

# **Revitalization of the Jamaican Dairy Sector: Strategies for Financing New Investments in Dairying**

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## ***Abstract***

*The Jamaican dairy sector has undergone severe attrition, consequent to the adoption of a policy of trade liberalization in 1992, resulting in milk production declining 64 percent to current levels bordering on 14 million litres per annum.*

*The recent volatility in the international market for milk and dairy products, exposed the inherent weaknesses of over-reliance on imports to shape national food and nutrition policy. Consequently, the current political administration has positioned the revitalization of the dairy sector as a key plank of its policy for enhanced national food security.*

*The expansion of the local dairy sector, however, is constrained by high start-up capital cost requirements and marginal returns on traditional approaches to primary milk production which contribute to the difficulty in accessing capital financing from financial institutions. Therefore, novel approaches are required to finance dairy projects and to develop business models to lower barriers to entry, thus enabling the participation of small-scale farmers in the development process.*

*The Beef and Dairy Producers' Association of Jamaica (BDPAJ) has advanced a model — **Large-Scale Cluster Dairy Farms** — professionally managed nuclear farms, to enable small farmers to invest cows in the cluster under terms of a long-term management contract. Participants would benefit from greater economies of scale than they would achieve, operating as stand-alone units, thus being able to rationalize the utilization of their limited holdings.*

*Analysis of strategies for financing the implementation of the BDPAJ model indicates that consideration be given by local Development Financing Institutions to adopting lease financing as a means of enhancing financial viability.*

## **Introduction**

The volatility of the food and commodities market experienced between 2007 and 2008 has clearly exposed the nutritional vulnerability of large segments of the Jamaican population, and the fallacy of our historical over-reliance on imports as the basis of national food and nutrition policy. The food price shocks of the past two years have placed considerable doubt on the future reliability of traditional international markets to simultaneously guarantee access and affordability of basic foods.

The medium term prognosis to 2018 (OECD-FAO, 2009), is for a shift in the production of agricultural commodities - other than wheat and coarse grains - increasingly away from developed to developing countries. This shift is projected to be particularly pronounced for livestock products and is conditioned largely by factors related to environmental sustainability. On a longer-term basis, it has been projected that global food production will need to increase more than 40 percent by 2030 and 70 percent by 2050 compared to output levels of the period 2005-2007 (FAO 2009). Much of the additional lands required to meet these targets are expected to come from the Latin American region which has the capability to sustain primarily rain-fed production strategies.

Developing countries such as Jamaica are therefore challenged to implement public policy initiatives to drive domestic food production; particularly given the current global financial and economic crisis. The local capital market, which has been characterized more by short-term speculative behaviour, is unlikely to readily switch to investing in domestic agriculture with its characteristic lower returns and the risks presented by its vulnerability to meteorological hazards. For the immediate future, therefore, catalyzing agricultural development remains an imperative of the state. In its *World Development Report 2008*, the World Bank proposes a number of options available to developing country Governments for the provision of financial services to smallholders aimed at removing the pervasive financial constraints that perpetuate rural poverty. These include adoption/adaptation of a range of micro-financing strategies and the reform of public agricultural banks. Out of recognition of the limitations of conventional microfinance for financing term investments, Hollinger (2004) recommends a range of financing strategies more appropriate to agricultural projects with long capital recovery periods. Like the World Bank, Hollinger also posits a critical role for the state in incubating these non-traditional approaches to agricultural financing.

In this paper we examine a number of alternate financing strategies which might be applied to accelerate dairy development, the subject of investigation.

## **The Case for an Investment Focus on Dairy Development**

The gross turnover of the Jamaican dairy products market in 2007 was estimated at approximately \$13.15 billion (JDDDB, 2008). This was based upon data from the 2007 *Survey of Living Conditions* conducted by the Statistical Institute of Jamaica from which *per capita* expenditure on milk and dairy products was calculated at \$4835. In juxtaposition to this, local milk production at 14.1 million litres, generated revenues at farm-gate amounting to \$554 million, a share of only four (4) percent of industry turnover by Jamaican farmers.

The huge disparity between industry value and farm gate returns, points to the untapped opportunities available to investors.

