The Ugandan Dairy Sub-Sector
Targeting Development Opportunities

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The Ugandan Dairy Sub-Sector
Targeting Development Opportunities

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Executive Summary

This report examines current trends and circumstances in the Ugandan dairy sub-sector, with a view towards guiding new efforts in dairy research and development. The analysis relies on multiple sources of data; a) several reports on the dairy sub-sector produced over the last decade, including an appraisal of the industry conducted by ILRI with Ugandan partners in 1996, and b) primary data obtained from recent land management household surveys conducted by IFPRI in 2002, as well as from national household and community data surveys conducted by the Gov. of Uganda in 1999/2000. The latter data were geo-referenced and put into a GIS, and a key contribution of this report is the spatial analysis of patterns of dairy development and associated factors. Following is a brief description of some of key findings of the study. General implications for dairy research and development are indicated, in the context of a proposed model for pro-poor dairy development.

Key findings

Increase in milk supply relative to demand
The evidence shows clearly that there has been a significant increase in the seasonal surpluses as a result of increased milk production relative to demand. Although figures and estimates vary considerably, total milk supply grew from 350-400 M l/year in 1990 to some 550-750 M l/year recently. It appears that during the second half of the 1990s, growth in dairy production accelerated to a higher rate than experienced up until then. Further, this relative increase in supply is confirmed by falls in real prices of milk received by farmers. In the main milk producing area of the west, real milk prices (deflated by CPI) appear to have fallen by 36% between 1995 and 2000. This has indications for strategies for further dairy development: seasonal surpluses may require transforming milk for preservation, finding markets further a field, and stimulating demand. However, projections to 2010 suggest that under several scenarios of growth in milk production and in economic growth nationally, demand could still outstrip production, providing new opportunities in the industry and for smallholder farmers.

Milk surpluses and deficits vary regionally across Uganda
Analysis using GIS coupled with national surveys, comparing local milk supply and demand, shows clear areas of net milk surplus and deficit (see Figure 16). Areas in the west and around the lake zone exhibit overall surplus, requiring excess milk to be moved to urban consumption areas. In the east however, there are major areas of apparent overall milk deficit. Development strategies in surplus areas will necessarily aim to improve market infrastructure and reduce market transaction costs, while those in milk deficit areas may target increasing production. Further research will better define target zones for alternative development strategies.

Consumption of dairy products still low
Comparisons with neighboring Kenya and Tanzania show that in terms of per unit income per capita, consumption of dairy products in Uganda remains very low, in spite of recent growth in income levels generally. FAO figures on milk availability
suggest that dairy product consumption, around 20kg/capita/year, did not increase during the period 1995-2000. As shown in the analysis, however, there is good evidence to support the view that average consumption overall nationally is around 28 kg/capita/year. Nevertheless, when compared to levels of average income, Uganda milk consumption is particularly low. In Kenya, where incomes are lower, some $0.07 of every dollar of income is spent on milk and dairy products, while in Uganda the figure is less than $0.02 (Figure 14). Efforts to increase demand, coupled with increasing incomes, may be key to a sustained growth in the dairy sub-sector.

**Higher proportion of improved dairy animals than reported**

Official figures suggest that improved dairy animals remain a very small proportion of total cattle population. In 1999, these were reported to be about 5% of the total. However, evidence from recent random surveys suggests that the proportion may be significantly higher overall, and over 50% in some areas specializing in dairy production. This contrasts markedly with FAO figures showed that although there was annual growth rate of 2.6% in milk production nationally between 1985 and 1998, the main cause of growth was simply the percentage of cows milking, which contributed about 73% of the increase, while increase in cattle numbers contributed 22% of the growth. (Figure 11). There was apparently zero growth in productivity, with yield remaining at a reported average of 350 liters per cow per year between the two years, suggesting little increase in proportion of improved animals. This is in sharp contrast to Kenya and Tanzania, where per cow productivity grew strongly during the same period. If one accepts recent national production estimates of over 700 M l/year, well above official estimates, then this would correspond with the higher estimates of improved cattle population, and increases in per cow productivity. Clearly, additional information is needed. The upcoming agricultural census should provide this.

**Low availability of artificial insemination (AI) and veterinary services**

In a potentially related issue, national community survey data show very low levels of access to AI services in particular (Figure 4). In many districts, less than 2% of communities reported availability of AI services locally, and in large parts of the country, particularly central-west and the north, there is no reported access to or use of AI at all. Access to AI is highest in the lake zone, although even there, not more than 30% of communities report access to AI. Reported access is higher in the case of veterinary services, with over half of communities reporting access in most areas (Figure 6). Again, there does appear to be some pattern to the level of access, with the highest levels occurring generally in zone of Lake Victoria, with a number of exceptions. While provision of these services, particularly AI, may largely be driven by level of demand, increased dairy cattle productivity in the long run may require interventions to increase their availability and access.

**Informal milk market continues to dominate the sub-sector.**

Although recent data are not very reliable, the informal or indigenous/raw milk market continues to dominate the dairy sub-sector. As in other countries such as Kenya and Tanzania that exhibit similar markets, this is driven by lower retail prices in such market channels, and consumer preferences for whole raw milk. The Gov. of Uganda, through the Dairy Development Authority, is now taking proactive measures to address this issue, by working with small milk traders and vendors to find mutually
acceptable mechanisms for setting and enforcing minimum standards of milk quality and handling. Such positive policy interventions may reduce the informal trade to some extent, but that market is likely to continue to play an important role. Given that fact, interventions to improve market access and infrastructure will have to consider ways of working within the dualistic nature of the milk markets that smallholder producers participate in.

Conclusions
The findings of this study suggest that dairy development efforts will have to work within the context of a number of constraints, perhaps most importantly the apparent seasonal milk surpluses and relatively low consumption levels of milk. On the other hand, low demand per capita income may also offer an opportunity for generic promotion of milk consumption, as is being pursued currently by USAID/Land O Lakes in Uganda. Low productivity and access to services may also offer opportunities for positive interventions, given that areas for demand for those interventions are specifically targeted. Indeed, the study shows that this sort of targeting may be critical for successful interventions, as there is considerable variation in dairy production systems, constraints and opportunities across the country. Additional research will be necessary to accomplish more detailed targeting and assessment of potential impact of dairy development interventions. The data available currently were not adequate to accomplish this, such as quantifying impacts of milk market infrastructure through milk price formation analysis, as has been done in Kenya.

**Potential Dairy Research and Development Interventions**

**Dairy Development Interventions**

The following potential development interventions are implied directly by this study, although in some cases more detailed assessment may be desired:

1. **Generic promotion of milk and dairy product consumption.**
   Because of very low milk and dairy product consumption relative to income, coupled with rising incomes, generic promotion of milk consumption may be an important entry point for dairy development. USAID is currently pursuing this approach already in Kenya where milk consumption levels are much higher; the opportunities for this intervention to be successful may be greater in Uganda. This is already being pursued by USAID/Land O Lakes.

2. **Investment in dairy production and productivity in milk deficit areas**
   There appear to be areas of clear potential milk deficit in eastern Uganda. While it would be useful first to verify this, for example through price comparisons, there may be immediate opportunities to invest in dairy production and productivities in these areas.

3. **Improving product quality in small scale milk markets**
   Some activities, such as those led by the DDA, are currently aimed at improving quality among small-scale milk market agents. However, these are limited in scope to groups of organized traders, and may not adequately
address the small-scale market more generally. Training modules for small scale market agents developed by ILRI/FAO with partners in other African countries could be modified and applied to the needs of the Ugandan milk markets.

**Dairy System Research and Assessment**

The study also highlights some areas where further research or assessments may be needed before making investments in dairy development.

1. **Assessment of milk marketing constraints in milk surplus areas.**
   The areas with greatest milk surplus, and lowest farm-gate milk prices, have long been known to be in southwestern Uganda, which is verified in the mapping exercise. What remains less clear is the extent to that infrastructure, such as poor roads and milk collection or institutions form the largest constraint, compared to institutional issues such are organization of milk collection, distribution, etc.

2. **Assessment of demand for improved dairy cattle, and reproductive services.**
   AI services are seen to be little used in many areas. Before investing in AI delivery, it would be important to understand farmer demand for improved dairy cattle, and demand for such services. An import element would be to understand this demand in the context of the markets for milk, the risks small farmers face, and access to credit.

3. **Variation in milk prices, spatially and seasonally**
   Due to lack of adequate data, we were unable to map and analyze variations in milk prices, and the effects of infrastructure and supply/demand on that variation. With relatively simple additional data collection, this would be possible. Linked to this lack of information is the suggestion from some that it may be inappropriate to promote dairy development in areas far removed from urban demand centers. Analysis of spatial price variation would significantly inform this debate, coupled with existing information on returns to dairy production at the farm level.

4. **Verification of milk deficits in targeted areas**
   As discussed above, there exist apparent milk deficit areas. Before investment in milk production in those areas, however, it would be useful to verify those deficits, and quantify them, as well as understand their cause.

5. **Informal milk market share and constraints**
   The data available were not adequate to be able to revise the informal milk market share estimates significantly. This may be needed before investment is targeted at formal market development. Such an assessment can generally be done using rapid appraisal methods. Further, interventions to address milk quality in informal markets will need to have better understanding of key points in the market channels affecting quality.
**Pro-Poor Dairy Development**

The constraints and characteristics of the Ugandan dairy sub-sector are very similar to those in many other countries in Sub-Saharan Africa and in South Asia: feed constraints coupled with soil nutrient deficits, poor farm management and poor farmer access to information, inadequate and variable market access, and largely unregulated markets driven by consumers demand for low-cost and traditional products. ILRI’s research across countries in these two regions suggest that some elements of what might be termed a “Model for Pro-Poor Dairy Development” are generally relevant in many country cases, and this is apparent in the case of Uganda. This model aims to raise the welfare of farmers and small market agents, to meet the needs of poor consumers, and to sustain the natural resource base in the context of continued intensification of production systems.

**Objectives of pro-poor dairy development**

1. Employment creation in rural and periurban areas through both farm and non-farm dairy activities.
2. Reliable income generation and asset accumulation for resource-poor farmers.
3. The provision of low-cost and safe dairy products to resource-poor consumers.
4. Improved natural resource management and sustained farming systems through dairy cattle-mediated nutrient cycling.
5. Improved child nutrition and cognitive development in resource-poor households.

**Elements of a model for pro-poor dairy development**

Such a model, built on evidence from a number of developing countries, includes the following main elements:

1. Build on traditional dairy product consumption habits and preferences, at the same time as promoting demand for new products.
2. Build on indigenous markets for milk and dairy products, at the same time as promoting appropriate formal market development.
3. Emphasize and support the role of smallholder dairy production as primary means of rural income generation and sustaining the intensification of mixed crop-livestock systems.

