ANNEX II
Pilot Project Identification

Pilot Project: Frome Estate – Electric Power Cogeneration

This pilot project entails a complete refurbishing of the Frome Estate to turn it into a modern sugar mill and sugar refinery equipped with a 29 MWe cogeneration power plant, as the schematic below shows. According to Mukherji Associates, who have inspected the estate, the current mill infrastructure is in disrepair and deemed obsolete, hence ~~no~~ effort to salvage it is recommended. Instead, new equipment should be purchased aiming at an efficient and cost-effective operation.

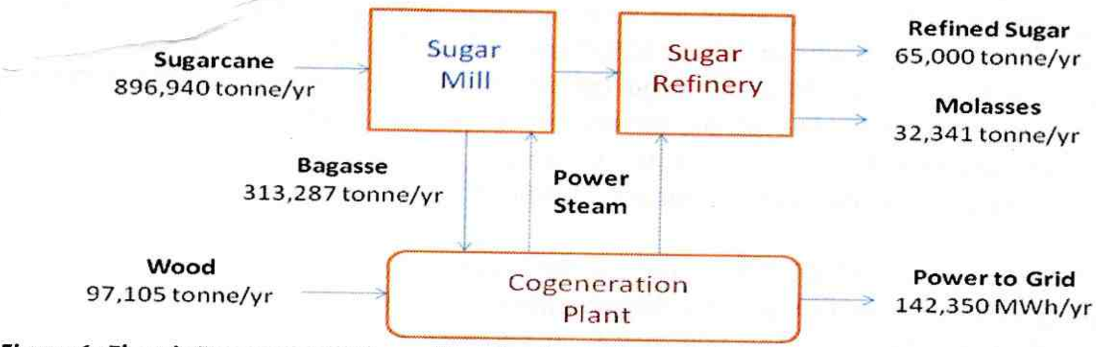


Figure 1: Electric Power Generation with refined sugar and molasses

At a glance, the key operating parameters of a refurbished Frome Estate are as follows:

(1) Sugar Mill

- Cultivated land: 4,800 hectares (ha)
- Sugarcane production: 408,000 tonnes/yr (average yield: 85 tonnes/ha)
- Sugarcane purchased: 488,940 tonnes/yr
- Crop period: 179 days/yr
- Harvest method: Manual (70%) and mechanized (30%)

(2) Sugar Refinery

- Refined sugar production: 65,000 tonnes/yr
- Molasses production: 32,341 tonnes/yr

(3) Cogeneration Plant

- Power production: 29 MW
- Power for export: 18 MW
- Electricity exported: 142,350 MWh/yr
- Boiler pressure: 65 bar
- Fuel used:
    - Bagasse: 313,287 tonnes/yr for 179 days/yr
    - Wood: 97,105 tonnes/yr for 186 days/yr

- Wood cost: $22.30/tonne (green basis)

Assumptions and Inputs to Financial Model

The mill will be supplied with sugarcane both from its own land and from independent farmers. More specifically, 45.5% of its cane supply (408,000 tonne/yr) will be harvested from land owned by the Estate and the rest from contracted farmers. An investment of almost $5.5M (in 2010 dollars) will be required for agricultural equipment, such as harvesters and trucks. Another $1.7M will be dedicated to installing an irrigation system in the estate's 4,800 hectares.

The new sugar mill, which will be processing a total of 896,940 tonnes/yr will require an investment of $24.7M, whereas the adjacent sugar refinery will need another $16.9M. The refined sugar is assumed to sell for $550/tonne ($0.25/lb) with an annual escalation factor of 5% due to increased future demand (global population growth) and land scarcity due to competing land uses. In addition, the refinery will be also producing molasses. The molasses are of vital importance to the country's economy, as they supply the rum industry. In our calculations we assume a selling price of $60/tonne for the molasses.

The major novelty of this pilot project is the cogeneration plant that will operate year-round using as fuel the mill's sugarcane bagasse during the crop season (179 days) and purchased wood during the off-season (186 days). A purchase price of $22.30/tonne of wood is the baseline in the proforma statements, but a sensitivity analysis has been performed to assess the effect of wood cost on the project's internal rate of return (IRR), as outlined later.

The cogeneration plant will be producing 29 MWe of power, of which 18 MWe will be exported at an assumed price of $0.10/kWh. The boilers of the cogen facility will be generating 65-bar steam. The capital cost of such a facility is estimated to be $44.8M. Although this is a significant investment, it will pay off: it will allow the mill to become completely self-sufficient in terms of power needs and to export annually 142,350 MWh of excess electricity to the grid to help Jamaica meet its increasing power needs, while reducing oil imports.

Overall, the investment required for such a new operation at Frome will be $94.8M (assumed 100% equity-financed), whereas its O&M will be costing $44.8M/yr. On the other hand, revenues from the sale of refined sugar, molasses, and electricity are expected to total $51.9M during the first year of operation.

Financial Model Results

As shown in the attached spreadsheet, assuming a straight-line 15-year depreciation of the capital cost (typical for this kind of operation), the Frome Estate is projected to finish the first year "in the black" with a net income of about $620,000 after taxes. The effective tax rate is assumed to be 20%, which is lower than Jamaica's 33.3% upper limit, but reflects better a leveraged financing investment, since interest expenses would offset income for tax purposes.

Over the 15 years of its depreciated life, the plant will generate a reasonable internal rate of return of 11.50% under the assumptions listed above.

The attached spreadsheet illustrates in detail the proforma statements for the Frome Estate pilot project under a set of assumptions that would justify the investment. While the authors feel the assumptions are realistic, the IRR is affected by a number of variables, some of which are beyond the mill's control and should hence be studied in more detail. Several crucial external variables are: (1) the cost of wood fuel purchased by the mill from farmers and used as fuel in the cogeneration plant during the off-season, when no bagasse is available; (2) the price and quality of the cane supply from the other plantations/farmers; (3) the value of sugar on the world market, which is currently high by historical standards; and (4) the price at which Jamaica's Utility Company is willing to purchase the mill's excess electricity (feed-in tariff).

Wood Fuel Supply

The critical issue for year-round cogeneration is the plant's ability to secure a sufficient supply of fuel at an acceptable price during the off-season. Wood (or other potential fuels) will have to be cultivated by farmers based on long-term contracts. In turn, the willingness of farmers to grow such biomass will depend on receiving a market-competitive compensation from the mill. The Mukherji report states that a land area of 7,000 ha will be required to generate the required 97,105 tonnes annually, but no further details are provided. This land size implies that the woody biomass that can be harvested sustainably is just less than 14 tonnes per hectare. This seems a reasonable assumption as higher rates of annual growth are achievable provided fast growing species are selected, the soils and rainfall are suitable and the plantation is well managed[14]. There is inevitably a time lag between planting saplings and reaching a steady state, where 14 tonne/ha-yr can be harvested. However, since the lead time to finance and then install the changes to the existing Frome sugar mill will realistically be at least 30 months, provided the planting of fast growing energy trees is given a priority, securing the funds needed for the first year operation of the plant may be possible. Other solutions that could help "bridge the gap" might be to bring the new plant into full year-round operation at full electrical output off-season over 1-2 years or to provide biomass to the cogen from some fast growing annual energy crops (high fiber sugar cane or sorghum) to cover that period. The optimum solution will need additional evaluation as part of a detailed feasibility study

The selling price for wood that will entice farmers to commit to supplying the power plant will depend on its competitiveness with other options (alternative crops) the farmers have in Jamaica. The Mukherji report assumes a price of $22.30/tonne of wood. To assess the effect of wood price on the economics of the Frome Estate operation, we performed a sensitivity analysis, as shown in Figure 2.

As the wood price is raised from $15/tonne to $30/tonne, the IRR drops from 11.50% to 10.65%. In other words, a doubling in wood expenses reduces the investment's performance by 7.4%. Hence, wood cost has a notable effect on the mill's profitability. Obviously even

[14] Based on a Winrock study of cotton wood grown for energy in the Mississippi, a climate somewhat less attractive to maximum growth than Jamaica, realistic sustainable removal rates of 23 tonne dry /ha-yr by year 3 and 31 tonne dry/ha-y by year 4

higher wood cost will have a detrimental effect on the rate of return making the investment less attractive.

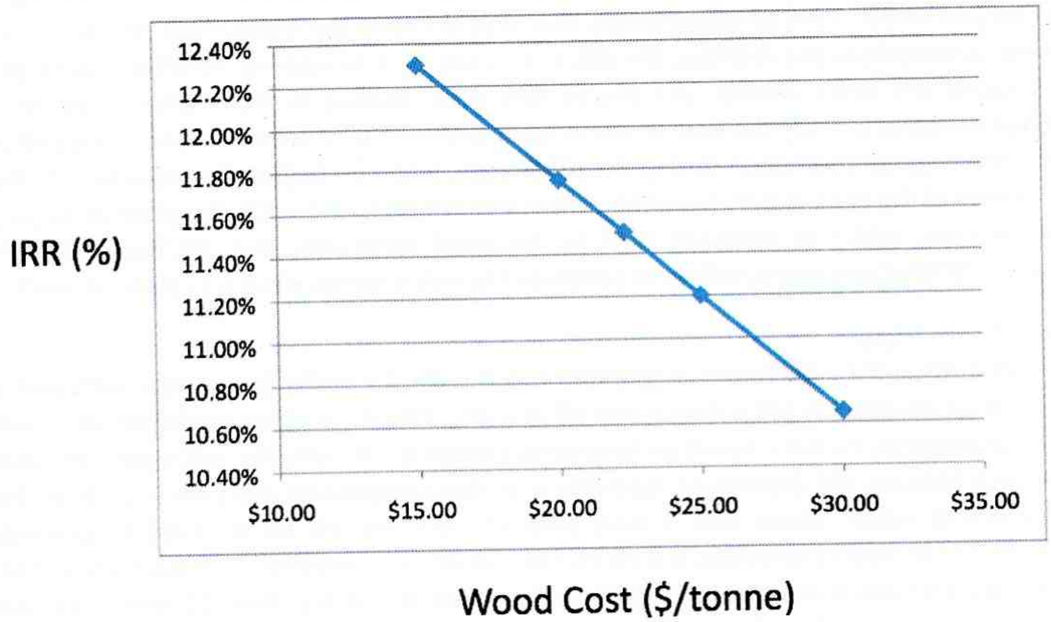


Figure 2: ***Effect of the cost of wood fuel on the internal rate of return (IRR) of the investment for the Frome Estate.***

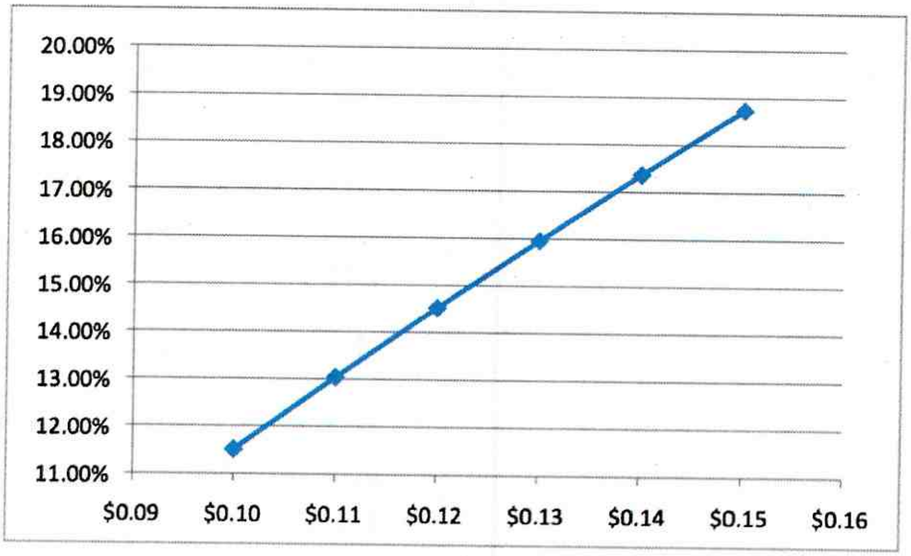
Electricity Selling Price

Another crucial factor, as with any cogen operation, is the price at which excess electricity will be sold to the State-controlled Utility Company. The Mukherji report assumed $0.10/kWh, although the authors advocated higher prices to make the investment more attractive. For the purpose of the base case evaluation provided above we assumed $0.10/kWh, but assessed the effect of higher prices on the base case IRR of 11.50%. We performed a sensitivity analysis by varying the feed-in tariff between $0.10/kWh and $0.15/kWh. The results are shown in Figure 3.

The effect of the electricity selling price on the IRR is dramatic underlining the importance of this issue to prospective investors. As the feed-in tariff rises from $0.10/kWh to $0.15/kWh, a 50% increase, the IRR jumps from 11.50% to 18.73%, a 63% increase. This is not surprising, since the revenues from the sale of electricity represent a significant portion (27.4%) of the Frome operation's total revenues from the start.

It should be noted that when sugar prices fall, electricity from cogeneration provides a financial cushion to help maintain the overall profitability of the mill. Moreover, a year-round cogeneration plant at the mill largely eliminates any need for the mill to import electricity from the grid even in the out-of-season period. In addition, the cogeneration plant provides round year capacity to the utility company thereby avoiding the need for Jamaica to build such an amount of additional capacity under its expansion plans.

IRR (%)



Electricity Selling Price ($/kWh)

***Figure 3:** Effect of the selling price of excess electricity on the internal rate of return (IRR) of the investment for the Frome Estate.*

These ramifications for the Frome Estate project need to be studied and well understood by all parties involved as the country is seeking investments for its sugar and biofuels industries and striving to reduce its dependence on foreign oil.

Financial Simulation for Power and Sugar at the Frome Estate

	YEAR 0	1	2	3	4	5	8	7	8	9	38	11	12	13	14	15
Initial Investment	$ 94,433,372															
Product value	$ 558	$ 598	$ 578	$ 606	$ 637	$ 669	$ 742	$ 737	$ 774	$ 813	$ 853	$ 896	$ 941	$ 988	$ 1,037	$ 1,089
Refined Sugar (per tonne)	$ 68	$ 60	$ 63	$ 66	$ 69	$ 73	$ 77	$ 80	$ 84	$ 89	$ 93	$ 98	$ 103	$ 108	$ 113	$ 139
Molasses (per tonne)	$ 188	$ 100	$ 185	$ 120	$ 116	$ 122	$ 124	$ 234	$ 141	$ 148	$ 155	$ 163	$ 171	$ 180	$ 189	$ 198
Exported electricity (per MWh)																
Product Revenue		$ 35,758,400	$ 37,537,500	$ 39,414,375	$ 41,385,894	$ 41[illegible]14,348	$ 45,627,066	$ 47,908,419	$ 50,343,440	$ 52,819,832	$ 55,459,984	$ 58,232,983	$ 61,144,632	$ 64,201,864	$ 67,411,957	$ 70,782,555
Refined Sugar		$ 1,948,460	$ 2,037,483	$ 2,139,357	$ 2,246,325	[illegible]58,64[illegible]	$ 2,476,573	$ 2,600,482	$ 2,738,422	$ 2,866,943	$ 3,814,298	$ 3,260,885	$ 3,318,845	$ 3,484,787	$ 3,659,827	$ 3,841,978
Molasses		$ 24,235,000	$ 14,846,250	$ 15,694,088	$ 26,478,792	17,302,73[illegible]	$ 14,167,868	$ 19,076,261	$ 20,838,875	$ 21,031,578	$ 22,083,157	$ 23,187,315	$ 24,346,681	$ 25,564,015	$ 26,842,216	$ 28,184,326
Exported electricity		$ 51925,460	$ 54,522,733	$ 57,247,828	$ 60,118,211	63,115,72[illegible]	$ 66,271,547	$ 69,585,883	$ 73,864,337	$ 76,717,554	$ 40,553,431	$ 84,581,183	$ 88,810,158	$ 93,250,666	$ 97,923,199	$ 182,808,459
Total Revenue		$ 44,834,814	$ 46,175,744	$ 47,561,816	$ 48,987,847	58,457,4[illegible]	$ 51,971,206	$ 53,538,343	$ 55,136,253	$ 56,790,342	$ 58,494,051	$ 60,248,872	$ 62,056,338	$ 63,918,029	$ 65,835,569	$ 62,818,637
O&M Costs		$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	6,322,[illegible]	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6.322.225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225
Depreciation (20 years)		$ 772,416	$ 2,023,764	$ 3,384,579	$ 8,800,139	6,326,[illegible]	$ 7,978,076	$ 8,732,515	$ 11,685,859	$ 13,604,944	$ 15,237,156	$ 18,810,006	$ 20,431,595	$ 23,810,422	$ 25,755,485	$ 28,675,998
Net Income	20%	$ 154,483	$ 484,753	$ 672,916	$ 960,828	1,267,[illegible]	$ 1,593,615	$ 1,946,583	$ 2,321,172	$ 2,720,998	$ 3,147,433	$ 3,602,001	$ 4,086,319	$ 4,602,042	$ 5,151,881	$ 5,735,208
Taxes		$ 617,933	$ 1,619,011	$ 2,691,663	$ 3,840,111	5,068.[illegible]	$ 6,382,461	$ 7,786,012	$ 9,244,687	$ 10,883,991	$ 22,549,725	$ 14,408,005	$ 16,345,276	$ 18,408,338	$ 28,604,324	$ 22,948,793
Income after tax		$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,295	6,322,[illegible]	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225	$ 6,322,225
(add back depreciation)		$ 6,944,158	$ 2,943,236	$ 9,813,888	$ 28,162,336	21,392,[illegible]	$ 12,704,686	$ 14,188,237	$ 15,646,912	$ 17,206,225	$ 18,911,949	$ 20,730,229	$ 22,667,501	$ 24,730,555	$ 26,926,549	$ 29,263,823
Cash Flow		$ 6,224,257	$ 6,387,618	$ 6,502,608	$ 6,574,975	6,609,[illegible]	$ 6,611,724	$ 6,584,892	$ 6,533,081	$ 6,459,685	$ 6,367,774	$ 6,260,098	$ 6,139,107	$ 6,007,841	$ 5,865,872	$ 5,717,368
Discounted cash flow	$ (94,033,372)	$ (88,609,826)	$ (82,221,406)	$ (75,718,798)	$ (69,143,824)	(62,534,0[illegible])	$ (55,922,291)	$ (49,337,399)	$ (42,804,318)	$ (36,344,629)	$ (29,976,856)	$ (23,726,766)	$ (17,577,659)	$ (11,578,618)	$ (5,704,746)	$ 12,622
Cumulative discounted cash flow																

Annual Escalation Rate (products)	5%
Annual Escalation Rate (supplies)	5%
Annual Discount Rate	12.50%

Pilot Project: Duckenfield Estate - Ethanol from Cane Juice

In contrast to the Frome example described previously and due to the smaller cane catchment area, the Duckenfield Estate seems more suited as an opportunity, to produce alcohol in place of granular sugar and molasses. Under this scenario, the mill will grind the cane as it has traditionally, but the cane juice will then pass directly to a fermentation tank, where yeast will convert the sugars to alcohol, and from there to distillation columns to raise the ethanol concentration to 95%. The hydrous ethanol produced in this way would most logically be dehydrated to fuel-grade concentrations at one of the Island's two idle large facilities for this purpose. As in the Frome example, the mill will produce and sell surplus electric power to the utility grid. Section 5.1 of the main report describes the technology, and the diagram below illustrates the process and indicates the volumes of inputs and products corresponding to nine months of operation during the year.[15] As in the case of Frome, electric power generation would continue year-round with supplemental fuel from cane trash, biogas or other sources. The return on investment is highly sensitive to the relative prices of sugar and ethanol but under a plausible scenario could yield a blended (equity and debt) return of 16 percent per year.

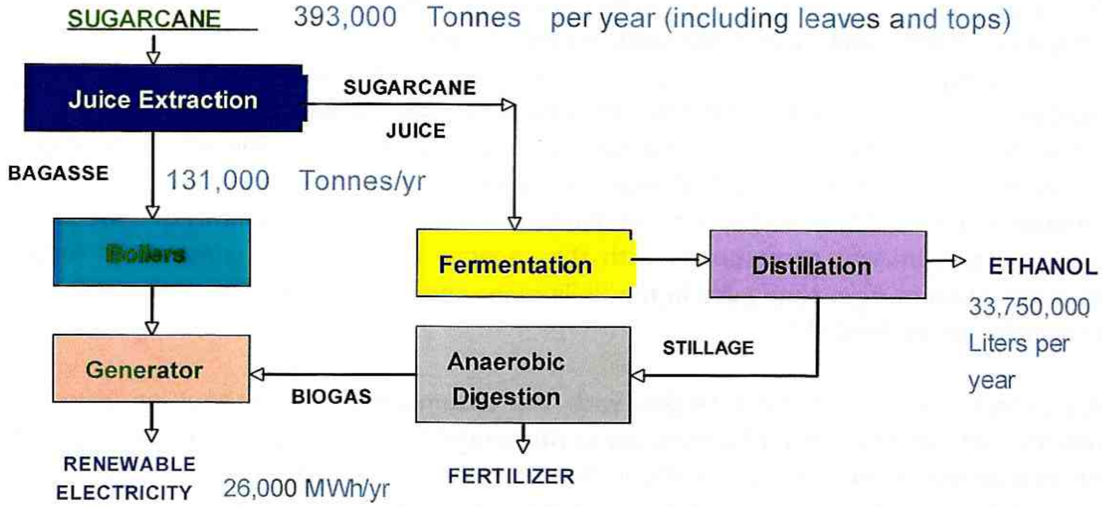


Figure 1: Ethanol and Electricity Production from Sugarcane

At a glance, the key operating parameters of a reconfigured Duckenfield Estate are as follows:
(1) Sugar Mill

- Cultivated land: 4,500 hectares (ha), including Jones and Golden Estates and small farmers
- "Clean" sugarcane consumption: 370,000 tonnes/yr (average yield: 82 tonnes/ha)

[15] Details of the project presented here are based on the San Carlos Bioethanol Project, a similar facility of comparable size constructed in the Philippines in 2007-2008.