The tremendous potential resident in an expanded local dairy sector is undergirded by the following:

1. The availability of substantial acreages of agricultural lands classified as being most highly suited to the production of improved pastures;
2. Access to a knowledge base derived from local, regional and international research centres to underpin internationally competitive production of milk;
3. The continuing operation of commercial centres of excellence which have sustained levels of efficiency in milk production comparable with international bench-mark producers.

With respect to land capability, agricultural lands considered best suited to the production of improved pastures was last estimated at approximately 491,000 hectares in 1982; representing 51 percent of total agricultural land area (CRIES, 1982). Notwithstanding the urgent need to update Jamaica's land inventory, current land allocation to beef and dairy farming, estimated at approximately 32,000 hectares (Duffus and Jennings, 2005) points to substantial resource underutilization.

A review of relevant research on milk production within Jamaica and other similar tropical and sub-tropical centres is given by Jennings (2006a). This indicates the untapped potential of the tropical

pasture system to sustain internationally competitive milk production from dairy cattle in countries such as Jamaica. This optimism has been vindicated from the performance on commercial farms such as Serge Island which has achieved output levels of 13,542 and 15,629 litres per hectare, respectively, from Jamaica Hope and Friesian cows grazing intensively stocked African star grass pasture supplemented with proprietary concentrate feeds (Jennings and Clayton, 1995). These levels of productivity rival the highest reported from similarly managed temperate pastures. The fact that Serge Island has consistently outperformed other participants in the Dairy Board's annual Cost of Production Surveys since 2000, at internationally competitive cost levels, speaks eloquently to the efficacy of their high stocking rate pasture management strategy.

The Jamaica Hope remains, with justification, the major contributor to local milk production; having over many years established its superior adaptability to the Jamaican environment. Analysis of the lactation curves of Jamaica Hope cows in the ALCAN herd indicated mean lactation yields of 3062 and 3589 litres respectively for heifer and mature lactations (Holness *et al*, 1994). Current national levels of performance (Miller *et al*, 2006) suggest that cow performance has fallen as much as 35 percent below earlier demonstrated herd potential; conditioned largely by inappropriate responses to spiraling input costs.

The attrition undergone by the dairy sector over the past two decades has had a negative impact on Jamaica Hope numbers. In order to reposition the breed to contribute significantly to a revitalized sub-sector, will require a return to the requisite methodologies for animal evaluation, obligatory to regaining competitive potential while repositioning the breed to exploit the growing export market for tropical dairy cattle genetics (Jennings, 2006b) .

The levels of output attained by Jamaica Hope cattle at Serge Island (Jennings and Clayton, *op cit*) converts to gross returns in excess of \$600,000 per hectare at current farm gate prices (\$45.00/litre). This eminently justifies claims by the dairy sector to be assigned priority in the drive for enhanced national food security. The availability of an extensive knowledge base to support sustained competitiveness presents a major source of competitive advantage.

## Critical Limitations to Accelerated Dairy Development in Jamaica

A likely medium term scenario in respect of the demand and supply of milk and beef is summarized in Tables 1 & 2. Beef as a co-product of the Dairy industry is included to complement any commercial appraisal of the potential opportunities for the sector.

**Table 1:** Projected Demand for Beef and Milk to 2020

	2009	2010	2011	2014	2020
Population Est. (million)	2.76	2.78	2.80	2.86	2.90
<b>Per capita consumption</b>					
Beef (kg/annum)	7.0	7.4	7.6	8.0	8.5
Milk (Litres/annum)	55	58	62	66	70
<b>Aggregate Demand</b>					
<b>Beef (kg M)</b>	<b>19.3</b>	<b>20.6</b>	<b>21.3</b>	<b>22.9</b>	<b>24.7</b>
<b>Milk (Litres M)</b>	<b>152</b>	<b>161</b>	<b>174</b>	<b>189</b>	<b>200</b>

Source: JDDDB (2009) A Medium Term Policy Framework for the Jamaican Cattle Sector

The demand projections (Table 1) are based upon annual *per capita* consumption since 2000, of 6.8 kg beef and 53 litres milk (in fluid equivalents).