**Building on traditional consumption habits.** The concept of value-addition is often used to promote processing of milk into a variety of dairy products. However, the choice of products promoted is often dictated by Western-style dairy processing practices. This typically ignores the fact that in many countries, consumer preferences and habits favor traditional products – Western-style products are often not regarded as good value for cost in the eyes of poor consumers. Markets for traditional products are typically the largest in any developing country, and so offer good opportunities. Building on traditional habits also requires focusing first on products known to consumers, and adapting them for better “quality”, safety, and value addition, while maintaining low retail cost as a primary consideration, given the majority of resource-poor consumers. At the same time, opportunities can be exploited for promotion of new products, which may offer better possibilities for fast growth within small market niches.
Building on indigenous markets. Indigenous markets continue to dominate many
development countries for the reasons above – strong traditional consumption habits,
which are typically not well served by Western-style dairy products, and which put a
high priority on low cost products. Indigenous markets, which are typically highly
labour-intensive and based on many small market agents, are known to generate greater
levels of employment than Western-style processed dairy product markets per unit of
milk handled. However, indigenous markets face major constraints due to lack of
established guidelines and procedures, lack of appropriate low-cost equipment, and
lack of relevant and supporting policies. The quality of products supplied through
indigenous markets may be highly variable, and may sometimes pose public health
threats. Such threats, however, are often exaggerated in the context of consumer
habits of home processing before consumption. Nevertheless, variable quality
impedes consumer confidence, raises transactions costs for consumers, and hinders
market development. Development of indigenous markets requires integrated
interventions to address the above constraints, including policies, guidelines and
training for small-scale market agents. However, this does not preclude the
simultaneous development of formal Western-style processed product markets, which
may offer greater long-term reliable market opportunities, including export markets.

Sustaining farming system intensification through smallholder dairy production.
Many mixed crop-livestock systems in poor countries are characterized by small and
shrinking land holdings, and by poor soil fertility. Poor soil fertility generally
remains the largest single technical constraint to agriculture in many countries.
Evidence from highland areas of East Africa, as well as South Asia, shows clearly that
small scale dairy production can play an important role in improving soil fertility and
natural resource management. Dairy cattle not only serve to improve cycling of
nutrients on farm by converting crop residues into manure, but also serve as a channel
for importing nutrients from off-farm through concentrate feeds and fodder brought
from off-farm. Smallholder producers are more likely to operate in this integrated
manner than large-scale producers, who are typically more specialized in dairy
production. Deliberate emphasis on smallholder production, and on production
strategies that integrate crops, livestock and resources management, serves to promote
both rural income generation and sustainable intensification.
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Introduction

Although Uganda's economy has steadily improved in recent years, recording 4.9% GDP growth in 2001\(^1\), the large proportion (about 90%) of its population that live in rural areas still remain among the poorest in the world. Smallholder dairy production offers not only opportunities for rural income generation for these poor, but also improved child nutrition through milk consumption, and improved natural resource management through cattle-mediated nutrient cycling. The dairy sub-sector is estimated to contribute about 20 per cent to the food processing industry while the food industry contributes about 4.3 per cent to the National GDP. Though small, this contribution to the GDP is steadily increasing as Ugandan GDP grows\(^2\).

During the period of national instability that lasted into the late 1980s, however, dairy production and marketing suffered along with other sectors of the economy. After that period a strong rebound occurred, partially driven by investment by donors and organizations such as FAO, which established new milk market infrastructure to improve market access. Changes continued to occur as general reforms towards greater private sector roles emerged. When the Ugandan milk market was deregulated in early 1990s, the private sector was given the opportunity in 1994 to openly compete with the parastatal Dairy Corporation, which remained generally bureaucratic and inefficient. After five years of liberalization of the sub-sector, that saw significant private investment, 13 private dairy processors had emerged. Milk production grew from some 355 M metric tons in 1985 to an estimate of 476 M metric tons in 1998, according to FAO figures.

However, constraints to the continued development of the sub-sector remain, and in some cases new constraints may have emerged. Processing capacity has again declined. The logistical costs of collecting small quantities of milk from scattered locations compounded by long distance leads to very high cost of operation for the factories (MAAIF/ ILRI, 1996). Out of the thirteen original private processing factories, eight have been forced to close mainly due to operating under capacity and at high cost. This is partially due to strong competition from the informal milk market, that which markets raw or boiled milk or traditionally processed products. With little capital costs, low cost margins and so the ability to offer cheap although variable quality raw/boiled milk to poor consumers, the informal market will continue to compete strongly. Although estimates vary, over 80% of marketed milk is sold in loose form by the informal sector driven mainly by traditional preferences for fresh raw milk which is boiled before consumption, and the unwillingness of consumers to pay the costs of formal processing and packaging. The formal market, supplying pasteurized milk and dairy products, generally struggles to compete and grow. This occurs in the context of growing moves towards more open trade, such as through WTO agreements, and also through renewed regional ties in East Africa.

There is also continued debate on appropriate strategies and priority regions for dairy development. As far back as 1996, there has been disagreement by dairy development agencies and planners on whether priority should be given to limited grazing dairy production in high rainfall areas close to Lake Victoria, or to grazing

\(^{1}\) International Finance Center website-http://biz.yahoo.com/ifc/ug/
\(^{2}\) Investment in Uganda’s dairy industry- http://www.ugandainvest.com/11.htm##_ftnref1
systems in lower rainfall zones of the southwest, traditional cattle keeping areas (MAAIF/ILRI 1996). According to Foodnet (2002), through state subsidy and donor support over the years, the Dairy Corporation is thought to have encouraged sub-optimal geographical patterns of milk production in the country. Some of the milk producing areas in the southwest supplying Kampala town, the major milk market, lie between 200 to 300 km away, potentially contributing to problems of spoilage and transportation. However, costs of production in the southwest are generally much lower than elsewhere, due to availability of land for grazing, and so the area may thus remain an appropriate priority region for dairy development. The debate continues.

Dairy policies have also evolved. After liberalization of the industry, there has been the perceived need to introduce new structures to regulate and develop it, particularly in the context of demise of the parastatal roles, and the strength of the informal market. The official regulatory and development roles originally invested in the Dairy Corporation were transferred to the Dairy Development Authority (DDA), a new body created in the late 1990s. The DDA roles include regulating health safety and promotion of dairy consumption. The DDA is now moving quickly to establish new regulations, including those addressing informal and small-scale milk marketing and new programs for dairy promotion. During this transition period, it remains unclear as to the extent which one organization can play both roles of regulation and support to the dairy industry, and to the success of the interventions underway.

This report aims to briefly address these issues, and then in the context of data available, some of which is comprised of rough estimates, to target research and development interventions. This is done by reviewing recent and past information produced in other dairy studies, and particularly by examining trends and by conducting original spatial analysis. The analysis relies on multiple sources of data; a) several reports on the dairy sub-sector produced over the last decade, including an appraisal of the industry conducted by ILRI with Ugandan partners in 1996, and b) primary data obtained from recent surveys conducted by IFPRI, as well as from national household and community data surveys conducted by the Gov. of Uganda. The latter data were geo referenced and put into a GIS, and a key contribution of this report is the spatial analysis of patterns of dairy development and associated factors. The analysis and outcomes are evaluated explicitly in the context of the model of pro-poor dairy development, described in the Executive Summary.

**Dairy Production Systems**

The cattle production systems in Uganda are mainly dependent on the agro-ecological and the socio-economic setting in which they operate. Rainfall patterns are a strong determinant of cattle and dairy production strategies. Bimodal rainfall (October-November, March-May) allows generally good rains in many parts of the country. The dry seasons are may often be severe leading to limited forage and water for cows and hence low levels of milk production. Conversely in the wet season, plentiful forage leads to increased production and seasonality in supply and prices of milk paid to farmers. Figure 1 shows variation in mean annual rainfall across Uganda. With an average of 1,135 mm across the country, the highest is found in the eastern region near Mt Elgon (1,229), and the lowest in the northern region (1,070).
Cattle production systems form a continuum with semi-nomadic pastoralism at one end and stall-feeding only or zero-grazing systems on the other, depending not only on agroclimate but also on market and socio-economic environment of the farmer. Pastoralists may be largely oriented towards subsistence and accumulation of capital in cattle to help address risk, while zero grazing farmers have a market orientation. Such farmers, while also viewing cattle as a means of accumulating capital for savings and insurance, will largely be driven by market and income opportunities for sale of milk and culled animals. In a few areas of small land holdings, zero grazing farmers may also exploit cattle manure as a soil amendment. This production system is characterized by high use of external inputs, some gathered from public lands and not purchased, (MAAIF/ILRI, 1996), and there are emphases on efficient use of land, labor and capital, among other production inputs.

MAAIF/ILRI (1996) categorized dairying into three systems: Intensive, Semi-intensive and Extensive dairying systems depending on the level of investment in both capital and dairy cattle management. Accordingly, higher levels of investment in dairying were generally located near major urban or consumption centers associated with higher milk prices and stable demand for dairy products. For the purpose of evaluating efficiencies in milk production systems K2-Consult (2002) categorized dairying into four groups:

- Communal grazing: Free range grazing on communal land owned by the clan,
- Free range grazing: Cow moves about all over the farm with no one herding,
- Fenced grazing: Cow grazes around paddocks, also eats concentrates,
- Zero grazing: Cow does not graze feed with concentrates and grass
Depending on the size of the grazing systems the categories were further divided according to sizes, leading to small, medium and large-scale farmers in each production system.

The adoption of grazing system differs from region to region. In northern and eastern Uganda, and in the dryer parts of the southwest communal or free-range grazing is the predominant farming system. In the west and central the primary system is fenced grazing. A minority of farmers in all regions practice zero grazing except in the north. There seems to be some apparent trend towards intensification in areas except in the north, based on comparison of reported levels of grazing systems in the mid 1990s (MAAIF/ILRI, 1996), and the apparent decrease in those systems reported in 2000 (K2-Consult, 2002). There are of course numerous exceptions to these generalizations.

**Figure 2: Average cattle density per square kilometer, by parish.**

The choice of cattle production and feeding system is of course closely related to the relative density of cattle in a given area, as well as to human population density. Grazing systems can only function when densities are relatively low, and extensive land resources are available. Similarly, the incentives for farmers to choose stall-feeding and zero grazing will be strongest when land resources are limited relative to labor. Figure 2 depicts cattle density across Uganda, based on official parish-level numbers of reported cattle from government statistics. Cattle density shows a clear pattern, with the highest levels found in the lake zone and parts of the southwest and west. As has been found in other countries, such as in Kenya (Omore et al, 1999), cattle density is typically closely and positively correlated with human population density. As such, pastoral areas which although in some cases heavily dependent on
cattle for livelihoods, generally exhibit very low cattle density levels. Large parts of the country thus show density of less than 10 animals per square kilometer. These patterns of density, and thus of potential milk supply, translate into different strategies for dairy development. These will be discussed further later in the report in spatial analysis of milk surplus and deficit.

_Cattle breeds and population_

According to MAAIF/ ILRI (1996) breeds of animals in the country included purebred exotic animals, indigenous, their grades and crosses. Purebred exotic cattle include Friesian, Friesian-Holstein, Ayrshire, Guernsey, Simmental, Black and White Dane. Indigenous breeds include Nkendi shorthorn Zebu, Ankole longhorn and Ngada. Some crosses of exotic dairy breeds and tropical breeds in the country were with Sahiwal and Red Sindhi.

The national cattle population over the last ten years has experienced steady growth. This growth has been attributed to the increasing demand for milk by consumers and milk processing plants, better herd management, adoption of improved breeds and improved animal health and support services. According to FAO data\(^3\) the national cattle population has increased at an average rate of 1.1% from 4.8 million in 1980 to an estimated 6.0 million in 2000. Using the national household survey from 1999/2000, we estimated the cattle population to be 5.9 million, a figure comparable to that from FAO, suggesting that these are reasonable approximations.

