Managing Dairy Cattle For International Competitiveness In Unfavourable Economic Environments

A Strategy for Developing Sustainable Competitive Advantage in Milk production in Jamaica

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SUMMARY AND CONCLUSIONS

The local production of milk has declined to 15.4 ml in 2004; 60 percent below the peak attained in 1992. This decline in output has resulted in substantial exit from the sector since 1990 by a majority of small and medium scale producers; 64% of these farmers having retreated from the formal milk market. Associated with this severe attrition has been a significant down turn in the demand for proprietary feeds for dairy cattle, fertilizers and other ancillary goods and services.

The principal factors which have impacted negatively on the demand for fresh milk have been identified as: -

i) **The influx of imported milk solids, particularly powdered milk**, which followed liberalization of the dairy trade in 1992. This in tandem with the simultaneous massive devaluation of the Jamaican dollar and subsequent prolonged high rates of inflation severely eroded consumer purchasing power.

ii) **The retention, in contravention of the GATT and WTO accords, of massive levels of domestic subsidies to milk producers in the main exporting countries; including high levels of export rebates**.

iii) **The absence, locally, of countervailing measures** adequate to nullify the negative impact of dumped milk solids on the market for locally produced milk. The prolonged retention of a soft tariff regime for imported milk solids; this in spite of a WTO-agreed bound rate of 100% duty on Agriculture imports, rendered the local sector unable to recover from the dislocations of 1992.

iv) **Excessive trade margins on fresh milk, ex-farm, have served to reinforce the clear shift away from liquid milk** by consumers. These trade margins have been driven by the introduction of the 'exclusive distributor' into the dairy chain as well as the ever-reducing capacity utilization at processing plants.

v) The vast majority of farmers, without any upstream integration into the market, were essentially helpless and hapless bystanders to the decimation of the market for their product.

vi) In spite of the obvious shift away from the consumption of high-priced fresh milk, **the opportunity was not grasped by the processing and manufacturing sectors to diversify into value-added products**, such as ice cream and yoghurt, imports of which have grown phenomenally, since 1996.

vii) As the initial link in the chain, local dairy farmers failed to influence any reduction in price through the non-adoption of appropriate and

available technologies to enhance their ability to compete with artificially priced imports.

viii) **Local traders in imported milk powder, the principal substitute for fresh milk, were handed, *carte blanche*, the opportunity to build consumer loyalty by pegging their prices sufficiently below fresh milk to retain the market while appropriating to themselves the majority of the surplus intended, *a priori*, for the consuming public, by government's retention of a low-tariff regime.**

ix) **As a consequence and in spite of the influx of milk solids commencing in 1993, consumption of milk and dairy products has declined 8% over the past decade; the poorest 40% of the population being even more marginalized with respect to minimum accepted standards of nutrition.**

Given its high direct multiplier effect on the economy as well as its linkages with other key agro industrial sectors, local milk production remains a highly sensitive segment of rural economic activity. The potential returns per hectare and the actual gains realized by many producers accord dairy farming high priority in any policy for rural development.

A sufficiently broad knowledge base is currently available to support significant increases in efficiency and the achievement of real and sustained international competitiveness in the local production of milk. **The factor central to Jamaican farmers attaining sustainable competitive advantage in the production of milk is identified as the increased utilization of pastureland**. This in turn is highly dependent upon the level of fertilizers, particularly nitrogen, applied to grass pastures. This has enhanced the cost- focused strategy pursued by New Zealand in achieving cost leadership internationally**. Given our superior natural endowments for the production of pastures, Jamaica's attainment of sustainable competitive advantage in milk production is limited only by the attitudes of all stakeholders to the obvious need for a paradigm shift in the conventional approaches to dairying at farm, manufacturing and marketing levels.**

The recovery of the sector ought to be considered a national imperative, which will require effective coordination, and cooperation between government and all other stakeholders in overcoming the economic, geopolitical and technological hurdles to the achievement of sustained international competitiveness.

RECOMMENDATIONS

The foregoing analysis provides a logical framework for recommended ameliorative action aimed at enabling the attainment of sustainable competitive advantage by the local dairy industry, having elucidated the strengths and weaknesses particular to milk production and marketing in Jamaica. The study has also identified technological and other strategic opportunities which might lead to recovery of the local sector; enabled by appropriate policy shifts. Government's catalytic role in the nation's attainment of sustainable competitiveness has been long accepted even in highly industrialized economies (Porter, 1985, 1990). This author has suggested that this enabling function of the state takes on even more critical importance in developing countries.

The World Bank has recently indicated its overdue recognition of Porter's axiom in its publication, **'Beyond the City. The Rural Contribution to Development**.' (de Ferranti *et al*, 2005). Among their recommendations is the restoration of a pro-rural bias to national priority setting within Latin America and the Caribbean, to exploit the higher returns to state investment in the rural versus urban (manufacturing) sector. They further stressed the need to provide breathing space to domestic agriculture in any liberalization strategy to afford this sector sufficient time to increase its competitiveness.

The congruence between the Porter axiom and current World Bank philosophy provides the contextual background for the following recommendations aimed at forging a national strategy for the rehabilitation of the local Dairy Industry.

A) Government as Catalyst and Enabler

- **Empowerment of the Jamaica Dairy Development Board** to function as the agency for the transformation of local dairy farming within the medium term into an efficient and internationally competitive economic activity primarily through policy intervention and as technology change agent.

- **Reform of the existing tariff regime for imports of milk solids** to provide, over the medium term, an enabling environment which would stimulate technology adoption and reinvestment in the local dairy sector.

- Enable the intended reshaping of the structure of the local dairy industry to **facilitate the critical upstream integration by local dairy farmers**. As a first step, facilitation of the completion of the Milk Marketing Project of the JDFF through the adoption of an appropriate business model is paramount.

- **Supporting focused site-specific (on-farm) research** to develop recommendations for pasture management specific to the unique geographical attributes under which individual dairy farmers operate.

Ideally, a zoned approach to agriculture is critical to enhancing competitiveness. In this regard any initiatives to attract new entrants into dairying should be based on exploiting the natural advantages of specific geographical niches. The alternative of intervening by way of irrigation, in particular, would impose a severe hurdle to entry.

- **Financing** (or co-financing with industry stakeholders), the establishment within HEART/NTA of **a medium-term programme of certification and ongoing skills upgrading for dairy farmers and potential entrants**. A 2000 MOU Min.Ag./HEART/JDFF already exists for the establishment of a modular training programme.

- Application of incremental revenues from tariff reform to the **widening of Government's social safety net programme to reduce the nutritional vulnerability of a significant segment of the Jamaican population.** In this regard the School Feeding Programme and the Food Stamp Programme offer the important added opportunity of positively influencing recovery of the local dairy farming sector.

- **Financing or co-financing with industry stakeholders research by the Scientific Research Council into the product diversification and value-added production critical to stimulating the demand for local milk**.

- **Enhancing overall industry competitiveness by promoting consumer awareness and sophistication**. In this regard the Consumer Affairs Commission of the MICT offers the possibility for ensuring that policy outcomes accrue more equitably throughout the value chain. As a first step disseminating information on industry costs is essential to enhancing consumer sophistication and driving down the inflationary effects of the excessive margins currently characteristic of the dairy trade.

- **Stimulating technology uptake by dairy farmers through access to financing** which recognizes the global realities of the cost of financing **technology change**. In this regard the current clear policy shift of the international financial bureaucracies should be urgently harnessed. Integral to this should be a focused campaign enabled through concessional financing to build recognition of grass as a crop.