**Table 2:** Forecast of Beef and Milk Production – 2009 – 2020

Year	BEEF HERD		DAIRY HERD		Total Slaughter	Beef Prod. (kg M)	Milk Prod. (L M)
	Breeding Females	Slaughter No.	Breeding Females	Slaughter No.			
	2009	31500	22050	7500			
2010	35100	24580	8620	6460	31040	6.52	16.8
2011	39300	27500	9920	7440	34940	7.34	19.5
2012	44000	30800	11400	8550	39350	8.26	22.7
2013	49300	34500	13120	9840	44340	9.31	26.4
2014	55250	38670	15100	11325	49995	10.50	30.4
2020	82900	58030	27100	20700	78730	15.80	56.9

Source: JDDDB (2009) A Medium Term Policy Framework for the Jamaican Cattle Sector

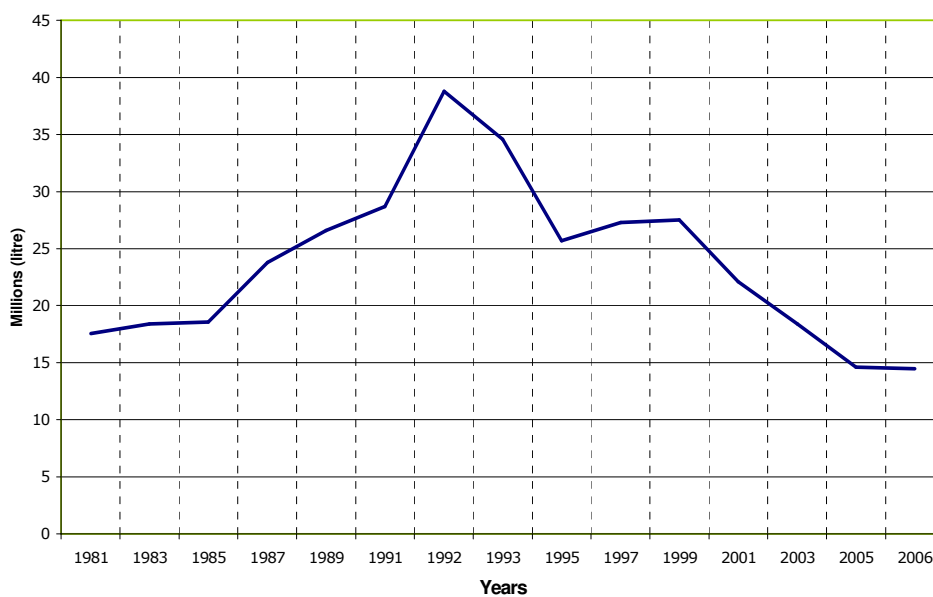
The supply scenario in Table 2, assumes base breeding herds of 7500 and 31,500 dairy and beef cows respectively. The projections are based solely upon natural expansion of the local cattle populations. They suggest that in the absence of major cattle importation, Jamaica is likely to experience supply gaps of the order of 72 and 36 percent in respect of its consumption of milk and beef respectively. It should be noted that Table 2 projects a 2020 contribution of approximately 2.7 million kilograms of beef from the dairy herd; 17 percent of total projected beef production.

The overarching assumptions in the foregoing are:

- a) The presence of a supportive public policy environment;
- b) The consequential attainment of levels of production efficiency which will stimulate demand for the incremental production.

The sensitivity of the local dairy sector to the abrupt policy shifts that have characterized change of political administration in Jamaica is captured in Figure 1 and has prompted a call for national consensus on the adoption of a policy of *National Food Sovereignty* (Jennings 2008).

**Fig 1. Local Milk Production  
1981-2006**



The primary inflection point in the graph above coincides with the abrupt shift in 1991-92 from a manifestly supportive policy of state intervention in maintaining parity between the prices of local and imported milk, to a policy virtually of *laissez faire* trade liberalization. This led to severe dislocations in the local sector manifested in the massive exodus of small and medium-scale producers and a consequent 64-percent reduction in milk production between 1992 and 2007.

