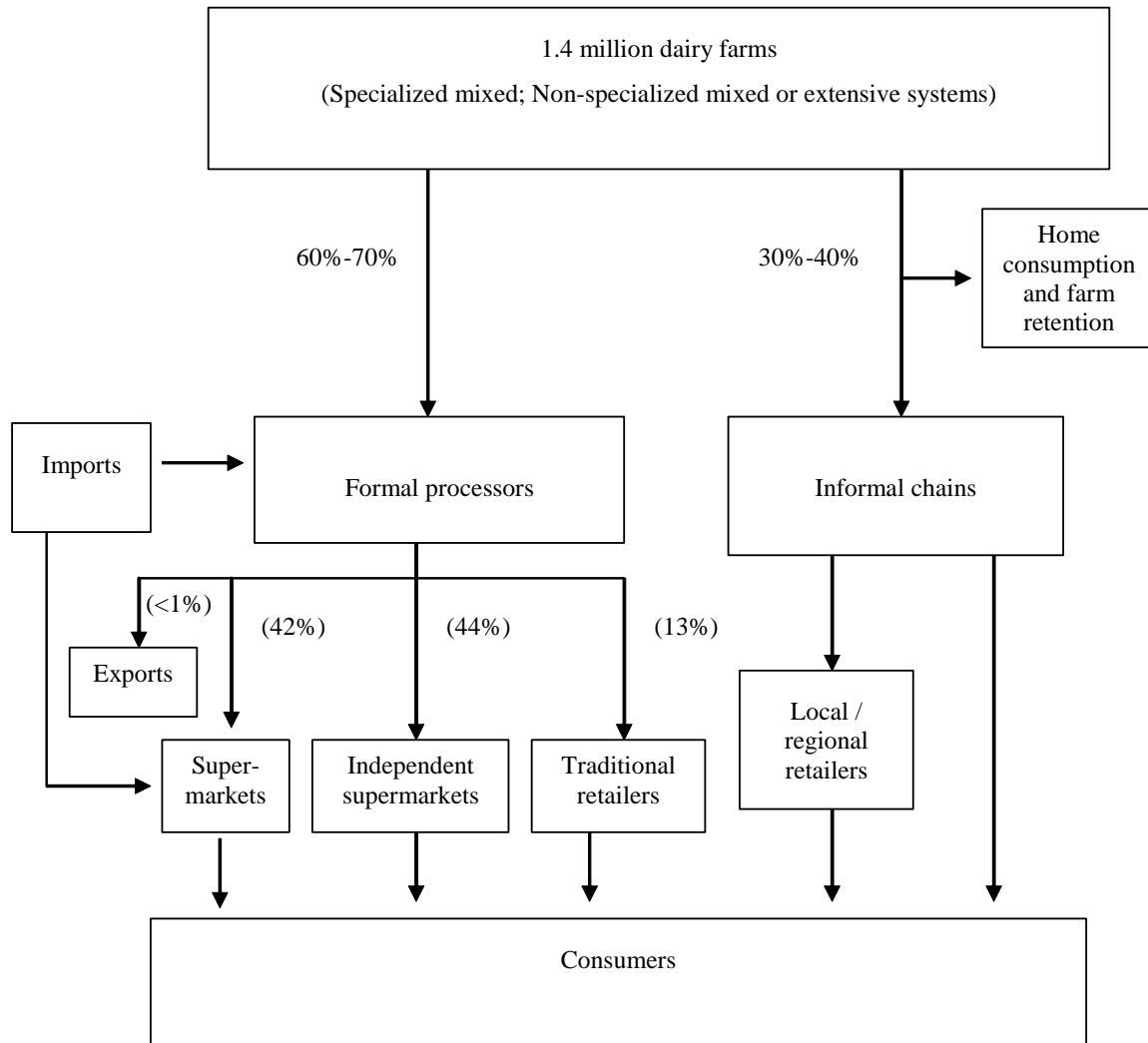
⁴ The current processing industry even differs from those prevalent in USA, Europe and Australia, where large cooperatives dominate milk processing and marketing (FAO, 2003).

Finally, in order to increase milk quality, the government aims that all producers acquire on-farm cooling and storage meeting international standards and at eliminating type 'C' milk from the market, C-type milk is marketed through informal channels, sold in plastic bags and requires boiling before drinking. This is expected to further force small dairy producers out of the (formal) market (Matthey *et al.*, 2004).

Whereas the economic reforms of the 1990s have led to significant changes both in dairy production and processing, only minor changes have occurred in dairy distribution. The three main actors in the Brazilian food retailing industry are: supermarkets or hypermarkets (with five cash registers or more), self-services shops, including independent supermarkets, and traditional retailers. Supermarket chains and independent supermarkets are by far the dominant food retailers as they account for about 42 and 44 % of sales, respectively, through about 16 % and 1.5 %, respectively, of all stores. Traditional retailers account for 13 % of all sales and 82 % of stores (Farina, 2002).

The last ten years have witnessed a marginal increase in the number of traditional stores and independent supermarkets, and a decrease in the number of supermarkets and hypermarkets, suggesting that traditional retailers can exist alongside larger stores. Farina and Nunes (2002) argue that increases in the number of traditional retailers and independent supermarkets originate from the management strategies of large food processors that, in order not to have to deal with large monopsonistic retailers, are willing to supply independent supermarkets and small retailers with dairy products.

A significant change in the milk marketing system has been the rapid concentration within the supermarket industry: in 1994 the 10 largest supermarket chains earned about 24 % of total supermarket revenue, whereas in 2000 they earned 47 %. Furthermore, the reconfiguration of the procurement, processing and distribution systems in Brazil led to an increasing segmentation and dualistic development of the market into the formal and informal supply chains. The Brazilian milk supply chain and its components is represented in Figure 11.