- **Adoption of a clear and unequivocal policy on Jamaica Hope Breeding**. In this regard, it is recommended that **divestment** to the industry stakeholders be given consideration. The returns to Breeding organizations internationally, accrue from the premium prices attracted by animals of proven genetic merit; returns from milk contributing significantly less proportionally, than would be typical for commercial herds. The Bodles herd has not been adequately funded on a consistent basis, since the initiation of the series of structural adjustment of the Jamaican economy in 1997-1998. It has therefore been able to function,

neither as the elite pure-breeding herd originally intended, nor consistently yield returns to ensure its commercial viability. Any reorganization to ensure the adoption of commonly accepted principles of pure-breeding could be sustained only through divestment to committed industry stakeholders who would be better able to tap into existing sources of international financing normally accessible primarily to non-government organizations. As a transitional phase, consideration might be given to establishment of a **MinAg/JLA/Breed Society joint venture equity arrangement.**

B) Industry as Implementer

- **Dairy farmers need to send a clear signal to Policymakers of an unequivocal commitment to capitalizing on the opportunities provided by Government since 2000 to employ the mechanism of the Jamaica Dairy Farmers' Federation as an avenue for self-actualization and economic empowerment.**

- **Farmers and processors need to agree on the adoption of a payment scheme for milk based upon solids content** as a means of driving product diversification, increasing demand and accruing increased value throughout the chain.

- **Industry stakeholders need to develop a common recognition of fresh milk as a commodity. This therefore limits market strategy to a cost focus, particularly where the primary competition is heavily subsidized (at source) imports. Thus while the impact of technology change at the farm level is expected to be incremental, processors of liquid milk must seek to maximize plant capacity through appropriate product mixes to reduce processing and marketing costs and final costs to the consumer.**

- **Capitalizing on the yet available opportunities presented by the (transient) low international price of powdered milk to widen product mix and stimulate consumption of processed liquid milk through recombination**. This offers the possibility of offering fluid milk at prices as low as 25-30% below those of fresh milk. Current JBS regulations are understood to permit recombination providing the labeling of the product makes the distinction between fresh and recombined milk. It has been estimated (Jennings,2002) that this strategy, if properly targeted, could stimulate demand for as much as an additional 10 million litres of locally produced milk, annually, over the medium term.

- **Investment in R and D. As a means of driving ongoing innovation at farm, manufacturing and marketing levels of the chain.** Industry

stakeholders should commit to contributing to R and D or direct contract-financing of company-specific research by existing Agricultural and Industrial R and D institutions. The **Dairy Cess** to the JLA, in place since 1987 provides an appropriate model. Government could catalyze this process by a review of current Financial Accounting regulations to allow such contributions as legitimate investment (Jennings, 1994).

- Significant opportunities exist for **greater industry specialization as a key element of any strategy for attaining sustainable competitive advantage** Specialization into **replacement rearing** and **commercial production of fodder such as hays and haylages** would promote the increases in stocking densities on specialized milking farms required for greater feed conversion efficiencies. This is considered particularly essential to tapping the inherently higher levels of efficiency on small and medium-scale Dairy Farms. In a similar vein **tillage and general equipment hireage** would reduce the high fixed costs associated with underutilization of these resources on farms generally. This would promote the development of local competencies in areas such as **contract hay and silage making on large farms hence driving down the cost of producing milk.**

PREAMBLE

The Dairy Industry continues to be a significant sector of the Jamaican economy. At a mean per capita expenditure on milk and dairy products of $2,620 in 2003 (SLC: PIOJ/STATIN), the gross turnover from the industry of J$8.6 (including an estimated 25 percent of expenditure on meals away from home) was equivalent to 1.8 percent of Gross Domestic Product (GDP) (ESSJ: PIOJ/2003).

The local dairy farmers' share of this turnover has seen drastic decline since 1992 as local milk production fell from 38.8 million litres to 18.4 million litres in 2003 and further to 15.4 million litres in 2004 (Fig. 1). In constant dollars the farmer's share of dairy industry turnover as fresh milk, fell from 17.4 percent in 1994 to 9.7 in 2003 (Table 1). In terms of constant dollars expenditure on liquid milk and condensed (including evaporated milk), the principal manufacture utilizing locally produced fresh milk, was in reality equivalent to $222.7 compared to $411.6 per capita in 1994, a decline of 42 percent (Table 2). Simultaneously, but to a lesser extent, demand for dairy products in total, declined by 8.2 percent.

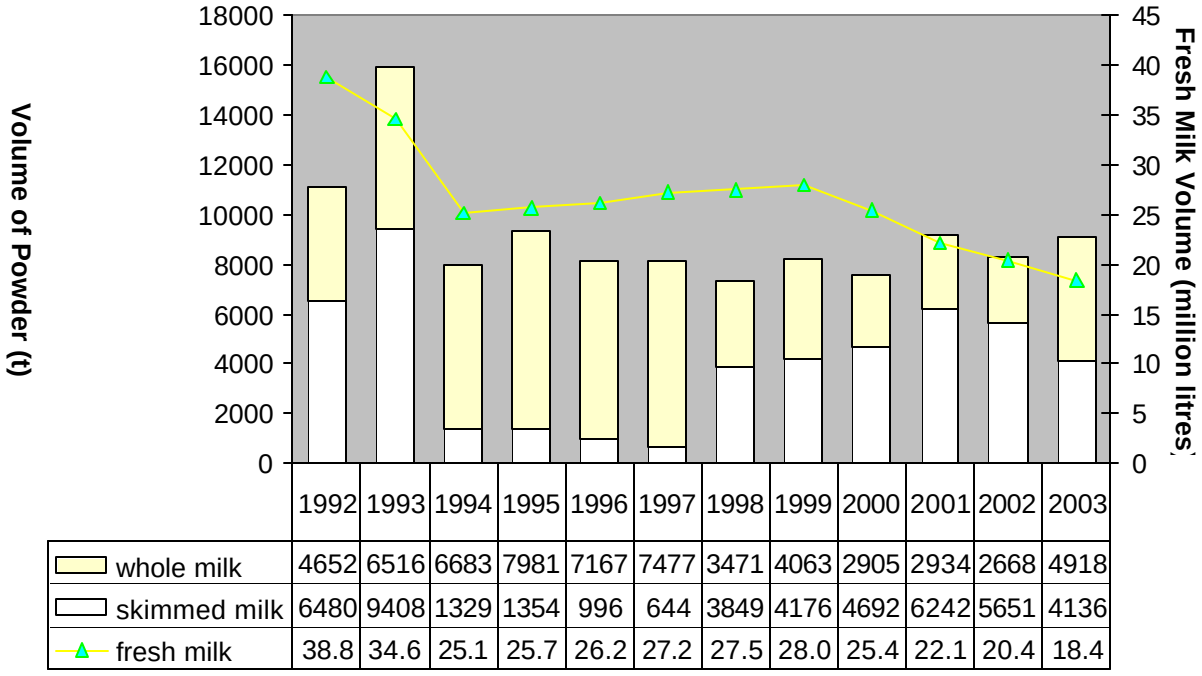
Table 1: Comparative Share Of The Local Market Between The Main Dairy Products 1994-2003 (Constant J$) [1.]

PRODUCT/YEAR	**1994**	**2003**
Liquid Milk	.174	.097
Condensed/Evap. Milk	.301	.270
Powdered Milk	.175	.228 [2.]
Butter/(Marg.)	.135	.098
Cheese	.114	.102
Others	.100	.205
Industry Turnover ($m)	**4596.8**	**4511.0**

1. Calculated from data on Mean per capita Expenditure (STATIN).

2. Readjustment to 1994 Classification Scheme; flavoured,. Powdered milk included since 2003 as Food Drink

Figure 1. Trends in Fresh Milk Production and Milk Powder Imports 1992 - 2003



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
whole milk	4652	6516	6683	7981	7167	7477	3471	4063	2905	2934	2668	4918
skimmed milk	6480	9408	1329	1354	996	644	3849	4176	4692	6242	5651	4136
fresh milk	38.8	34.6	25.1	25.7	26.2	27.2	27.5	28.0	25.4	22.1	20.4	18.4

The Table indicates that, omitting the linkages to feed and fertilizer manufacturing and services such as transport, domestic production of milk had a consistent, direct multiplier effect of 3.1-3.2 during the decade ending 2003.