- Total sugarcane consumption: 393,000 tonnes per year (including leaves and tops to supplement bagasse fuel)
- Crop period: 270 days/yr
- Harvest method: Manual (70%) and mechanized (30%)

<u>(2) Fermentation and Distillation</u>
- Hydrous ethanol production: 33,750,000 Liters/yr

<u>(3) Cogeneration Plant</u>
- Power production: 7.4 MW
- Power for export: 3.1 MW
- Electricity exported: 26,000 MWh/yr
- Boiler pressure: 67 bar
- Fuel used:
    - Bagasse: 131,000 tonnes/yr
    - Methane from biogas: 1.5 million cubic meters/yr

This pilot builds on plans by the Duckenfield Estate to increase sugarcane production by cultivating more land and improving yields. Currently, the mill counts on cane from approximately 3,000 captive hectares (Jones and Golden estates) and purchases from independent farmers, who cultivate an additional 500 hectares. Yields range from 44.5 tonnes/ha on small farms to 86.5 tonnes/ha on the Jones Estate. The plan is to expand the cultivated area to 4,500 total hectares, and assuming that the owners are able to achieve average yields of 82 tonnes/ha, the mill will have available 370,000 tonnes of cane per year to process. That amount corresponds with the capacity of a recently constructed facility that produces ethanol from cane juice in the Philippines and can thus serve as a model for a similar installation at Duckenfield.

The prospect evaluated here begins with the assumption that without an investment in ethanol, cane production and processing at Duckenfield would expand, reaching 37,000 tonnes per year of crystalline sugar and 3,700 tonnes per year of molasses. The pilot project would add ethanol fermentation and distillation equipment, upgrade the boiler house to generate sufficient high pressure steam, add turbine generators to supply electric power for on-site requirements and 3.1 MW for export to the grid, and install an anaerobic digester to treat wastes and produce methane as a fuel supplement. The resulting capability would permit the mill to sell 33.75 million liters of ethanol and 26,000 megawatt hours of electricity per year. Assuming the cost of cane and other operation and maintenance costs would be the same, whether the mill produced sugar or ethanol, the project amounts to a capital investment to be amortized by the higher revenues that energy products could command relative to sugar.

Additional assumptions involve extending the cane-harvesting season to 270 days per year, in order to take better advantage of processing capacity and reduce the time during which the mill will require supplemental fuel to continue generating firm electric power for export. Since fermentation is less exacting than sugar production in terms of the time intervals between peak sugar conditions and cane harvesting and also before crushing, and because concentrated cane juice can be stored and techniques used to promote early ripening, moving to a 270 day crushing season seems possible. However, this would need to be explored in more depth during a feasibility study. The analysis also assumes that, unlike the proposed arrangement at Frome, supplemental fuel will be in the form of 23,000 tonnes per year of cane tops and leaves delivered with the cane to increase the production of bagasse, which can be stored to fuel off-season power generation.

Specific features of the pilot appear below, and the spreadsheet at the end of this section outlines in detail the proforma statements for the Duckenfield pilot project. As in the case of the Frome example, the authors feel the assumptions are realistic, but the IRR is affected by a number of variables, some of which are beyond the mill's control and should be studied in more detail. Several crucial external variables are: (1) the price of sugar, assumed here to return to historic levels from its current highs; (2) the value of ethanol, which is tied closely to petroleum; and (4) The price at which Jamaica's Utility Company is willing to purchase the mill's excess electricity (feed-in tariff).

Added Component	Investment (US$)
Distillery	$4,011,593
Boiler plant	$3,947,051
Steam turbine	$2,128,594
Anaerobic digestion system	$1,197,110
Composting system	$74,471
Electrical system	$3,525,897
Construction and commissioning	$2,168,834
Total Investment	$17,053,549

Sugar Cane	Tonnes/y
Jones Estate (1,300 ha; 87 tonnes/ha)	113,100
Golden Estate (2,500 ha; 85 tonnes/ha)	212,500
Small Farmers (600 ha; 74 tonnes/ha)	44,400
Total clean cane (tonnes/yr)	370,000
Leaves and tops	23,000
Total "trashy" cane (tonnes/yr)	393,000

Ethanol Refinery	Liters/y
Ethanol production	33,750,000

Cogeneration	
Power production capacity (MW)	7.4
Surplus power (MW)	3.1
Boiler pressure (bar)	67
Bagasse (tonnes)	131,000
Power export (MWh/yr)	26,000
Days/yr	350

Table 1: Pilot Project Cost and Operating Characteristics

As indicated earlier, the upgrade could yield an internal rate of return (blended debt and equity) of 16 percent per year, assuming prices and revenues shown in Table 2 (below). "Internal rate of return" in this discussion refers to the financial performance of the incremental investment in ethanol production, and not the profitability of the mill as a whole. Variations in either the ethanol price or the value of sugar that would not be produced will cause significant changes in the predicted IRR. For example, at the current sugar price of US$0.37 per lb. (approximately $800 per tonne), ethanol is clearly uneconomical (See Figure 2.) On the other hand, as the graph in Figure 3 illustrates, sugar prices have been well below US$0.20 per lb. ($440 per tonne) for almost all of the past 30 years, and recent increases, due at least in part to weather in India and Australia, may be temporary, as they were in 1980.

Product Revenue	Price	Amount/yr
Ethanol	$0.50/liter	$16,875,000
Foregone sugar revenue @ 37,000 tonnes/yr	$480/tonne	$(17,760,000)
Foregone molasses revenue @3,700 tonnes/yr	$60/tonne	$(222,000)
Exported electricity	$150/MWh	$3,900,000
Total Net Revenue		$2,793,000

Table 2: Price and Revenue Assumptions

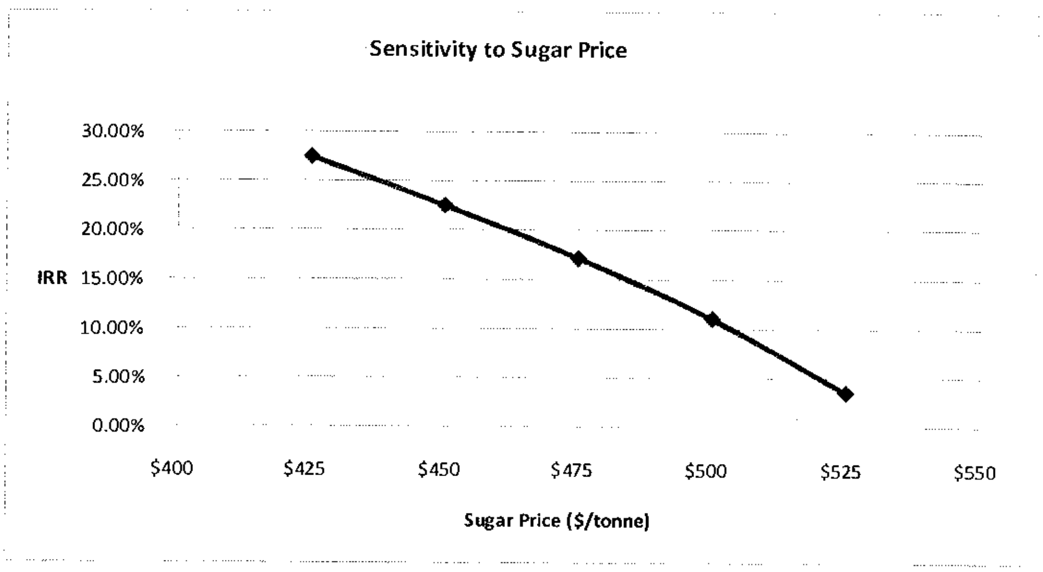
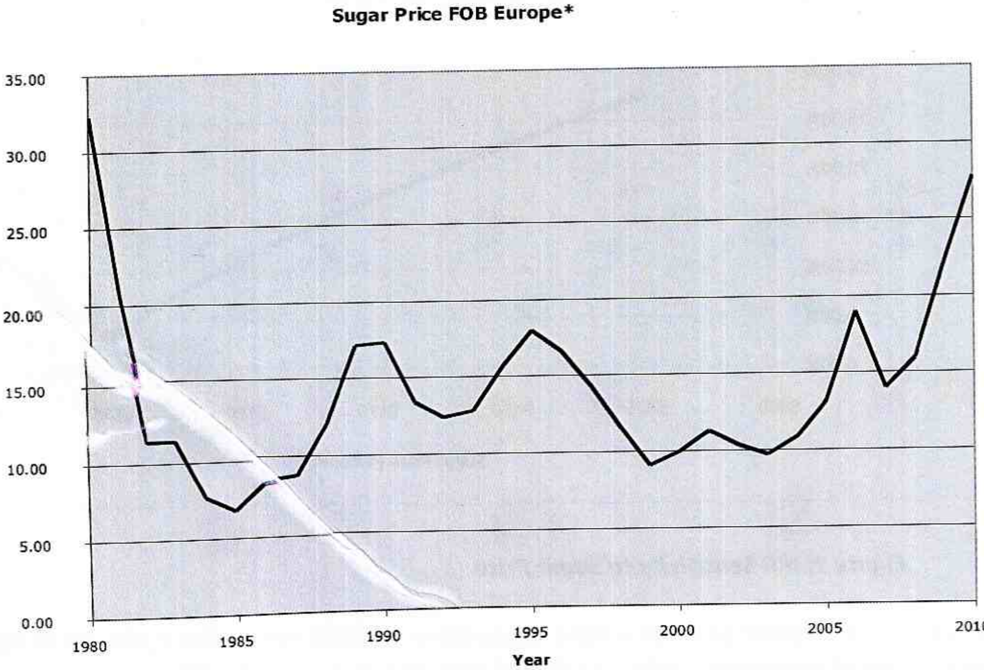


Figure 2: IRR Sensitivity to Sugar Price

Sensitivity to ethanol price at a fixed sugar price of $480 per tonne is shown in Figure 4. At this price, ethanol production offers an IRR of 15% and higher when ethanol is at or above US$ 0.50 per liter, comparable in terms of heating value to US$3.00 per gallon gasoline. However at US$0.45 cents per liter, only ten percent less, the IRR of the ethanol investment drops to 3.3 percent per year. This is clearly an inadequate long-term level. However,if sugar prices decline at the same time, and it is not unusual for sugar prices and crude oil process to be linked, a higher IRR would result (see Fugure 3). The key to an investment in an ethanol plant is the anticipated long-term future trends in sugar and ethanol prices. Although, one might expect petroleum prices to increase over time, that cannot be guaranteed. Similarly, one might expect from historical performance that current sugar prices will fall.

To offset pricing risks, the mill could retain its sugar production capacity as a hedge against high sugar and low ethanol prices. This would involve building the new ethanol distillery next to the adjacent sugar refinery and making provisions to "mothball" each plant when the other is operating. Some modest additional costs would be needed (e.g. ability to dry plant and, perhaps, an inert gas system to purge air from closed vessels). While combined operation is theoretically possible, designing an ethanol distillery to run at less than 75% full capacity is a challenge, and for the overall size of Duckenfield we believe this would be less attractive. Another issue is the need for a reliable source of ethanol to supply the Jamaican domestic market.



*Contract No. 407 (aka no.5), London Daily Price, for refined sugar, f.o.b. Europe, spot, through June 2006. Starting in July 2006, spot price replaced by average of nearest futures month for which an entire month of prices is available.
Source: US Department of Agriculture, http://www.ers.usda.gov/briefing/sugar/Data/Table02.xls

Figure 3: Historical Sugarcane Prices

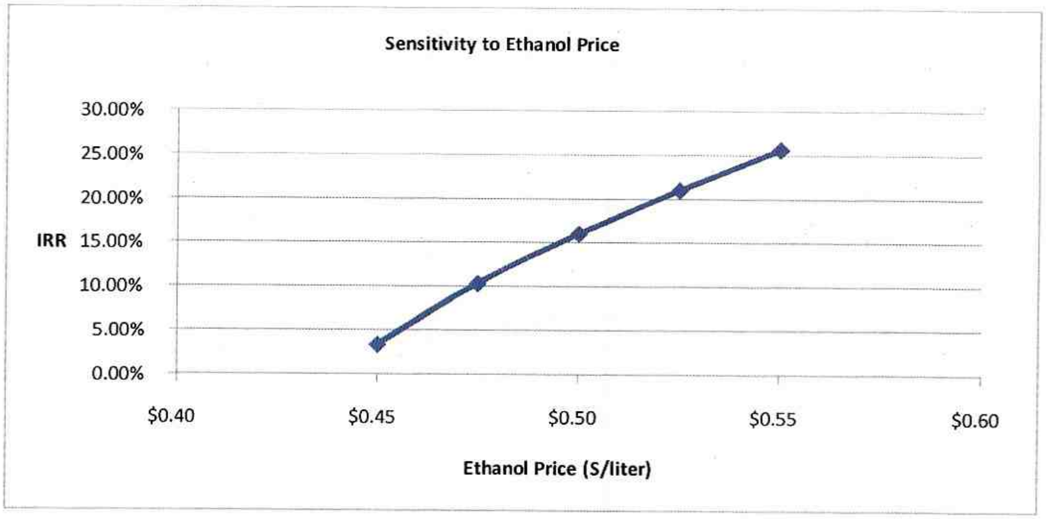


Figure 4: IRR Sensitivity to Ethanol Price

Financial Simulation for Ethanol and Power Production at Duckenfield

	YEAR															
	8	1	2	3	4		6	7	8	9	28	11	12	13	14	15
Initial Investment	$ 17,053,549															
Product Values																
Ethanol (per liter)	$ 0.50	$ 0.58	$ 0.53	$ 8.55	$ 8.58	$ 8.61	$ 8.64	$ 8.67	$ 8.78	$ 8.74	$ 8.78	$ 9.81	$ 8.86	$ 8.98	$ 8.94	$ 8.99
Refined Sugar (per tonne)	$ 488	$ 468	$ 564	$ 529	$ 550	$ 58[illegible]	$ 613	$ 643	$ 675	$ 709	$ 745	$ 782	$ 821	$ 862	$ 985	$ 958
Molasses (per tonne)	$ 68	$ 60	$ 63	$ 66	$ 69	$ [illegible]	$ 77	$ 88	$ 84	$ 89	$ 93	$ 96	$ 103	$ 108	$ 113	$ 119
Exported electricity (per MWh)	$ 158	$ 150	$ 158	$ 165	$ 174	$ 18[illegible]	$ 191	$ 281	$ 211	$ 222	$ 233	$ 244	$ 257	$ 269	$ 283	$ 297
Product Revenue																
Ethanol	$	16,875,400	$ 17,718,758	$ 18,664,688	$ 19,534,922	$ 28,511,668	$ 21,537,251	$ 22,614,114	$ 23,744,828	$ 24,932,863	$ 26,178,664	$ 27,487,597	$ 28,861,977	$ 38,385,876	$ 31,828,329	$ 33,411,346
Foregone sugar revenue @ 37,400 tonnes/yr	$	(17,768,000)	$ (18,648,000)	$ (29,588,400)	$ (20,559,428)	$ (22,587,391)	$ (22,666,761)	$ (23,888,499)	$ (24,990,104)	$ (26,238,609)	$ (27,551,589)	$ (28,929,169)	$ (38,375,627)	$ (31,894,408)	$ (33,489,129)	$ (35,163,585)
Foregone molasses revenue @3,780 tonnes/yr	$	(722,000)	$ (233,108)	$ (244,755)	$ (256,993)	$ (269,642)	$ (283,335)	$ (297,581)	$ (312,376)	$ (327,995)	$ (344,395)	$ (361,615)	$ (379,695)	$ (398,680)	$ (418,614)	$ (439,545)
Exported electricity	$	3,868,008	$ 4,095,888	$ 4,299,750	$ 4,514,738	$ 4,748,474	$ 4,977,498	$ 5,226,373	$ 5,487,692	$ 5,762,876	$ 6,858,188	$ 6,352,689	$ 6,670,323	$ 7,883,848	$ 7,354,032	$ 7,721,733
Total Revenue	$	2,793,800	$ 2,932,650	$ 3,879,283	$ 3,233,247	$ 3,384,989	$ 3,564,654	$ 3,742,887	$ 3,938,431	$ 4,126,533	$ 4,332,868	$ 4,549,503	$ 4,776,978	$ 5,015,627	$ 5,266,618	$ 5,529,949
Incremental O&M Costs relative to sugar and molasses	$	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Depreciation (15 years)	$	1,136,903	$ 1,136,983	$ 1,136,983	$ 1,136,983	$ 1,136,903	$ 1,136,903	$ 1,136,903	$ 1,136,903	$ 1,136,903	$ 1,136,903	$ 1,136,993	$ 1,136,903	$ 1,136,903	$ 1,136,983	$ 1,136,983
Net Income	$	2,656,097	$ 1,795,747	$ 1,942,379	$ 2,896,343	$ 2,258,88[illegible]	$ 2,427,751	$ 2,005,984	$ 2,793,128	$ 2,989,636	$ 3,195,956	$ 3,412,599	$ 3,648,475	$ 3,674,923	$ ¢,129,715	$ 4,393,846
Taxes	20% $	331,219	$ 359,149	$ 388,476	$ 419,269	$ 451,601	$ 485,558	$ 521,297	$ 558,626	$ 597,926	$ 639,191	$ 682,528	$ 728,415	$ 775,785	$ 825,943	$ 876,609
Income after tax	$	1,324,477	$ 1,436,597	$ 1,553,983	$ 1,677,875	$ 1,886,405	$ 1,942,281	$ 2,884,787	$ 2,234,583	$ 2,391,784	$ 2,556,765	$ 2,738,080	$ 2,922,066	$ 3,103,139	$ 3,383,772	$ 3,514,437
(add back depreciation)	$	1,136,983	$ 1,136,903	$ 1,136,983	$ 2,136,983	$ 1,136,982	$ 1,136,903	$ 1,136,983	$ 1,136,983	$ 1,136,983	$ 1,236,903	$ 1,136,983	$ 1,136,983	$ 1,136,983	$ 1,136,903	$ 1,136,983
Cash Flow	$	2,461,781	$ 2,573,581	$ 2,698,407	$ 2,813,978	$ 2,843,388	$ 3,479,184	$ 3,221,690	$ 3,372,486	$ 3,528,687	$ 3,693,668	$ 3,866,983	$ 4,048,963	$ 4,248,842	$ 4,440,675	$ 4,651,346
Discounted cash flow	$	1,122,446	$ 1,913,651	$ 1,725,481	$ 1,555,956	$ 1,403,488	$ 1,266,017	$ 1,142,268	$ 1,030,776	$ 938,386	$ 839,749	$ 758,112	$ 684,581	$ 618,115	$ 558,236	$ 584,215
Cumulative discounted cash flow	$ (17,853,549)	$ (14,938,703)	$ (13,817,853)	$ (11,291,652)	$ (9,735,695)	$ (8,332,295)	$ (7,666,278)	$ (5,924,818)	$ (4,893,234)	$ (3,962,928)	$ (3,123,178)	$ (2,365,867)	$ (1,688,566)	$ (1,862,451)	$ (504,215)	$ (8)

Inputs

Annual Escalation Rate (products)	5%
Annual Escalation Rate (supplier)	3%
Annual Discount Rate	15.97%

Pilot Projects: Discussion of Other Sugarcane Sites

The pilot project evaluation for Frome has similar application to Moneymusk, where the sugar cane harvest in 2006 was 760,000 tons, compared to 897,000 tons at Frome. Since the new owners of Moneymusk, following divestiture by the Sugar Company of Jamaica, will also be able to supply cane from lands that were previously within the Bernard Lodge catchment area, the available sugar cane harvest after new investment and rationalization is likely to exceed that of Frome. As a result, and dependent on decisions by the new owners, a scheme similar to that described for Frome with comparable benefits and returns, is an option. As at Frome, lengthening the cane harvest season (213 days in 2006) and increasing biomass fuel supplies (bagasse and possibly purpose grown) for a new cogeneration plant will be desirable to maximise returns from the new investments. As the cane season is extended, water supply for irrigation will grow in significance. Options will need to be explored to use more efficient methods of irrigation (e.g. drip feeding) and possibly cultivation of sweet sorghum as an alternative to sugar cane in the early/late harvest periods. The other key factor is an appropriate payment for electricity sales that recognizes the full savings in imported fuel that electricity from a new cogeneration plant would provide. Both of the preceding are essential for a commercial success and hence for a decision by the new owners to invest.

The Pilot project evaluation for Duckenfield, which had a total sugar cane harvest of 331,000 in 2006, is also applicable to Long Pond, where the 2006 sugar cane harvest was 338,000 ton. However, one important difference needs to be noted, and that is the longer and more pronounced dry season in the catchment area of Long Pond compared to Duckenfield, as shown in Figure 3. This is important, because in order to justify the investment needed to convert an existing a sugar mill to one producing ethanol and electricity (the pilot concept for Duckenfield), it is necessary to find ways to extend the harvest season to secure high availability from the new plant. Another problem at Long Pond is the loss of catchment areas due to its proximity to the rapidly developing tourist areas of the north coast. So even though Sweet Sorghum might be considered as an alternative to sugar cane and require less water, land for this crop will be less easy to obtain and secure in the long term.

An alternative that Long Pond may wish to consider is to just to invest in higher efficiency cogeneration based on sale of electricity to the Jamaican grid. This requires less investment, but again, it is most likely to be attractive when the operating period of the new plant can be extended to most of the year rather than being restricted to the current length of the cane harvest.

Worthy Park

This privately-owned site already has a highly integrated production of sugar and rum, and the cane catchment area has little room for expansion. As a result, the main option that Worthy is considering is investment in a more efficient cogeneration plant that would allow it to sell elecricity to the grid. This will only be possible if OUR finds a way to give full recognition to the value that this type of project would provide in terms of avoided imports of fossil fuel.

Duckenfield

As an alternative to conversion from sugar to ethanol production, Duckenfield could remain a sugar producer, but by adding a modern cogeneration plant, it could also become an electricity supplier to the grid. The economics of this is likely to require finding a way to extend the cane harvesting season and increasing available biomass (bagasse and bioenergy crops). The more regular rainfall in the Duckenfield capture area is an advantage. An indication of the overall economics can be estimated from the pilot case for Duckenfield by

Added Component	Investment (US$)
Distillery	0
Boiler plant	$3,947,051
Steam turbine	$2,128,594
Anaerobic digestion system	0
Composting system	0
Electrical system	$3,525,897
Construction and commissioning	$1,000,000
Total Investment	$10,601,542
Power export (MWh/yr)	26,000

Table 2: Investment Breakdown for Power Export at Duckenfeld

At a value of $150/MWh, the power would generate revenues of $3,900,000 per year, which would pay the initial investment back in less than three years.

