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# FARMER'S PERCEPTION OF RISK IN NON-BANANA TREE CROPS IN DOMINICA

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## ABSTRACT

This paper compares the returns from different tree crops on basis of their gross margins. Although banana dominates the cropping pattern, it does not offer the highest returns per acre or the best returns to labor. The classic gross margin analysis does not adequately explain what farmers do. The gross margins do not cater for varying amounts of riskiness associated with alternative crops. The paper goes on to identify the main risk as markets. In many non-banana tree crops, lack of an organized market meant that only 20 to 30% of potential crop was harvested. The other factors accounted for are the seasonality of crop and its effect on a farmer's cash flow, and the tolerance of a crop to negligent husbandry. These factors are quantified in the form of a yield discount factor. Returns discounted for risk show that banana is one of the more attractive crops.

## PURPOSE OF RISK ANALYSIS

The major problems in agriculture are voiced by the farmer as markets, labor and transport. Crops ideally should have organized markets, require a minimum of labor and have a high unit value, so that transport costs are minimized. In choosing what crops to grow or what cropping mix to establish, the farmer will take into account what already exists on his land, how much labor he has available for a particular crop during a particular season and in theory try then to maximize his income.

Gross Margines, that is the difference between the farmers production cost and revenue, all other things being equal, would determine the farmers cropping pattern. This is a gross over-simplification as most farmers are heavily intercropped and a more realistic view would be given by presenting cropping mixes and the comparative costs and returns for each mix. It is still a useful first step to look at returns to single crop acreages to see which crops will be significant in a whole farm environment. It also helps understand the particular economic risks associated with each crop, which intercropping as a general policy of risk aversion tends to mask.

This paper seeks to look at gross margins alone and compare them for different tree crops. Then to show that the classic gross margin approach does not reflect what farmers actually do and that farmers discount potential returns on the basis of perceived risk.

The major economic risks perceived by farmers are:

Markets: The ability to sell the crop.

**Frequency of income:** The number of months in which the crop can be sold. That is how regular is the farmer's income.

**Husbandry latitude:** The cost of neglecting the crop for short periods in a year. This is to put a cost on the propensity of Dominican farmers to leave the island for short periods to go about other business, leaving the farm in the hands of a less interested party.

There are other management risks that should be considered but are not quantified here:

- The perishability of a crop, although this is in part a marketing risk;
- The total labor requirements of a crop, when labor is in short supply.

#### POSITION OF BANANA IN THE FARMING SYSTEM

More than 75% of Dominica's farmers are banana farmers. Therefore, banana is the cornerstone of most farmers' production systems. The banana is rarely grown as a pure stand but intercropped with other tree crops.

Table 1. Importance of banana in farming systems.

Crop concerning which farmer was interviewed	% of farmers reporting banana as main crop	% pure stand	% intercropped with banana
Coconut	60	5	80
Cocoa	33	22	33
Coffee	71	60	53
Avocado	70	10	70
Mango	25		13
Grapefruit	80		80
Oranges	65	18	47
Lime	33		17
Passion fruit	38	55	

Source: Tree Crop Survey, Dominica, February 1991  
Sample of approximately 10 farmers per crop.

The government feels that economy is overly dependent on banana. This has become more of a worry in the light of 1992 and a possible fall in the price of banana. Farmers complain too that there is a lot of work and little profit in banana. Some farmers are leaving banana because of the problems experienced in getting labor and because of the uncertain future after 1992. Despite the cloud of 1992 and despite the labor problems, banana persists as the mainstay of the agricultural sector.

## TRADITIONAL METHOD OF COMPARING RETURNS FOR DIFFERENT TREE CROPS

### Gross Margin Per Acre.

This is the return to the farmer from growing one acre of the crop. It is the expected revenue from sale of the crop less all his production costs including all his labour costs, material costs and any transport costs to the point of sale.

Gross margin (GM) analysis does not take into account the cost of the land, tools or other capital items which may be used on the whole farm, hence the word "Gross" rather than "Net". Net margins will differ depending on the size of the farm.

Returns for Banana (year 3) and Navel Oranges (year 8) are presented in table 2.

### Return per Manday.

The return to labor is the total revenue expected less material costs and less transport costs. The return per manday is the return to labor divided by the number of mandays used in a year.

For larger farms where labor shortage is a main constraint this is an important parameter.

### Internal Rate of Return.

The Internal Rate of Return (IRR) measures the return from a crop over time. The revenue expected from a tree crop in the future has to be discounted against the costs of establishment and maintenance that precede the bearing period. To illustrate the point, figure 1 shows the gross margins from banana and orange. Figure 2 shows the "cumulative" gross margins. In figure 1 oranges look more attractive in the long term. In the second graph, income or loss from the previous year is carried over to the next year and banana looks a much more attractive crop.