Table 2: Estimate of Direct Contribution of Local Milk Production to GDP (1994-2003) In Nominal Dollars

	1994	**2003**
Local Production ML	25.10	18.40
Farm Gate Price ($/L)	12.50	18.875
Returns at Farm Gate $M	313.75	347.3
Per Capita Exp. On Liquid Milk	256.63	163.06
Estd. Value Contribution of Liq. Milk in Cond./Evap.	156.62	141.52
Total Per Cap. Exp. Liq. Milk	412.25	304.58
Adj. for meals away from home	+.25	+ .22
Population (million)	2.51	2.64
Contribution to GDP ($Billion)	**1.293**	**0.981**

The purpose of this study is to identify and elucidate the underlying causes of the declining market for dairy products since 1992 and in particular the decreasing consumption of locally produced milk; this to enable the development of fact-based strategies for the amelioration of the local dairy farming sector, as a significant contributor to national wealth creation and social stability.

BRIEF HISTORICAL REVIEW

Not unlike dairy production within the major milk producing countries, the local dairy farm sector has shown acute sensitivity to both internal and external economic pressures. Among the leading world producers the major fallouts in milk production were from over supply during the early- to mid-1980's as well as the imperatives of the global borderless trade policies of the late-1980's to the mid-1990's. These farmers were able to easily adjust to the drastic changes in the economic environment due to their ready adoption of a knowledge-based approach buttressed by decades of consistent, focused research,

which provided the technological base for easy adaptation. The New Zealand experience provides a clear example of this ready adaptation to change. Dairy farmers, after an initial two to three year adjustment period, consolidated on their knowledge-based culture to propel New Zealand to leadership in the international trade in dairy products while producing less than 6 percent of world milk production; dairy products accounting for 21 percent of that country's merchandise export earnings in 2003. (Evans, 2004)

Recovery within the European Union and North America while also being aided by technological shifts, such as increased utilization of pasture and fodder (EU), was perhaps given an even greater boost by domestic policies which intensified existing Government support by shifts from direct internal and export market support to less overt subsidy programmes.

In contrast, the Jamaican Dairy Industry has displayed a marked 10-12 year cyclicity coinciding with policy changes by incoming political administrations evident since the 1970's. Official reports of local milk production up to the 1980's were relatively constant at an estimated 45 million litres per annum. Milk entering the formal market however, showed serious declines during the early- to mid-1980's. During the earlier cycle milk sold to processors showed greatest recovery during the period 1977-1979, increasing from 13 million in 1971 to 21 million litres by 1979 (Anon 1981). This was aided by input subsidies. During the 1980's the earlier declines recorded during this second cycle were only reversed after major policy adjustments in 1987, leading to a peak output of 38.8 million litres of milk entering the formal market in 1992. The current cycle became evident in 1994 by which time local production had fallen by 35 percent below the peak output of two years prior. Following a rallying to 28 million litres between 1995 and 1999, the local sub-sector has undergone severe attrition with an average decline to 2004 of 9 percent per year.

These cycles of decline followed by slow recovery, coincide with recorded influxes in the importation of milk solids, the period of recovery being mediated by the response time in adjusting policy regimes to favour local producers of milk.

Technology adjustment at farm level has, historically, contributed only minimally to the recovery of the local dairy farm sector as dairy farmers have shown little willingness to apply the growing body of research work conducted locally as well as in similar tropical regimes on the feeding and management of dairy cattle. The fact that interest rates on Agricultural loans, after peaking at 38 to 40% percent during 1992-1994, has fallen steadily since, without any perceptible impact on the uptake of credit by the dairy farm sector, speaks clearly to a resistance to technological change. A notable exception during the decade of the 1990's, were major investments in an on-farm feed mill and fodder conservation equipment by a leading corporate farm.

.**A closer analysis of the changes in the internal and external economic environments over the past decade and the corresponding response of the local dairy sector and the political administration is therefore essential. It is also critical to review the existing knowledge base as this relates to optimizing milk production in tropical**

climates in order to determine its appropriateness to resolving the current deficiencies of the local dairy farming sector in its quest for increased competitiveness.

REVIEW OF THE EXTERNAL ECONOMIC AND TRADE ENVIRONMENT

The major change at the international level of direct relevance to the local dairy sector, has been the prepotency of the philosophy of global 'free' trade and the divergence between precept and praxis by the most vocal proponents of this trade and economic model. The agreements reached during the Uruguay Round of the GATT were institutionalized as global policy within its successor, the World Trade Organization since its inception 1995. The failure to advance to consensus, particularly with respect to Agricultural trade, after several rounds of Ministerials since, indicates the deep rifts between developing and developed countries in respect of the issues related to the counterbalancing between subsidies and tariffs.

The most recent OECD database (OECD 2004) indicates that, notwithstanding the GATT and subsequent accords, the members of the OECD have largely retained their subsidy regimes in respect of their domestic agricultural sectors. Producer support (PSE) in 2003 accounted for 36 percent of gross farm-gate receipts compared to 40 percent during the period 1986-1988 (Table 3). Support to their milk producers totaled US$47.4B in 2003, 18.4 percent of total PSE to agriculture, a reduction from 20 percent during 1986-1988. The subsidies to milk represented a movement downward from 59% - 49% of farm gate receipt between 1986 and 2003; approximately 50% of EU PSE's estimated to have been accounted for by export rebates (Fowler, 2002).

Table 3: Estimates of Producer Support to Milk by OECD Countries – 1986-2003 (US$M)

COUNTRY/YEAR	1986-88	1999	2003
European Union	20,866 (.57)[1]	21,018 (.51)	22,556 (.51)
United States	11,641 (.60)	13,918 (.56)	10,992 (.45)
Japan	4,326 (.84)	5,124 (.81)	4,758 (.77)
Canada	1,742 (.61)	1,620 (.57)	1,957 (.59)
Australia	300 (.29)	281 (.15)	337 (.15)
New Zealand	74 (.09)	13 (.01)	18 (.01)
OECD (Milk)	**48,107 (.59)**	**48,704 (.53)**	**47,396 (.49)**
OECD (Agric.)	**241,077 (.40)**	**274,155 (.40)**	**257,285 (.36)**

1. ( ) Percent of value of gross farm receipts

Source: OECD PSE/CSE database 2004

might be recalled that the 1995 WTO accords restated the commitments of the Uruguay round concluded in 1994, to significant reductions in trade distorting interventions in Agriculture within 6-10 years, the lower end of the range applicable to developed countries.

A direct consequence of the maintenance of these high levels of support to their dairy industries has been a steady recovery in the production of fluid milk within the major producing countries following the declines, which resulted from the Uruguay Round of the GATT in 1988 (Table 4). The table indicates recovery with consistent growth of 1.2 percent per year in liquid milk production by the main producer countries since 1996. The stagnation in domestic consumption, however, at approximately 89% of production, has driven an expansion in exports of the primary milk solids of 17.7% on a fluid equivalency basis between 1996 and 2004. In actuality, the export forecast for 2005 of approximately 5.02 million tonnes would represent an increase of 62% over exports in 1996 or 7% annualized.

Table 4: Cow's Milk Production, Primary Exports and Approximate Fluid Equivalent Consumption by the Main Producing Countries - 1996-2004

	1988	1996	2000	2004	2005(f)
Milk Production (MT- million)	**428.2**	**364.3**	**381.6**	**404.1**	**411.4**
Exports (MT '000):					
Butter	**N/A**	**609**	**712**	**842**	**860**
Cheese	**"**	**847**	**1068**	**1294**	**1304**
SMP	**"**	**698**	**1211**	**1222**	**1144**
WMP	**"**	**944**	**1333**	**1653**	**1716**
Total Exports in Fluid Equivalents (MT – million)	**"**	**28.6**	**40.4**	**46.3**	**46.2**
Domestic Consumption Fluid Equiv. (MT mil.)		**335.7**	**341.2**	**357.8**	**365.2**

Adapted from: USDA/FAS. World Dairy Markets and Trade

Export volumes of the four primary milk solids traded internationally by the leading exporters are set out in Table 5.