Given the protracted capital recovery period associated with new investments in dairy farming, sector stakeholders have sought to raise a consciousness of the need for a public policy environment which provides a planning horizon which extends beyond the term limit of political administrations. This reality and the need to protect the livelihood of the large number of resource poor farmers, who characterize the Jamaican dairy sector, lend credence to the need for a national policy of *Food Sovereignty* based upon a clear recognition of the following:

1. *The right to affordable, nutritious food as a basic human right;*
2. *The obligations of the state in facilitating the legitimate exercise of this right;*
3. *The responsibility of the state in the protection of the livelihood of its citizens;*
4. *(Given global imperatives), the role of the state in facilitating the attainment of sustainable competitive advantage in food production.*

The foregoing defines specific roles for the state in terms both of technical intervention and fiscal policies, which would facilitate accelerated growth in domestic milk production within an international market environment in which the rate of demand growth for dairy products is unmatched by the rate of increase in milk production by the traditional market suppliers. It is therefore critical that viable production systems be identified as the basis for rationalizing public or private investment. In this regard the Jamaica Dairy Development Board in collaboration with the Beef and Dairy Producers Association of Jamaica recently undertook a feasibility study of various business models for intensive dairy production, as a guide to investment decision-making.

### **Analysis of Models for Intensive Milk Production**

In terms of scale and scope, milk production systems in Jamaica may readily be defined in terms of farm size and degree of specialization. The industry is predominated by small farms – farms milking less than 10 cows – which represent 73 percent of dairy units but only 13 percent of the national

breeding herd (Table 3). Contrastingly large farms (>100 cows) account for 68 percent of the breeding herd while representing only 12 percent of holdings. Medium sized operations are typified by the dairy land settlements such as the Rhymesfield Cooperative farms in Southwest Clarendon and the St. Elizabeth Dairy Cooperative farms at Cabbage Valley, Bogue and Luana.

**Table 3.** Profile of the National Dairy Herd – 2004

	<b>Small</b>	<b>Medium</b>	<b>Large</b>	<b>Total</b>
<b>No. farms</b>	185	39	30	254
<b>Total Herd</b>	2749	3192	12570	18511
<b>Breeding Herd:</b>				
<i>Cows</i>	<i>1400</i>	<i>1905</i>	<i>6758</i>	<i>10063</i>
<i>Heifers</i>	<i>127</i>	<i>189</i>	<i>1061</i>	<i>1377</i>
<b>Total</b>	<b>1527</b>	<b>2094</b>	<b>7819</b>	<b>11440</b>
<b>Area in farms (ha)</b>	584	661	6130	7375
<b>Area in Pasture (ha)</b>	576	588	4395	5559
<b>Mean stocking rate (Animal Units/ha)</b>	3.1	3.8	1.9	2.1

Source: Jennings *et al* (2004)

The degree of specialization which has contributed to the sustained competitiveness among world leading milk producers, is largely absent in Jamaica; most operations opting for the traditional integrated milk production–cum-heifer replacement rearing systems superimposed upon full grazing of pastures. The medium scale cooperative farms range between 9 and 14.5 ha, some farms carrying as many as 70 cows; their influence reflected in an average stocking rate among medium-sized farms of 3.8 animal units shown in Table 3. In terms of specialization, only the operations at Serge Island have adopted the type of enterprise specialization common to countries such as New Zealand, where distinctive competencies have been exploited through specialized milking farms; replacement rearing and other specialized operations such as fodder conservation outsourced to contractors. The derived economies of scope, in combination with its predominant unsupplemented pasture based systems of management, have in no small measure contributed to New Zealand having sustained over many years, its international cost leadership in the production of milk.

In evaluating potential investment models, the prevailing traditional systems of dairy management were compared with more specialized models including partial zero grazing which incorporates night grazing and daytime confinement feeding of a complete diet – Total Mixed Ration (TMR) – following the morning milking. Performance coefficients were optimized for each model. The basic features of the selected enterprise models are summarized in Table 4.