From apparently none in 1958, the exotic\(^4\) dairy cattle population grew to an estimated 18,000 head in 1969 (MAAIF/ ILRI, 1996). The number of exotic and crossbreeds increased from 209,000 in 1994 to 279,000 in 1999 (Table 1). This represents an increase from 4.1 to 4.7% of the proportion of improved cattle to the total herd. However, analysis of IFPRI land management survey data indicates farmers reported that of those surveyed, 26% of the herd was improved. This may be due to some bias in the survey sample, particularly in terms of sites selected, although this was a random survey within sites. It may also be due to different definitions of improved animals in the minds of farmers. However, the results may indeed be indicative: similar results have been found in Western Kenya, where surveys showed much higher proportions of improved dairy cattle (Waithaka et al 2002).

Table 1: Cattle population (‘000) in Uganda over for the period 1994 – 1999

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<tr>
<td>Indigenous cows</td>
<td>4,897</td>
<td>5,045</td>
<td>5,196</td>
<td>5,352</td>
<td>5,514</td>
<td>5,679</td>
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<tr>
<td>Exotic &amp; cross-bred cows</td>
<td>209</td>
<td>221</td>
<td>234</td>
<td>248</td>
<td>263</td>
<td>279</td>
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<tr>
<td>Total</td>
<td>5,106</td>
<td>5,265</td>
<td>5,430</td>
<td>5,600</td>
<td>5,776</td>
<td>5,956</td>
</tr>
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\(^3\) FAO website- http://apps.fao.org/page/collections?subset=agriculture

\(^4\) Exotic refers to European dairy breeds, or their crosses with indigenous cattle.
Estimates were made from the IFPRI land management household survey of the proportion of local versus crossbred cattle across the country (see Appendix for details). These results are shown by district in Figure 3. Note that these estimates do not match official statistics, which show lower proportions overall of improved dairy cattle (4.7% of the national herd overall). However, they reflect recent surveys, and the distribution of variation is likely to be similar to other reports, even if the absolute proportions are not. In most areas of the country, local cattle account for more than half. This is particularly true in the north, where nearly all cattle are indigenous Zebu.

The highest proportions of crossbred cattle are found in parts of the lake zone and the west and southwest. In some of these areas, more than half of all cattle are crossbred dairy cattle, indicating significant orientation towards dairy production. It should be noted that the breeds of local cattle may differ significant, from the Ankole in the southwest to the East African shorthorn zebu in the north. Overall, the percentage of improved cows was higher in central (40%) and western (32%) regions compared to eastern (9%) and northern (4%) regions. The relatively low percentage of improved breeds in some parts of the country, along with good agroclimatic conditions in many areas, suggest that there may be potential for increasing milk production through upgrading the cattle population, where market conditions are appropriate. However, the observed proportions of improved cattle are higher than previously reported in the key milk producing areas, suggesting that upgrading of animals is occurring spontaneously in respond to farmer demands. Because improved cattle produce more milk on average, these results have significant implications for estimates of total milk production in the country.
Breeding management

According to MAAIF/ ILRI (1996), in the mid 1990s only a small proportion (2-15 %) of farmers used A.I services; thus breeding is predominantly through natural mating. Although the more recent studies did not look at the breeding methods used, their costs and their efficiencies, that picture does not seem to have significantly changed, based on survey estimates. The low use of A.I. is attributed to low availability, high cost, uncertain reliability and the widespread misconception that A.I. produces disproportionately more bull calves. In some cases, poor A.I. service may lead low efficiency of conception and repeated service, contributing to farmers’ low opinion of the service.

Figure 4: Proportion of communities with reported access to artificial insemination (AI) services, by district.


Figure 4 shows reported access to AI services, reported as the proportion of farmers in the community who use such services. The reported access is generally very low. Large parts of the country, particularly the central-west and the north, report no access to or use of AI at all. Access to AI is highest in the lake zone, although even there, not more than 30% of farmers report use of AI.

In each of the dairy production systems, cows are often not serviced for a relatively long period (4-5 months) after calving, reducing productivity. It is not clear whether

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5 In all maps depicted, areas indicated where No Data are available will likely have results similar to neighboring areas.
this is due to *post partum anoestrus*, failure to detect heat, retained *corpus lutea*, poor nutrition, reproductive diseases, or that mating is delayed deliberately. In some cases, farmers may choose to delay breeding and instead gain cash flow from longer lactations, and also to reduce or delay risk associated with calving. According to MAAFI / ILRI (1996) there is potential for reducing the high overhead costs of frozen semen through the use of fresh semen and bull “camps” (individually owned dairy bulls with fees paid for natural service). This system would improve the efficiency of insemination where the potency of semen has been reduced by incompetence of A.I. technician, poor storage or transportation of semen.

Any attempt to expand A.I. services would need to assess very carefully first the level of demand for improved animals, and then the demand by farmers for AI as a source of improved animals. Targeting that intervention based also on local demand for milk and linkages to milk markets further removed, would also be important.

*Figure 5: Comparison of communities with reported access to artificial insemination (AI) services, with proportion of improved cattle.*

Source: Estimates based on national community level surveys, 1999/2000, and on IFPRI land management survey.

As a first step in that direction, the data available allow us to make some comparisons of level or reported access to AI, with the proportion of improved dairy cattle estimated in the district. Areas of concern that could be targeted for intervention may be those where AI service is low, yet there are relatively high proportion of improved dairy cattle. Figure 5 makes that comparison. It shows that there may be large areas

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6 The categories for high and low were set so as to roughly separate the parish level observations into two equal groups. Thus low AI is set at 0-3% reported availability, and high AI access is set at 4-29% reported availability. Areas of low levels of improved cattle are those with less than 30% reported improved cattle, and high levels are those above that figure.
in the central-west and southwest (dark blue) where there are many improved dairy cattle, yet where access to AI is low. In these areas, less than 3% of communities report access to AI, yet surveys show that more than 30% of cattle may be improved. Data are not available for large parts of the country, however, and more accurate and meaningful targeting would require additional data collection.

Milk yields by breed

Although MAAFI / ILRI (1996) did not estimate milk yield per cow for different breeds, in extensive production system, where indigenous cows are predominant, milk yield was estimated to be 545 liters per cow for 1995. In a communal grazing system, K2-Consult (2002) estimated milk yield for indigenous cow for the year 2000 to be 810 to 990 liters per year. However, this must be regarded as unrealistically high. The annual yield of 243 liters per local cow estimated from the IFPRI management survey is comparable to the figure of 250 liters per local cow in Kenya (Omore et al, 1999). Estimates from the land management survey data also showed improved cattle to produce 900 liters per cow per year, below the Kenyan estimate of 1,555 liters per year per cow. This may be realistic, given the generally lower level of intensity of production in Uganda compared to most dairy regions of Kenya.

Milk production and feeding strategies

In most of Uganda’s production systems, lack of adequate feed resources was identified as a constraint in meeting the genetic potential of dairy animals (MAAFI/ILRI, 1996). To increase productivity there is need to improve all year-round fodder availability matched to strategic supplementation (legumes and concentrates). According to MAAFI/ILRI (1996) there was relatively little use of crop by-products/residues for cattle feed, except under the most intensive production practices in peri-urban areas. Only in areas where milk fetches high prices, are lactating cows sometimes supplemented with some purchased concentrates, brewer’s mash, molasses or maize bran, usually 2-3 kg/cow/day at milking. Purchase of concentrates was mainly found in intensive production system while in semi-intensive and extensive systems there was hardly any purchase. However, there was some limited investing by farmers in improving the quality of feed resources (improved grass and legume pastures) and grazing management (e.g., fencing, paddocking, rotational grazing) in the extensive agro-pastoral systems. This mirrors the indication by K2-Consult (2002) that animal husbandry in Uganda depends mainly on pastures. Less than half of the farmers surveyed in that study used supplements. There is a significant difference in type of supplement used among regions. In the north, nutrient supplement was mainly in the form of salt/mineral licks (82%). Eastern and central regions had a much higher tendency to supplement ecological feeding with dairy feeds (81% in the east and 89% in central) and in the west 59% and 37% of the farmers used mineral licks and dairy feed, respectively. The adoption of readily available productivity enhancing technologies such as use of poultry waste for cattle feed is minimal despite the importance of commercial poultry in the Ugandan diet (MAAIF/ILRI, 1996). This could be simply due to lack of adequate attention to this technology by extension services, or because the manure is applied on plots for growing high value crops such as tomatoes and vegetables. Although recent studies do not show the level of use of purchased concentrates the earlier studies show an upward trend in percentage of users.
Lack of capital to develop pastures was cited as a major factor constraining milk production in most of the milk producing areas, especially in western and central-rural regions (K2-Consult, 2002). Poor pastures lead to poor animal productivity and are also a deterring factor to improve the quality of the animals. Creating a credit facility to farmers for improving pasture was recommended as one way of improving quality of pasture. However, this is unlikely to be successful if farmers do not have the needed management skills. Training in pasture management is also important in improving pasture quality.

**Labor**

K2-Consult (2002) reported inadequate labor for carrying out different farm activities as a major constraint affecting production. In the eastern region (zero grazing and fenced systems), central-urban (fenced), northern (communal) and central-rural (free-range), labor expenses accounted for the largest share of the total variable costs farmers incurred. For instance, in eastern region, the costs attributed to labor ranged from 27.5 percent to 33 percent of total variable costs under zero grazing system and as high as 41.8 to 68.4 percent in the northern region under communal grazing system. In western Uganda, however, where animals are often grazed in fenced paddocks rather than herded, labor expenses were not as important as other costs except in medium fenced farms where the share of labor cost to total costs was about 57 percent. This high proportion of total cost may be attributed to production or acquisition of fodder, which is an intensive activity in the fenced farms. In the central region, labor was both very costly and not readily available. This may be attributed to the various employment options available in this area, which is near to main urban areas, and thus high opportunity costs.

Across all the production systems, the opportunity cost of land and labor devoted to forage production (and/or cut-and-carry) is an important factor influencing the quantity and quality of forage offered to cattle. According to MAAIF/ ILRI (1996) returns to land and labor are positive in all dairy production systems, with evidence that less intensive systems continue to enjoy comparative economic advantages. Thus, good land availability and labor constraints appear to favor semi-intensive or extensive systems with improved or natural pastures. Labor constraints may be the result of relatively high opportunity costs to labor. In 1996 the labor/milk price ratio for Uganda was about 115 while in Kenya the ratio was around 80. These could directly reflect the higher value of labor in Uganda in alternative agricultural activities, and/or a high labor constraint in general. Recent reviews suggest that these ratios have not changed significantly, and labor opportunity costs continue to provide incentives to avoid high intensity production strategies such as zero grazing.

**Animal health management**

Common livestock diseases in Uganda are rinderpest, contagious bovine pleuropneumonia (CBPP), trypanosomiasis, foot and mouth disease (FMD), tick borne diseases mainly East Coast fever, rabies, brucellosis, black quarter, anthrax and lumpy skin disease. According to MAAIF/ ILRI (1996) tick-borne diseases, especially East Coast fever, present the biggest health problems for dairy cattle. Many farmers, if not all, practise disease prevention measures including regular spraying and/or dipping of dairy cattle with acaricide. Under intensive dairying, animals are often sprayed twice
a week. Most farmers also treat infected animals. There have been efforts to introduce the infection-and-treatment method in Uganda, particularly in areas of the southwest where grazing is prevalent, but these have been hampered by the deaths of some cattle and so loss of confidence by farmers in the method. Preventive treatment of trypanosomiasis is also done as considered appropriate. Regular vaccination against rinderpest and contagious bovine pleuro-pneumonia are done by the Department of Veterinary Services and Animal Industry (DVSAI), with the assistance of government and donor funds.