Pilot Project: Biodiesel Refinery

As the National Biofuels Policy indicates, development of biodiesel in Jamaica is in its infancy. The Petroleum Corporation of Jamaica's Center of Excellence for Renewable Energy is conducting exploratory research to identify promising crops and their potential under local conditions and likely productivity on marginal lands. Most of the recent effort has focused on jatropha curcas and castor, both of which have been the subject of small field trials.

Given the early stage of biodiesel feedstock development, determining the size and location of a processing facility is difficult, as is predicting the likely cost of raw material to the prospective processor. For this reason, the "pilot project" described here is a generic one, designed to illustrate the economic relationships among feedstock cost, processing plant scale and product selling price. The approach is to estimate what the processor could afford to pay for vegetable oils from jatropha, castor or other sources, since a target price in this form could be useful in designing and evaluating approaches to cultivation and harvesting.

Section 2.6 of the main report discusses sources of biodiesel in detail. Based on Brazilian experience, the cost of small-scale production of castor beans, for example, containing 48% oil, is US $0.50 per Kilo ($1.00 per Kilo of oil), which amounts to $3.40 per gallon, or roughly twice the cost of crude oil.

Large-scale mechanized production of castor or jatropha could be less costly, but it might also displace sugarcane. As a large-scale field crop, soy might be a better alternative, since it has food as well as energy value. Another solution would be higher oil-yielding palm trees, which would not compete with cane for land and could possibly provide solid fuel for off-season sugar mill operation.

From a processing standpoint, as illustrated in Section 6 of the main report above, oilseeds will be harvested manually and/or mechanically and sent to a crusher for extraction of crude vegetable oil. Recycled oil can also be used, but depending on its free fatty acid (FAA) content, pretreatment may be needed (Fig. 1). However, such a unit can be ordered as a standard part of the integrated modular biodiesel unit to allow maximal flexibility in dealing with a variety of virgin and recycled feedstocks.

The oil is subsequently led through a series of vessels, where the transesterification process takes place at 50-60^{0}C in the presence of excess methanol and potassium hydroxide, which catalyzes the reaction. This standard process leads to the formation of primarily a mix of methyl esters (biodiesel) and glycerin in a weight ratio of approximately 10:1.

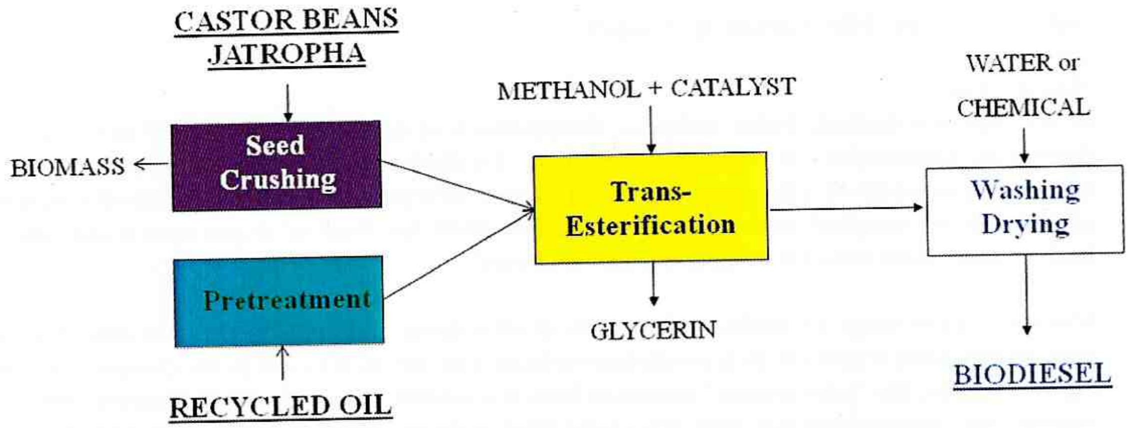


Figure 1: Biodiesel Production from Oil-Seed Plants and Recycled Oil

After a series of washing and drying steps to remove impurities (methanol) and moisture, the biodiesel is ready for testing to qualify it as appropriate for commercial use through blending with diesel. The glycerin is generated as a dilute aqueous solution that can be used in a number of ways, such as:

- Subjected to anaerobic digestion for conversion to methane, which can be used as a fuel for power and/or heat generation.
- Mixed with animal feed (as long as it is methanol-free) as a carbon supplement.
- Upgraded through distillation to a high purity (and high value) product that has applications in the cosmetics industry.

The latter application requires the purchase and operation of a distillation column, whereas anaerobic digestion and animal feed are lower value, but also lower-cost, options with modest revenue-generating potential.

The solid leftovers from the crushing of the seeds, along with other plant material, constitute a steady source of biomass that should be considered as the basis for cogeneration or for use as a natural fertilizer. Although cogeneration is usually not practiced at biodiesel plants due to their rather small size (and hence limited quantities of biomass), this possibility should be re-examined in Jamaica particularly in coordination with the cogeneration plans of the sugarcane-to-ethanol industry.

A more detailed discussion or processing technology and associated costs can be found in a report[16] by the US National Renewable Energy Laboratory. Process and cost data in the economic analysis that follows are generally from this source.

Revenue versus cost of feedstock

In general terms, the cost of processing vegetable oils into biodiesel are in approximately the same range as refining petroleum (US$ 0.50 per gallon), so the oil feedstock has to cost less than crude oil to be profitable without subsidies in some form. The crude oil price on the New York Mercantile Exchange was US$89.55 per barrel, or US$2.13 per gallon, on January 20, 2011. All countries with commercial

[16] Tyson, K Shaine, *et al.*, *Biomass Oil Analysis: Research Needs and Recommendations*, Golden Colorado, National Renewable Energy Laboratory, NREL/TP-510-34796, 2004. http://www.nrel.gov/docs/fy04osti/34796.pdf

biodiesel subsidize it one way or another, e.g., through lower excise taxes or mandatory use, and such a subsidy would probably be necessary, based on the analysis presented below.

Section 4.2 of the main report discusses possible uses for biodiesel and concludes that stationary applications represent the largest and most easily accessible market. As of January 20, 2011, Petrojam sells diesel fuel at the refinery gate, net of taxes, for J$64.5161 per Liter (US$2.85 per gal.). (See http://www.petrojam.com/index.php?q=latest-prices.) Taxes add another J$27.4041, bringing the total to J$91.9202 per Liter (US$4.06 per gal.). Biodiesel has a 10% lower calorific value per gallon, so the equivalent biodiesel price ex-refinery, without taxes, would be $2.57 per gallon. One way for Jamaica to encourage the formation and growth of a biofuels industry would be to exempt biodiesel from these taxes, which would bring the equivalent value to US$3.65 per gallon.

While agronomic trials are under way, and crops suitable for Jamaican conditions have not been selected, the scale and cost of vegetable oil supply remain difficult to predict. On the other hand, with values for the biodiesel fuel product and experience elsewhere with conversion costs, it is possible to calculate how much a processor could afford to pay for feedstock and realize an attractive return on investment under different price and scale scenarios.

With this in mind, results of four cash flow simulations appear below. These reflect plant capacities of 3 million and 15 million gallons per year and product prices equivalent to Petrojam's diesel with and without value-added and special consumption taxes, as shown in Table 1.

	Product Price	
Plant Scale	**US$2.57 per Gallon**	**US$3.65 per Gallon**
3 Million GPY	**Scenario A**	**Scenario B**
15 Million GPY	**Scenario C**	**Scenario D**

Table 1: Biodiesel Production Scenarios

The simulations reflected the following additional assumptions:

- Investment per annual gallon of plant capacity:
  - US$2.50 (3 million gpy)
  - US$1.00 (15 million gpy)
- Methanol and other reagents: US$0.25 per gallon of product
- Other plant operating cost: US$0.15 per gallon per year
- Sales, general and administrative costs:
  - US$100,000 per year (3 million gpy)
  - US$500,000 per year (15 million gpy)
- Depreciation: 15 years, strait line
- Taxes: 20 percent of net income
- Annual escalation rate: 3 percent per year (product price; feedstock and processing costs
- Hurdle rate of return on investment (discounted cash flow IRR): 15 percent per year

For illustration and simplicity, the 15 percent ROI assumes 100 percent equity financing. Debt leverage could improve this value for equity holders in an actual project. The implicit feedstock values corresponding to the four scenarios are as follows:

Scenario	Implicit Value of Vegetable Oil Feedstock
A	US$1.68 per gallon
B	US$2.73 per gallon
C	US$1.93 per gallon
D	US$2.99 per gallon

Table 2: Biodiesel Feedstock Values

From the two tables above, one can see that scale economies improve the economic prospects to a limited degree, while the effect of tax treatment is more than US$1.00 per gallon of feedstock at either scale. The detailed cash-flow simulations are presented in the tables below.

Financiel Analyais for 3 Mifion Gallons per Year Biediesel With Taxes

	Item	YEAR 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Initial Investment	$7,$00,000															
2																	
3																	
4	Product Value per Gal. Biedlesel		$2.$7	$2.65	$2.73	$2.81	$2.89	$2.98	$3.07	$3.16	$3.26	$3.36	$3.46	$3.56	$3.67	$3.78	$3.89
5	Feedstock Cost per Gallen		$1.68	$1.73	1.7	$1.$3	$1.89	$1.94	$2.00	$2.06	$2.12	$2.19	$2.25	$2.32	$2.39	$2.46	$2.54
6	Biodiesel Sales		$7,714,910	$7,946,357	$8,184,748	$8,438,298	$8,683,199	$8,943,695	$9,212,806	$9,488,366	$9,773,017	$10,066,208	$18,368,194	$18,679,240	$18,999,617	$11,329,605	$11,669,494
7	Feedstock cost @1.02 gal/gal prod.		$5,131,984	$5,285,944	$5,444,522	$5,607,858	$5,776,094	$$,949,376	$6,127,858	$6,311,694	$6,581,044	$6,696,076	$6,896,958	$7,103,867	$7,316,983	$7,536,492	$7,762,587
B	Gross Margin		$2,582,926	$2,660,413	$2,740,226	$2,$22,433	$2,907,10$	$2,994,319	$3,084,148	$3,176,673	$3,271,973	$3,378,132	$3,471,236	$3,575,373	$3,682,634	$3,793,113	$3,906,987
9	Gross margin per gallen		$0.86	$8.89	$8.91	$8.94	$8.97	$1.00	$1.83	$1.06	$1.09	$1.12	$1.16	$1.19	$1.23	$1.26	$1.30
18																	
11	Processing Cost																
12	Methanol and ether reagents @ $0.25/ Gal.		$750,000	$772,500	5795,675	$819,545	$844,132	$869,456	$895,539	$922,405	$950,878	$978,580	$1,887,937	$1,038,175	$1,069,321	$1,101,488	$1,134,442
13	Other Plant Operating Cest @ $0.15/Gal.		9458,888	$463,580	$477,485	$491,727	$506,479	$521,673	$537,324	$553,443	$570,047	$587,148	$604,762	$622,905	$641,592	$660,840	$688,665
14	SG&A		$100,000	$103,000	$106,090	$109,273	$112,551	$115,927	$119,405	$122,967	$126,677	$130,477	$134,392	$138,423	$142,576	$146,853	$151,259
15	Total Processing Cest		$1,380,888	$1,339,888	$1,379,178	$1,428,545	$1,463,161	$1,587,856	$1,552,268	$1,598,836	$1,646,881	$1,696,285	$1,747,091	$1,799,584	$1,$53,489	$1,909,094	$1,966,367
16																	
17	Depreciatien (15 yaar)		$580,000	$500,000	$500,800	$508,000	$500,800	$580,000	$508,000	$508,000	$580,000	$580,000	$500,000	$508,088	$500,000	$500,000	$508,808
18																	
19	Net Income		$782,926	$821,413	$861,056	$901,887	$943,944	$987,262	$1,831,888	$1,077,837	$1,125,172	$1,173,927	$1,224,145	$1,275,869	$1,329,145	$1,384,019	$1,448,548
20																	
21	Taxes (28%)		$156,585	$164,283	$172,211	$188,377	$188,789	$197,452	$286,376	$215,567	$225,034	$234,785	$244,829	$255,174	$265,829	$276,804	$288,188
22																	
23	Income After Tax		$626,340	$657,131	68,845	$721,510	$755,155	$789,810	$825,504	$862,269	$908,137	$939,142	$979,316	$1,020,695	$1,863,316	$1,107,216	$1,152,432
24	(Add Back Nen-cash Depreciatien)		$500,000	$$00,000	$588,800	$508,800	$500,800	$500,000	$500,000	$500,000	$508,008	$580,000	$508,008	$588,880	$500,000	$508,800	$588,888
25	Cash Flow	-$7,508,000	$1,126,348	$1,157,131	$1,188,845	$1,221,510	$1,255,155	$1,289,810	$1,325,504	$1,362,269	$1,488,137	$1,439,142	$1,479,316	$1,520,695	$1,563,316	$1,607,216	$1,652,432
26	Discountad Cash Flow	-$7,500,008	$979,426	$874,957	$781,685	$698,482	$624,834	$557,628	$498,306	$445,32$	$398,006	$355,734	$317,969	$284,229	$254,083	$227,146	$283,875
27	Cumulative Olsc. Cash Flow	-$7,588,808	-$6,528,574	-$5,645,616	-$4,863,932	-$4,165,530	-$3,541,496	-$2,983,875	-$2,485,569	-$2,048,241	-$1,642,234	-$1,286,501	-$968,532	-$684,303	-$438,220	-$203,075	$0

	INPUTS	VALUES
1	Investment ger Annual Gallon	$2.50
4	Product Annual Escallatien Rate =	3%
5	Feedstock Annual Escallation Rate =	3%
12-14	Processing Annual Escallatien Rate =	3%
26	Annual Discount Rate (IRR) =	15%

Financial Analysis for 3 Millien Gallens per Yeer Biodiesel Witheut Taxes

	Item	YERR 0	1	2	3	4	$	6	7	8	9	18	11	12	13	14	15
1	Initial Investment	$7,500,000															
2																	
3																	
4	Product Value per Gal. Biodiesal		$3.65	$3.76	$3.87	$3.99	$4.11	$4.23	$4.36	$4.49	$4.62	$4.76	$4.91	$5.05	$5.20	$5.36	$5.52
5	Feedstock Cest per Gallon		$2.73	$2.82	$2.98	$2.99	$3.88	$3.17	$3.26	$3.36	$3.46	$3.57	$3.67	$3.78	$3.90	$4.82	$4.14
6	Biodiesel $ales		$18,958,888	$11,278,500	$11,616,855	$11,965,361	$12,324,321	$12,694,851	$13,874,873	$13,467,119	$13,871,132	$14,2$7,266	$14,715,884	$15,157,361	$15,612,082	$16,080,444	$16,562,857
7	Feedstock cest @1.02 gal/gal prod.		$8,367,074	$8,618,087	$$,876,629	$9,142,92$	$9,417,216	$9,699,732	$9,990,724	$10,290,446	$18,599,168	$18,917,134	$11,244,64$	$11,581,988	$11,929,447	$12,287,331	$12,655,951
8	Gross Margin		$2,582,926	52,668,413	$2,748,226	$2,822,433	$2,987,185	$2,994,319	$3,084,148	$3,176,673	$3,271,973	$3,370,132	$3,471,236	$3,575,373	$3,682,634	$3,793,113	$3,986,987
9	Gross margin per gallon		$0.86	$0.89	$0.91	$0.94	$0.97	$1.00	$1.03	$1.86	$1.89	$1.12	$1.16	$1.19	$1.23	$1.26	$1.38
18																	
11	Processing Cost																
12	Methanel and other reagents @ $8.25/ Gal.		$750,000	$772,500	$795,675	$819,545	$844,132	$869,456	$895,539	$922,405	$950,878	$978,580	$1,007,937	$1,038,175	$1,069,321	$1,101,400	$1,134,442
13	Other Plant Operating Cost @ $0.15/Gal.		$458,800	$463,588	$477,485	$491,727	$586,479	$521,673	$537,324	$553,443	$$70,847	$587,148	$684,762	$622,905	$641,592	$660,848	$680,665
14	$G&A		$100,800	$103,000	$106,090	$109,273	$112,551	$115,927	$119,485	$122,967	$126,677	$130,477	$134,392	$138,423	$142,576	$146,853	$151,259
15	Total Processing Cost		$1,300,000	$1,339,000	$1,379,170	$1,420,545	$1,463,161	$1,507,0$6	$1,552,268	$1,598,836	$1,646,881	$1,696,205	$1,747,091	$1,799,504	$1,853,489	$1,909,094	$1,966,367
16																	
17	Depreciation (15 year)		$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,808	$508,088	$500,000	$500,000	$500,800	$500,080	$500,000	$588,888
18																	
19	Net Income		$782,926	$621,413	$861,056	$901,887	$943,944	$987,262	$1,031,888	$1,877,837	$1,12$,172	$1,173,927	$1,224,145	$1,275,869	$1,329,145	$1,384,819	$1,440,540
20																	
21	Taxes (20%)		$156,585	$164,283	$172,211	$180,377	$188,789	$197,452	$286,376	$215,567	$225,034	$234,785	$244,829	$255,174	$265,829	$276,804	$288,188
22																	
23	Inceme After Taa		$626,340	$657,131	$688,845	$721,510	$755,1$5	$789,810	$825,504	$962,269	$908,137	$939,142	$979,316	$1,028,695	$1,863,316	$1,107,216	$1,152,432
24	(Add Back Nen-cash Depreclatlan)		$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$508,008	$508,888	$500,800	$500,000	$580,880	$508,800	$500,000	$508,000	$500,000
25	Cash Flow	-$7,500,880	$1,126,340	$1,157,131	$1,188,045	$1,221,510	$1,255,155	$1,289,818	$1,325,504	$1,362,269	$1,400,137	$1,439,142	$1,479,316	$1,520,695	$1,563,316	$1,607,216	$1,652,432
26	Discounted Cash Flow	-$7,500,000	$979,426	$$74,9$7	$781,685	$698,402	$624,034	$557,620	$498,306	$445,328	$398,006	$355,734	$317,969	$284,229	$254,083	$227,146	$203,075
27	Cumulative 8isc. Cash Flow	-$7,580,880	-$6,520,574	-$5,645,616	-$4,863,932	-$4,165,530	-$3,541,496	-$2,983,675	-$2,485,569	-$2,040,241	-$1,642,234	-$1,286,501	-$968,532	-$684,303	-$430,228	-$283,875	$8

	INPUTS	VALUES
1	Investment per Annual Gallen	$2.50
4	Product Annual Escallation Rate =	3%
5	Feedstock Annual Escallatien Rata =	3%
12-14	Processing Annual Escallatien Rate =	3%
26	Annual Discount Rate (IRR) =	15%

Financial Analysis for 15 Million Gallons per Year Biodiesel With Taxes

	Item	YEAR 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Initial Investment	$15,000,000															
2																	
3																	
4	Product Value per Gal. Biodiesel		$2.57	$2.65	$2.73	$2.81	$2.89	$2.98	$3.07	$3.16	$3.26	$3.36	$3.46	$3.56	$3.67	$3.78	$3.89
5	Feedstock Cost per Gallon		$1.93	$1.99	$2.05	$2.11	$2.17	$2.24	$2.30	$2.37	$2.44	$2.52	$2.59	$2.67	$2.75	$2.83	$2.92
6	Biodiesel Sales		$38,574,550	$39,731,786	$40,923,740	$42,151,452	$43,415,996	$44,718,476	$46,060,030	$47,441,831	$48,865,086	$50,331,038	$51,840,970	$53,396,199	$54,99$,085	$56,648,027	$58,347,468
7	Feedstock cost @1.02 gal/gal prod.		$29,508,699	$30,393,960	$31,305,779	$32,244,952	$33,212,301	$34,208,670	$35,234,930	$36,291,97$	$37,380,737	$38,502,159	$39,657,224	$40,846,940	$42,072,349	$43,334,519	$44,634,555
8	Gross Margin		$9,065,851	$9,337,827	$9,617,961	$9,906,500	$10,203,695	$10,509,806	$10,825,100	$11,149,853	$11,484,349	$11,828,879	$12,183,746	$12,549,258	$12,925,736	$13,313,508	$13,712,913
9	Gross margin per gallon		$0.60	$0.62	$0.64	$0.66	$0.68	$0.70	$0.72	$0.74	$0.77	$0.79	$0.81	$0.84	$0.86	$0.89	$0.91
10																	
11	Processing Cost																
12	Methanol and other reagents @ $0.25/ Gal.		$3,750,000	$3,862,500	$3,978,375	$4,097,726	$4,220,658	$4,347,278	$4,477,696	$4,612,027	$4,750,388	$4,892,899	$5,039,686	$5,190,877	$5,346,603	$5,507,001	$5,672,211
13	Other Plant Operating Cost @ $0.15/Gal.		$2,250,000	$2,317,500	$2,387,025	$2,458,636	$2,532,395	$2,608,367	$2,686,618	$2,767,216	$2,850,233	$2,935,740	$3,023,812	$3,114,526	$3,207,962	$3,304,201	$3,403,327
14	SG&A		$500,000	$515,000	$530,450	$546,364	$562,754	$579,637	$597,026	$614,937	$633,385	$652,387	$671,958	$692,117	$712,880	$734,267	$756,295
15	Total Processing Cost		$6,500,000	$6,695,000	$6,895,850	$7,102,726	$7,315,807	$7,535,281	$7,761,340	$7,994,180	$8,234,006	$8,481,026	$8,735,456	$$,997,520	$9,267,446	$9,545,469	$9,831,833
16																	
17	Depreciation (15 year)		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
18																	
19	Net Income		$1,565,851	$1,642,827	$1,722,111	$1,803,775	$1,887,888	$1,974,525	$2,063,760	$2,155,673	$2,250,343	$2,347,854	$2,448,289	$2,551,738	$2,65$,290	$2,76$,039	$2,881,080
20																	
21	Taxes (20%)		$313,170	$328,565	$344,422	$360,755	$377,578	$394,905	$412,752	$431,135	$450,069	$469,571	$489,658	$510,348	$531,658	$553,608	$576,216
22																	
23	Income After Tax		$1,252,681	$1,314,261	$1,377,689	$1,443,020	$1,510,310	$1,579,620	$1,651,008	$1,724,539	$1,800,275	$1,878,283	$1,958,631	$2,041,390	$2,126,632	$2,214,431	$2,304,864
24	(Add Back Non-cash Depreciation)		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
25	Cash Flow	-$15,000,000	$2,252,681	$2,314,261	$2,377,689	$2,443,020	$2,510,310	$2,579,620	$2,651,008	$2,724,539	$2,800,275	$2,876,283	$2,95$,631	$3,041,390	$3,126,632	$3,214,431	$3,304,864
26	Discounted Cash Flow	-$15,000,000	$1,958,853	$1,749,914	$1,563,369	$1,396,805	$1,248,068	$1,115,241	$996,612	$890,657	$796,013	$711,468	$635,936	$566,458	$508,165	$454,291	$406,150
27	Cumulative Disc. Cash Flow	-$15,000,000	-$13,041,147	-$11,291,233	-$9,727,864	-$8,331,059	-$7,082,991	-$5,967,750	-$4,971,138	-$4,080,482	-$3,284,469	-$2,573,001	-$1,937,064	-$1,366,606	-$860,441	-$406,150	$0