**Table 4.** Basic Features of Selected Dairy Enterprise Models

Enterprise Type	Management System	Stocking Rate (AU/ha)	Farm Size (ha)	Replacement Rearing		Annual Output (litres'000)
				Yes	No	
Traditional 1200-Cow Dairy	Full grazing + Purchased Concentrate feed	5.0	361	*		4470
Specialized 1200-Cow Dairy	Partial Zero Grazing - TMR	6.25	192		*	3910
Specialized 440-Cow Dairy	Partial Zero Grazing - TMR	6.25	70		*	1640
Traditional 250-Cow Dairy	Full grazing + Purchased Concentrate	5.0	75	*		853
Traditional 25-Cow Dairy <sup>1</sup> .	Full grazing + Purchased Concentrate	4.3	9.0	*		81.4
Specialized 60-Cow Dairy	Partial Zero Grazing - TMR	6.0	10.0		*	224

Source: Jennings *et al* (2008); <sup>1</sup>Miller, R.C. Pers. Comm.

The projected financial performance of each enterprise model, assessed at peak performance, is summarized in Table 5. The investment analysis assumes a project life of 14 years, except for the 25-cow model which is evaluated over a 10-year project life-span. For each model, lease-hold land tenure is also assumed.

**Table 5.** Financial Performance of Enterprise Units (\$M except otherwise stated)

<b>Model</b>	<b>Sp. 1200</b>	<b>Tr. 1200</b>	<b>Sp. 440</b>	<b>Tr. 250</b>	<b>Sp.60</b>	<b>Tr. 25</b>
Cap. Invest	149.1	144.1	84.6	48.8	16.6	8.232
Investment/ha	0.776	0.339	1.21	0.651	1.663	0.915
Peak year	6	5	6	5	5	7
Op. Exp	93.66	79.89	43.24	21.2	6.9	4.19
Gross revenue	147	128.3	51.0	28.1	6.95	4.20
Unit Cost/L (\$)	21.0	20.6	26.4	24.9	30.9	47.05
Loss period	Yr. 1	Yr 1	Yr 1-5	Yr. 1&3	Yr 1-8	Yr. 1-4
Net Income	46.1	40.2	5.73	5.60	(0.72)	0.73
Returns/ha	0.240	0.111	0.082	0.075	(0.072)	0.08
NPV (8%)	414.5	212.9	62.9	14.74	1.085	(4.655)
IRR (%)	30	20	16	11	9	4.0
IRR1	25	18	12	7	4	-
IRR2	27	17	12	8	5	-

*IRR1 – Adjusted for 10% increase in operating costs*

*IRR2 – Adjusted for 10% reduction in farm-gate price*

The foregoing highlights the importance of both scale and scope in achieving financial viability in *de novo* investments in dairy farming. Only enterprises carrying between 440 and 1200 cows, exhibit the robustness to attract significant investment capital. The sensitivity analyses suggest that new investments in enterprises below 440 cows are likely to be considered high-risk by traditional lenders.

## **Integrating the Small Farmer into a Large Farm Model**

Milk production, historically, has been a major contributor to the livelihood of the Jamaican small farmer. The entry of *Nestlé* into Jamaica during the late 1940s and their establishment of an elaborate country-wide churn collection network, created an assured stream of cash flows for several thousand small farm families up to the oil crisis of the mid-1970s which forced a rationalization of the collection system. The liberalization of the dairy market in 1992 essentially put paid to churn collection as the cost of collection made even the B-grade milk, assigned *a priori* to the small farmer, uncompetitive with essentially dumped milk powder. A demographic survey of the dairy sector in 2004 (Jennings *et al* 2004), recorded the exodus of over 500 small farmers, over 65 percent of this cohort, between 1990 and 2004.

Analysis of the viability of *de novo* investments in milk production clearly indicate that, in spite of its social desirability, the re-entry of small farmers into the dairy sector, in their traditional mode,

would be faced with severe financial constraints. Further, the requirements for compliance with minimum standards of Public Health pose severe additional barriers to entry.

The availability of several large tracts of underutilized state lands, many of which are classified as best suited to the production of pastures, presents an opportunity for public facilitation of small farmer participation in a revitalized dairy sector. The projected viability of farms milking upward of 440 cows allows for the establishment of nuclear farms as clusters which could facilitate least-cost investment by small farmers which would collectively afford the individual small farmer the benefits of economies of scale.

The Beef and Dairy Producers Association of Jamaica (BDPAJ) has advanced such a cluster model and has secured the commitment of the Ministry of Agriculture and Lands to making an initial two properties available through a long-term lease. The following analysis summarizes the salient features of the model and examines various financing scenarios from the perspective of their impact on overall financial and economic viability.