According to K2-Consult (2002), in all regions and production systems health costs, which include veterinary services, vaccination and acaricides application, are major components of total variable production cost, which reduce profit margins significantly. Veterinary services and animal health care constitute major expenses in the fenced grazing system and the large farm size -free-range systems especially in the north. Interventions to increase competitiveness in the Northern region should target reducing the cost of animal health care. Lack of easy access to veterinary services, high cost and lack of awareness were identified as major constraints in improving animal health. Suitable policy environment was recommended to promote improve delivery of veterinary services.

**Competitiveness of milk production**

According to MAAIF/ ILRI (1996) important determinants of profitability, investment and operation costs vary between production systems. It showed that engaging in intensive dairying substantially increased both annual per-cow investment and operating costs compared with the extensive systems under communal grazing. The major differences in investment costs hinge on the value of the cattle, investments in water resources and disease control. The high input costs associated with veterinary drugs (especially acaricides), concentrate feeds and labor may not be possible for the majority of smallholders.

There was little evidence in the main production systems of incentives for adoption of more intensive dairy production technologies such as zero grazing. Returns to land and labor from the different production systems were similar, with some indication that the highest returns are available in fenced grazing systems. Thus, land availability and labor constraints appeared to favor semi-intensive or extensive systems with improved or natural pastures. These could directly reflect the higher value of labor in Uganda in alternative agricultural activities, and/or a high labor constraint in general. There is therefore a need, within the location-specific analyses of production systems, to investigate the comparative and competitive advantage of dairying in various regions of the country with the view to providing incentives to intensifying dairying in designated areas. This entails evaluating technical and economic efficiency of using available resources under different dairy production systems vis a viz alternative uses for the same farm resources. This research is currently being conducted under a collaborative project by NARO, the Univ. of Makerere and ILRI, in key milk producing areas. Results will be available in 2004.

Some indicative data on competitiveness are currently available. In K2-Consult 2002, based on farm surveys from the major regions, competitiveness was determined using
gross margin analysis and unit cost ratios. The gross margin was computed by subtracting total variable costs from the total value of milk (less the amount of milk lost), milk products and the value of other non-milk benefits from dairy farming such as beef and manure. The unit cost ratio (UCR) was calculated by dividing the total variable costs by the total value of the products, and indicates lack of short-term competitiveness if greater than one. Results of the gross margin analysis indicate that all the farm categories under different grazing systems in eastern region were competitive even when non-milk products were not considered in the analysis. Generally, free-range system ranked highest in competitiveness followed by fenced system and then zero-grazing system. These findings are likely to be based on the fact that land costs are not included in a gross margin analysis – where land costs are significant, such as in fenced systems, the analysis will overstate the level of competitiveness. In all cases, competitiveness improves when other non-milk benefits were considered, indicating the importance of the culled cattle and manure sales to farmers’ returns. MAAFI/ILRI (1996) also conducted gross margin analysis, using more limited survey data, with similar results, although that study found higher returns in more intensive systems. Because gross margin analysis does not incorporate some important costs, particularly land and family labor, these results cannot be seen as particularly meaningful.

Recent research by ILRI and partners suggests that dairy farm competitiveness is too complex to be reasonably addressed by the gross margin analyses cited above, and is difficult to measure even when opportunity costs land and labor are included. This is because of significant returns to the dairy enterprise that accrue from non-marketed outputs and benefits. The most important of these are manure used on farm to sustain food and cash crops, and the value of cattle as assets. The cattle asset value is expressed in two forms: insurance value, obtained from simply keeping cattle which can be used to meet unexpected emergency needs, and finance value, the value obtained from cattle as an inflation-resistant savings mechanism for planned expenditures such as school fees or small enterprise investment. Research in Kenya suggests that across different dairy production systems, these non-marketed benefits can add up to an additional 19% to total “returns” from the dairy enterprise (Ouma et al., 2003). These significant additional benefits means that dairy production will continue to appear viable from the farmer perspective, even when milk prices fall significantly. More detailed analysis, including assessment of these non-market benefits, would be needed to be able to gauge the relative competitiveness of different production systems and regions in Uganda. Failing that, the current evidence shows that milk production in most settings is competitive in Uganda.

**Government Support Services**

**Dairy Research**

Until early 1990s there was no dairy research in the country after most institutions were destroyed during the war. Currently agricultural research has been re-organized through the formation of the National Agricultural Research Organisation (NARO), in 1993, which reports to the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). The funding agency is the Uganda National Council for Science and Technology, which reports to the Ministry of Finance and Economic Planning. Continued strengthening of research activities at Makerere University will facilitate basic and applied research to be undertaken, especially on collaborative arrangements
with national, regional and international organizations. Areas of major research include animal health, breeding, and nutrition. However, emphasis is given to addressing practical problems faced by dairy farmers.

**Animal Health Services**

The incidence of cattle diseases increased dramatically during the period of civil war and has remained high, resulting in a significant economic loss. The provision of animal health services has been re-organized and continues to receive government and donor funds. Farmers commonly vaccinate their animals as required. However, major difficulties in improving the animal health status of the national herd remain and include inadequate drug supplies, breakdown of essential support infrastructure, rising costs and budgetary constraints (GTZ, 1991).

After destruction of the communal dips and spray races during the civil war some farmers have purchased and are using hand sprayers. Most of the privately owned dips and spray races are operational. The Milk Production Enhancement Programme aimed to increase the availability of drugs and medicines through financing and equipping the initial stock for the department of veterinary services and animal industry. The stock was replenished and sustained through a Drug Revolving Fund. Farmers were charged the full cost of replacing the inventory of drugs and medicines (i.e. cost-recovery approach). Under the Livestock Services Project, supply of drugs has been gradually privatized. Most veterinary offices may lack adequate facilities to support satisfactory field vaccination campaigns.

Privatization of veterinary services (financed by the World Bank under the Livestock Services Project) started in 1992-1993, along with disease control, tsetse fly control, forage development; and institutional development. A number of veterinary doctors have gone private and have been assisted under the Livestock Services Project. The government planned to enhance delivery of animal health services through provision of vaccines, disease surveillance, rehabilitation of veterinary laboratories and manpower training.
Figure 6: Proportion of communities with reported access to veterinary services

Figure 6 illustrates the proportion of communities who reported having access to veterinary services, based on the national community survey. In most areas, over half of communities report having access to these services. There does appear to be some pattern to the level of access, with the highest levels occurring generally in zone of Lake Victoria, with a number of exceptions. It should be noted that in the survey, this access was recorded as a simple yes/no for each community. The figures mapped are averages for each district. See the Appendix for details. This level of reported access appears to be quite high in many areas, and is certainly much higher generally than access to AI, as would be expected. However, it also suggests that in some districts many communities, more than half, report no access at all to veterinary services.
One useful targeting exercise is to compare the level of access to veterinary services reported by communities in 1999/2000, with cattle densities in the same area. Areas of concern and potential intervention may be where there are high cattle densities, yet low reported access to veterinary services. Figure 7 makes this comparison, and the area in bright red are those where there are few vets but many cattle. Curiously, some of these include areas close to Kampala, where veterinary services would be expected to be relatively available. Other areas of low access yet significant cattle are found in the west and north. Note that community survey data are not available for many parishes. More complete data would allow a better understanding of areas of where veterinary coverage may be inadequate.

**Breeding services**

A National Breeding Committee, under MAAIF, was set up to prepare the national cattle breeding policy document. It is expected that the breeding policy and strategy will stipulate ways and means aimed at: (i) progressive upgrading through natural mating and A.I., and selection within the crossbred population; and (ii) conservation of indigenous breeds and their improvement by selection within-breed. Where the standard of nutrition and husbandry is low, the recommended level of upgrading would be about 25 percent exotic, where it is medium about 50 percent and where it is

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7 Categories of vet services, in proportion of communities reporting access, are 0-71% = low, 71-89% =medium, 89-100% high. Categories of cattle density, in average cattle per square km, are 0-10=low, 10-50=medium, 50-6900=high.
high about 75 - 100 percent. Animals for upgrading the national herd can be sourced from the improved dairy breed types (exotic and crossbreds) in the major milksheds. However, there is no indication that appropriate semen is available to implement the above recommendations. The civil disturbances and subsequent financial constraints caused a substantial reduction in activities of the Artificial Breeding center, a center for artificial insemination (A.I.) in Entebbe.

As indicated above, only a small proportion (2-15 %) of farmers use A.I. The average performance of A.I. is also low, ranging from 2.0 to 2.5 inseminations per pregnancy, and could be contributing to farmers’ negative attitude towards the service. Although the ability of the farmer to detect heat signs early is important in determining the success of the A.I. services the efficiency and of the technicians and the potency of the semen may be questionable. Farmer’s also see AI technicians as sources of general information about animal husbandry and production. Increased demand for their services may be stimulated from training of A.I. technicians in wider dairy extension.

**Extension and Training**

Extension services in Uganda are increasingly being driven by changes proposed under the Plan for the Modernisation of Agriculture (PMA), designed to drive agriculture away from predominantly subsistence to commercial farming. The plan aims to overcome the key factors undermining agricultural productivity, namely: poor husbandry, low use of improved inputs, limited access to technical advice, poor access to credit, poor transport, communication and marketing infrastructures and insecure land tenure rights. Based on these needs, five programs were identified for development and implementation, amongst which is the National Agricultural Advisory Services (NAADS) program. The rationale for the NAADS program is the failure of the traditional extension approach to bring about greater productivity and expansion of agriculture, despite costly government and other donor interventions. The aim is to develop a decentralized, demand-driven, client-oriented and farmer-led agricultural service delivery system particularly targeting the poor and the women. The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) has overall national responsibility for the program. Key elements of NAADS include

* Empowering subsistence farmers to access private extension services.
* Developing private sector delivery capacity and systems.
* Developing sustainable financing institutions and mechanism.

This will be implemented in two 5-year phases. The first phase, just beginning aim to shift from public to private delivery with mostly direct public financing while building the foundation for greater private sector financing. To achieve these, structures are being set up to establish mechanisms for direct flow of funds to sub-counties and farmer groups, as well as mechanisms for sub-counties and farmer groups to source services. The main components of NAADS include:

1: Advisory and information services to farmers - support initiatives by farmers, working together in groups with their sub-county government, to contract agricultural advisors to deliver identified priority services, with matching grants from government.
2: Technology development and linkages with markets - support the multiplication of technologies at sub-county and district levels, through linkages among farmers, advisers and researchers.
3: Quality assurance - regulations and technical auditing of service providers.
4: Private sector institutional development - program will be established and supported to assist private service providers to retrain and up-grade their skills, and to train leaders of farmers' organizations in managerial and leadership

5: Program management and monitoring - establish and support public institutions at both the national and local government levels to monitor and evaluate program activities.

Subsistence farmers are not expected to pay for the service, to ensure that the poor are active in contracting for this service. Some concerns about NAADS centre on the adequacy of planning the program and the control that farmers exercise. However NAADS was the subject of a long and thorough consultation process, and provision is made for NGOs to help build farmer capacity to plan, monitor and evaluate extension activities. There are also concerns that the direction of extension contracts is in the hands of local political administration. In spite of these concerns, NAADS appears to be a bold and innovative experiment which is being observed by governments elsewhere.