The IRR is expressed as a percentage, and can be seen as the interest that would be earned on all the expenditure over the period being considered. The higher the IRR, the more attractive the investment appears. The IRR is not a wholly adequate measure though. Comparing short term crops like passion fruit and banana with long term crops such as cocoa or orange, tends to make the shorter term crop look too attractive.

From the farmer's perspective, the risk inherent in the longer term crops is greatly reduced by:

- Intercropping, which means that there is a return from the land but not necessarily that crop. Also requirements for weeding are shared.

**Table 2. Cost of Production per Pound**

BANANA		
Year 3 production		
Total production 8.91 tons	Price/lb:	33.0 cents
	EC Cents	
<b>Maintenance</b>		
Labor	5.3	
Materials	11.1	72%
<b>Harvesting</b>		
Cost of picking	2.55	
Cost of heading	1.20	
Cost of packing and post-harvest	0.97	21%
Cost of transport	1.79	8%
Total cost	22.9	100%
Revenue	33.0	
Gross margin	10.1	
ORANGES (WASHINGTON NAVEL)		
Total production 5.24 tons		
	Price/lb:	60.0 cents
	EC Cents	
		% maintained
<b>Maintenance</b>		
Labor	1.9	
Materials	1.7	26%
<b>Harvesting</b>		
Cost of picking	5.25	
Cost of heading	1.94	
Cost of packing and post-harvest		50%
Cost of transport	3.50	224%
Total cost	14.4	100%
Revenue	60.0	
Gross margin	45.6	

Figure 1  
Compare Banana and Orange  
GROSS MARGINS

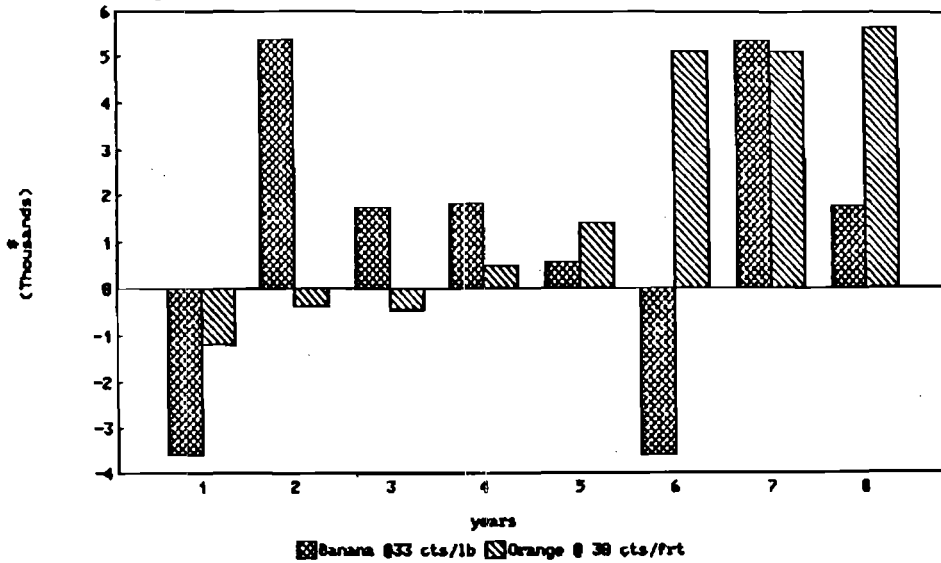
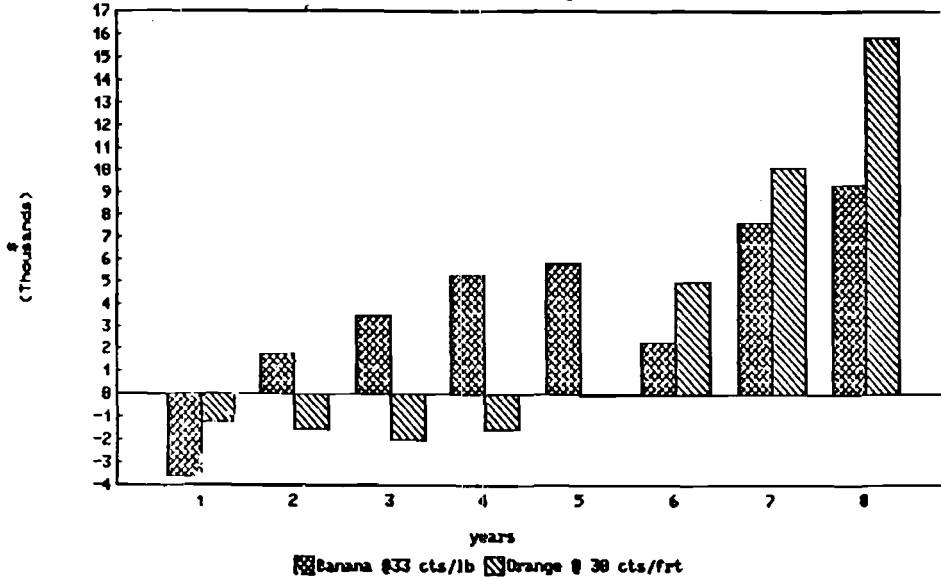