	INPUTS	VALUES
1	Investment per Annual Gallon	$1.00
4	Product Annual Escalation Rate =	3%
5	Feedstock Annual Escalation Rate =	3%
12-14	Processing Annual Escalation Rate =	3%
26	Annual Discount Rate (IRR) =	15%

Financial Analysis for 15 Million Gallons per Year Biodiesel Without Taxes

	Item	YEAR 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Initial Investment	$15,000,000															
2																	
3																	
4	Product Value per Gal. Biodiesel		$3.65	$3.76	$3.87	$3.99	$4.11	$4.23	$4.36	$4.49	$4.62	$4.76	$4.91	$5.05	$5.20	$5.36	$5.52
5	Feedstock Cost per Gallon		$2.99	$3.08	$3.17	$3.26	$3.36	$3.46	$3.57	$3.67	$3.78	$3.90	$4.01	$4.13	$4.26	$4.38	$4.52
6	Biodiesel Sales		$54,750,000	$56,392,500	$58,084,275	$59,826,803	$61,621,607	$63,470,256	$65,374,363	$67,335,594	$69,355,662	$71,436,332	$73,579,422	$75,786,804	7,060,409	$80,402,221	$82,814,287
7	Feedstock cost @1.02 gal/gal prod.		$45,684,149	$47,054,673	$48,466,314	$49,920,303	$51,417,912	$52,960,449	$54,549,263	$56,185,741	$57,871,313	$59,607,452	$61,395,676	$63,237,546	$65,134,673	$67,088,713	$69,101,374
8	Gross Margin		$9,065,851	$9,337,827	$9,617,961	$9,906,500	$10,203,695	$10,509,806	$10,825,100	$11,149,853	$11,484,349	$11,828,879	$12,183,746	$12,549,256	$12,925,736	$13,313,508	$13,712,913
9	Gross margin per gallon		$0.60	$0.62	$0.64	$0.66	$0.68	$0.70	$0.72	$0.74	$0.77	$0.79	$0.81	$0.84	$0.86	$0.89	$0.91
10																	
11	Processing Cost																
12	Methanol and other reagents @ $0.25/ Gal.		$3,750,000	$3,862,500	$3,978,375	$4,097,726	$4,220,658	$4,347,278	$4,477,696	$4,612,027	$4,750,388	$4,892,899	$5,039,686	$5,190,877	$5,346,603	$5,507,001	$5,672,211
13	Other Plant Operating Cost @ $0.15/Gal.		$2,250,000	$2,317,500	$2,387,025	$2,458,636	$2,532,395	$2,608,367	$2,686,618	$2,767,216	$2,850,233	$2,935,740	$3,023,812	$3,114,526	$3,207,962	$3,304,201	$3,403,327
14	SG&A		$500,000	$515,000	$530,450	$546,364	$562,754	$579,637	$597,026	$614,937	$633,365	$652,387	$671,958	$692,117	$712,880	$734,267	$756,295
15	Total Processing Cost		$6,500,000	$6,695,000	$6,895,850	$7,102,726	$7,315,807	$7,535,281	$7,761,340	$7,994,180	$8,234,006	$8,481,026	$6,735,456	$8,997,520	$9,267,446	$9,545,469	$9,831,833
16																	
17	Depreciation (15 year)		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
18																	
19	Net Income		$1,565,851	$1,642,827	$1,722,111	$1,803,775	$1,887,888	$1,974,525	$2,063,760	$2,155,673	$2,250,343	$2,347,854	$2,44$,289	$2,551,73$	$2,658,290	$2,768,039	$2,881,080
20																	
21	Taxes (20%)		$313,170	$328,565	$344,422	$360,755	$377,578	$394,905	$412,752	$431,135	$450,069	$469,571	$489,65$	$510,348	$531,65$	$553,608	$576,216
22																	
23	Income After Tax		$1,252,681	$1,314,261	$1,377,689	$1,443,020	$1,510,310	$1,579,620	$1,651,008	$1,724,539	$1,$00,275	$1,878,283	$1,958,631	$2,041,390	$2,126,632	$2,214,431	$2,304,864
24	(Add Back Non-cash Depreciation)		$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
25	Cash Flow	-$15,000,000	$2,252,681	$2,314,261	$2,377,689	$2,443,020	$2,510,310	$2,579,620	$2,651,008	$2,724,539	$2,800,275	$2,878,283	$2,958,631	$3,041,390	$3,126,632	$3,214,431	$3,304,864
26	Discounted Cash Flow	-$15,000,000	$1,958,853	$1,749,914	$1,563,369	$1,396,805	$1,248,068	$1,115,241	$996,612	$890,657	$796,013	$711,468	$635,938	$568,458	$508,165	$454,291	$406,150
27	Cumulative Disc. Cash Flow	-$15,000,000	-$13,041,147	-$11,291,233	-$9,727,864	-$6,331,059	-$7,082,991	-$5,967,750	-$4,971,138	-$4,080,482	-$3,284,469	-$2,573,001	-$1,937,064	-$1,368,606	-$860,441	-$406,150	$0

	INPUTS	VALUES
1	Investment per Annual Gallon	$1.00
4	Product Annual Escalation Rate =	3%
5	Feedstock Annual Escalation Rate =	3%
12-14	Processing Annual Escalation Rate =	3%
26	Annual Discount Rate (IRR) =	15%

ANNEX III
Jamaica Biofuels Implementation Plan

After completion of a preliminary feasibility study and publication of a government policy, crucial steps remain to be taken to bring into being an economically viable and self-sustaining biofuels industry in Jamaica. Success will depend on a variety of actors outside the government, and the Ministry of Energy and Mining took the first step to engage the private sector at a workshop on November 23, 2010 in Kingston. Part of the discussion at the session concerned remaining actions required for development of a biofuels sector, and the deliberations provided a starting point for a series of steps described below. The necessary actions fall into six main groups: engagement of institutions and enterprises outside the government; public information and outreach (described separately); in-depth conceptual engineering design and financial feasibility studies; technology identification, screening and application; establishment of financing mechanisms; negotiation of prices acceptable to all parties for harvested sugar cane, independent electric power from sugar mills, and biodiesel feedstocks; and project implementation. An illustrative schedule, covering a five-year time frame, appears at the end of this annex.

Institutional Engagement

The successful formulation of a policy and the November workshop provide an opportunity to expand the existing Biofuels Task Force with broader membership to address implementation challenges. Added members, beyond those currently represented, should include sugar estate owners, the Sugar Divestment Enterprise, All-Island Jamaica Cane Farmers Association, Jamaica Cane Products Sales, Ltd., Ministry of Industry, Development Bank of Jamaica, Agricultural Support Services Project, Petrojam, Ltd., JB Ethanol, Jamaica Manufacturers' Association, Jamaica Promotions Corporation, Jamaica Public Service Co., and the Office of Utility Regulation. The list is not exclusive; others may be important to add as well.

In addition to an elected chairperson, such an expanded task force would benefit from a full-time coordinator, perhaps assigned from the staff of the Ministry of Energy and Mining. Among the roles the group could assume would be to identify needs for any future studies and oversee them, resolve disagreements and conflicts, coordinate members' independent activities, and monitor and report progress towards a biofuels industry. It could also conduct a public information and outreach effort, based on a plan developed separately, including public meetings and other means of communication with stakeholders.

The task force may also benefit from the formation of working groups or committees to address specific opportunities and challenges. For example, a sugar cane working group might be able to advance aspects of cane and ethanol production expeditiously without requiring participation of the rest of the members at the same level of activity. Another group might focus on how to advance the introduction of oil crops, looking at the main areas of crop selection and production, as well as at business models that could provide the framework for a commercially viable sub-sector for this biofuel.

Finally, the challenges of creating a biofuels industry are not unique to Jamaica. Many countries have successfully implemented programs to encourage sugar mills to become more energy efficient and sell surplus electricity to the grid, and some have established commercially successful domestic liquid biofuels programs. Other countries have been less successful, and biofuel programs have not thrived. With access to the experiences of countries that have been successful, as well as to those who have not, the task force can take advantage of valuable sources of "lessons learned" and guides to paths most likely to lead to success.

Research and Technology Surveillance

In order to take maximum advantage of the best available technology for growing feedstocks and processing them economically under Jamaican conditions, farmers and producers need access to expertise. Jamaica already has significant scientific and technical resources in the University of the West Indies, University of Technology and Sugar Industry Research Institute (SIRI), and the Center of Excellence for Renewable Energy (CERE), all of which are represented on the existing task force. Workshop participants recommended expanding SIRI's role to encompass other energy crops besides sugar cane, e.g., woody or oleaginous plants, with financial support from other sources to supplement the sugar industry funding, on which the institute currently depends. This would provide a source of scientific knowledge and a conduit for disseminating information derived from research activities, like the ongoing agronomic trials for *Jatropha curcas* under the auspices of the PCJ's CERE.

The task force might also consider seeking assistance with building technological capacity by promoting access to expertise through study tours and other activities aimed at transferring skills needed to take maximum advantage of any investment in modern processing facilities. Technical exchanges could help Jamaican professionals better configure and operate new mills for low process energy consumption to maximize sales of electricity, for example, plan and manage biomass fuel and feedstock cultivation so as to maximize operating time or take advantage of energy crops to generate power year-round.

Another workshop recommendation was to foster closer relationships between an expanded SIRI and the universities, where additional expertise resides but is not readily accessible to biofuel farmers and producers. An improved linkage would serve to identify real-world scientific challenges for faculty to address and at the same time, provide an efficient mechanism for applying results of their research in the field. University research focused on biofuels could possibly attract grant support from a variety of international sources, and with a level of core activity, faculty would be in a position to offer informed general advice and help on identification, screening and selection of alternative technologies and approaches from vendors and other sources outside of Jamaica.

In-Depth Project Feasibility Studies

In order to attract capital and secure government support for cane energy projects, especially, decision-makers will need the results of in-depth feasibility analysis of specific investment prospects. Studies at three prospective locations would likely be sufficient, covering at a minimum, options for sugar production and electric cogeneration without ethanol, production of ethanol and electricity alone, and flexible co-production of sugar, molasses, ethanol and electric power following the Brazilian model. The feasibility studies should include conceptual system designs, identification and sizing of major components, energy and mass balances, capital and operating costs, and revenue requirements.

Candidate mill sites could be selected on the basis of owner and management interest and willingness to cooperate with the studies, share costs, and proceed with projects if the results are favorable. Outside financial support would no doubt be needed for the studies, and the first step, perhaps to be undertaken by the task force, would be to secure grant support from interested entities like the Organization of American States, the Inter-American Development Bank, or the European Union.

If successful, the studies will identify and document viable investment opportunities, leading to financing, construction, and operation of new biofuel facilities in succeeding months (See Project Implementation below). At the same time, they will serve as concrete indications of the specific impacts of these facilities for policy makers.

Biofuels Financing

Expanding biofuels production will require substantial investments of capital in agricultural production and processing facilities. Under some circumstances, non-recourse project financing by foreign investors is a possibility, but not without firm raw material and product off-take agreements, which are unlikely in Jamaica, where among other things, the law prohibits exclusivity for domestic ethanol for fuel blending. While individual sugar estate owners may be able to raise capital on the strength of their own balance sheets, small farmers and other prospective biofuel enterprises may be too small or weak financially.

One way to address capital availability would be to establish a biofuels investment fund in Jamaica with the capability to lend to individual ventures and to attract and pool capital from private investors wishing to diversify their exposure within the sector, interested philanthropic foundations, the private sector windows of multilateral development banks, and other similar entities. The fund could then make loans to developers and farmers on terms appropriate to their projects, accompanied by technical expertise from SIRI and others. In the case of small farmers, loans could take the form of services and equipment to upgrade their productivity, to be repaid out of product sales.

Another role the fund could play would be to manage a price stabilization arrangement for fuels, similar to one that existed for sugar prior to privatization of The Sugar Corporation of Jamaica. When biofuel prices are high, a portion of sales proceeds could be set aside to support prices when they are too low to amortize investments in production. In that way, the fund would provide a hedge against investors' risk of fluctuations in world oil prices.

A funding mechanism along these lines would not have to be built in Jamaica from scratch. The country already counts on the Development Bank of Jamaica and the Agricultural Support Services Project, institutions that could play key roles in establishing and administering it.

Feedstock and Electricity Pricing

Two issues that arose in the formulation of the biofuels policy were pricing arrangements for sugar cane produced by independent farmers and for independent power exported to the electrical grid by processing installations. Although the feasibility study could estimate the costs and benefits of biofuel production, such an analysis cannot readily determine how the achievable benefits should be divided among interested parties. For example, the study estimated that, at least in the case of cogeneration at one Jamaican sugar mill, a price of $0.15 per kWh for cogenerated electricity would result in an annual return of approximately 15 percent. The study also estimated that the value of electricity to the national grid, expressed as avoided cost, was between $0.20 and $0.25 per kWh. Whether a return of 15% is sufficient to result in equity being invested in a new biofuel cogeneration plant, and how the potential net benefit of $0.05 to $0.10 per kWh should be distributed among the investor, the utility rate payer, and the public service company remains to be determined, presumably through negotiations among prospective producers, Jamaica Public Service, and the Office of Utility Regulation.

Similarly, cane prices paid to farmers by sugar mills have been based historically on the production of granular sugar and do not reflect any additional benefits associated with bioethanol or energy sales. As the sector become more multi-product oriented, a more sophisticated payment model will be needed to incentivize farmers to provide sugar mills with feedstock that maximizes overall value. These pricing arrangements will require negotiation between the cane growers and the sugar mill estates and possibly others.

Finally, the study estimates based on Brazilian experience that biodiesel from plants like castor, and by extension jatropha, are unlikely to be produced economically without some form of subsidy. Such a subsidy may be justified as a means to slow urban migration or as an offset against other costs associated with rural poverty. How such a subsidy, if justified, might operate, and at what level is another feedstock price-related subject for agreement among the government and other parties involved in any prospective biodiesel industry.

An expanded biofuels task force could play a key role in identifying the parties, bringing them together, and providing a neutral forum for resolving differences and reaching agreement on how to distribute the benefits of biofuel ventures. The result would be to enlist the cooperation of all parties, so projects can move forward.

Project Implementation

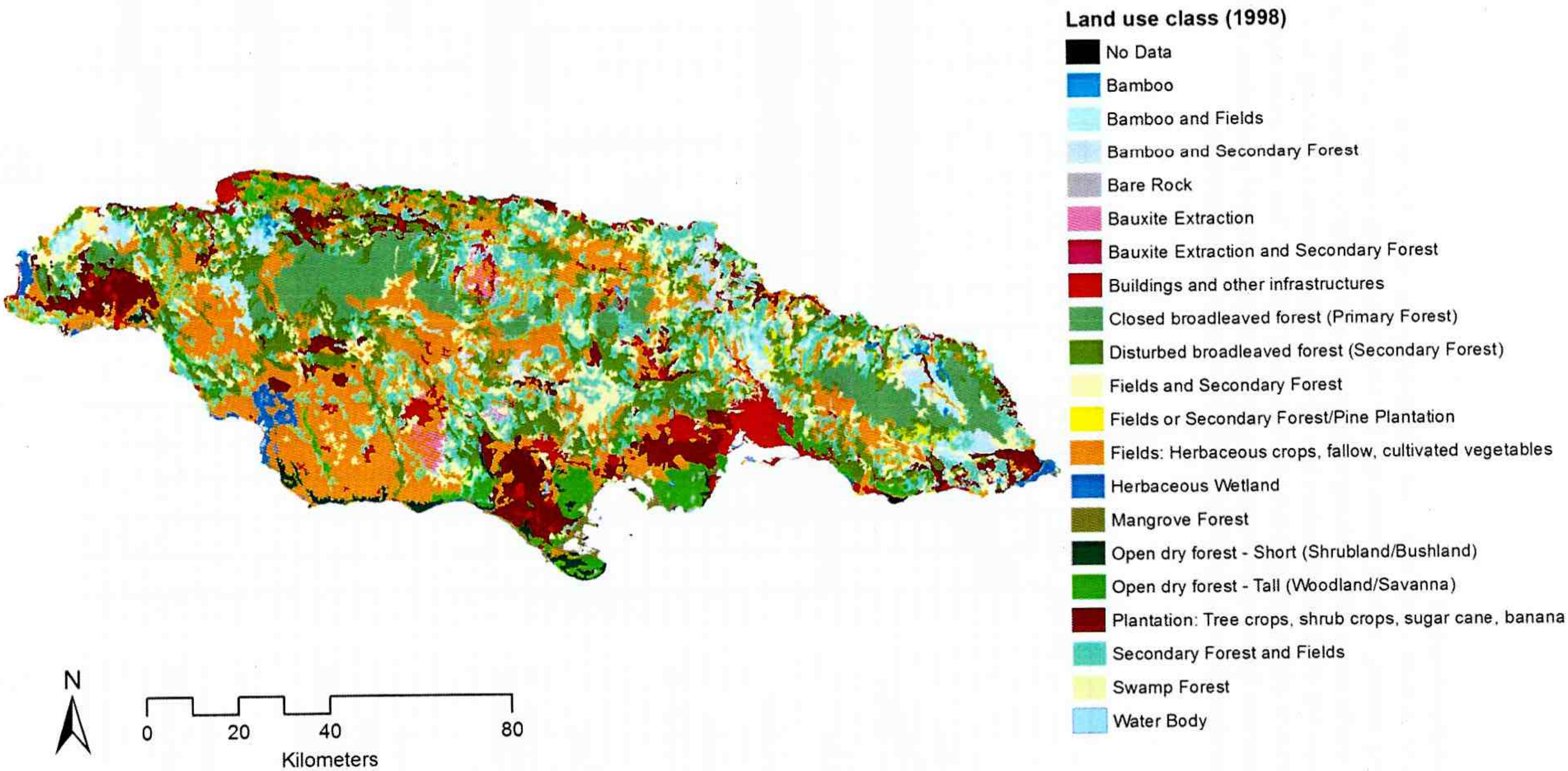
Task Force activities will focus on establishing the basis for project implementation and facilitating ensuing activity, which will be largely led by the private sector. If the feasibility studies' results are positive, pricing negotiations are successful, public support is forthcoming, and a financing mechanism comes into being, project developers should be in a position to move forward with major investments in biofuel facilities. The next steps would include final contractual and financing arrangements, detailed design and bid preparation, site preparation, facility construction and shakedown, and commencement of operation.