Table 5: Exports of Milk Solids (MT '000) 1996-2005 by Major Exporting Countries

	CHEESE		BUTTER		SMP		WMP	
	1996	**2005**	**1996**	**2005**	**1996**	**2005**	**1996**	**2005**
OCEANIA	284	510	313	466	317	481	368	874
US	32	19	19	0	32	150	18	0
EU	485	506	144	313	166	320	480	542
TOTAL	**801**	**1154**	**476**	**779**	**515**	**951**	**866**	**1416**

Source: USDA/FAS World Dairy Markets and Trade

The data clearly demonstrate a consolidation of their market leadership by New Zealand and Australia whose combined export of the primary milk solids is forecasted to grow to 2.331 million tonnes in 2005 an increase of 82 percent over 1996. Contrastingly, growth in exports of milk solids from the USA is projected at half the level forecasted for the Antipodes. This is expected to exert a push effect on world prices of these products as Oceania, with a forecasted 54 percent of the international dairy products market is expected to move from its enforced position of price takers to price leaders. The retention and intensification of producer support by the EU and USA, however, will exert a mediating effect on this increase. Already year-end 2004 price of European whole milk powder, the most important traded solid, increased by 21 percent over the December 2003 price, the November price reaching a 10-year high of US$2,425 (FOB) per metric ton. The average FOB price of cheddar for 2004 (approx. US$2,900/t) represented a 13.7 percent increase over the previous peak price of 1996 (USDA/FAS).

The World Bank projects that by 2020 livestock production will account for 30% of the world's output of agricultural products. With respect to milk global consumption is projected to increase from 422 million tons to 648 million tons over the same period. (de Haan et al, 2001). Their forecast was that developing countries will be the most important supplier to this growing market.

These trends speak clearly to the need for a revitalization of the local dairy farm sector given the implications for future prices of milk solids within the local trade as well as the ever-increasing expenditure of foreign exchange.

As demand patterns increasingly shift away from the consumption of butter, the dehydration of whole milk into powder is expected to continue to pose an increasingly severe threat to vulnerable dairy sectors in developing countries. Holistic policies which provide an enabling environment for the expansion of the local dairy sector will need to be adopted if the dairy sector is to realize its potential for being a major contributor to wealth creation at the national level. Policies that

give focus to innovative methods for stimulating technology uptake at farm and manufacturer levels are likely to have most sustainable effects. The projected major opportunities for export, lend further justification to the need for an enabling policy environment.

THE LOCAL ECONOMIC AND TRADE ENVIRONMENT SINCE 1992

The expenditure of foreign exchange on milk solids in 2003 was US$39.15 million (Dairy Facts and Figures 2003-2004) compared to US$19.6 in 1992 (ESSJ: PIOJ 1993). The corresponding volumes imported were 9,981 and 19,069 metric tons. The differences in the imputed CIF value of these imports might be reflective of the distorting trade policies, which have been pursued throughout the period by the EU, our main supplier. Table 6 shows the pattern of imports (volume and value respectively) between 1999 and 2003 (JDDB: Facts and Figures 1999/2000; 2003/2004).

Table 6: Dairy Product Imports (Volume -Mt And Value -US$'000) For Selected Years (1993-2003)

PRODUCT (MT)	1993	1995	1997	1999	2001	2003
Milk and Cream	187	172	615	123	32	19.2
Skimmed Milk Powder	2905	1354	644	4176	6242	4136
Whole milk Powder	6516	7891	7477	4063	2934	4918
Cond./Evap. Milk	129	215	301	125	205	553
Whey Powder	113	278	377	257	338	273
Ice Cream	0	36	607	983	2061	3633
Cheeses	5163	4739	4739	4395	6109	4258
Butter Fat/Oil	2153	2047	1803	1937	2296	1414
Total (Volume)	**17,166**	**16,914**	**16,823**	**16,274**	**20,374**	**19,069**
Total (Value)	**33,598**	**37,784**	**38,105**	**33,459**	**48,336**	**39,147**

Source: Dairy Facts and Figures 1999-2004, JDDB

The local dairy farm sector has shown little sign of recovery from the immediate influx of milk solids, which followed liberalization of the Dairy Trade a decade ago and in particular of powdered milk which increased from approximately 7,222 metric tons in 1990 to 9,408 MT in 1993 (COMSEC, 1997), a difference of 21.9 million litres in fluid equivalents. These increased levels of imports were sustained through 1995, coinciding with a period of rapid devaluation of the Jamaican Dollar and high rates of inflation, which severely sapped the purchasing power of the Jamaican consumer.

With the rate of exchange of the Jamaican versus the US dollar slipping from 21.57:1 to 61.8:1 between 1991 – 2004 (Source: BOJ 2005) this drove a primarily exchange-rate led increase in the Consumer Price Index (CPI) from 299.3 to 2032.1, during the corresponding period (STATIN, 2005). Concomitantly, the farm gate and retail prices of fresh milk moved, respectively, from J$9.50 and J$19.59 per litre at year end 1991 to $24.00 and $69.70 at December 2004.

With reduced spending power and the removal of the price-equating mechanism formerly administered by the Jamaica Commodity Trading Corporation (JCTC), the initial switch from fresh to powdered milk has continued apace since the early 1990's. This has clearly been exacerbated by the ever-increasing margins taken ex-farm as reflected in the 1.06:1 margin between retail and farm gate price existing in 1992 having ballooned at the expense of the local producer to 1.9:1 currently. Major contributors to this widening margin have been the advent of the 'exclusive distributor' and the low capacity utilization within local milk processing plants, which have an installed capacity estimated at 80 million litres per year. It is worthy of note that the main producers of fruit juices, which have become increasingly popular over the past decade and a major competitor to liquid milk, are not involved in the business of milk processing. This therefore points to the ever-reducing throughput at the major milk processing plants, this inefficiency exerting a disproportionate push effect on ex-plant prices for milk.

It must be recalled that resulting from a 1987 agreement between stakeholders of the dairy sector; margins were apportioned at 20, 30 and 35 percent respectively to farmers, processors and retailers respectively. The subsequent advent of the exclusive distributor resulted in the insertion of an additional 8-12 percent margin within the chain, thus contributing to the cost-push and subsequent reduction in demand for liquid milk. Given that such overt cartelization is no longer legally tenable, alternate strategies for driving chain costs downward would have to be sought to promote the rebuilding of market share. This provided the basis for the COMSEC (1997) recommendation for Government to enable forward integration into processing and marketing by small and medium scale producers through an association of milk producers; hence the Jamaica Dairy Farmers' Federation (JDFF).

Additionally, product diversification offers significant possibilities for regaining market share as indicated in the tremendous expansion in imports of products such as ice cream and yoghurt. The fact that the JBS standard for fresh milk is set at 3.25% butterfat and average fat content in Jamaica Hope milk is of the order of 4.5 to 4.8%, indicates the potential for the expansion of the market for products such as premium ice cream and skimmed milks, particularly in an increasingly health-conscious market. This would be facilitated by the adoption of milk payment schemes based on milk solids which potentially could raise farm gate returns per litre by more than 10 percent.