![Figure 8: Proportion of communities with reported access to extension services, by district.](image)


While NAADS promises new and better services to farmers, it is useful to examine what the current levels of access to extension may be. Based on data from the national household survey, access to extension services is relatively low. Figure 8, which is based on estimates made from national community surveys in 1999/2000, shows that in those districts were data are available, typically less than 30% of
households report being visited by extension services. It should be noted that the pattern of access does not appear to reflect distance to major urban or administrative centers. Even some districts very close to major cities report low access to extension services. Under the new NAADS program, it is hoped that this situation will improve. It suggests, however, that major challenges remain to meeting the aim of providing such services to a major of rural households.
Milk Consumption and Dairy Product Markets

Consumption of and demand for milk

In Uganda, the most commonly purchased types of milk are: unprocessed raw milk, domestically processed packaged milk (pasteurized and UHT) and boiled unpackaged milk. The most commonly consumed dairy products include: yogurt and indigenous fermented milks, ghee, butter, cheese of different types, ice cream, sweet and sour cream. K2-Consult 2002 suggest that milk in Uganda is consumed in five main forms, 1) warm after boiling, 2) cold after boiling, 3) in beverages, mainly tea, coffee and cocoa, 4) in raw form (unboiled), and 5) as a fermented milk. Based on these consumption habits, unprocessed milk marketed through the informal channels exhibits the highest demand followed by processed packaged milk. Different types of imported milk including milk powder, UHT and condensed milk are available in many supermarket outlets. Such products are, however, consumed by a small segment of the population comprising mainly the high-income class and expatriates.

According to K2-Consult 2002, the high-income groups and people with a traditional cattle-keeping origin consume the most liquid milk directly (cold or warm after boiling), and these groups also exhibit the highest levels of milk consumption. However, consumption of milk in beverages such as tea is the most common practice among most Ugandans. Drinking raw milk (un-boiled) is common among traditional cattle-keeping groups. This is, however, a dangerous mode of consumption due to the potential transmission to humans of zoonotic diseases such as brucellosis. The fermented milks consumed in Uganda are mainly those made through traditional fermentation of raw milk often simply through natural spoilage. The market for yogurt, commercially fermented milk, seems to be steadily increasing based on the number of processors currently involved in its production. (K2-Consult, 2002). Nevertheless, the consumption of processed dairy products (ghee, yogurt, butter, cheese, ice cream) is very low compared to the consumption of milk. Demand for these products only amounts to a few thousand liters raw milk equivalent per day.

Household consumption

Estimates of milk consumption among households are subject to chronic shortcomings due to a) the wide variation in consumption patterns between households in different regions, ethnic/religious groups, and levels of income b) seasonality in consumption patterns, and c) the fact that a significant proportion of dairy product consumption may occur outside the household (milk in tea at the office, etc). Nevertheless, the data available may allow some indications. Analysis of the IFPRI land management data (577 households) showed that the northern region had the lowest per-capita annual milk consumption followed by eastern, central and then western (Table 2). In general these per-capita milk consumptions were lower that those estimated by K2-Consult (2002) but they followed the same order save central region, which according to that analysis had the highest while this results placed it third. The K2-Consult consumption figures are very high, suggesting per capita annual consumption of 91 liters in the central region, and 52 liters in the west. Given their small sample size, these should not be regarded as reliable. Urban households are expected to consume more milk, and as well as higher income households.
MAAFI/ILRI (1996) estimated levels of per-capita milk consumption to be about 75, 38 and 13 liters for high, medium and low-income households respectively, ignoring regional differences. These great differences highlight the variation between households that makes accurate milk consumption estimates difficult.

### Table 2: Household milk consumption by region

<table>
<thead>
<tr>
<th></th>
<th>Northern</th>
<th>Eastern</th>
<th>Central</th>
<th>Western</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average household size</td>
<td>5.2</td>
<td>5.4</td>
<td>5.1</td>
<td>5.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Average milk consumed per household per day (liters)</td>
<td>0.1</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Estimated milk consumed per household per year (liters)</td>
<td>26.7</td>
<td>98.3</td>
<td>127.5</td>
<td>171.6</td>
<td>117.8</td>
</tr>
<tr>
<td>Estimated milk consumed per person per year (liters)</td>
<td>5.4</td>
<td>17.4</td>
<td>26.3</td>
<td>33.8</td>
<td>22.1</td>
</tr>
</tbody>
</table>

Source: IFPRI Land management survey

Given that the IFPRI survey was not designed specifically to address dairy product consumption, the figures in Table 2 should be regarded as indicative of relative differences between regions, and not as good measures of levels of consumption. The general picture that emerges is that milk consumption is highest in the Western region, an area of traditional cattle keeping, somewhat lower in Central, declining to Eastern and Northern regions. A crude average among the regions, which is not weighted by human population, is per capita consumption of 22.1 liters, which is lower than 46 and 30 liters estimated by the K2-Consult (2002) and Foodnet (2002) respectively. Clearly, accurate estimates of individual consumption levels have not yet been produced. Below, in the section on demand and supply projections, we suggest some estimates of average milk consumption levels based on comparisons with production.

The World Health Organization milk consumption recommendation of 200 liters per annum is often quoted as standard by which consumption should be measured in all countries. However, it should be recognized that even in many rich industrialized countries, this level of consumption is not met – Japan for example. In spite of that, it would be difficult to argue that those Japanese consumers are malnourished. Milk consumption is clearly tied to traditional habits, and in some societies, other sources of protein and micronutrients are more important and are adequate. Levels of milk consumption should be viewed in the context of household purchasing power, and total consumption of proteins and micronutrients.

**Milk and Dairy Product Marketing Chains**

The two main channels of marketing milk and dairy products in Uganda are the formal and informal markets. The informal market can be described as that which supplies fresh raw milk and traditional products such as traditionally soured milk and which operates using traditional rather than modern handling and processing practices. It may also operate largely outside of formal milk market regulation. The formal market focuses on Western-style products using modern processing and handling methods, and operates largely within market regulations.
The informal market is driven by the unwillingness of poor consumer households to pay for the extra costs of pasteurization and packaging, and by their preferences for raw whole milk. A 1993 survey conducted in all the major milksheds, showed that majority of milk consuming households preferred raw milk (over 60%) compared with pasteurized milk (DCI, 1993). As might be expected, fresh whole milk was found to be popular with low-income households, while pasteurized milk was consumed mostly by the higher income groups. Other reasons why informal milk market is important to consumers are: easy access to the milk as much is delivered to doorstep, and low priced milk. However, for the consumers whose choice of where to buy milk is determined by quality prefer buying from collecting centers and retail outlets because they are assured of higher quality. According to K2-Consult (2002), among the households who buy unprocessed milk, the majority buy it from vendors, while others either get it directly from farmers, collecting centers or retail outlets.

While estimates vary significantly, it is clear that the informal market commands the largest share of milk and dairy product market in Uganda. MAAFI/ILRI (1996) estimated the informal market at 92% of marketed milk. K2-Consult (2002) came up with approximately the same estimate, suggesting that less than 10% of the milk produced in various regions is traded in the formal market. A recent report by Kasirye (2003) suggests that of the total installed capacity in the formal market of 343,000 liters/day, only some 30% is currently utilized on average, which gives a measure of formal market activity. Comparing this to total national milk production (estimate of 743 million liters – see below), and assuming that 40% of milk is not marketed (10% for calves, 5% lost, and 25% consumed in producer households), this again leads to the figure of 92% share for the informal market of all marketed milk. This figure thus seems to be somewhat robust, and appears not to have changed since the mid 1990s, in spite of significantly increased activity by the private sector in milk processing and dairy product promotion.

**Practices in informal and formal milk markets**

Informal market practices are considerably varied. As illustrated in the milk marketing chain diagram (Figure 9) the farmer either vends his/her milk directly to the consumer or may pass through one or more middlemen before reaching the final consumer. S/he may either take milk directly to a roadside collection point or sell to a rural trader, who either takes the milk, usually by bicycle to a collection point or sells to a second trader or directly to a consumer.

Informal sector traders who don’t have access to milk coolers often have boiled milk to maintain shelf life, and sometimes to readily available chemical preservatives such as hydrogen peroxide to reduce spoilage. Traders may also add water to milk in an attempt to increase revenue. Precisely where these practices occur in the informal sector supply chain is not clear. Milk wholesalers tend to blame the bicycle men but there are incentives for sellers to adulterate milk at all levels of the supply chain, so in reality the problem is probably widespread. In Kenya, research on milk quality found that adulteration varied considerably by season and by market channels, with more adulteration in the dry season when milk prices were higher and the economic incentives to increase volume greater (Omore et al, 2001).

Formal market practices are in many cases similar to those in the informal market, and sometimes they overlap in the sense that they are the same market depending on
some of the same market agents. In the formal market, there may be even more intermediaries between the farmer and the consumer. Farmers may deliver milk directly to milk collection points (MCPs), or to processing plants. In other cases, traders buy the milk from the farmer and sell it at a milk collecting point. These traders most commonly sell their milk at privately owned MCPs or MCPs which serve some processors whose quality requirements are less stringent than those of Dairy Corporation Ltd (DCL). The DCL may be a less attractive client because of its low buying price and mode of payment as well as stringent quality requirement. Processing plants collection milk from the MCPs, for delivery to the plant. Once private factories have processed their milk, it is taken overnight to depots in Kampala from where most of it is distributed early in the morning to retail outlets. Some milk is sold from depots to informal sector distributors (the “bicycle men”), and some is sold by street vendors, often women. Indeed, K2-Consult (2002) indicates that the majority of the processed milk consumed is bought from such vendors.

In both markets, milk is often transported in 20-litre plastic jerry cans from various centers until a van is full. Plastic jerry cans are preferred over aluminum churns by vendors because they are cheap and easily packed on the vans to maximize the carrying capacity. Such containers are not of food-grade standard, and some moves towards increased use of approved metal milk cans is occurring under new regulatory pressure from the DDA.

The areas of overlap between formal and informal markets are the following:
- traders who buy milk from farmers to delivery to MCP’s may also sell raw milk to other traders or consumer
- raw milk traders may buy milk from the same MCP’s that serve processors
- some retail vendors may sell either raw or pasteurized milk.