### ***Basic Features of the BDPAJ Model:***

For the purposes of this analysis, the *BDPAJ model* assumes the technical coefficients of the *specialized 1200-cow* dairy farm described in Table 4. The financial coefficients have, however, been updated to reflect changes in costs and prices since the analysis was undertaken in 2007.

The nuclear or cluster farm will be operated by a dedicated management company established by BDPAJ, which will retain direct ownership of a nucleus herd of 200 cows. Ownership of the remaining 1000 cows will be reserved for small farmers, with a ceiling of 10 cows per farmer, to be managed through a lease-contract with the nuclear farm.

### ***Comparative Analysis of Strategies for Financing Cluster Farm Establishment:***

The analysis compares the financial performance of the following strategies:

1. A basic *all-equity* capitalization approach;
2. Lease financing of small farmer cattle facilitated through a Cow Lease Assistance Programme with seed capital provided by the state;

3. Procurement of farm equipment through a capital (net) leasing facility to be made available through the Development Bank of Jamaica.
4. Equity participation (33% of capitalization) by GOJ by way of 3% cumulative preference shares redeemable over 14 years

The comparative financial performance of the four options for capitalizing the cluster farm is summarized in Table 6. The data is expressed in J\$ million except otherwise stated.

Table 6: Financial Coefficients of Capitalization Options

	<b>Base Option</b>	<b>Cow-leasing</b>	<b>Equipment Leasing</b>	<b>Pref. Shares</b>
Cap. Invest	329.07	253.19	248.92	329.07
Peak Op. Ex	119.3	96.3	121.1	122.7
Unit Cost (\$/L)	26.69	21.56	27.11	27.47
Net Income	112.5	130.7	109.3	114.9
Returns/ha	0.585	0.681	0.569	0.598
NPV...8%, 14yrs	476.9	663.3	485.9	472.3
IRR (%)	25	38	29	25

The cow leasing option assumes an annual lease payment equivalent to 20 percent of the value of the heifer (\$90,000) or cow (\$80,000). The annual lease payment on equipment is calculated on the basis of 10 percent of initial value. The cost of insurance (5% of value) on the leased assets will be borne by the lessee as well as the maintenance costs on leased equipment.

The analysis highlights the potentially significant positive impact of non-traditional (within the Jamaican context) capital financing options such as cow-leasing and equipment leasing on the overall financial viability of dairy projects. The ready availability of lease financing, particularly for capital intensive projects, has contributed significantly to the sustained international competitiveness of cattle farming in the major producing countries. Cow-leasing presents as a clear option for implementation through state-funding of a cow-lease assistance fund. With respect to equipment leasing it is suggested that that this presents an option for portfolio diversification by the Development Bank of Jamaica which could act in the role of broker or direct lessor, facilitated through available multi-lateral funding.

As a means of securing the participation of resource poor farmers, the option of the state taking an initial equity position through an issue of preference shares is considered a critical intervention. While this option, *a priori*, has no impact on project financial viability, it represents an opportunity for wealth accretion by the small farmer who would have the opportunity to acquire over time, through his milk contribution to the project, the initial equity stake by the state.

## **Summary and Conclusions**

The upheavals in the global food market of the previous two years have reinforced doubts regarding the capacity of traditional food exporters to simultaneously guarantee both access and availability even into the medium term. Developing countries such as Jamaica are therefore confronted with the challenge of guaranteeing enhanced national food security by significantly expanding endogenous food production.

With respect to milk production, Jamaica is conferred with clear strategic advantages by virtue of land capability, animal genetic resources and the requisite knowledge base. In spite of the demonstrated local capacity of dairy farming, under intensive management, to generate very high returns per unit area of land, access to capital remains a major limiting factor to exploiting the patent market opportunities.

The Government of Jamaica has given high priority to revitalization of the dairy sector for greater contribution to national food security and increased livelihood restoration and protection of the substantial numbers of resource-poor farmers who historically represented the largest cohort of milk producers.

A *Large-Scale Cluster Dairy Farm* model has been proposed by the Beef and Dairy Producers Association of Jamaica as a vehicle for integrating small farmers into a business model which affords them the benefits of scale economies. Analysis of this model indicates that it is financially viable (IRR -25%). However, access to capital poses a significant challenge to its implementation.