In tandem with the ever-increasing trade margins on fresh milk, ex farm, the retention of a 'soft' tariff regime for imported milk solids has reinforced the shift away from the consumption of fresh milk. The tariff regime includes a waiver of duty on skimmed milk

powder for retail in sachets (since 1987) as well as a two-tiered duty structure (5 or 50%) for 'non-sachet' powder imported as manufacturing raw material or consumer goods respectively. Following the extension of the 5% concession to all manufacturers in 1996, milk powder declared as direct consumables fell from 35% (1996) to 5% of total in 1998. Correspondingly, duties collected on milk powder for direct consumption, fell from the equivalent of US$884,466 in 1996 to US$264,537 (1997) and further to US$36,300 in1998 (Dairy Facts and Figures, 1999-2000).

The shift in demand for liquid milk as reflected in per capita expenditure between 1994 and 2003 is shown in Table 7.

Table 7: Mean Per Capita Expenditure on Selected Dairy Products 1994 v 2003

	1994	**2003**	**2003[1]**	**2003[2]**
Liquid Milk	256.6	253.6	253.6	131.2
Condensed & Evap.	444.6	707.6	707.6	366.1
Food Drink	N/C	585.3	-	-
Powdered Milk	259.7	257.4	596.8	308.7
Butter	202.3	256.6	256.6	132.7
Cheese	168.3	268.3	268.3	138.8
Others	147.9	291.8	537.6	278.1
Total	**1477.4**	**2620.5**	**2620.5**	**1355.7**

Source STATIN: Survey of Living Conditions Data File
[1.] Readjustment to 1994 Classification Scheme; flavoured powdered included since 2003 as Food Drink.
[2.] Inflation adjusted.

The Table shows that in constant dollar terms the demand for milk and dairy products, overall, has fallen by 8.2 percent over the decade ending 2003; only powdered milk (18.9%) and other solids including ice cream, yoghurt, etc. (88%) recording any growth in per capita consumption. In contrast the effective demand for locally produced milk fell by 48.9 percent during the corresponding period. The international trend away from the consumption of butter is also evident in the Jamaican market place, real per capita consumption having declined over the past decade by 34.4 percent.

A deeper perspective of the consumption of dairy products between 1994 and 2003 is provided in Table 8, which compares real per capita expenditure by the poorest 40% of

the population with that by the wealthiest quintile. The data point to an increasing marginalization among the poor in relation to their consumption of dairy products, as, whereas in 1994, the per capita expenditure on milk and dairy products would have been equivalent to the purchase of 90.6 ml per day of fresh milk, this had fallen even lower to 80.4 ml by 2003. Although corresponding consumption among the wealthiest quintile would also have fallen (248 vs. 220 ml per day), consumption by this group was maintained well above the WHO recommended minimum daily allowance of 200 ml per caput.

Table 8. Changes in Real per Capita Expenditure (Constant J$) Within Wealth Groups (1994 v 2003)

	1994		2003	
	Poorest 40%	**Wealthiest 20%**	**Poorest 40%**	**Wealthiest 20%**
Liquid Milk	115	512	35	345
Condensed & Evap.	202	928	207	652
Powdered Milk	190	320	230	433
Butter	100	377	80	205
Cheese	58	402	46	320
Others	60	339	66	534
Total	**725**	**2878**	**664**	**2489**
Equivalent of fluid milk (l/yr)	22.8	90.6	21.5	80.4

Adapted from: STATIN. JSLC Database ;CPI Annual Review

It is clear that a strategy is required for directly targeting the most vulnerable segments of the population. It is suggested that the School Feeding and the Food Stamp Programmes provide a ready framework for cost-effective Government intervention.

On the basis that fresh milk is estimated to account for 20 percent of the value of condensed/evaporated milk, the trends in Table 7 indicates a decline in market share from 23.4% to 15.1% between 1994and 2003. At current value this represents annual loss to the economy of $727 million or $240M at farmgate. Compared to the 1992, the year of peak production, the loss to the rural economy approximates $560 million per annum.

To this must be added the significant reductions in the use of proprietary feeds and fertilizer by the dairy farm sector. Cattle feed sales, which in 1992 totaled approximately 22,000 tonnes, fell to 5030t in 2003 (Data Bank, Min. Ag.). Feed to dairy cattle traditionally accounts for 60-65%. On this basis the feed industry at current prices has lost a market valued at J$144M per annum. The Fertilizer trade has also suffered significant loss; the sale of fertilizer for use on pastures having declined from 4454 MT in

1994 (Calculated from Mc Catty, 1995) to 384 MT in 2004 (Source: Antilles Chemicals). At current cost of fertilizer nitrogen ($51-57/kg) the reduced demand represents, plausibly, annual retail losses of $12.0 M at 1994 average rate of application (81kg N/ha) and current 'hectarage' in dairying (7375ha – Jennings *et al*, 2004).

The comparative data from the STATIN Consumer Price Index Surveys for 1992 and 2004 (Table 9) and the changes in CPI between 1991 and 2003 (Table 10) are instructive to any assessment of the price interactions within the Jamaican market place, which might influence consumer choice. The data clearly indicate that, notwithstanding the increasing margins over the past decade the growth in the retail price of fresh milk was outstripped by the increase in price of powdered milk by a factor of 1.24 as indicated for the Kingston Metropolitan Area.

Table 9: Comparative Changes In Year-End Prices: Fresh V Powdered Milk (1992-2004)

	1992	**2004**	**CHANGE**
Fresh Milk:			
Farm Gate ($L)	9.50	24.00	0.51
Retail (KMA) ($L)	19.59	67.70	+2.46
Margin	1.062	1.90	
Powdered Milk:			
Export Price/kg (J$) (US$)	39.85 (1.795)	146 (2.362)	+2.66 (0.32)
Equivalent market price (KMA)	77.50	318	+3.10
Margin	.944	1.18	
CPI	385.5	1890	+3.90

Source: Consumer Price Indices Annual Review Data File , STATIN.

It is worthy of note that the year-end equivalent retail price (80g. sachets) for powdered milk at J$318/kg (US$5.15/Kg) compares with year-end mean prices (FOB) for SMP and WMP, of US$2,362.50 or US$2.36 per kg. (USDA-FAS 2004). The more than doubling in retail price must be seen within the context of a waiver of duty on skimmed milk powder in sachets and only 50 percent duty on similarly packaged whole milk powder. Our own limited surveys suggest that these margins are at the lower end of the range common in the trade in milk solids and help to explain the reduced demand for dairy products generally over the past decade.

Table 10: Consumer Price Indices for Selected Years and Food Groups

	1991	1992	1993	1999	2001	2003
All Groups	299.3	419.6	546	1265.9	1460.2	1786.8
Food and Drink	322.1	452.1	595.8	1274.3	1421.8	1704.2
Dairy, Oils & Fats	**460.0**	**635.2**	**803.1**	**1476.3**	**1621.2**	**1993.4**
Meat & Fish	334.0	462.1	597.8	1074.5	1156.9	1353.8
Meals ex home	281.4	425.2	594.3	1496.3	1629.6	1962.6

Source: STATIN- Consumer Price Indices Annual Review 2004

The retention of low tariffs on milk powder in spite of a WTO agreed Bound Rate of 100%, is implicated as a major causal factor in the reversals in local milk production, itself further exacerbated by the extraction of excessive margins between farm gate and the retail trade, as although the consumer rationally makes choices between the varying milk solids on offer, the other solids unlike powdered milk, are not readily substitutable for fresh milk.

The structure of the local supply and distribution chain for fresh milk has perhaps equally contributed to the demise of the sector. This factor was clearly identified in the COMSEC Report of 1997 and informed the recommendation, adopted by the Government of Jamaica, for fostering the establishment of the JDFF and facilitating their upstream integration into the market through the Milk Marketing Project of 2000 to accrue greater benefits to the rural economy while driving a sustained increase in demand for fresh milk through cost and price reduction strategies. The report also identified the need for a reform of policy with respect to tariffs on imports of milk solids. The Jamaica Dairy Development Board has recently reviewed their recommendation of an across-the-board 50 percent duty on all imports of milk solids, as a practical alternative to an earlier recommendation of a countervailing 137.5 duty on whole milk powder by the Anti Dumping Advisory Board. A recommendation by the JDDB for a comprehensive revamping of the current tariff regime to favour the revitalization of the dairy farm sector and by extension rural development has been drafted for consideration by Cabinet.