These areas of overlap and joint activity are important in that they point to areas where the development of formal markets can build on existing market agents currently working in the informal market. This suggests that formal market development need not necessarily have large negative consequences for the employment generation that occurs in the informal market. The potential for general employment is likely to be greater in the informal market. In Kenya for example, research has shown that every 100 liters of milk handled on a regular daily basis in the informal market creates approximate two full time jobs, at wages higher than the official minimum wage (Omore et al, 2002). Any new policies and regulations affecting these markets should take these facts into account, and while enabling the development of the formal market should assist the effectiveness of the informal market in maintaining standards of quality and hygiene.
Figure 9: Milk market flow diagram

**INFORMAL MARKET**

- Farmer
  - Rural trader
    - Collection point
      - Itinerant trader/urban wholesaler
        - Urban wholesale market or urban milk cooling center
        - Bicycle mounted trader or street side vendor
          - Consumer

**FORMAL MARKET**

- Farmer
  - Fed to calves
  - Farm gate sales
  - Processing plant
    - Distribution depot
      - Retail outlet

Post harvest milk losses

Milk is obviously highly perishable and considerable attention must be given to hygiene practices, preservation, and appropriate container use at all market levels in order to avoid quality deterioration due to bacterial buildup. Losses due to spoilage are however difficult to estimate reliably. K2-Consult (2000) estimates farm losses at 22.5%, informal market losses at 37%, and formal market losses were estimated at 17%. A recent report by Kasirye (2003), estimates losses in the formal sector processing at <1%, and at MCP at 11% and 37% in dry and wet season, respectively, and losses on farm at 10-52%. Clearly, the estimates vary widely and must be regarded as unreliable, except perhaps for those in processing, which are more carefully recorded. It should also be noted that spoiled milk on farm and even at collection points may not be fully “lost”, in that soured milk has value and may often be consumed. Its value per unit may nevertheless have declined compared to fresh milk. The above estimates appear to combine both complete losses (spillage) with partial losses (spoilage in some settings). Given these uncertainties, an assumption of 5% total losses (loss of the full value of the milk) is used in the dairy sub-sector analyses in this report. A new project led by the FAO on post harvest milk losses in Uganda, Kenya, Tanzania, Ethiopia and Syria is addressing this issue, and will have more clear indications by 2004.

Competitiveness of the informal and formal markets

According to K2-Consult (2002), in all regions the monthly profit margin realized from vending raw milk is several times higher than that realized from vending processed milk. Labor and transport costs are the major expenses in vending processed milk. These results were also confirmed by Foodnet (2002). According to Foodnet (2002) the farmers associations’ milk collecting points and formal sector milk processors were making financial losses. Results from cost/benefit analysis showed that losses from collecting points were mainly due to poor cost management and low throughput. Formal sector milk processors operated below capacity (30% capacity utilization, according to Kasirye, 2003) and with high cost of operations. Examination of a large UHT processor in southwest Uganda also showed that the large losses were due to operation at low capacity and poor cost management.

Transactions in milk supply chains are mainly conducted on a spot cash basis hence there are minimum transaction costs for sellers. In this type of instant transaction risk (particularly that of spoilage) is transferred at each link of the chain. However, a few farmers, particularly those located far from milk collection points, sell milk on credit, which in some cases may make these farmers vulnerable to economic losses if buyers do not pay reliably.

It should be noted that margins in formal and informal markets are not only driven by differences in the levels of variable costs and investment required, but also by consumer willingness to pay for differences in quality, which is largely reflected in price. Only with greater consumer demand for quality, or with lower variable costs and thus retail prices, will the formal sector be able to increase market share, and so reduce the inefficiencies cause by underutilization of capacity.
Quality and safety regulations

Ensuring that all stakeholders handle milk appropriately requires an efficient regulatory mechanism to control their activities, but also requires that standards are set appropriately and practically, and incentives are provided for compliance. K2-Consult (2002) suggested that Uganda lacks an efficient regulatory mechanism despite existing laws such as in the Dairy Industry Act of 1998, which provides for the processing and marketing standards. This stems from the observation that regulations are commonly ignored, which problem is attributed to light penalties and constraints to law enforcement. The fact that the standards may not be practical from the point of view of market agents and consumers is not considered.

A modern food law was drafted by the UNBS and when enacted to a law would be expected to provide a legal framework for regulating the quality of milk and dairy products. In addition, Uganda Dairy and Industry Stakeholders’ Associations (UDISA) together with Uganda National Bureau of Standards have completed formulation of Code of Practice for Raw Milk Handling and Marketing. However, it is unclear to what extent such top-down regulations will be observed by the mostly small agents in the dairy industry. Experience from around the world has shown that when regulations try to impose high economic costs on market actors, then they are largely sidestepped through informal market activity, even if such activity poses increased risk of fines and confiscation of goods and equipment. Partly as a result, informal milk markets dominate most developing country dairy industries, including in India, the world’s largest milk producer, where some 85% of milk is channeled through informal and traditional markets. A more successful approach to raising standards is likely to be achieved through engaging directly with the primary market agents (small scale in the case of Uganda) to match standards with their ability to comply.

The DDA has taken positive steps to engage directly with those considered to be outside of the regulatory framework (small-scale traders) ADD BITS HERE FROM UGANDA FAO REPORT

Dairy product exports and imports

Since the dairy industry in neighboring countries of Rwanda, Burundi and the DR Congo are not well developed many government and consultancy reports suggest the existence of considerable market potential for dairy exports to these countries. Due to extremely high population densities (and attendant land scarcity problems), potential for significant dairy exports to Rwanda appear feasible and attractive (once political stability is restored in those countries). Indeed, in 1995 there was considerable formal sales of fresh liquid milk to Rwanda from Kabale district, estimated at about an average annual volume of 2.6 million liters, which has since been reduced due to Rwandan government restrictions on imports of raw milk. Exports to Kenya have also been a feature of the industry in recent years, due to lower milk prices in Uganda generally compared to high prices in the milk deficit zones of Kenya close to the Ugandan border. Anecdotal evidence exists to suggest that the informal market exports raw milk to Kenya, sometimes from as far away as Mbarara.

Some milk and milk products have also been imported regularly, much of which may be supplying demand for specialty products such as cheeses that local processors may
find difficult to match in terms of quality. As shown in Table 3, Uganda has been a net importer of dairy products in the 1990s in value terms. This does not include informal market trade, and there are some suggestions that exports have increased recently in relative terms

Table 3: Import and export of dairy products by value (‘000 US $) for 1994 – 1999

<table>
<thead>
<tr>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Imports</td>
<td>2,817</td>
<td>2,657</td>
<td>2,376</td>
<td>1,485</td>
<td>3,285</td>
<td>1,471</td>
</tr>
<tr>
<td>Exports</td>
<td>239</td>
<td>275</td>
<td>254</td>
<td>476</td>
<td>2,622</td>
<td>163</td>
</tr>
</tbody>
</table>

National Milk Production and Supply Estimates

Milk production trends

By about 1970 to 1971, Uganda produced an estimated total of 353 million liters and the effective demand for liquid milk was almost met (MAAFI/ILRI, 1996). However, from 1971, as a result of general economic decline and civil strife, the dairy industry collapsed and the gap between supply and demand started widening again. Since 1986 a number of policies have been pursued leading to a turn around of the dairy industry. According to MAAIF/ ILRI (1996), national milk production and marketed milk increased at a rate of 2.85% per year in the period 1990 to 1995 (Table 4).

Table 4: Milk production estimates and sources of information (M l/year)

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<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAFI/ILRI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Produced</td>
<td>353</td>
<td>365</td>
<td>-</td>
<td>420</td>
<td>-</td>
<td>436*</td>
</tr>
<tr>
<td>Marketed</td>
<td>-</td>
<td>203</td>
<td>-</td>
<td>234</td>
<td>-</td>
<td>283*</td>
</tr>
<tr>
<td>FAO</td>
<td>247</td>
<td>430</td>
<td>456</td>
<td>458</td>
<td>509</td>
<td>511</td>
</tr>
<tr>
<td>IFPRI land management survey/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>national hh survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K2-Consult</td>
<td>-</td>
<td>-</td>
<td>362</td>
<td>-</td>
<td>640</td>
<td>786</td>
</tr>
</tbody>
</table>
*Estimated in 1996 through projections

However, estimates of national production figures vary quite widely. The estimates of milk production in Table 4 differ significantly because they are derived using different methods and sources of data. Where surveys are sources of information, such as in MAAFI / ILRI (1996) and K2-Consult (2002) the sample sizes were small and could not allow very accurate estimation of national production. For example, the estimate of K2-Consult (2002) used cattle population from old census results and milk yields estimation averaged across regions, in spite of different breed mix among cattle populations. Using the estimated cattle population of 6.0 million head and assuming that lactating cows constituted 50% of the herd, and based on the findings of 21.82 liters of milk per month, K2-Consult (2002) estimated national milk production for the year 2000 to be 786 million. The cattle breed and yield data from the IFPRI land management survey combined with estimates of cattle numbers from the national household survey, leads to an estimate of national milk production of 743 million liters. This compares well with the 718 million liters for 1999 estimated by Uganda Investment Authority®. However, FAO indicates significantly lower figures, 511 million for 2000. The actual current figure is thus likely to be in the range of 550-750 million/year, although the low end of the range suggests no growth in per cow yields. It is interesting to note that this range is higher than the projection made in 1996 of 436 million for 2000, which was based on trends in growth of production in the early 1990s. This suggests that growth in production accelerated in the second half of the 1990s, which may also be suggested by the apparent unrecorded increase in the proportion of improved cattle, as indicated above. This has implications for potential future growth of the dairy sub-sector, in the context of relatively low levels of

®Uganda Investment Authority website- http://www.ugandainvest.com
demand. This is addressed further in the discussions of sources of growth and of consumption below.

**Sources of change in increase of national milk production**

According to K2-Consult, 2002, the increase in milk production from mid 1980s to mid 1990s was attributed mainly to increase in cattle population and very little if any to animal productivity. This is supported by the official data on trends of cattle population and milk production from FAO data show that increase in milk production has mainly come from increase in cattle population (Figure 10).

![Figure 10: Trends in national cattle population and milk production](image)

Source: FAO data

Similarly, a further analysis by Nicholson et al (2001) using FAO data, showed that although there was annual growth rate of 2.6% in milk production between 1985 to 1998 the main cause of growth was percentage of cows milking, which contributed about 73% of the change while increase in herd size contributed 22% (Figure 11). Based on FAO figures, there was zero growth in productivity with yield remaining at 350 liters per cow per year during that period on average across all breeds of cattle and production systems.
Figure 11: Changes in milk production, yield and number of cows, based on FAO figures.


Table 5: Sources of change in total milk production for Uganda, Tanzania and Kenya.

<table>
<thead>
<tr>
<th>Source</th>
<th>Milk production (million lts)</th>
<th>% Change</th>
<th>Herd effect</th>
<th>% Milking effect</th>
<th>Productivity effect</th>
<th>Interaction effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>355</td>
<td>2.6</td>
<td>22</td>
<td>73</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Tanzania</td>
<td>430</td>
<td>3.4</td>
<td>28</td>
<td>19</td>
<td>41</td>
<td>11</td>
</tr>
<tr>
<td>Kenya</td>
<td>1,484</td>
<td>4.1</td>
<td>10</td>
<td>61</td>
<td>18</td>
<td>10</td>
</tr>
</tbody>
</table>


In Kenya and Tanzania, increases in per cow yield have contributed to average annual growth in production since 1985 of 4.1% and 3.4% respectively. According to the official figures, in contrast to Uganda, increase in milk yield contributed 18% and 41% of increase in total milk production for Kenya and Tanzania, respectively (Table 5). This would mean that yield in Uganda has remained unchanged despite investment by NGO’s and donors such as DANIDA, USAID and FAO who have targeted development of the dairy industry. However, as indicated above, the available survey evidence suggests that the proportion of improved cattle has increased more than is currently recorded, and partly as a consequence yield and total production have also increased more than is acknowledged. Assuming the high range estimate of 743 million liters annual production, this would suggest that per cow annual yields have increased to some 495 liters, an increase of over 40% during a 15 year period. This production estimate would also suggest that the overall rate of increase in production has been 3.8%, close to that observed in Kenya.