It is concluded that the problems of capitalization of the model would be significantly alleviated through the adoption by the state of financing strategies such as cow-leasing and capital leasing

which are common among the world-leading milk producing countries. Further, although equity participation by the state expectedly has little influence on financial viability, it presents a means of reducing barriers to entry and promoting wealth accretion by resource poor farmers, which deserves consideration.

## References

**Comprehensive Resource Inventory and Evaluation System Project (CRIES) 1982.** *Jamaican Resource Assessment*. USDA – Soil Conservation Service, 1982

**Duffus, B.G. and Jennings, P. G. 2005** *The Current State of the Jamaican Cattle Sector*. [www.jlaltd.com](http://www.jlaltd.com)

**Food and Agriculture Organization of the U.N. 2009** *World Agriculture: Towards 2030-2050. An FAO Perspective*. Rome, Italy

**Hollinger, F. 2004** *Financing Agricultural Term Investments*. Agricultural Finance Revisited No. 7. FAO/GTZ

**Holness, J.A.Y., Fielding, W. and Wellington, K.E. 1994** *Characteristics of Jamaica Hope Lactation Curves in the ALCAN Herd, 1990-91*. *JAGRIST* 5 (2): 18-26.

**Jamaica Dairy Development Board 2008** *Dairy Facts and Figures 2007-08*. Available at [www.jddb.gov.jm](http://www.jddb.gov.jm)

**Jamaica Dairy Development Board 2008** *A Medium Term Policy Framework for the Jamaican Cattle Sector: Strategic and Public Policy Prescriptions for Enhancing the Contribution of Beef and Dairy Production to National Development*. Available at [www.jddb.gov.jm](http://www.jddb.gov.jm)

**Jennings, P.G. 2006.** *Livestock Production in Unfavourable Economic Environments: Strategies for Attaining Sustained Competitive Advantage*. BookSurge LLC (Pub). Available at [www.amazon.com](http://www.amazon.com)

**Jennings, P.G. (2006)** *A Perspective on the Market Potential of the Jamaica Hope*. Presentation to Annual Conference 2006, the Jamaican Society for Agricultural Sciences, Bodles, Sept. 26, 2006. Available at [www.jddb.gov.jm](http://www.jddb.gov.jm)

**Jennings, P.G. 2008.** *Recovering from the Trauma of Liberalization: The Jamaican Dairy Industry as Case Study*. Paper presented at International Congress on Tropical Agriculture, Port of Spain, Trinidad and Tobago, Nov. 30- Dec. 05, 2008. Available at [www.jddb.gov.jm](http://www.jddb.gov.jm)

**Jennings, P.G. and Clayton, D.M. 1995.** *Comparative Performance of Jamaica Hope and Friesian Cattle under Intensive Grazing Management*. *JAGRIST* 7: 23-25.

**Jennings, P.G., Miller, R.C., Ffrench, D.L. and Pryce, M.A. 2004** *Current Demographics of the Jamaican Dairy Farming Sector: Analysis of a 2004 Survey*. Presented to JLA/JDDB Dairy Farmers' Seminar, JLA, Kingston, July 22, 2004.

**Miller, R.C., Ffrench, D.L., Duffus, B.G. and Jennings, P.G. 2008.** *Revitalization of the Jamaican Dairy Sector: Evaluation of the Feasibility of Business Models for Intensive Dairy Production*. Paper presented at 19<sup>th</sup> Annual Conference, Jamaican Society for Agricultural Sciences, Bodles Agricultural Station, Feb. 20, 2008.

**Miller, R.C., Ffrench, D.L., and Jennings, P.G. 2006** *Tracking Milk Production Efficiencies on Jamaican Dairy Farms*. Presentation to 17<sup>th</sup> Annual Conference, JSAS, Bodles, September 06, 2006. Available at [www.jddb.gov.jm](http://www.jddb.gov.jm)

**OECD-FAO 2009** *Agricultural Outlook 2009-2018*. OECD/FAO

**The World Bank 2007** *World Development Report 2008: Agriculture for Development*. The World Bank, Washington, D