The reduced output from, and financial returns to, the dairy farm sector, reflect a continued attrition which has seen a reduction from 753 to 254 farmers engaged in formal milk production; 64% of the small and medium size farms recorded in 1990 (Data Bank, Min. Ag.) having exited the sector. Correspondingly, land allocated to specialized dairy

farming declined by 32.5%, to 7,375 ha and the size of the national breeding herd fell to 11,440 in 2004 from 13,551 in 1990 (Jennings et al 2004).

Dairy farmers will need to display a readiness to critically review their farm management and overall business strategies to enhance their competitiveness within the reality of the global market place. In order to inform and jump-start this process a review of the extant, relevant body of knowledge will be attempted in order to identify opportunities for enhancing the development of real competitive advantage for local milk production

REVIEW OF RELEVANT RESEARCH ON MILK PRODUCTION WITHIN JAMAICA AND OTHER SIMILAR TROPICAL/SUB-TROPICAL CENTRES

PERSPECTIVES

Milk production in Jamaica over the past fifty years has been influenced by two conventions:

i) **The quest for the '15-quart cow' by every Jamaica Hope producer influenced by a misinterpretation of the earlier achievements at Bodles and later at Chateau Farms where individual lactation records greater than 20,000 lb (9,100 litres) were set and broken respectively. The 'bragging rights' attached to these achievements by farmers were of inestimable psychic value.**

ii) **The conventional 'wisdom' that tropical pastures were only good for about four quarts per cow per day, hence the inescapable need for proprietary concentrate feeds to achieve commercially acceptable levels of yield**.

The first convention led to a situation whereby, unlike leading world dairy producers, there was an overwhelming preponderance of 'purebred cattle breeders' and very few commercial farms to exploit the advantages of the breeders' efforts. Breeders of purebred Jamaica Hope cattle therefore reaped none of the economic rents associated with pure-breeding of dairy cattle among the developed countries.

With Government historically leading the development of cattle breeding in Jamaica, private breeders took little responsibility for the genetic improvement of their herds or the national gene pool. Consequently when economic imperatives forced a severe cutback or curtailment of Animal Breeding Services, and given that Jamaican breeders, unlike their international counterparts, gained no premiums for breeding stock from local sales and very little of the potential foreign exchange earnings, farmers saw little incentive in taking ownership of the milk recording, progeny testing or other breeding services characteristic of other dairy breed societies worldwide and so critical to continued breed improvement. This occurred, notwithstanding the availability of low-cost international

financing to non-Governmental agencies during much of the earlier period of Jamaica's structural adjustment programme.

Today dairy farmers have remained insensitive to the difference between biological and economic efficiency, which is critical if we are to move from farming systems which overemphasize yield per animal to ones which evaluate efficiency in terms of input: output relationships. The reality that the environmental (management) component of phenotypic variance for milk yield accounts for thrice the contribution from additive genetic value (heritability), remains largely unrecognized.

The second convention has led to an unfortunate over-dependence on concentrate feed for rationing dairy cattle and subsequently high-cost milk production relative to our international and regional competitors. With land accounting for 48% of the major assets held on Jamaican dairy farms (Jennings *et al*, 2004), optimal utilization of this asset is critical to improving efficiencies.

The Jamaica Dairy Development Board (JDDB) has, through the conduct of an annual cost of production survey beginning 2000, attempted to sensitize dairy farmers to the need for cost minimization within a buyer's market. Encouragingly we have recorded a reduction in mean variable cost per litre from $17.41 (US$0.36) per litre in 2001 to $15.76 (US$0.26) in 2003- Table 11 (Ffrench *et al*, 2004) .

Table 11: Mean Annual Variable Cost of Producing Milk 2000 – 2003

	2000	**2001**	**2002**	**2003**
Overall Variable Cost/l (J$)	15.91	17.41	17.02	15.76
(US$)	**0.34**	**0.36**	**0.35**	**0.26**
Irrigated Farms ($JS)	15.36	2131	18.33	17.42
Non-Irrigated Farms	18.30	18.83	17.23	15.20
Small Farms (< 10 cows)	8.00	12.34	12.21	13.69

The 2003 cost of production compares favourably with those reported from the US and the EU of US$0.30 and 0.35 respectively. Costs from New Zealand of US$0.18 – 0.20 per litre, however, put our current state of competitiveness in proper perspective (NZ Agritech, 2003). It is encouraging that several of the farms participating in our annual surveys consistently return costs which approximate those reported for New Zealand.

An examination of the cost structure on dairy farms in 2003 indicated that purchased feed, at 38 percent, was the major component of variable cost followed by labour

(20.6%), utilities (6.6%), rental (5%), fertilizers and pasture maintenance (4.7%) and health care (3.5%).

At current cost of concentrate feeds of approximately $13,000 per ton, the data above suggest (given 15.4 million litres produced in 2004) that feed allocation per litre of milk was equivalent to 0.44 kg per litre. This compares with a review of published data for 1974-1977 (Jennings 1980) from the official milk recording scheme, which showed that concentrate feed allocation was then 0.37 kg/litre of milk (Table 12).

Table 12: Production and Performance of Recorded Jamaica Hope Cows 1974-1977

Year	No. Cows	Milk Prod. (L)	Fat %	Concentrates		Calving Interval (mth)	Days Open	Services/ Concep.
				Kg.	% NE			
1974	1446	2529	4.4	915	34	14	155	2.0
1975	2340	2142	4.4	763	29	15	177	1.8
1976	2652	2347	4.5	915	33	15	189	1.5
1977	2281	2085	4.5	814	28	16	202	1.6
Mean	2180	2276	4.4	852	31	15	181	1.7

Extract from Jennings (1980)

From an estimated 7,500 cows milked daily, lactation, yield in 2004 was calculated at 2,053 litres per cow, a 10 percent reduction in yield below that of their ancestors 5-6 generations removed. Empirically, this might speak to a decline in genetic potential. However, the more plausible reason is the reduced contribution to milk production from pastures.

REVIEW OF THE STATE OF KNOWLEDGE WITH REFERENCE TO MILK PRODUCTION ON TROPICAL PASTURES

Given the unfavourable milk price of the past two to three years Jamaican Farmers have cut back on their aggregate purchases, of both concentrate feeds and fertilizers which has led to lowering of per cow and per hectare yields to levels well below **the 2,210 litres per cow and 11,050 litres per hectare reported by Jennings (1980) from irrigated,**

unsupplemented Pangola grass pastures. These were stocked at 5 cows per hectare (2/ac) and fertilized at the rate of 316 kg N/ha per year in six applications per year.

The yield from this early study was consistent with the review of Stobbs and Thompson (1975) which concluded that milk production from **unsupplemented** tropical pastures would be limited to approximately **7.2 litres per day** of lactation from Jersey cows.

Another contemporaneous study (McDowell et al, 1975) was already challenging these limits in reporting average **unsupplemented yields from Holstein cows of 10.9 litres per day** stocked at 2.5 cows per hectare on well fertilized Pangola grass pastures in Puerto Rico.

Subsequent work in Cuba (Martinez et al 1980) was to lift the bar even higher with black and white cows stocked at 3.6 cows per hectare on Coast Cross I (*Cynodon sp*.) pasture **producing beyond 4120 litres of milk per year without recourse to supplementary feed.**

These levels of individual animal performance question the justification for the over- reliance on concentrate feeds by Jamaican Dairy Farmers and necessitate an examination of the possible role for concentrate feeds on improved tropical pasture.