The herd effect refers to growth in milk production due to increase in overall national herd, the % milking effect is that growth due to increase in proportion of milking cows in the herd, and the productivity effect is that growth due to increase in yield per milking cow. The interaction effect captures some of the growth trends associated with a combination of the above factors.
In general, the above discussion and differing estimates suggest that accurate figures on total production and on average yields are not available, and that a greater effort to obtain accurate livestock data across the country may be needed. However, the survey data available points clearly to the possibility that yield and production growth have been stronger than officially reported.

**Changes in milk Prices**

Low farm-gate milk prices, which vary from season to season and region to region, are cited by farmers as one of the major constraints to milk production. According to K2-Consult (2002) the main reasons given for low prices were cost of labor and transport to the farms and collecting points, abundance of seasonal supply by farmers and the low prices offered by processors in turn driven by willingness of consumers to pay. In western Uganda, the region producing the largest quantity of milk but farthest from the main consumption areas, average farm gate milk prices are the lowest throughout the year, particularly in the wet season. The processors who collect the milk from these areas factor in the cost of labor and transport, and thus offer low price to the farmer. According to Foodnet (2002) the informal sector offers higher prices than the formal sector thus farmers and rural traders prefer to sell their milk through informal sector traders. This is in spite of formal market processors being reliable buyers who can be depended on to buy milk regularly. This price structure is typical of milk markets in many developing countries, and mirrors that found in Kenya and Tanzania.

According to MAAIF/ ILRI (1996) farm-gate milk prices increased from UShs 60 in 1988 to 270 by June 1995. However, since then in the period 1995 to 2000, prices for central and western regions, the main milk producing regions, decreased by 16% and 36%, respectively (Table 6). The IFPRI survey data suggest much higher prices, but this is based on a very small sample of a few dozen farms, and cannot be regarded as reliable.

Table 6: Regional price estimates by various studies (Ushs)

<table>
<thead>
<tr>
<th>Year</th>
<th>Source</th>
<th>Central</th>
<th>Western</th>
<th>Eastern</th>
<th>Northern</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>MAAI/ ILRI</td>
<td>280-450</td>
<td>240-350</td>
<td>-</td>
<td>-</td>
<td>270</td>
</tr>
<tr>
<td>2000*</td>
<td>K2-Consult</td>
<td>228-243</td>
<td>202</td>
<td>299</td>
<td>350</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>IFPRI land management survey data</td>
<td>308</td>
<td>189</td>
<td>518</td>
<td>767</td>
<td>388</td>
</tr>
</tbody>
</table>

*Prices for year 2000 have been deflated using CPI and 1995 as base year. From World Bank Group website-http:www.worldbank.org/data/dataquery.html

Figure 12 shows the changes in real milk prices for central and western regions between 1995 and 2000. This fall in milk prices acts as a disincentive to expansion and intensification of dairying.
Prices play a major role in decision making process of a farmer during resource allocation among various competing enterprises. At micro level market prices may be reflective of a number of supply, demand and policy factors. The geographic location of producer and consumer affect the cost of delivery thus prices may show spatial pattern due to condition of roads and distances traveled. According to Staal et al (2002) the costs include cash cost of transport, labor, processing, plus a reasonable profit, and also unobserved cost of the risks posed to buyers and sellers of non-delivery and non-payment, among others. Due to lack of detailed market margin and cost data, and because of unobserved nature of some costs, a few available spatial and household variables were used to determine the effect of these costs on milk prices. By using prices as dependent variable the analysis allows estimation of the manner in which producer prices decay as one moves away from markets.

In the case of Uganda, however, the available data were not adequate to conduct a spatial analysis of farm gate milk price differences. Nevertheless, data on price changes over time are adequate to suggest that decreases in real farm gate prices over time have been significant. These may be closely linked to the apparent significant increase in overall production and thus milk supply during the recent past.

**Projecting milk consumption**

If we translate the estimated milk production figures into potential consumption, we get some range of overall consumption levels that match those suggested from the surveys. The 2000 milk production estimates above of 511 to 743 million liters translate into per capita consumption of some 19 to 28 liters per annum, which approximates the range of the IFPRI and Foodnet surveys, although somewhat lower.\(^{10}\) If post-harvest milk losses are higher, as suggested by KS-Consult, then

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\(^{10}\) Assumptions used to make these consumption estimates are that 10% of production is fed to calves, 5% of milk is lost through spoilage or spillage, and that human population in 2000 was 22.5 million (using estimate of 22 million for 1999 by Uganda Bureau of Statistics). It is also assumed that dairy product imports and exports net to zero, or to a negligible proportion of total production.
consumption levels are even lower on average. Given the fact that the estimate of 743 million liters should be regarded as the top of the potentially reliable range, then it is very unlikely that average consumption per person exceeds 30 liters per capita, and is more likely in the mid 20s range, given losses and other uses of milk on farm, such as for calf feeding.

For the purposes of projections, we have used the higher figures for production and consequently for consumption, given that they are supported both by the farm level surveys of production, and by the household level surveys of milk consumption. Using the figures at the upper end of the range, Figure 13 compares levels of milk production and per capita consumption in Uganda and its neighbors Kenya and Tanzania.

FAO data suggest that per capita milk consumption in Kenya decreased from 77.8 liters to 72.6 liters between 1995 and 2000, although as in Uganda, there is evidence that production is much higher than officially reported (unpublished data, Smallholder Dairy Project, Kenya). However, regardless of the exact figures, it is clear that per capita consumption remains far higher in Kenya compared to Uganda and Tanzania.
An important issue in considering milk consumption is not simply the per capita level, but the level of consumption relative to income. Low consumption per unit of income may suggest an additional area of potential growth in demand. In order to assess this, we compared per capita income estimates with a rough proxy for per capita income, which is annual per capita GDP.

Figure 14 compares the ratio of per capita annual consumption with per capita annual GDP. The ratio thus describes the units of milk consumed per approximate unit of income in $.
The results in Figure 14 show clearly that consumption per unit income in Uganda is very low compared to both of its neighbors. Only some 24 mls of milk is consumed on average per $ GDP in Uganda, compared to 36 mls in Tanzania, and over 70 mls in Kenya. This is in spite of the fact that per capita milk consumption levels are lower in Tanzania – they nevertheless apparently spend more of their income on milk as a proportion. These results have important implications in that they suggest that purchasing power may be less of a constraint to increased consumption in Uganda compared to its neighbors, if consumer interest and preferences for milk can be increased.

**Projection of Demand and Supply of Dairy Products**

Accurate projections in demand and supply of dairy products to determine the production gaps are difficult to make in the absence of reliable data on their key determinants such as cattle population (including its growth rate), and income elasticity of demand for milk products. However, some projections of supply and consumption of milk in Uganda have been made below, based on the data available.

The demand for milk, like other consumer goods, is a function of population size, income levels and the price and income elasticity of demand for milk, retail price, and taste and preference over other products. The supply of milk is mainly influenced by producer prices, access to resources and services, the size of the national dairy herd and estimated milk yields. The levels of consumption and supply of milk can be
forecasted based on assumptions about trends in these variables. Given the uncertainties, several possible scenarios are examined.

**Projections in milk supply**

The projection in supply up to the year 2010 assumes increase in national milk production will continue emanating from continued growth in cattle population and in yields. However, since it is not possible to differentiate these sources of growth, an overall rate of growth in production is used instead. We begin with the high range estimate of 743 million liters above. Two scenarios are projected: a) an annual growth rate of 2% in milk production, which is a growth rate that represents an intermediate figure based on estimates of recent trends, of 0% growth according to some official figures, and 3.8% growth based on the our estimates using recent farm level data (described above), and b) an annual growth rate of 3.8%, the high range of the estimates above. Fifteen percent of production is assumed to be fed to calves (10%) and lost through spoilage and spillage (5%), so supply is 85% of total production. Much of this may be consumed within producer households. The 2% growth rate scenario leads to a total supply in 2010 of 763 million liters, about a 21% increase from the 2000 level of 632 million (85% of 743 million estimated above). The 3.8% growth rate scenario leads to a total supply in 2010 of 917 million liters, about a 45% increase from the 2000 level. The high range of the apparent current growth rate of 3.8% would thus lead to a substantial increase by 2010.

**Projections in demand**

To project milk demand and consumption to the year 2010, we begin with a human population growth rate of 2.37%\(^{11}\), population of 22 million and annual per-capita milk consumption of 28.5 liters, again based on the high range estimate above. Further, the human population growth rate is assumed to decline by .05% annually, so that by 2010, the growth rate is 1.9%. The income elasticity of demand for milk is assumed to be 0.8, which is similar to estimates from other countries. Two scenarios are considered a) an average real GDP growth rate of 4%\(^{12}\) which reflects recent trends in the Ugandan economy and b) and a GDP growth rate of 2%, which reflects the possibility of an extended economic slow-down. Other factors that affect milk consumption (the relative price of milk, etc) are assumed to remain constant. The 4% GDP growth rate scenario results in an overall level of consumption in 2010 of 1,064 million liters, while the 2% growth scenario leads to a lower estimate of 911 million liters.

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\(^{11}\) International Finance Center website- http://biz.yahoo.com/ifc/ug/

\(^{12}\) IMF website- http://www.imf.org
Figure 15 illustrates the supply and consumption projections under the alternative scenarios. Under the conservative growth rate assumptions (2% in milk production and 2% in GDP), demand outstrips supply in 2010 by 148 million liters. In a mixed scenario of 3.8% growth in production and 2% growth in GDP, supply approximately equals demand, exceeding it by just 7 million liters. Under the strongest growth assumption (3.8% in production and 4% in GDP), demand again outstrips supply by 147 million liters. It should be noted that the projections consider the national aggregate only, without looking at the distribution of supply and demand regionally in the country. Acknowledging the obvious inadequacies of these rough estimates and the assumptions required, the results suggest nevertheless that demand could exceed supply under several alternative scenarios – either under moderate growth in production, or under strong growth in incomes, even with strong growth in production. The results suggest that continued investment in dairy development is justified. If consumption as a proportion of income increase, as Figure 14 suggests may be possible, then the supply gap could be even larger, and opportunities for smallholder producers even greater.

**Mapping of milk surplus and deficit**

Most milk production has been reported to be restricted to the area found in the belt South of Latitude 1º, commonly referred to as the milk shed area. This area extends from Mbale in the East to Kabarole in the West and Kabale in the Southwest (K2-Consult, 2000). According to DDA figures approximately 52% (360 million litres per annum) of Uganda’s milk comes from 12 Districts in the south-west of the country, with Mbarara alone producing 15% (105 million litres) of the national total. The only other region of the country that contributes significantly to production is the northeast,
where Kotido and Moroto’s nomadic cattle herders produce an estimated 16% (112 million litres) of national milk output. The proportion of this milk that is marketed is probably low. However, as noted by Waithaka et al, 2002, the regions assumed to have surplus milk may end up with pockets of deficit when analyzed using GIS. Mapping of milk supply and demand using GIS conspicuously reveals pockets of potentially unmet demand. According to land management survey data the estimated national milk production for the year 2000 exceeded national demand by 251.9 million. This may erroneously imply that all the parts of the country were self-milk sufficient.

To scrutinize the pattern of milk surplus or deficit in all parts of Uganda the analysis was disintegrated to parish level. Estimates of annual surplus or deficit of milk per parish was calculated and mapped based on estimated production and consumption, and the results are shown in Figure 16 (see Appendix for details of the estimations).