Jamaica Biofuel Implementation Schedule

Year	2011				2012				2013				2014				2015			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Biofuels Task Force																				
Appoint coordinator	■																			
Expand membership	■	■																		
Elect chair		■																		
Select feasibility study targets			■																	
Oversee feasibility studies				■	■	■														
Inputs to technology surveillance			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Monitoring and new program initiatives							■	■	■	■	■	■	■	■	■	■	■	■	■	■
Technology Surveillance																				
Continuing agronomic studies	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Expand SIRI Role			■	■																
Technical Exchanges			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Grant-supported university research			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Feasibility Studies																				
Gather data; confer with owners				■				■												
Design systems				■	■	■		■	■	■										
Estimate costs and revenue requirements					■	■			■	■										
Analyze feasibility							■				■									
Report results							■				■									
Financing Mechanisms																				
Explore interest with investors	■	■	■	■	■	■														
Develop legal framework			■	■	■	■	■													
Issue securities						■	■			■	■			■	■			■	■	
Make loans to project developers								■				■				■				■
Ongoing management; price stabilization						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Pricing Negotiations																				
Electric power					■	■	■				■									
Cane feedstock					■	■	■				■									
Vegetable oil/oilseed feedstocks							■	■								■				
Project No. 1 Implementation																				
Contracts and project structure							■	■												
Financial closing; commitment to proceed								■												
Detailed design and specifications									■	■										
Site preparation											■	■								
Facility construction													■	■	■	■				
Facility operation begins																■				
Project No. 2 Implementation																				
Contracts and project structure											■	■								
Financial closing; commitment to proceed												■								
Detailed design and specifications													■	■						
Site preparation															■	■				
Facility construction																	■	■	■	■
Facility operation begins																				■

ANNEX IV

Land Use Maps (1998) from the Forestry Department, Jamaica Ministry of Agriculture



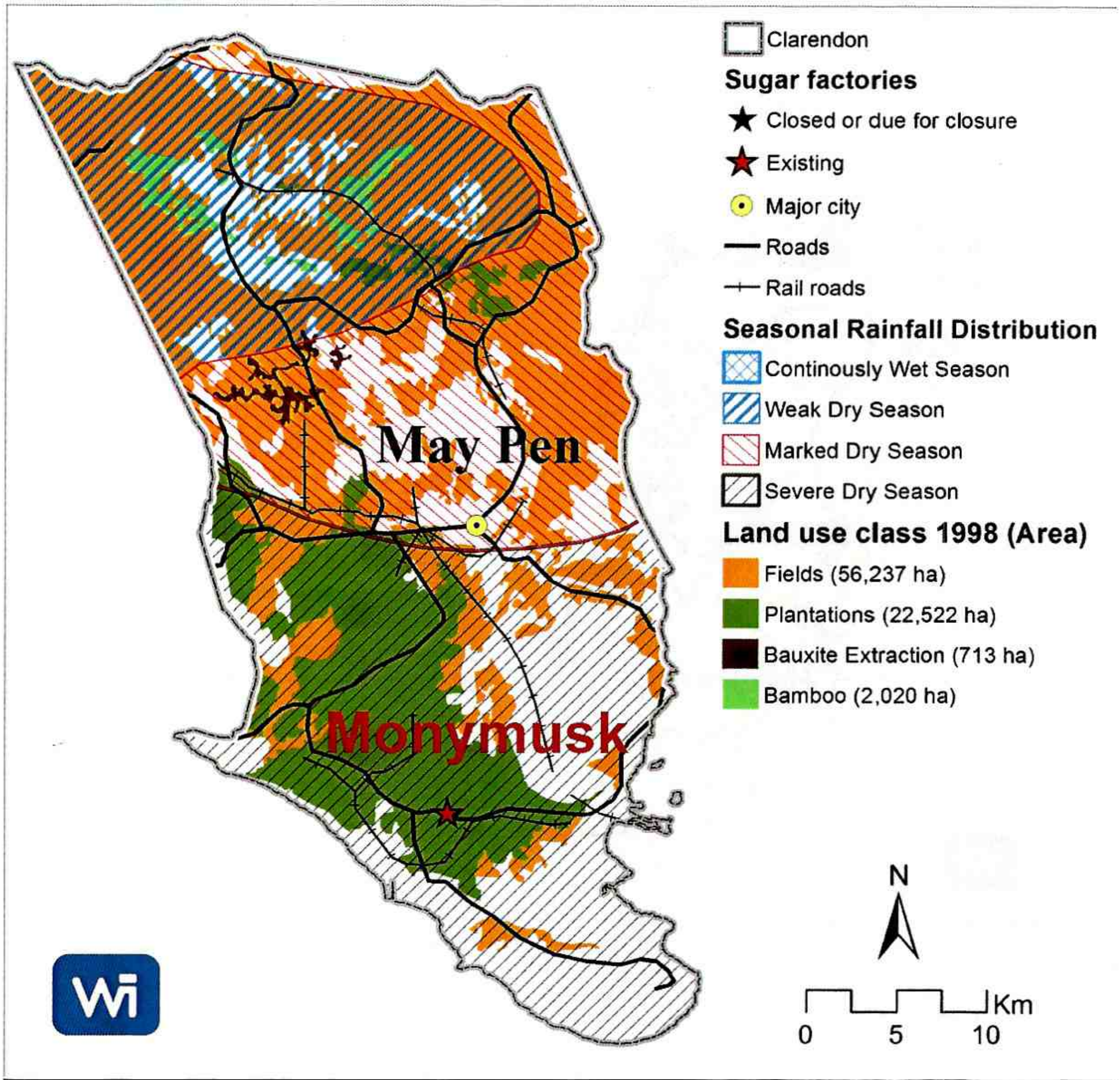
This table summarizes the area (ha) of each of the land use classes represented in the 1998 land use map for Jamaica. (Details in parish table and maps that follow)

Land use category (1998)	Area (ha)
Bamboo	2,980
Bamboo and Fields	29,429
Bamboo and Secondary Forest	13,481
Bare Rock	934
Bauxite Extraction	5,104
Bauxite Extraction and Secondary Forest	2,819
Buildings and other infrastructures	52,292
Closed broadleaved forest (Primary Forest)	89,448
Disturbed broadleaved forest (Secondary Forest)	185,056
Fields and Secondary Forest	120,536
Fields or Secondary Forest/Pine Plantation	4,287
Fields: Herbaceous crops, fallow, cultivated vegetables	292,676
Herbaceous Wetland	12,785
Mangrove Forest	9,764
Open dry forest - Short (Shrubland/Bushland)	12,262
Open dry forest - Tall (Woodland/Savanna)	43,310
Plantation: Tree crops, shrub crops, sugar cane, banana	87,199
Secondary Forest and Fields	168,333
Swamp Forest	2,247
Water Body	1,070
No data	680

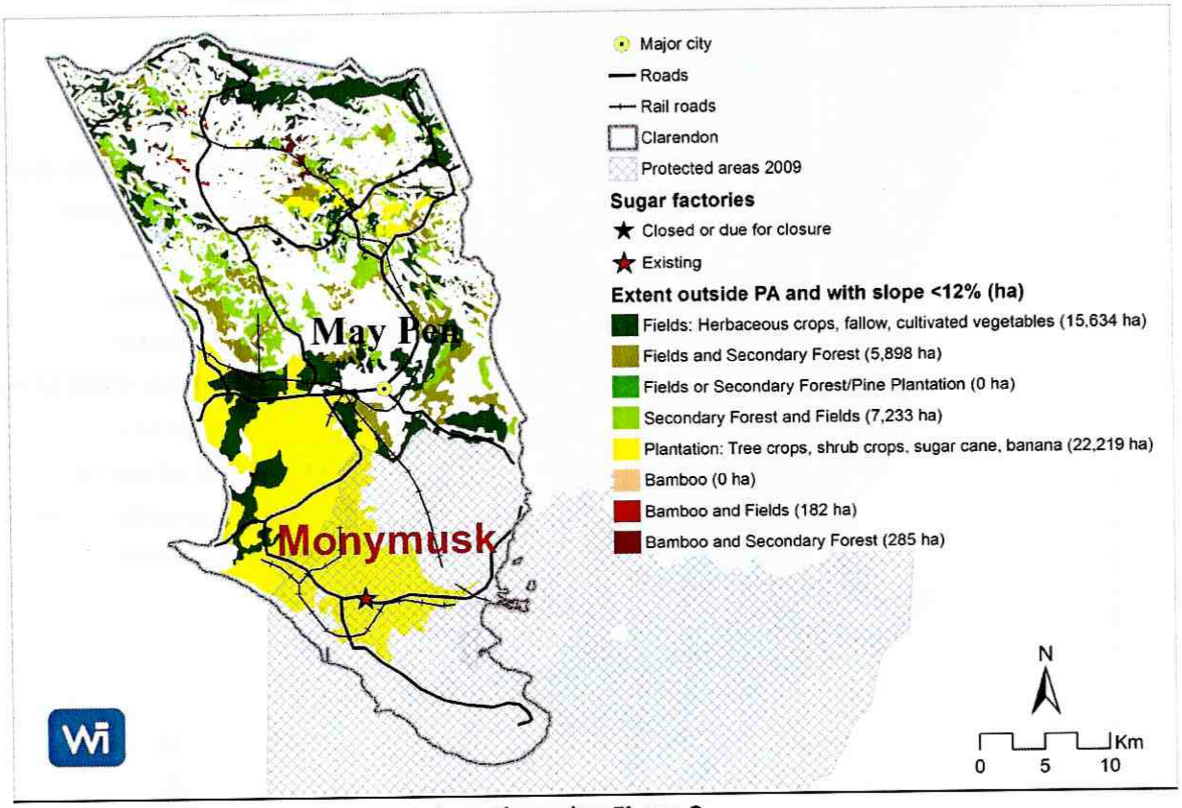
Area (ha) for disaggregated land use categories outside of protected areas with slopes <12% (Maps Figure 2)

Land Use Category / Parish	Clarendon	Hanover	Man-chester	Portland	Saint Andrew	Saint Ann	Saint Catherine
Fields: Herbaceous crops, fallow, cultivated vegetables	15,634	6,533	22,951	1,574	1,361	27,551	13,153
Fields and Secondary Forest	5,898	5,885	7,527	1,899	1,299	8,867	8,341
Fields or Secondary Forest/Pine Plantation	0	0	0	32	1	0	0
Secondary Forest and Fields	7,233	1,971	8,556	3,872	690	17,259	11,512
Plantation: Tree crops, shrub crops, sugar cane, banana	22,219	1,267	198	1,428	77	660	13,635
Bamboo	0	79	0	262	0	0	0
Bamboo and Fields	182	2,209	14	810	382	30	35
Bamboo and Secondary Forest	285	1,367	0	89	0	0	0

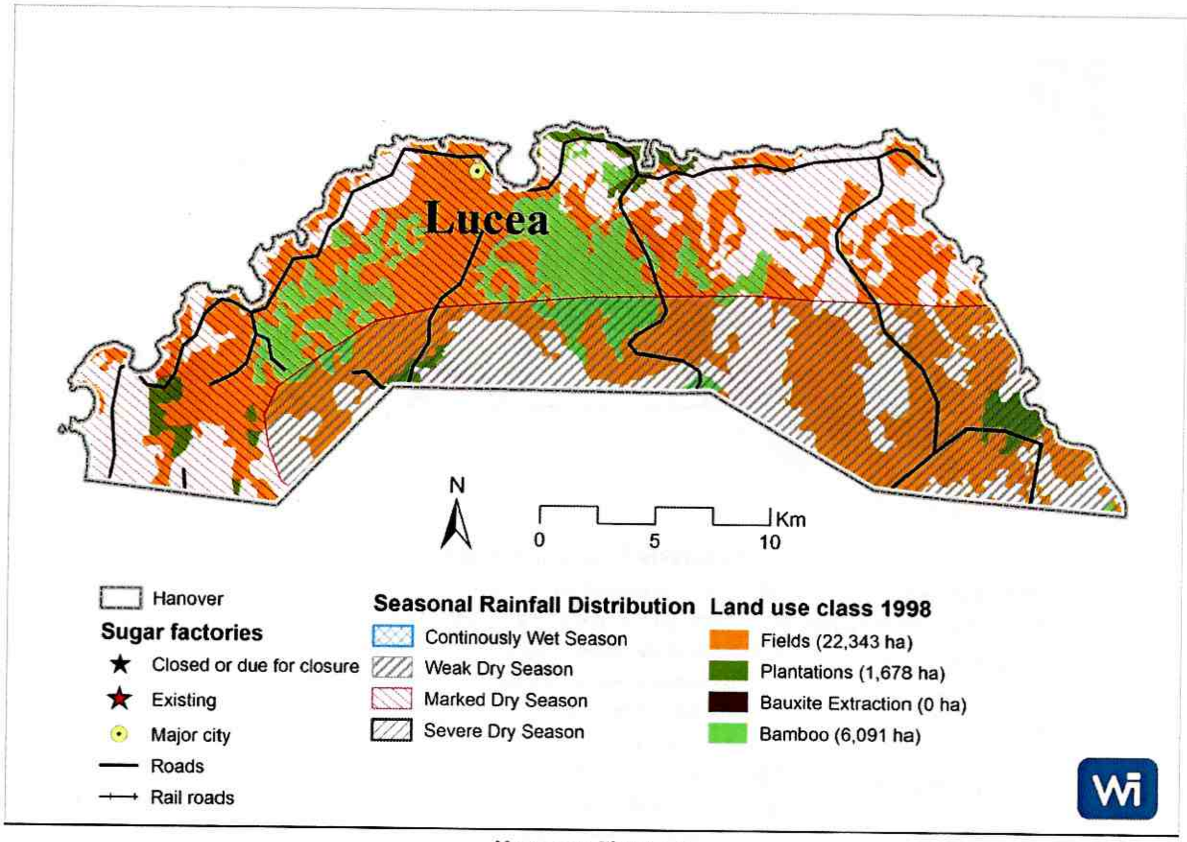
Land Use Category / Parish	Saint Elizabeth	Saint James	Saint Mary	Saint Thomas	Trelawny	Westmoreland
Fields: Herbaceous crops, fallow, cultivated vegetables	60,191	7,839	4,719	3,801	9,986	19,952
Fields and Secondary Forest	3,240	1,864	5,323	4,941	1,824	3,138
Fields or Secondary Forest/Pine Plantation	0	0	2	23	0	0
Secondary Forest and Fields	5,597	2,488	6,645	4,046	3,677	5,967
Plantation: Tree crops, shrub crops, sugar cane, banana	5,015	2,481	2,279	8,804	5,879	15,664
Bamboo	0	510	0	0	0	0
Bamboo and Fields	163	2,006	831	564	55	1,419
Bamboo and Secondary Forest	0	1,157	2,962	37	0	5