THE NUTRITIVE VALUE OF IMPROVED TROPICAL PASTURES AND THE ROLE OF SUPPLEMENTARY FEEDING IN MILK PRODUCTION

The results of a review of the response to supplementary feeds by dairy cows grazing tropical pastures (Jennings and Holmes, 1985) are summarized in Table 13. The data clearly debunk the myth of the limited value of tropical pastures for milk production as per hectare yield as high as 19,850 litres per hectare from unsupplemented pastures far exceeds the peak output of 16,980 litres/ha reported from temperate pastures in Western Europe (Gordon, 1973). At the individual cow level, imputed mean lactation yield of 2,625 litres clearly indicates the under-exploitation of Jamaican pastures for forging competitive advantage for local milk production.

Overall marginal response to supplementary feed was 0.82 litres additional milk per kg additional supplement. In terms of proprietary feeds, standard concentrates for dairy cows, at 12-12.5 MJ ME/kg DM, could potentially support incremental yields of approximately 2 litres per day. The response of 0.82 is therefore indicative of the large substitution effect of concentrates on herbage intake.

The realized response of 0.82 litres/kg, however, might be positive, from a contribution analysis perspective, under conditions where the ratio between the farm gate price of milk and the unit cost of concentrate feeds exceeds 1.22:1; where the potential of the herd is significantly higher than the range of lactation yields reported in the studies cited or where seasonal herbage deficits limit intake.

A rational approach to the feeding of concentrates, therefore, would warrant matching the nutrient requirements of the lactating cow with the nutritive value of the available feeding stuffs. The results of research conducted over the past two decades provide clear evidence of the nutritive value of improved tropical pastures for production of milk. A summary of some of the available data is given in Table 14.

Table 14. Nutritive Value of Tropical Pastures

Sampling Interval (days)	Grass	Fertilizer N Level (Kg./ha)	CP(%)	Digestibility DMD(%)	Calc. ME, (MJ/Kg DM)	Source/Country
14	Setaria	N/A	19.0	66.0	9.18	Wan Hassan, 1987 (Malaysia)
28	Setaria	N/A	14.3	60.3	8.42	" "
14	Digitaria (Pangola)	N/A	15.8	64.2	8.98	" "
28	Digitaria	N/A	13.9	59.1	8.41	" "
14	Guinea	N/A	17.3	64.0	8.80	" "
28	Guinea	N/A	12.7	57.7	8.16	" "
28	African Star	268.8	22.0	69.4	10.62	Caro- Costas *et al*, 1976 (P. Rico)
	"	470	22.5	68.5	10.48	" "
	"	672	24.3	70.3	10.76	" "
20	"	400	15.4	56.5	8.47	Jerez *et al*, 1985 (Cuba)
21	Coast Cross I	434.5	13.4	53.4	8.17	Jerez *et al*, 1984
	African Star	"	12.3	57.0	8.72	"
	Pangola	"	11.9	52.0	7.96	"
14	Florico	246.7	18.0	68.0	10.20	Mislevy, 1989 (Ona, Florida)
21	"	"	16.0	67.0	10.05	"
21	Tifton	447.5	13.5	58.0	8.7	Miller *et al*, 2003 (SIFL, Jamaica)
	African Star	"	14.0	58.4	8.75	"
14-21	"	78.0	17.1	62.0	9.29	Miller (P ers. com) WINDALCO, Ja.
Continuous stocking	Tifton 78	252	13.2	57.1	8.57	Hill *et al*, 1995- Tifton, Georgia
"	Tifton 85	"	14.2	59.4	8.91	"

The contrast in **crude protein content (11.9-24.3%); digestibility (52.0-70.3%) and estimated metabolizable energy value (ME) (8.0 –10.8 MJ/kg DM)** with earlier reports in the literature has resulted from the recognition that pasture sampling technique for cattle must reflect the high selectivity, particularly of the lactating cow, at pasture. Consequently sampling techniques for nutritive assessment of pasture based on cutting at ground level would significantly understate crude protein content (>5 units) IVOMD (>10% units) and ME (>2 MJ). ME contents of grazed herbage of 8 – 10 .8 megajoules (MJ) are potentially adequate to support daily yields of 7.8 to 13.2 litres per day. This to a large extent explains the unsupplemented yields (equivalent to 6.2 – 13.75 litres/day) summarized in Table 13.

In respect of the place for the feeding of concentrates to grazing dairy cows under Jamaican pasture conditions, it is suggested that concentrates will continue to have an important role in any strategy aimed at maximizing output per hectare of land employed in dairying. Given that irrigated pastures account only for 15% of dairy pastures (Jennings et al 2004) and the virtual absence of fodder conservation, the levels of output per hectare shown in Table 13 are unlikely to be achieved without recourse to supplementary feeding. **The strategic role of concentrate feeds would therefore be as 'pasture extender', allowing increased number of cows carried per unit area without sacrificing individual yields**. The concept is clearly demonstrated by Yazman *et al*, 1982 in a Puerto Rican study. In this study, stocking rate on heavily fertilized African Star grass pasture was doubled from 2.5 to 5 cows per hectare; cows at both rates offered concentrate feeds at 1 kg per 2 litres of milk. The result was an increase in per hectare yields from 13,000 to 25,750 litres per hectare, a 96% increase from the doubling of stocking rate.

Under local conditions, Serge Island Farms Ltd. has in the past applied this strategy, successfully achieving per hectare yields of 13,542 and 15,629 litre/ha from Jamaica Hope (JH) and Friesian (Fr.) cows respectively, stocked at 4.6 and 4.4 cows per hectare (Jennings and Clayton, 1995). Feed allocated per cow per year was 1.56 (JH) or 2.2t (Fr.) and pastures (African Star) were fertilized at a rate equivalent to 340 kg N/ha/yr. This basic strategy has continued to underpin SIFL'S position as consistent cost leaders among medium and large farms since the inception of the JDDB Annual Cost of Production Surveys.

COMPARATIVE COST OF PASTURES VIZ-A-VIZ PROPRIETARY FEEDS

Any strategy for attaining and sustaining competitive advantage to local milk production would need to be based on the relative costs of supplying the nutrient requirements of the lactating cow from pasture or from concentrate feeds. A recent study of the local cost of producing grass under commercial conditions at SIFL (Miller et al 2003) and a current study at WINDALCO'S Manchester Pastures Dairy are of great significance to the development of a national strategy for cost effective feeding of dairy cattle.

The pertinent data from these studies are summarized in Table 15. The data indicate that on a dry matter equivalency basis grass (mean cost - $467/kg DM) at below 1/30th the current cost of concentrate DM at $13,000 per metric ton (fresh weight). On the basis of metabolizable energy supplied (Pasture 8.92 MJ vs. Concentrate 12.0 MJ/kg DM) the relative costs indicated from our pasture studies are $0.053 and $1.26 per MJ ME from pasture and proprietary feeds respectively.

Table 15. Summary and Results from SIFL (2001-2003) and WINDALCO (2003-)

	SIFL		**WINDALCO**
	2001-2003		**2003-Present**
Pasture Type	African Star	Tifton 85	African Star
Grazing Cycle	21 days		14-21 days
Kg. N/ha./yr	447		78 days
Mean annual rainfall(mm)	1618 – 1813		1046-1811
Stocking Rate(Cows/ha)	5.4		2.3
Herbage DM Yield/kg./yr.	20,344	26,105	20,770
Cost/t. DM ($)	528.5	402.0	470.0
Crude Protein (g/kg.)	140.0	140.0	171.3
IVOMD	.584	.580	.620
Est. Met Energy (MJ/Kg DM)	8.76	8.70	9.30

When examined from the perspective of the relative costs of satisfying the cow's nutrient requirements, the urgent need to cultivate and utilize grass as the valuable crop it is, becomes self-evident.

As a guide Table 16 attempts to correlate the nutritive value of pastures under good or poor management, with concentrate feed required to sustain yields of 4,000 litres per cow per year of 4.5% butterfat and the implied direct cost of production. The calculations assume a mature Jamaica Hope cow of 400kg live weight and indicate that the difference between good and poor pasture management could, in economic terms, amount to as much as 9 percent of current farm gate price.