Figure 11: Formal and informal milk supply chains in Brazil.

Elaborated from Costa *et al.* (2004); Farina (2002); IFCN, (2005); Phillips, (2006).

Trends in the dairy sector, with increasing concentration of production in the hands of few farms as well as increasing concentration of processing, suggest that the development of the sector is following an unequal development path, excluding smallholders from the direct benefits of the growing demand for dairy products particularly in the mainstream urban markets.

The modernization process of the Brazilian dairy industry certainly caused it casualties, directly hitting those who could not participate in the formal dairy chains and the decline in the aggregate number of dairy farms over the last two decades bears testimony to their the exit from the dairy sector. However, without further information on their shift in livelihood to alternative sources of employment and incomes (e.g., shift from mixed farms to pure crop production, or shift to the non-farm sector), it is difficult to pass a judgment on the poverty impacts of the fall in dairy farms.

The national reduction in the \$1 a day poverty index from 14 % to 8.2% between 1990 and 2001 does not indicate that the potential of dairy farmers from the business has significantly contributed to changes in the national poverty headcount.

V. Summary and Overall Conclusions

Smallholders (< 2 ha of land) engaged in mixed crop-livestock farming currently constitute the majority of rural people in developing countries, and projections clearly indicate that they will remain a prominent feature of rural areas well into the next decades.

In developing countries smallholder livestock producers account for a significant share of meat, particularly ruminant meat, and milk output. They also contribute significantly more to rural (self-)employment than large-scale industrial producers. At the market chain level, in most developing countries small-scale processors and distributors also handle a larger share of market output than their large-scale counterparts.

Although in most cases small-scale producers and processors operate informally, on the one hand, informal is not necessarily synonymous with illegal and, on the other, these producers are often willing to formalize their transactions but unable to do so because of an 'unfriendly' institutional and regulatory infrastructure making formalization difficult and unprofitable.

Drivers of change in the livestock sector, i.e., changes in demand, production / supply technology, national policies and international setting, will certainly impact on smallholder mixed crop-livestock farmers via changes in market shares of the associated processing and marketing businesses.

The impact of these drivers will vary depending on country's (i) resource endowment; (ii) role of agriculture / livestock sector in the economy; (iii) economic and institutional framework, and may spur or harm the development of mixed crop-livestock production systems.

Three dominant patterns of livestock sector development affecting mixed livestock production systems seem to emerge, stylized as follows:

- (i) **Positive livestock sector development**, supported by a strong interconnectedness between the demand for and supply of livestock products, benefiting the majority of rural producers and leading to a smallholder based rural development. An example might be the development of the dairy sector in India, characterized by an increasing number of small dairy farms using improved production technology and able to compete with large producers.

(ii) **Livestock sector stagnation / involution**, characterized by a sluggish and even contracting livestock sector, both unable to respond to and lead any significant social transformation. This situation may occur in countries where governments have not designed policies which allow farmers to compete in the downstream markets for meat and dairy products, so that both small and large-scale producers end up with few or no incentives to respond to market signals in rural areas. Zambia represents this development path, as in the last fifteen years or so the livestock sector, and dairy production in particular, have been unable even to keep pace with population growth, let alone respond to increasing demand for product quality.

(iii) **Positive but inequitable livestock sector growth**, characterized by a dualistic pattern of development where few and large market-integrated producers benefit from the drivers of change in the livestock sector, while the majority of smallholder producers, processors and retailers are not only unable to benefit from the 'changing livestock landscape' but at times are even forced out of the market. A representative case is the Brazilian dairy sector, which on aggregate has been performing particularly well since the structural reforms of the 1990s. However, since then the number of dairy farms has declined by 3 to 4 % per year while informally marketed milk increased in market share by around 10 %.

There is thus both good news and bad news. The good news is that the 'changing landscape' can benefit smallholders who, given an appropriate institutional and infrastructural setting, are able to compete with large producers and contribute to rural employment and agricultural growth. The bad news is that in some cases the 'changing landscape' is either not benefiting smallholder livestock producers at all or is mainly benefiting the already well-off and educated producers. Many smallholder producers might be forced out of the sector without being able to find productive employment in other sectors and may induce migration to urban areas as casual labourers.

Furthermore, 'modern' supply chains tend to cater for higher income groups and more advanced producers while low-income consumers represent a huge market (13 billion International \$ at PPP) whose needs often go unmet (vs 10 \$ billion in 'mature' markets). Therefore, bowing to pressures exerted by high income consumers will harm both poorer producers and consumers.

There is thus certainly room for policies to turn the changing livestock landscape into an opportunity rather than a threat for smallholder livestock producers and their direct and indirect employees. Under this perspective, two key encouraging elements deserve to be emphasized.

The first is that it has been shown that livestock production activities can be efficiently organized in a decentralized manner by exploiting the capital, physical labour and entrepreneurship of small rural producers. This smallholder based rural development strategy, if scaled up at the level of countries, would certainly contribute to broad-based agricultural growth, rural employment and poverty alleviation, and ultimately mitigate the presumed trade-offs between growth and equity.

The second is that policy makers, international organizations and development practitioners are increasingly appreciating the poverty-reduction potential of the livestock sector and are becoming aware that technical solutions alone are rarely able to deliver efficient and equitable outcomes. Policies are therefore beginning to focus not only on technical issues, but also on the economic and institutional context in which these technologies are supposed to be used, as neither a favourable context with lack of access to appropriate technologies nor access to appropriate technologies in an unfavourable context significantly assist the less endowed livestock holders to benefit from the changing livestock landscape, and to contribute to agricultural and rural growth.

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