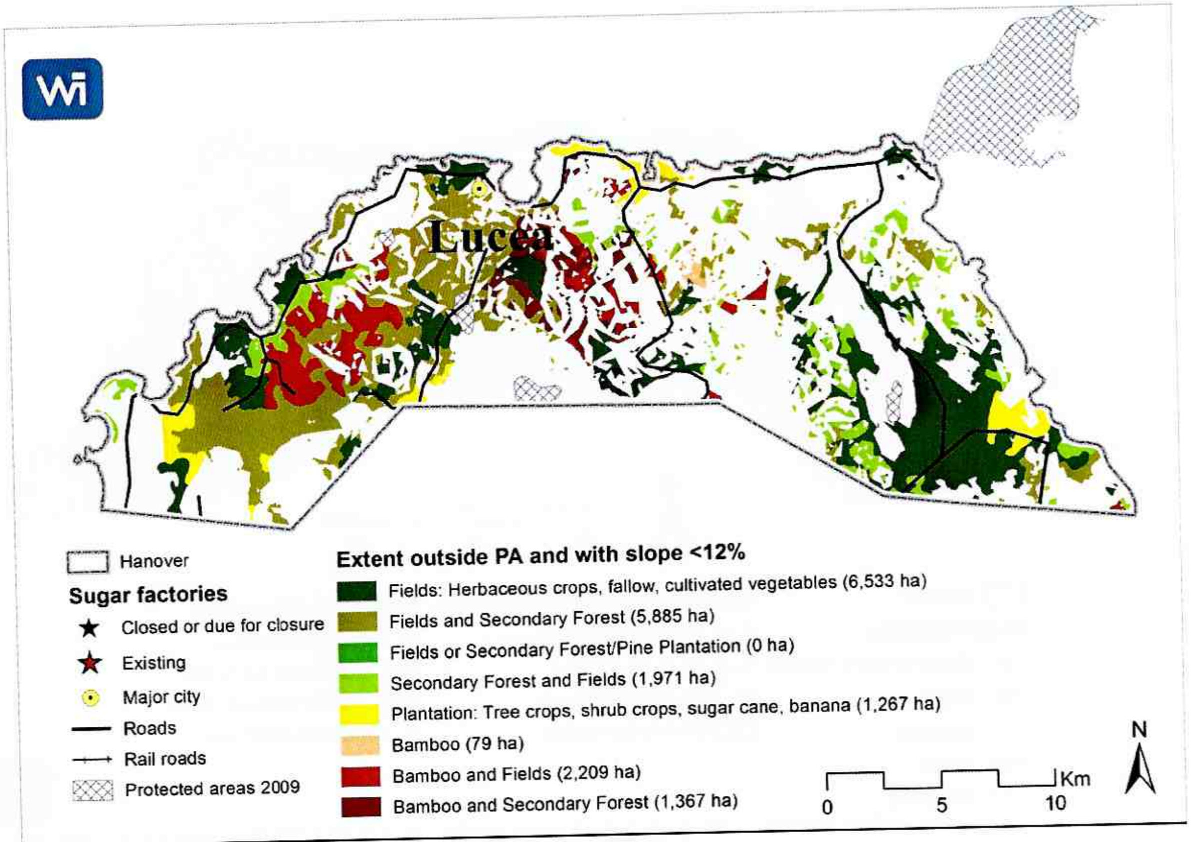
Clarendon Figure 1



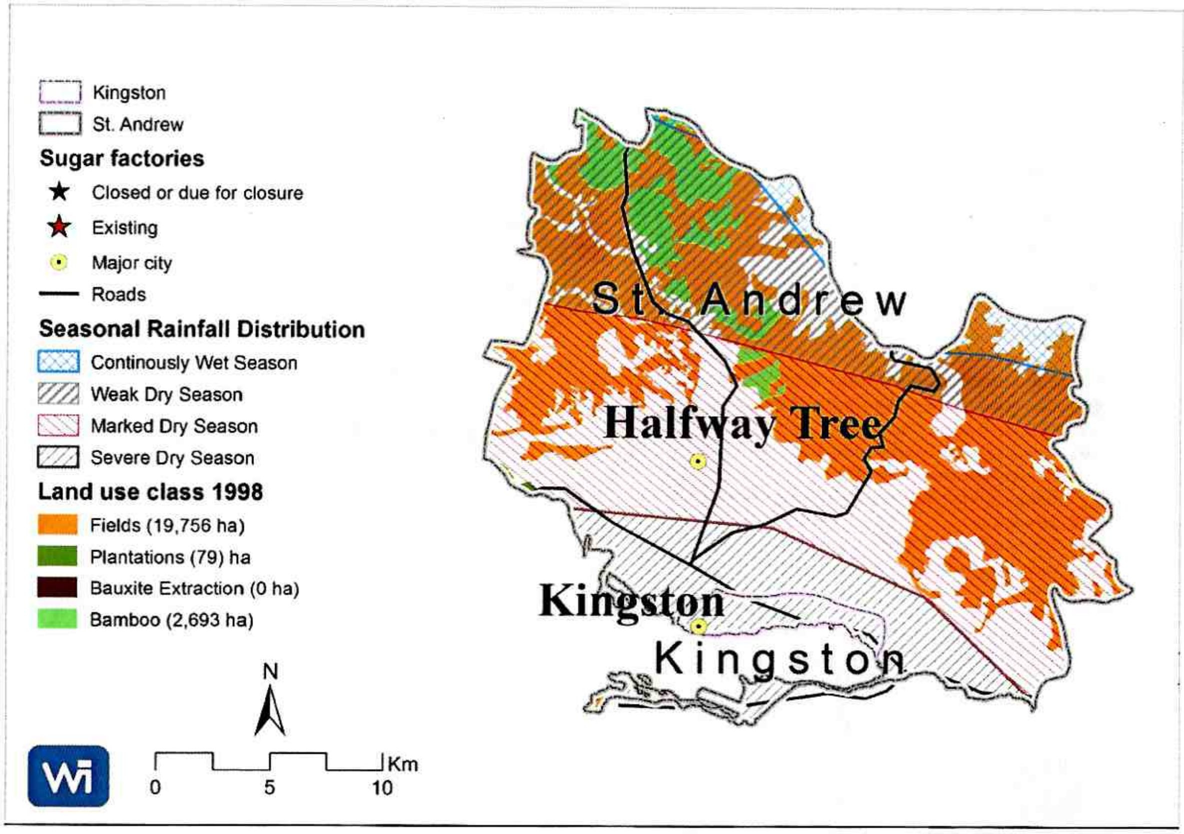
Clarendon Figure 2



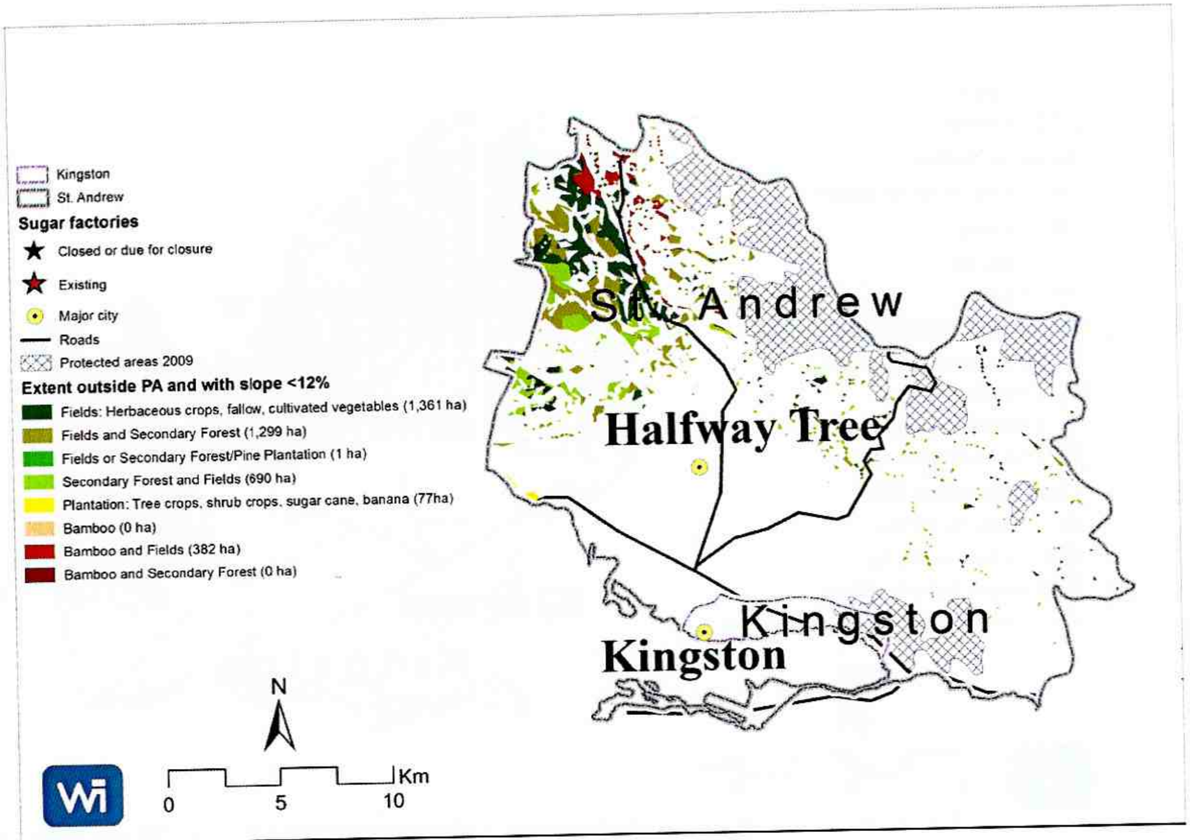
Hanover Figure 1



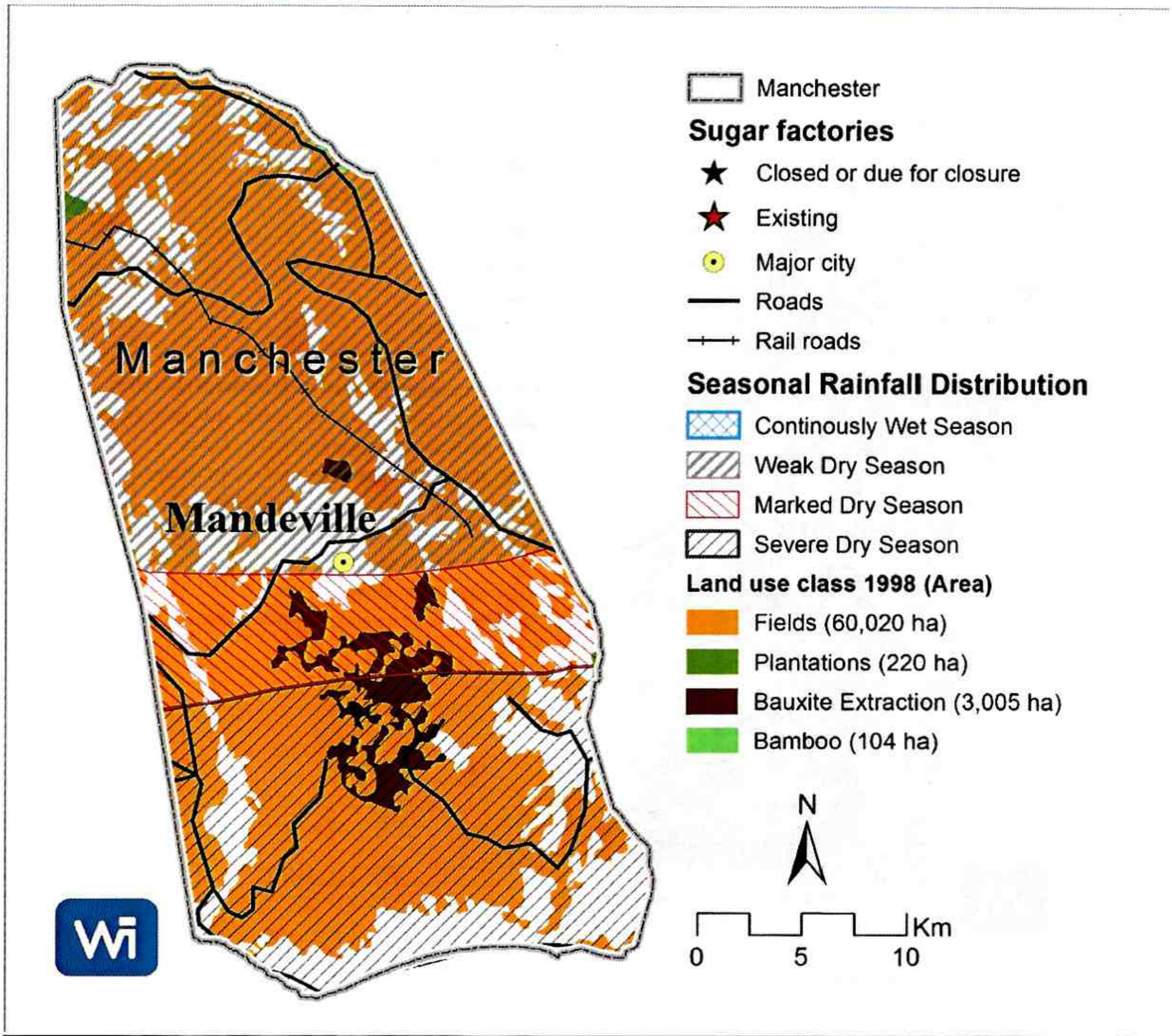
Hanover Figure 2



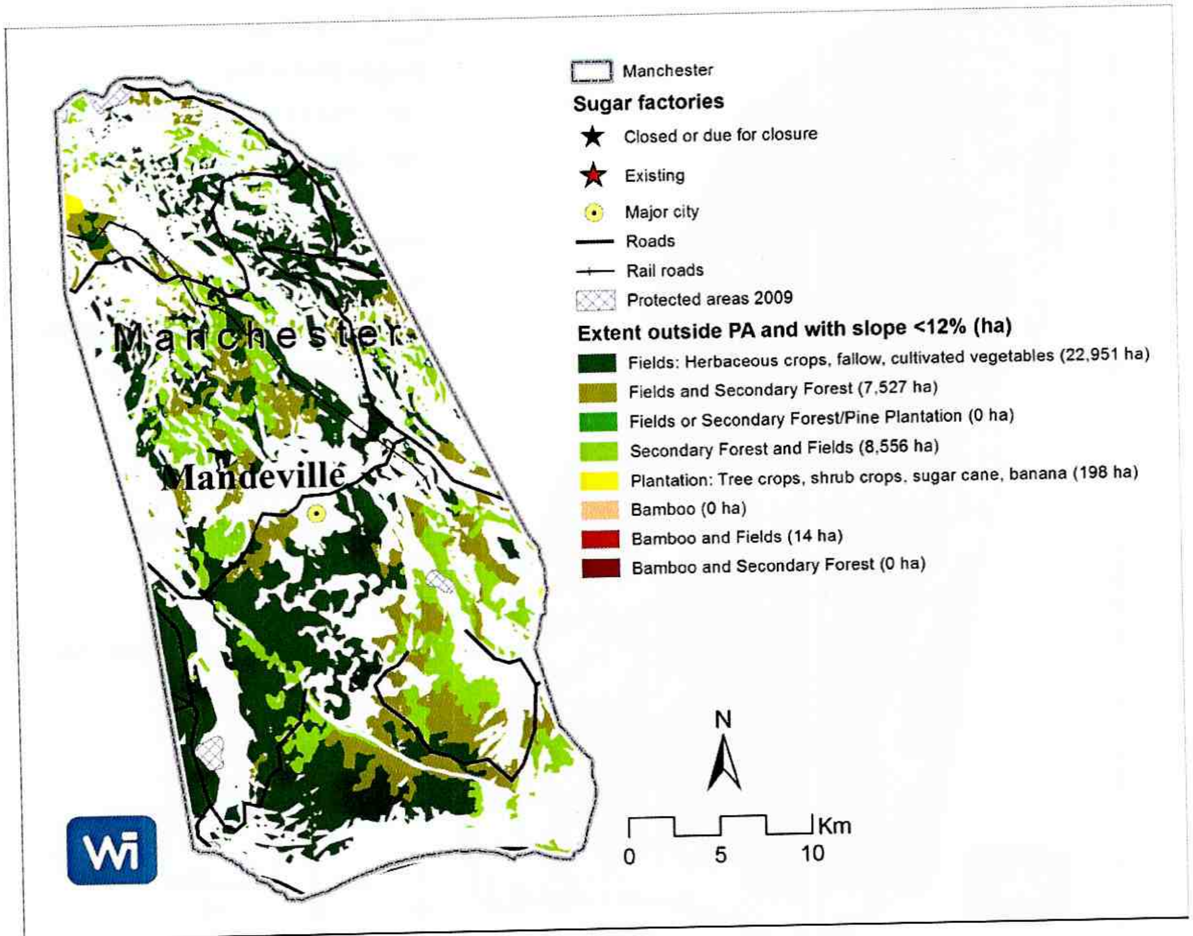
Kingston St. Andrew Figure 1



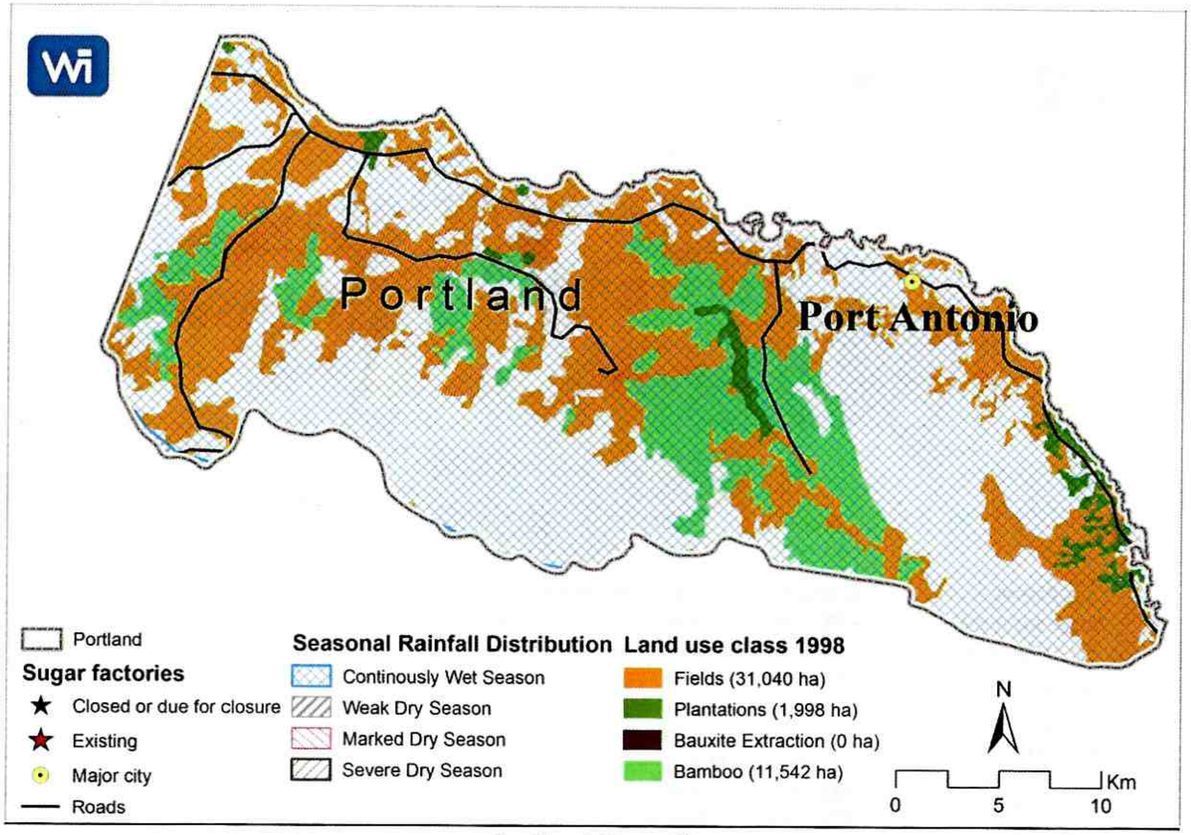
Kingston St. Andrew Figure 2



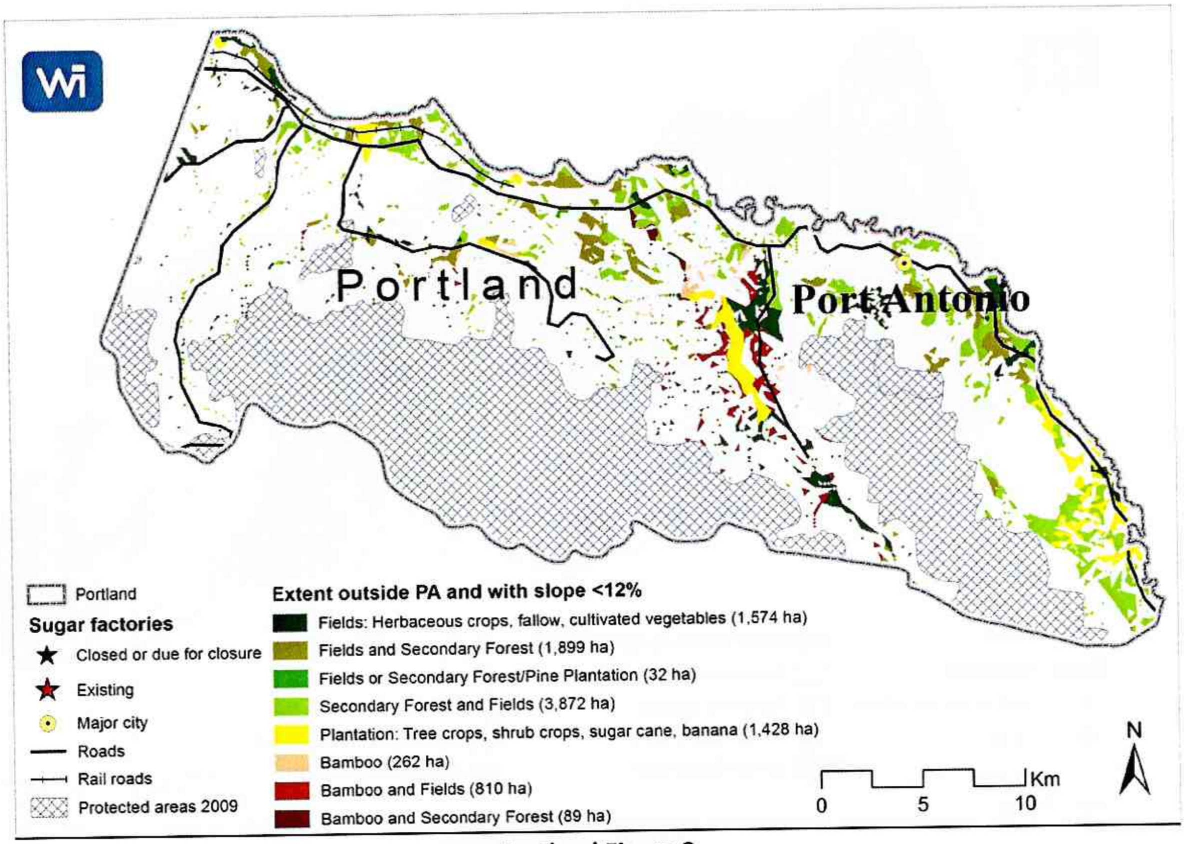
Manchester Figure 1



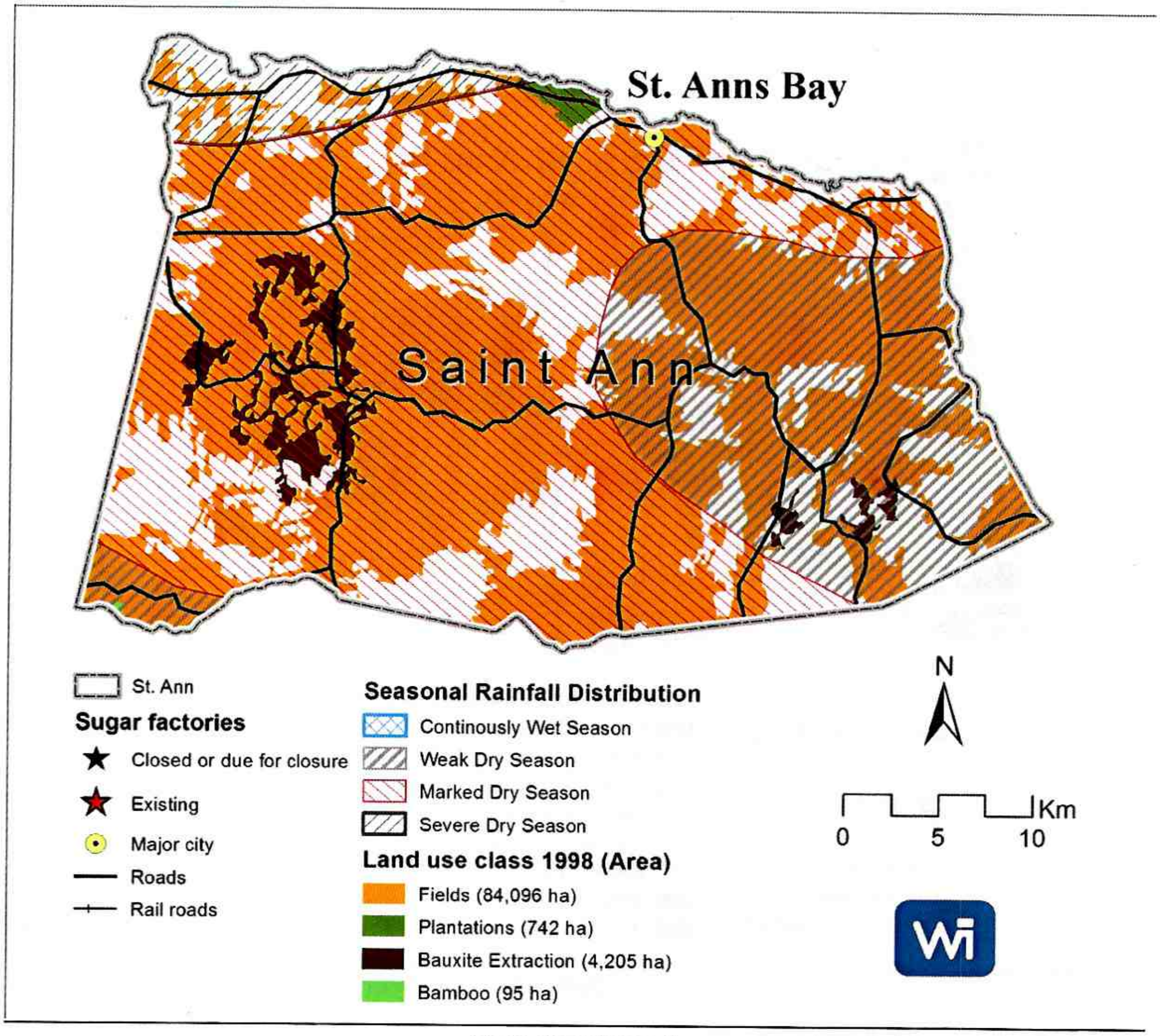
Manchester Figure 2



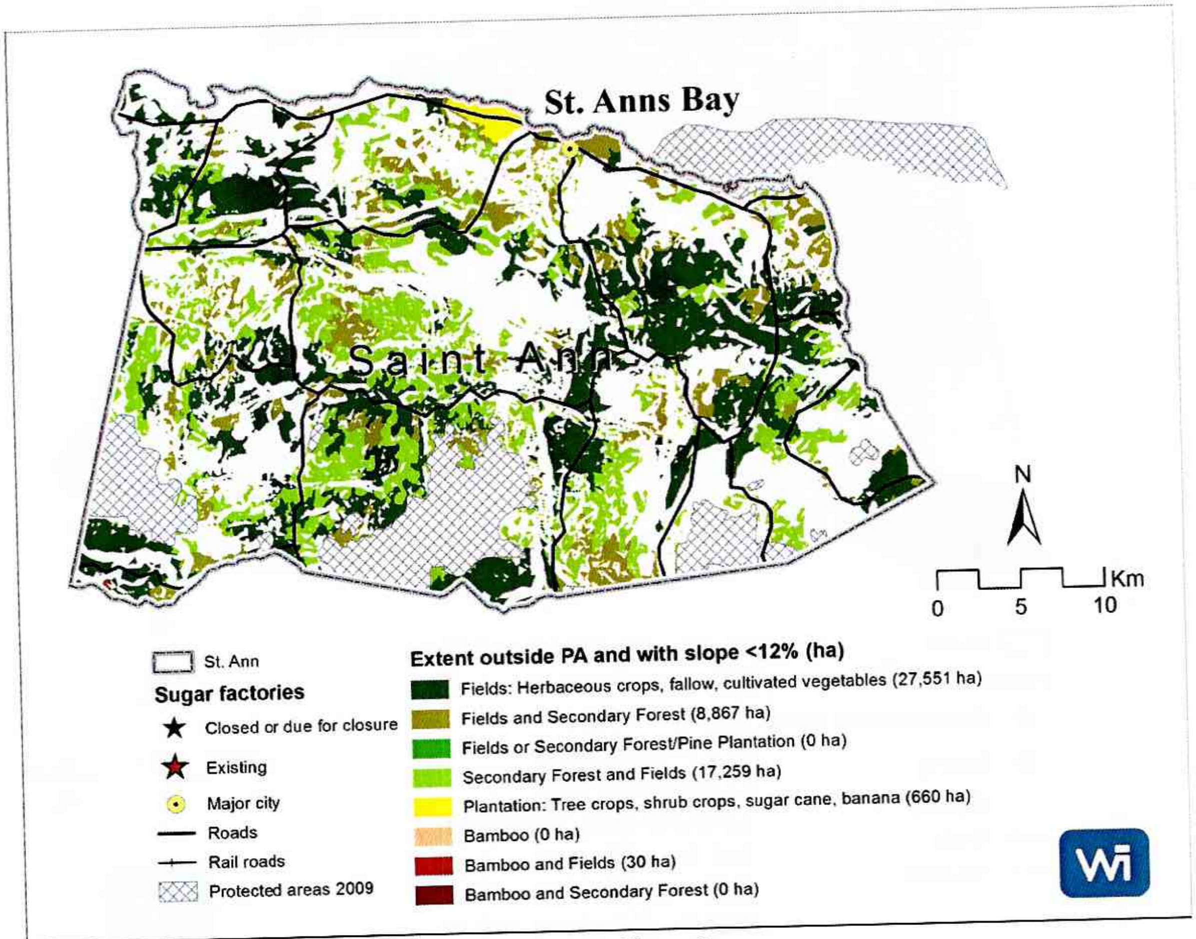
Portland Figure 1



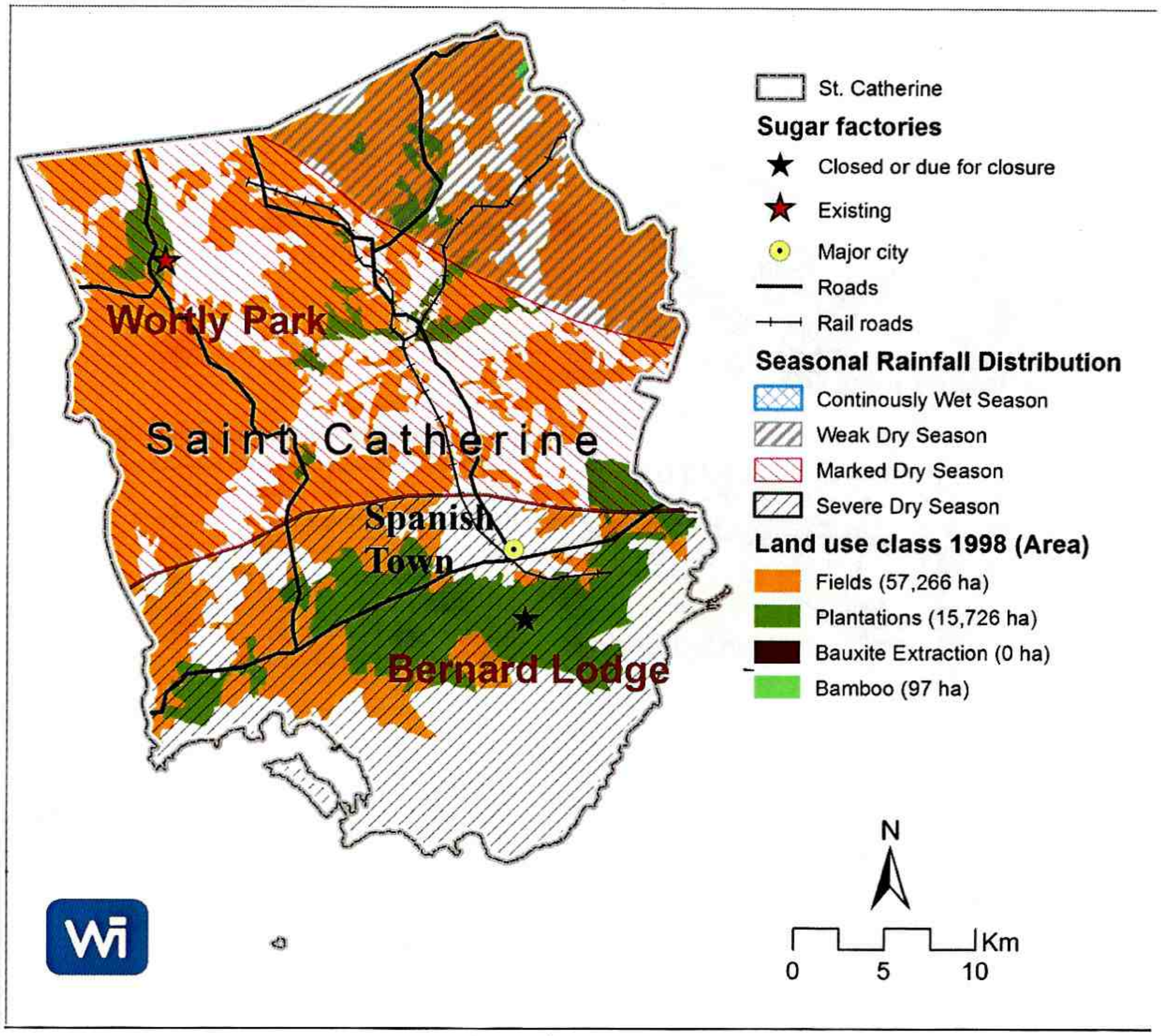
Portland Figure 2



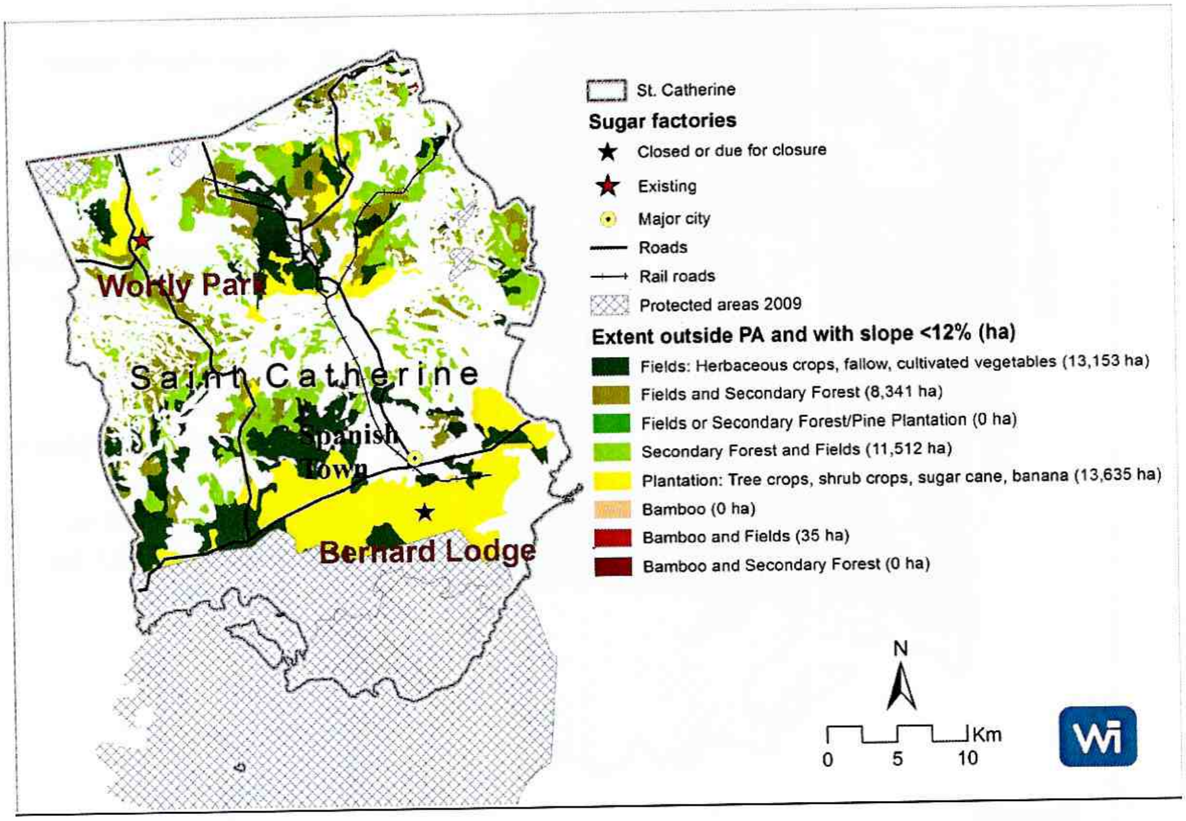
Saint Ann Figure 1



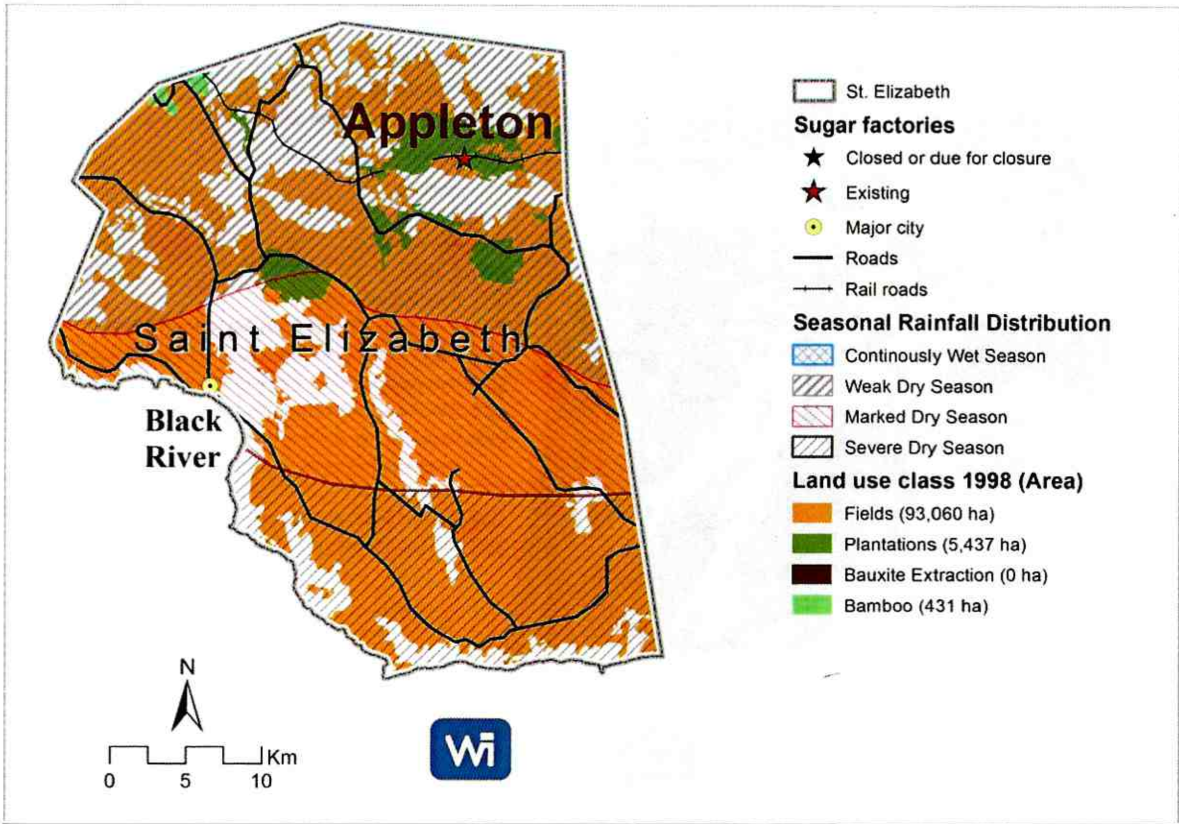
Saint Ann Figure 2



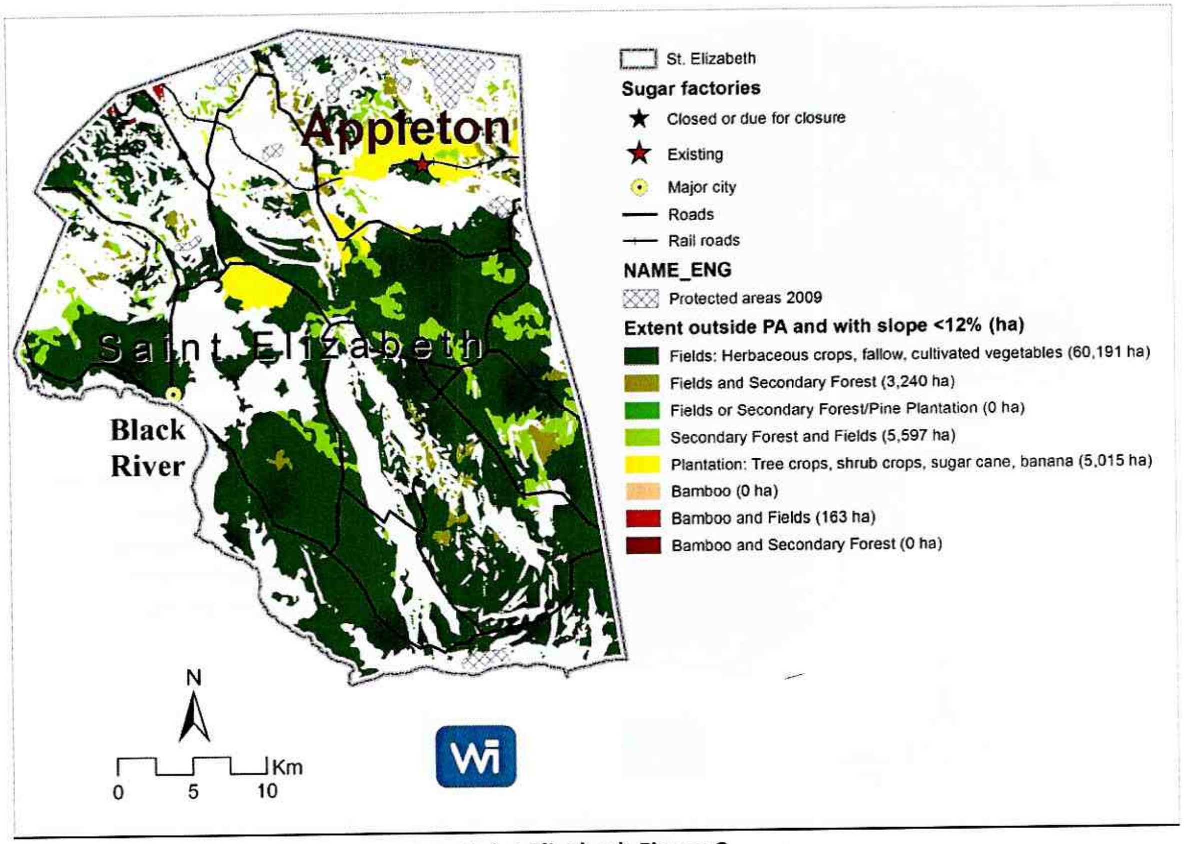
Saint Catherine Figure 1



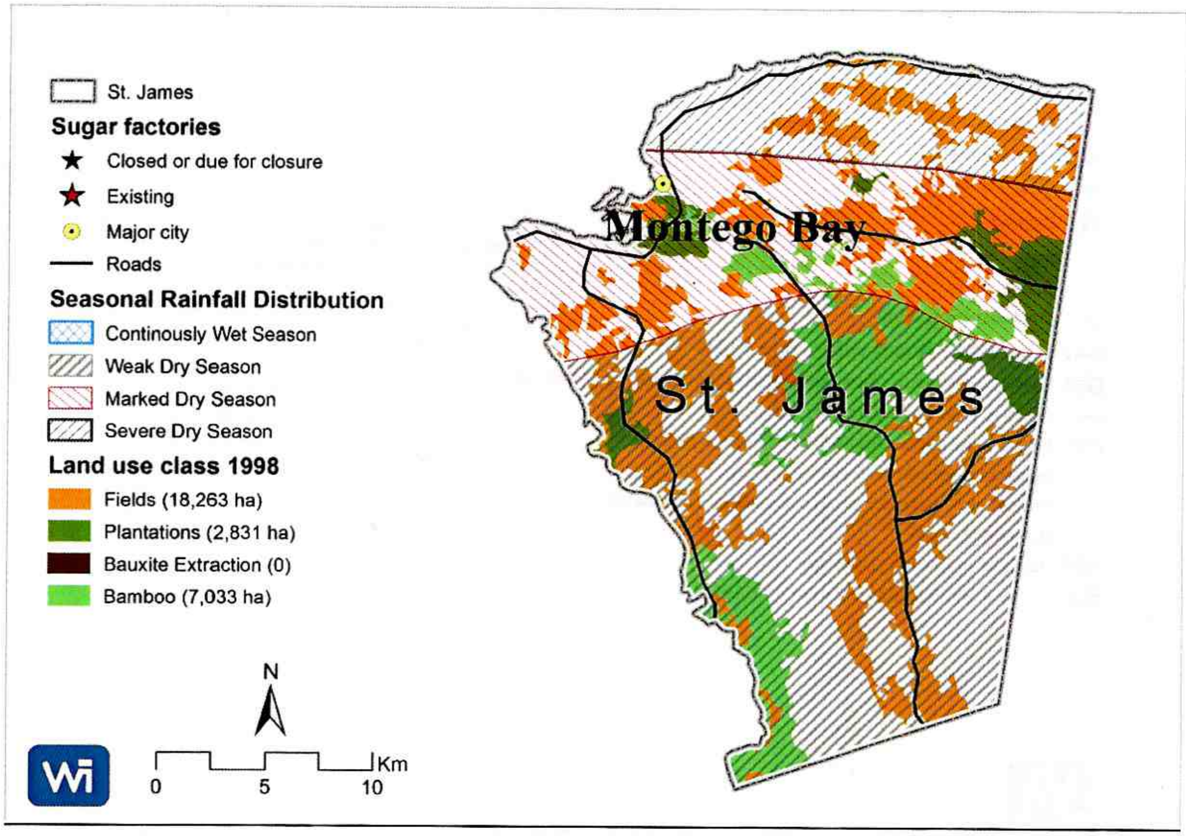
Saint Catherine Figure 2