Table 16. Implications of Pasture Management for Production Costs

	Good Pasture	Poor Pasture
Digestible CP (g/kg DM)	>95	<55
IVOMD	>0.63	<0.53
ME (MJ)	>9.5	<7.0
Genetic Potential (l/yr)	4000	4000
ME Requirement/day	125	125
Est. DMI/day (kg)	11.7	11.7
Concentrate Req./day	6.6	8.8
Additional Cost/litre	**-**	**+2.15**

Any competitive strategy for local milk production therefore must address the relevant issues of managing improved tropical pastures for international competitiveness in milk production.

MANAGING PASTURES FOR COMPETITIVE ADVANTAGE IN LOCAL MILK PRODUCTION

The relative costs of supplying the cow's energy needs from pasture vis-à-vis concentrate feed, speak eloquently in justification of greater investment in the improvement of pastures.

The principles underlying the very high levels of output from improved tropical pastures may be summarized into the following:

i) The management of pastures to maximize the production and intake of leaf by the grazing dairy cow will lead to maximum output of milk.

ii) High output per unit area from pastures is dependent upon the judicious application of fertilizers, particularly N, in order to exploit the high potential response by improved tropical grasses.

iii) In order to sustain high individual yields at high rates of stocking, cows must retain the opportunity to select herbage of the highest quality. This can only be achieved by maximizing herbage production through the requisite input of soil nutrients.

iv) Sustaining the yield of the individual cow of high genetic merit will require a requisite input of concentrate feeds to offset the reduced

herbage availability and the opportunity for selection afforded the cow from increased stocking rate.

Table 17, adapted from Jennings (1992a) applies the results of the early studies principally in Puerto Rico (Vicente-Chandler *et al*, 1964) to develop guidelines for increasing the carrying capacity of the pasture system within the context of concentrate feeds used as 'Pasture Extender'.

Projected carrying capacities are calculated on the basis of the production of leaf dry matter and assume an average response to fertilizer N of 30 kg DM per additional kg N up to 450 kg N (after Vicente-Chandler *et al*, 1964). The underlying assumption is that soil moisture availability is not limiting.

Table 17. Carrying Capacities and Estimated Milk Yields at Varying Levels of Fertilizer N

N Level (kg/ha)	Estimated Herbage (kg DM/ha/an	No. Cows Per ha.	Milk Prod./ha No supplement	Supplement (40% DMI)
0	10,000	2.0	4,925	7,100
56	11,800	2.3	5,850	8,450
112	13,450	2.7	6,780	9,780
170	15,140	3.0	7,400	10,100
225	16,800	3.5	8,620	12,450
336	20,200	3.9	9,850	14,200
450	23,550	4.7	11,700	16,900

The model projects that the pastures grazed by Jamaica Hope cows of medium genetic merit (3,500 litres/yr) and offered 40% of estimated dry matter intake as concentrates (App. 5.5 kg/day fresh wt) could be managed to achieve carrying capacities of up to 4.7 cows per hectare with resulting yields of up to 16,900 litres per hectare (supplemented). It should be noted however that the substitution effect is recognized through inputting the mean response to concentrate feed of 0.8 litre/kg calculated by Jennings and Holmes (1985). **Consequently, incremental output from pasture from supplementary feeding is likely to be a maximum of 40- 45% in contrast to the 96% increase earlier cited from the Puerto Rican Study** (Yazman *et al* 1982).

The projections in Table 17 are in reality very conservative as subsequent introduction of the *Cynodons* (African Star, Coast Cross I, Florico, Florona, Tifton hybrids etc.) have demonstrated that these cultivars may significantly out-yield those included in the 1964

study of Vicente-Chandler *et al.;* indicating inherently higher response rates to fertilizer nitrogen. Thus Jennings (1992b) reported a response of 60 kg DM/kg N from African Star grass receiving 150 or 300 kg N/ha/yr and Jerez *et al.,* (1984) reported a 14 percent advantage in herbage available per cow daily from African Star grass compared to Pangola Grass. The more recent cultivars such as Tifton 85 are of even higher potential carrying capacity as indicated in our SIFL study, where a 28 percent advantage in annual dry matter yield was recorded (Miller *et al*. 2003). Similarly, McLeod,D.S., 2001 (unpubl.) found annual dry matter yield of 51,085 kg/ha compared to 20,785 from Pangola Grass at WINDALCO'S Grove Place Farm.

Table 18. Effect of Pasture Quality on Cost of Producing Milk

Ave Lactn. Yield (L)	**Yield/ Cow/ Day (L)**	**Energy Req.- M MJ ME/d**	**Est. DMI- D (kg)**	**Ration Energy Density M/D**	**Concentrate Fresh weight Required (kg/cow/day)**		**Production Cost/Litre ($)**	
					Grass ME(MJ) 9.5	**8.5**	**Grass ME 9.5**	**8.5**
2500	8.3	95	10.2	9.3	0	2.8	<6.50	12.70
3000	10.0	105	11.0	9.5	1.0	3.8	6.60	14.33
3500	11.7	113	11.3	10.0	2.6	5.7	8.40	18.40
4000	13.3	125	11.7	10.7	6.6	8.7	18.70	24.70
4500	15.0	135	12.3	11.0	8.5	10.0	21.40	25.10
5000	16.7	145	13.0	11.2	10.4	12.5	23.50	28.20

Assumptions: i. Milk Price - $24.00/L
ii. Concentrate - $13.20/kg. FW
iii. Grass - $0.50/kg. DM

The effect from maximizing the quality and the nutritive value of the herbage on offer at pasture, on concentrate feed requirement and ultimately feed cost, is demonstrated in Table 18.

It is therefore essential that Jamaican dairy farmers urgently assess their individual production strategies particularly as these relate to fertilizer versus concentrate feed use. Fertilizer application to pastures in Jamaica has been traditionally low except for a short period during the mid-late 1950's when Government incentive programmes attempted to promote the philosophy of managing grass as a crop. A similar campaign is urgently needed currently as levels of fertilizer use, already low in 1994 (McCatty 1995), have fallen subsequently. On the basis of McCatty's report we calculate that on dairy farms, no more than 80-90 kg N per hectare were applied during the early 1990s, on the

assumption that at that time dairy farms accounted for 75 percent of fertilizer purchase for use on pastures. Information provided by Antilles Chemicals indicate even lower current usage, with 816 and 384 metric tons purchased in 2003 and 2004 respectively, equivalent to a two-year average application rate of 51.2 kg N per hectare**. Based on the projections in Table 17 current levels of usage will be unable to support stocking rates and yields beyond 2.3 cows per hectare (<1/ac) and 8,455 litres per hectare respectively. The recent JDDB Demographic Survey of Dairy Farms (Jennings *et al*, 2004) indicated that mean realized yield per hectare was 4,032 litres/ha with highest outputs on medium sized farms (10 – 99 cows) at 5,563 litres from 3.8 animal units carried per hectare.**

The inference is therefore of a skewness in fertilizer use with the likelihood that less than twenty percent of dairy farms are currently applying nitrogen at even the low average levels of 80-90kg N/ha/yr applied in 1994.

From an environmental perspective, current average usage in no way poses a threat to the environment and there certainly is tremendous scope for increasing the use of fertilizer. At current price (Urea: $21,260 and AMSUL $13,087.82) the cost of nitrogen is equivalent to $45.80 and $60.59 respectively. **At an average response of even 30 kg of dry matter per kg fertilizer N, or equivalently 285 megajoules of metabolizable energy, the preferred strategy is self evident when alternatively a similar quantum of feed energy from concentrates would have a cost of approximately $360.00 (i.e $0.16/MJ ME from pasture versus $1.30 MJ – concentrate feed).**

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