![Figure 16: Estimated milk surplus or deficit, in kgs of milk/year/square kilometre, by parish.](image)

These rough estimates suggest that there are low levels of milk deficit across large parts of the country, particularly in the north and central-west. Larger deficits are suggested in the east. Surpluses can be found in the lake zone and in the west and southwest. It should be noted that in many cases, milk markets would bridge the surplus deficit gap, by moving milk from surplus areas in the southwest and around Kampala to urban consumption centers. It should also be noted that because there is no differentiation in types of local cattle, milk production in the southwest may be underestimated due to use of higher-yielding Ankole cattle.
This analysis allows the focused targeting of dairy development investments. For example, milk deficit areas may benefit from investment in measures to increase production, while milk surplus areas may need additional attention to market infrastructure and institutions to help collect milk more efficiently.

**Conclusions**

This report examines current trends and circumstances in the Ugandan dairy sub-sector, with a view towards guiding new efforts in dairy research and development. The analysis relies on multiple sources of data; a) several reports on the dairy sub-sector produced over the last decade, including an appraisal of the industry conducted by ILRI with Ugandan partners in 1996, and b) primary data obtained from recent land management household surveys conducted by IFPRI in 2002, as well as from national household and community data surveys conducted by the Gov. of Uganda in 1999/2000. The latter data were geo-referenced and put into a GIS, and a key contribution of this report is the spatial analysis of patterns of dairy development and associated factors. Following is a brief description of some of key findings of the study. General implications for dairy research and development are indicated, in the context of a proposed model for pro-poor dairy development.

**Key findings**

**Increase in milk supply relative to demand**

The evidence shows clearly that there has been a significant increase in the seasonal surpluses as a result of increased milk production relative to demand. Although figures and estimates vary considerably, total milk supply grew from 350-400 M l/year in 1990 to some 550-750 M l/year recently. It appears that during the second half of the 1990s, growth in dairy production accelerated to a higher rate than experienced up until then. Further, this relative increase in supply is confirmed by falls in real prices of milk received by farmers. In the main milk producing area of the west, real milk prices (deflated by CPI) appear to have fallen by 36% between 1995 and 2000. This has indications for strategies for further dairy development: seasonal surpluses may require transforming milk for preservation, finding markets further afield, and stimulating demand. However, projections to 2010 suggest that under several scenarios of growth in milk production and in economic growth nationally, demand could still outstrip production, providing new opportunities in the industry and for smallholder farmers.

**Milk surpluses and deficits vary regionally across Uganda**

Analysis using GIS coupled with national surveys, comparing local milk supply and demand, shows clear areas of net milk surplus and deficit (see Figure 16). Areas in the west and around the lake zone exhibit overall surplus, requiring excess milk to be moved to urban consumption areas. In the east however, there are major areas of apparent overall milk deficit. Development strategies in surplus areas will necessarily aim to improve market infrastructure and reduce market transaction costs, while those in milk deficit areas may target increasing production. Further research will better define target zones for alternative development strategies.
Consumption of dairy products still low

Comparisons with neighboring Kenya and Tanzania show that in terms of per unit income per capita, consumption of dairy products in Uganda remains very low, in spite of recent growth in income levels generally. FAO figures on milk availability suggest that dairy product consumption, around 20kg/capita/year, did not increase during the period 1995-2000. As shown in the analysis, however, there is good evidence to support the view that average consumption overall nationally is around 28 kg/capita/year. Nevertheless, when compared to levels of average income, Uganda milk consumption is particularly low. In Kenya, where incomes are lower, some $0.07 of every dollar of income is spent on milk and dairy products, while in Uganda the figure is less than $0.02 (Figure 14). Efforts to increase demand, coupled with increasing incomes, may be key to a sustained growth in the dairy sub-sector.

Higher proportion of improved dairy animals than reported

Official figures suggest that improved dairy animals remain a very small proportion of total cattle population. In 1999, these were reported to be about 5% of the total. However, evidence from recent random surveys suggests that the proportion may be significantly higher overall, and over 50% in some areas specializing in dairy production. This contrasts markedly with FAO figures showed that although there was annual growth rate of 2.6% in milk production nationally between 1985 and 1998, the main cause of growth was simply the percentage of cows milking, which contributed about 73% of the increase, while increase in cattle numbers contributed 22% of the growth. (Figure 11). There was apparently zero growth in productivity, with yield remaining at a reported average of 350 liters per cow per year between the two years, suggesting little increase in proportion of improved animals. This is in sharp contrast to Kenya and Tanzania, where per cow productivity grew strongly during the same period. If one accepts recent national production estimates of over 700 M l/year, well above official estimates, then this would correspond with the higher estimates of improved cattle population, and increases in per cow productivity. Clearly, additional information is needed. The upcoming agricultural census should provide this.

Low availability of artificial insemination (AI) and veterinary services

In a potentially related issue, national community survey data show very low levels of access to AI services in particular (Figure 4). In many districts, less than 2% of communities reported availability of AI services locally, and in large parts of the country, particularly central-west and the north, there is no reported access to or use of AI at all. Access to AI is highest in the lake zone, although even there, not more than 30% of communities report access to AI. Reported access is higher in the case of veterinary services, with over half of communities reporting access in most areas (Figure 6). Again, there does appear to be some pattern to the level of access, with the highest levels occurring generally in zone of Lake Victoria, with a number of exceptions. While provision of these services, particularly AI, may largely be driven by level of demand, increased dairy cattle productivity in the long run may require interventions to increase their availability and access.
Informal milk market continues to dominate the sub-sector.

Although recent data are not very reliable, the informal or indigenous/raw milk market continues to dominate the dairy sub-sector. As in other countries such as Kenya and Tanzania that exhibit similar markets, this is driven by lower retail prices in such market channels, and consumer preferences for whole raw milk. The Gov. of Uganda, through the Dairy Development Authority, is now taking proactive measures to address this issue, by working with small milk traders and vendors to find mutually acceptable mechanisms for setting and enforcing minimum standards of milk quality and handling. Such positive policy interventions may reduce the informal trade to some extent, but that market is likely to continue to play an important role. Given that fact, interventions to improve market access and infrastructure will have to consider ways of working within the dualistic nature of the milk markets that smallholder producers participate in.

Conclusions

The findings of this study suggest that dairy development efforts will have to work within the context of a number of constraints, perhaps most importantly the apparent seasonal milk surpluses and relatively low consumption levels of milk. On the other hand, low demand per capita income may also offer an opportunity for generic promotion of milk consumption, as is being pursued currently by USAID/Land O Lakes in Uganda. Low productivity and access to services may also offer opportunities for positive interventions, given that areas for demand for those interventions are specifically targeted. Indeed, the study shows that this sort of targeting may be critical for successful interventions, as there is considerable variation in dairy production systems, constraints and opportunities across the country. Additional research will be necessary to accomplish more detailed targeting and assessment of potential impact of dairy development interventions. The data available currently were not adequate to accomplish this, such as quantifying impacts of milk market infrastructure through milk price formation analysis, as has been done in Kenya.
References


Appendix: Details of Data Analyses

Three main data sets were used in the analyses:

1. National household survey:
The survey was conducted in 44 districts of Uganda in the year 1999/2000. An average of 10 households were randomly selected from 1,086 communities across the country. A total of 10,760 households were surveyed. A structured questionnaire was used to capture agricultural production and marketing activities of the selected households. GPS readings were also taken to identify locations of the households.

2. National community survey:
Communities were selected using a stratified random sample of communities from the different development domains. A total of 1,086 communities were surveyed from across the country in the year 1999/2000. The responses were therefore community-level based. A structured questionnaire was used to capture agricultural activities of the communities. Questions asked in the questionnaire included market information of agricultural inputs and outputs, availability and prices of consumer goods and other assets and availability of veterinary, extension and A.I services. GPS readings were taken to identify locations of the selected communities in the country.

3. IFPRI land management household survey:
The survey was conducted in the year 2002. Household and plot level data was collected from a random sample of 577 households from 28 districts in the study communities. A structured questionnaire was used to capture agricultural production and marketing activities of the selected households. Questions asked were on household characteristics, livestock and crop production, asset ownership, training, services and labor availability. Details of cattle breeds and milk yields, sales and purchases were also captured. GPS readings were taken to identify location of the households. Eighty farmers were randomly selected from four communities for soil fertility trials and land management experiments.

Mapping of measures of farmer access to services

Data used to estimate access to services was the national community survey dataset with 1,086 community observations. Three types of services were considered: extension services, artificial insemination and veterinary services.

Extension services
In the questionnaire, respondents were asked to report the proportion of farmers in the community visited by the extension agents. Five responses were possible: all, many, about half, few and none. These were transformed into a quantitative measure as follows: All=100, Many=75, About half=50, Few=25, None=0. Mean level of service access was computed per county, which was then mapped, for the counties where data was available.

Artificial insemination services
Respondents were asked to report the proportion of cattle keepers that practice artificial insemination. Again the responses were as for access to extension services,
and similar transformations were carried out. Means were calculated by county and mapped.

**Access to veterinary services**

Here respondents were asked to respond yes or no to availability of veterinary services, with yes coded 1 and no coded 0. Averages were calculated per counties – these averages were simple proportions of communities in the county with access to veterinary service. County percentages were mapped, again only for counties where data was available.

**Mapping of average milk surplus/deficit**

**Milk yield and total milk production**

Average annual milk yields were calculated using the data gathered during the IFPRI household survey. For Zebu and crossbred/grade cattle the average annual reported yields per cow were 243 and 900 kgs respectively. These were assumed to apply to cattle nationally, with the following modifications.

These means were then modified for agroclimatic conditions, which were represented by the index of precipitation over potential evapo-transpiration (PPE), an index of rainfall and temperature. It was assumed that in areas with high PPE, milk yields would be 20% higher, while in areas with low PPE, they would be 20% lower. Using GIS, these modified milk yields were then mapped based on maps of PPE.

**Total number of cows**

Estimates were then made of the total number of cows per parish. This was done on the basis of national census figures and the national household survey. The census indicated the human population per parish. The national survey provided average household size per parish, to allow an estimation of the number of households per parish. The national survey also provided as estimate of the average number of cows per household. Thus HHs /parish * Avg no. of cows/hh in that parish = Total no. of cows in that parish. These figures were included in the GIS.

**Percentage of local versus cross/grade cattle**

The IFPRI household survey dataset (577hhs) was used for this estimation. Due to the relatively small sample size, this was done at the district level. For each district, reported cattle kept by surveyed households were summed as local and cross/grade, and the proportions of the two types computed. In some cases, where the few observations available were clearly not representative of the district as a whole, the mean percentage for the surrounding district was used instead. Data was available for 42 districts, which were then interpolated using GIS to cover the entire Uganda.

**Total milk production**

Total milk production per parish was then computed by computing the numbers of local and cross/grade cattle respectively, using the percentages and total numbers above. These were then multiplied by the respective yields and summed to provide total annual milk production per parish.
Milk consumption
This was calculated using the national survey dataset, which included data for weekly consumption per household. These were converted to annual. Using the average household sizes, this was adjusted to consumption per capita. This covered 1021 parishes in 44 districts (out of 48 for the whole of Uganda). These were combined as mean consumption per capita for the four main administrative regions (Western, Eastern, Northern & Central.). Human population figures per parish were used to estimate average annual consumption per parish.

Surplus/deficit computation
This was conducted at the parish level. Surplus or deficit is simply total average annual milk production minus total average milk consumption. After converting into a uniform unit of milk per square kilometer, this was mapped using the GIS.