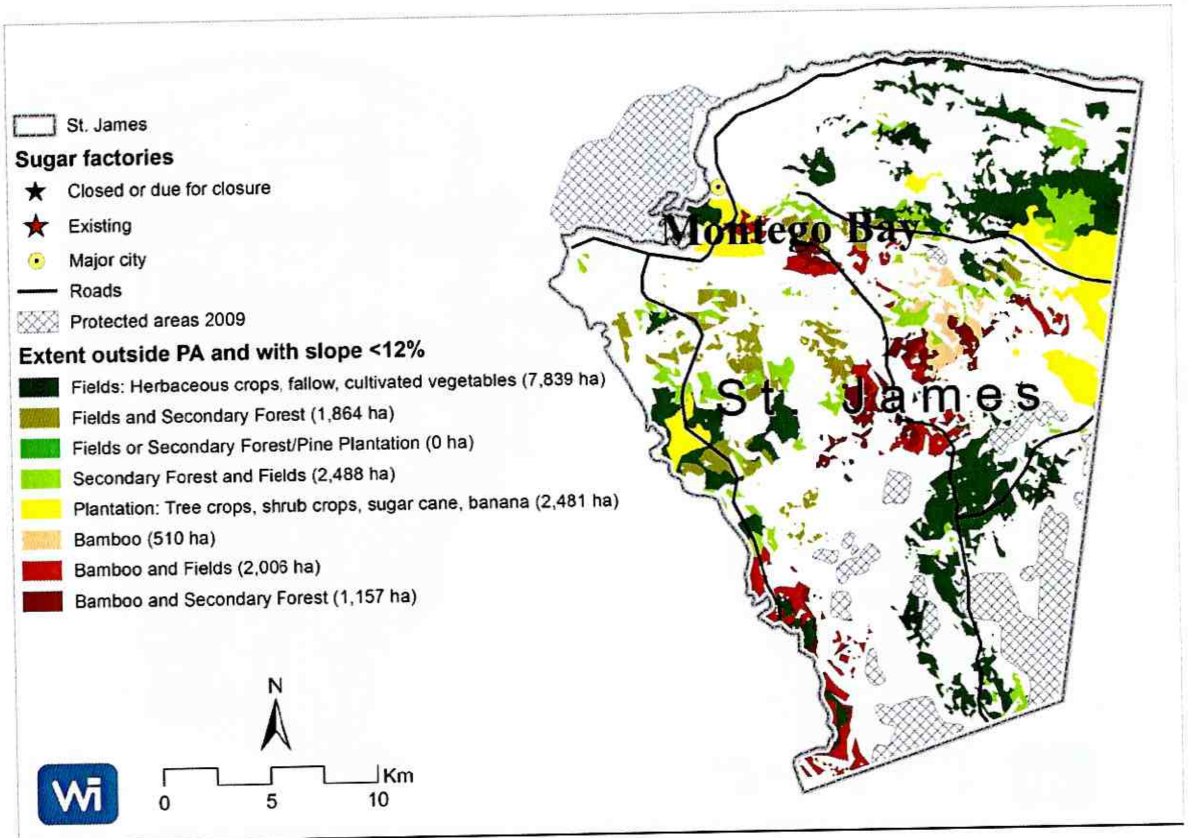
Saint Elizabeth Figure 1



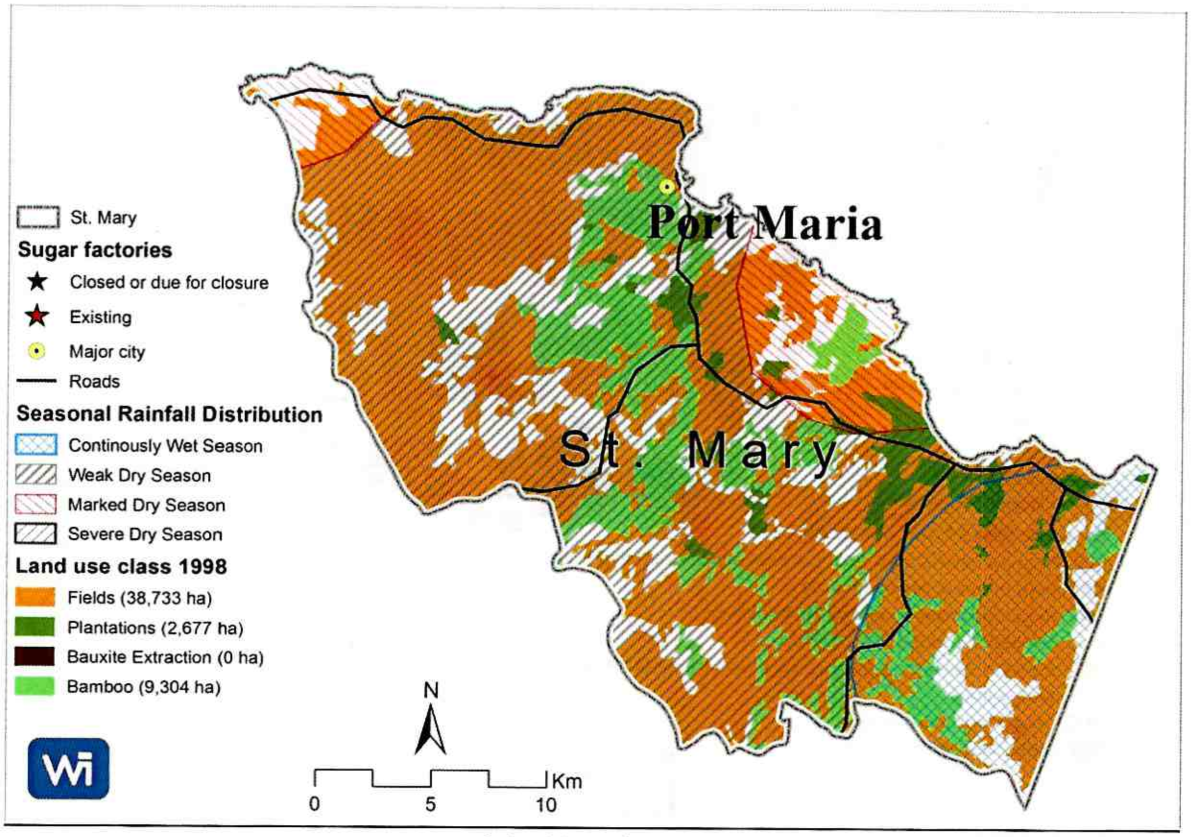
Saint Elizabeth Figure 2



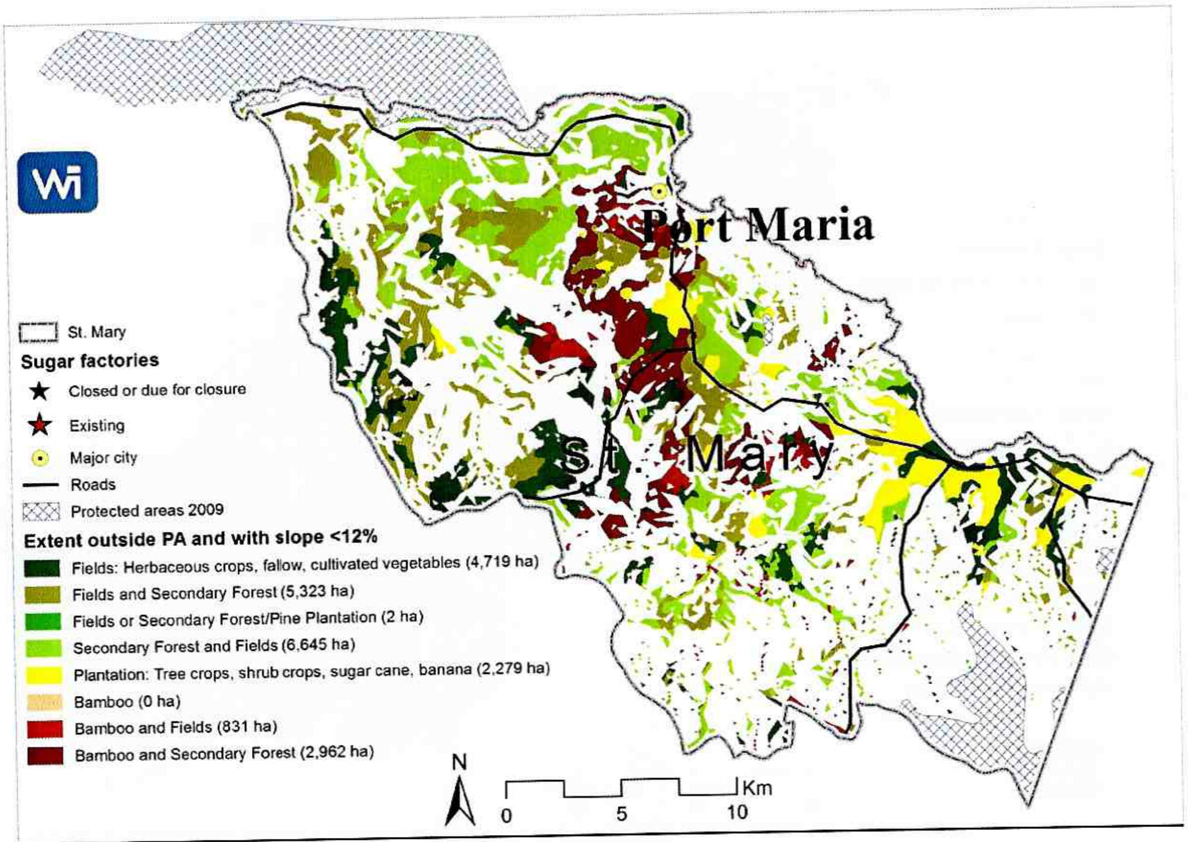
Saint James Figure 1



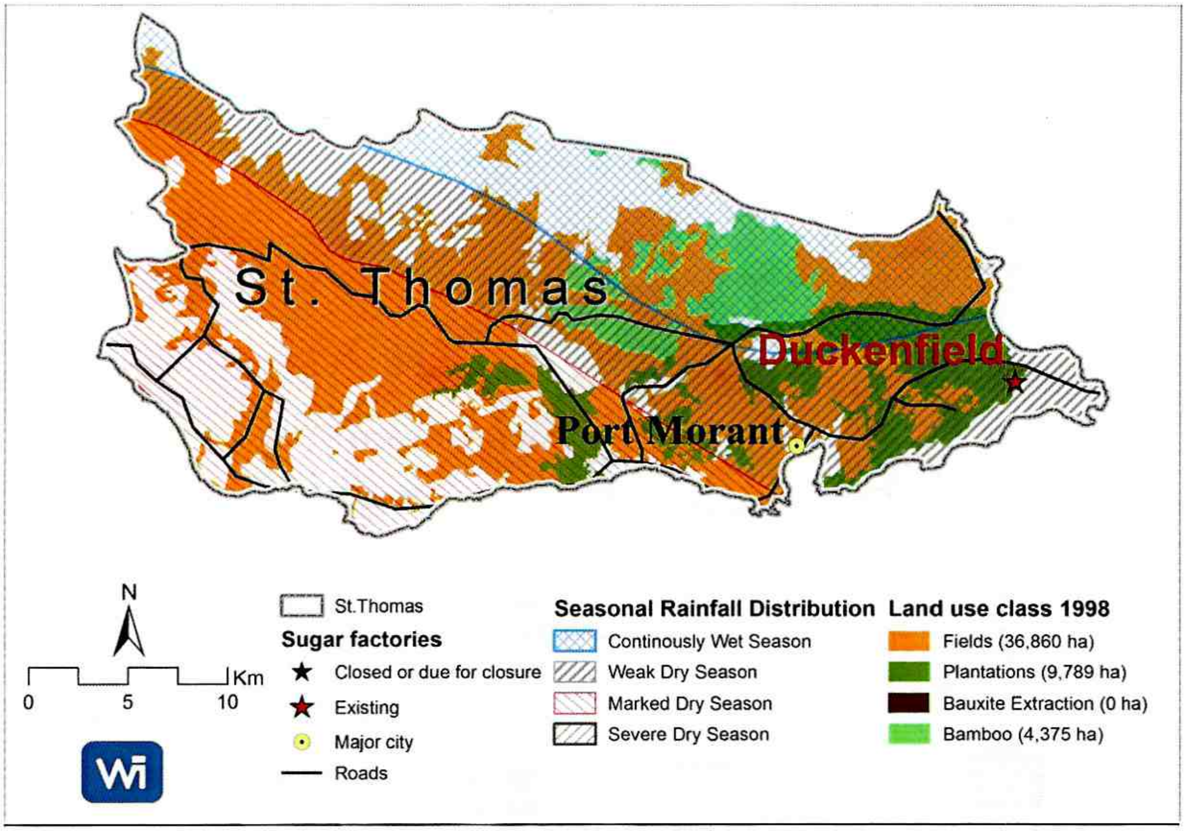
Saint James Figure 2



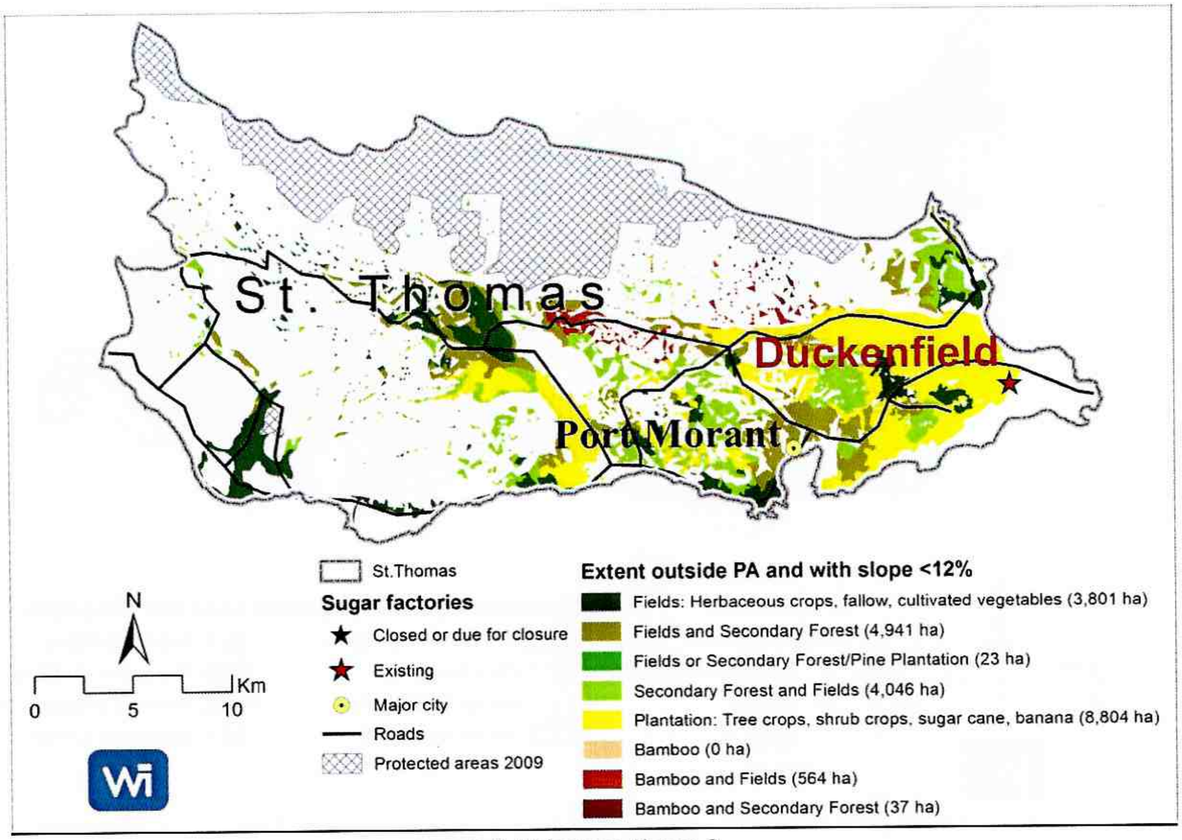
Saint Mary Figure 1



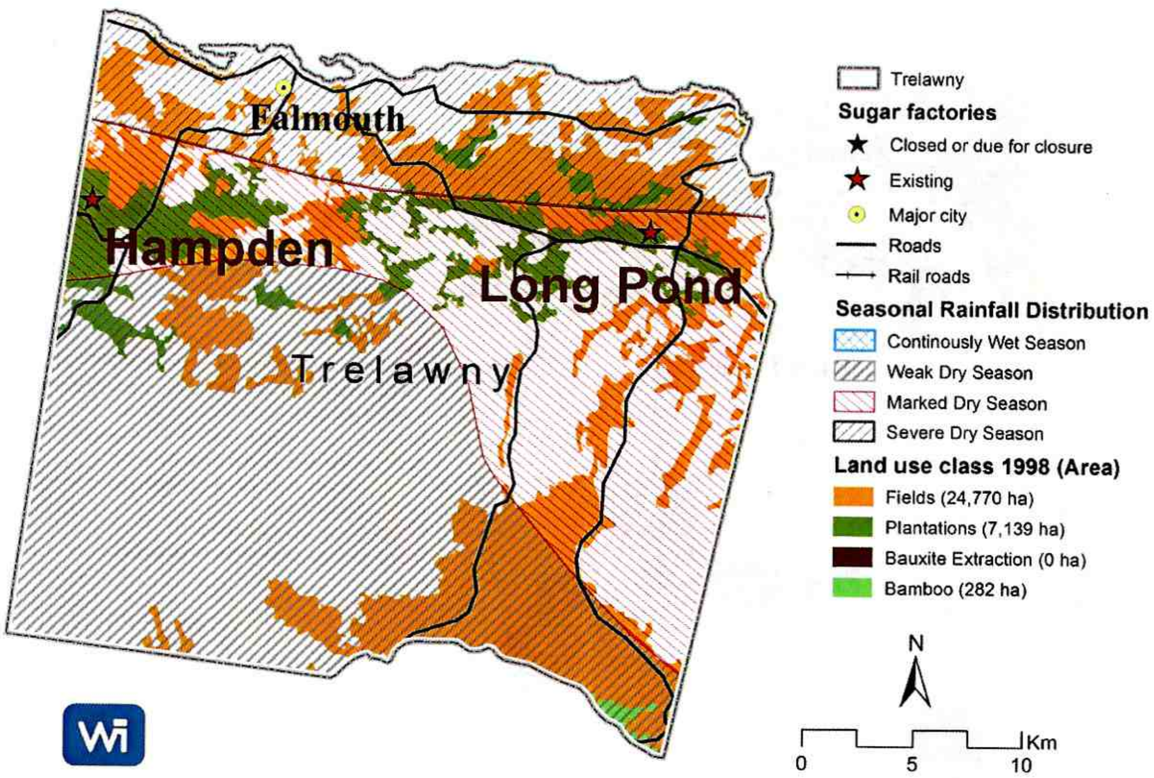
Saint Mary Figure 2



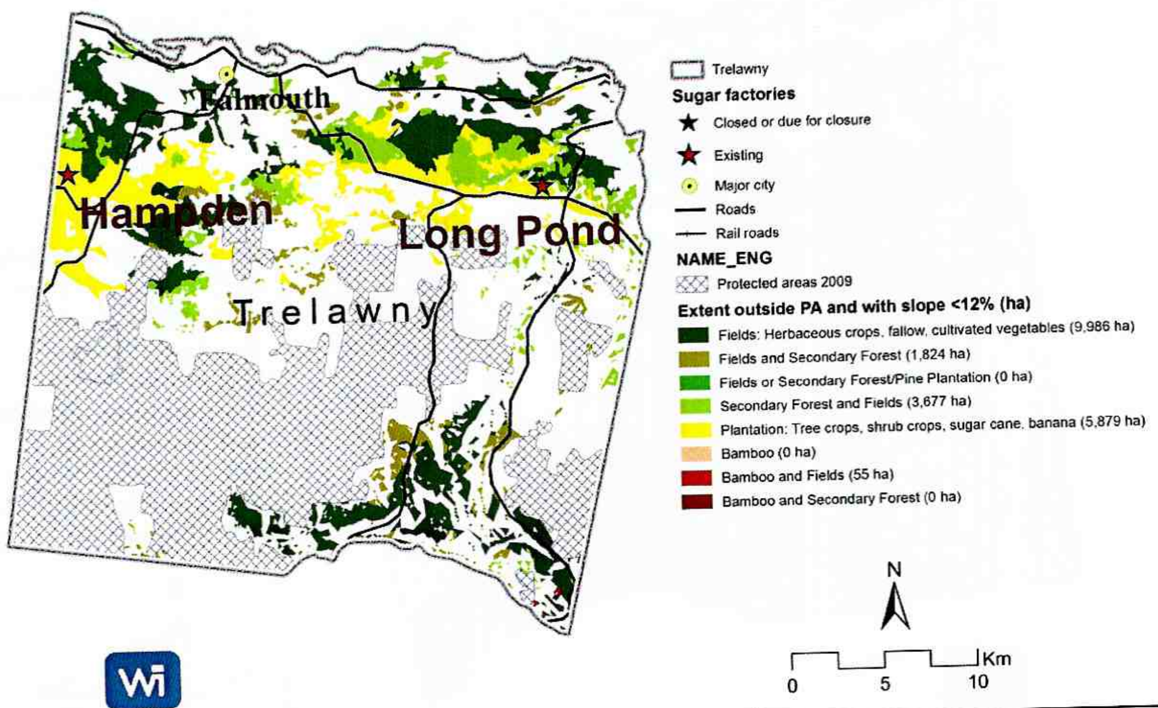
Saint Thomas Figure 1



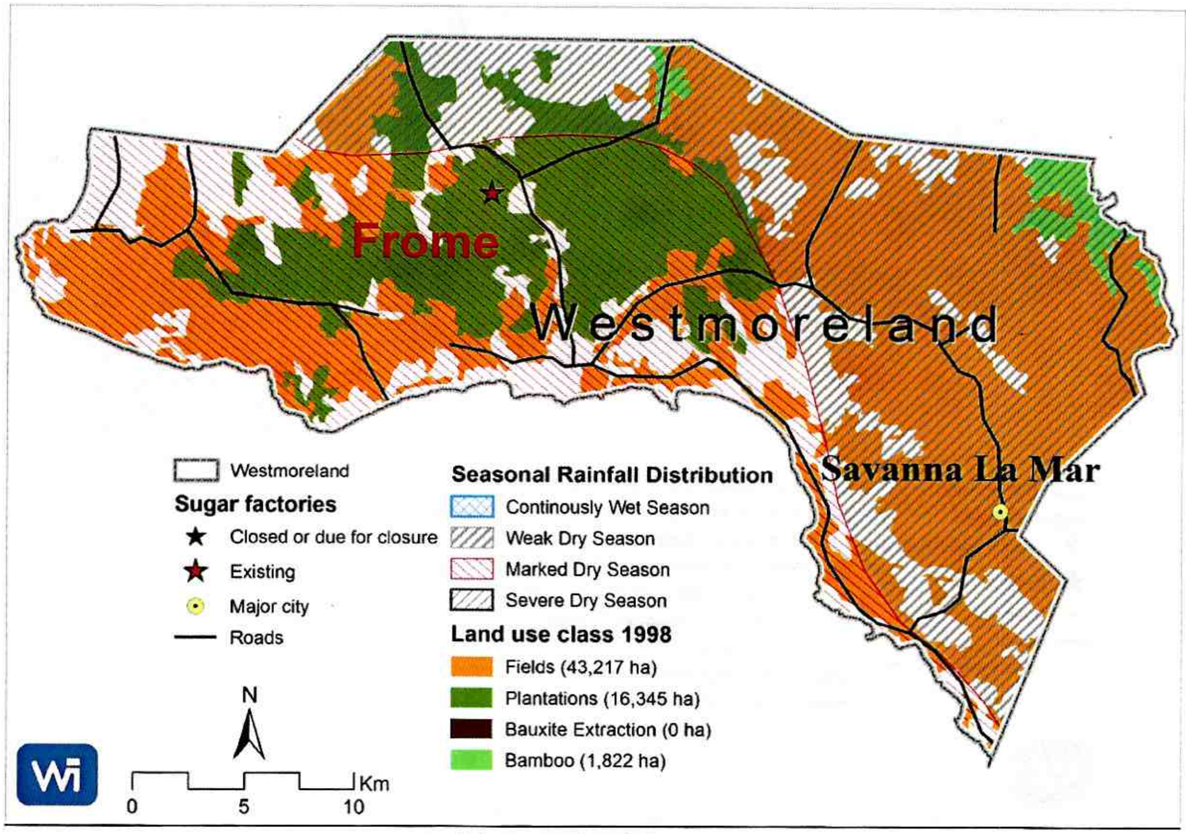
Saint Thomas Figure 2



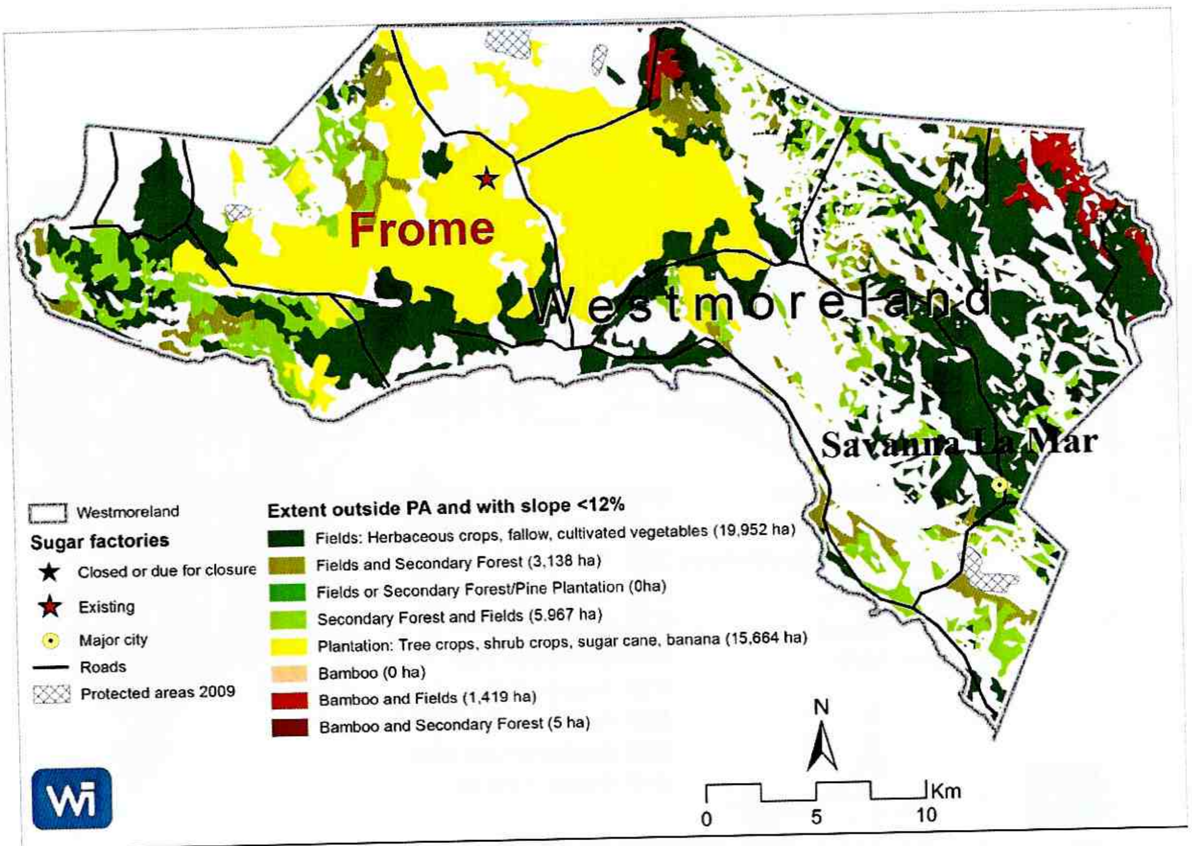
Trelawny Figure 1



Trelawny Figure 2



Westmoreland Figure 1



Westmoreland Figure 2

ANNEX V

Summary of Sugarcane industry Targets for 2010

Extract from work undertaken by Bradley Rein, Bradley K. Rein P.E., Director Processing Engineering and Technology, National Institute of Food and Agriculture, USDA

USDA National Institute of Food and Agriculture
www.nifa.usda.gov

Summary of JCS (I) Sugar Cane Industry Targets for 2010

Product	Production (tonnes/litres)		Cane Required (tonnes)		Land Required (reaped ha.)*	
	2010 Target	2009 Actual	2010 Target	2009 Actual	2010 Target	2009 Actual
Raw Sugar	200,000	126,000	1,900,000	1,300,000	25,000	29,000
Molasses (co-product)	67,000	40,000				
Additional Molasses for rum	67,000	0.0	400,000		5,000	0.0
Sub-total			2,300,000	1,300,000	30,000	29,000
Ethanol	70,000,000	0.0	1,000,000		13,000	0.0
Total			3,300,000	1,300,000	43,000	29,000

Notes:

Land required to be reaped under the JCS for 2010 assumed higher levels of productivity than actually achieved due to underperformance in replanting, maintenance, etc. actions proposed in the strategy.

The total cane required to meet these targets is 3,300,000 tonnes and 43,000 ha assuming a yield average of 76.74 tonnes/ha.

Source: JCS (I), SIA, SIRI