Figure 2  
Compare Banana and Orange  
CUMULATIVE Gross Margins



- The existence of project support for many of the crops where the Ministry of Agriculture (MOA) provides free planting material and inputs for up to 4 years (usually fertilizer and herbicide). The relative success of various MOA programmes in establishing new acreages of "diversification" tree crops attests to the ability of farmers to be helped over this risk.

Table 3 shows the returns to some of the major tree crops in Dominica. Most of the data was gathered from a survey conducted in February 1991 from a small random sample of farmers. Yields are based on what farmers expected to get per tree, not on what they actually harvested. Prices are the mean of the lowest price expected from the markets they sold to. The banana returns are adapted from a DBMC model in the light of three banana farmers keeping detailed records for a period of 11 months.

It was found that productivity varied greatly on farms and these gross margins should be treated as illustrative approximations and not definitive. It can be seen that the gross margins and returns for labor are higher for coffee liberica, oranges, mango, avocado and passion fruit. On the other hand, banana yields the highest internal rate of return. If farmers persist in growing banana, despite lower returns to land and labor, it is because they perceive it is less risky than other crops. Is it possible to assess this risk and give it an economic value so that the gross margins and returns to labor more truly reflect the choices that farmers make?

#### DISCONTINUING YIELD FOR RISK

In order to quantify risk in gross margin analysis it is necessary to reduce the yield of the crop (and reduce costs of harvesting and selling) by a risk factor and recalculate the gross margins, returns to labor and IRR. The risk factors used here are marketing, income frequency and husbandry latitude. A value of 1.00 means there is no risk associated with that particular risk factor, a value of 0.9 would mean you can expect only 90% of the yield. Each of the individual risk factors is multiplied together to give a Total Risk Factor.

#### Market.

The main risk that farmers face is marketing. That is, that they may not be able to sell their crop. In the aforementioned survey of 100 farmers it was found that most farmers failed to sell all the potential crop on their trees. Typically they were only able to sell 20 to 30% of their crop, and this to the huckster trade.

Those crops offering secure markets were: Banana, 33 cts/lb; coconut, 12 cts/nut; passion fruit, 45 cts/lb; coffee arabica (Parchment), 275 cts/lb; grapefruit, 7.5 (Jan-March), and 10.75 cts (Sept-Oct).

This security needs to be qualified though:

Coffee: The coffee market is newly established and some farmers have experienced problems in selling to the private firm of Bellot.



Table 3. Returns from main tree crops in Dominica

Crop		Gross margin per care	Return per manday	Internal rate of return <sup>1</sup> %
Banana		\$2,084	\$ 44	98
Cocoa	No project	874	\$ 35	2
	With project	1,091	44*	5
Coffee	Arabica	1,097	34	10
	Liberica	3,404*	57*	39
Coconut	Copra	46	24	neg
	Dry	610	56*	17
	Jelly	1,066	44*	28
Grapefruit	Agro	606	46*	10
	CCGA	226	27	-14
	Hucks	2,759*	88*	40
Lime		2,318*	40	30
Orange	W. Navel	5,673*	134*	61
	Valencia	5,621*	121*	67
Mango	Julie	7,391*	189*	71
Avocado	-	7,189	127	76
Passion fruit		4,918*	91*	74

<sup>1</sup>Over a period of 21 years for long-term crops; over 5 for passion fruit and banana.

\*Denotes return is higher than banana.

Grapefruit: Agro-industry has offered a secure market for 4 years, but in the last year uncertainty surrounded its future and farmers typically sold only a quarter of what they had planned to sell. The Citrus Packinghouse marketing period has become shorter and shorter and can only take a percentage of the farmers potential crop.

The other crops sell mainly on the huckster market which is characterized by small volumes taken from the farm and an inability to take any quantity of the crop when in full season. Prices tend to be high, as they are not "market clearing prices". That is, the prices do not adjust to assure that a farmer could sell all his crop if he so wished.

Table 4 shows the discount for market risks which is determined as the difference between the potential crop (defined as what the farmer had estimated he had on his tree) and the amount he recalled having sold or consumed.

Table 4. Yield discount factors for selected tree crops in Dominica

Crop		Market risk	Income frequency	Husbandry latitude	Total discount	Potential yield (tons)	Dis-counted yield (tons)
Banana		1.00	1.00	0.95	0.95	8.9	8.5
Cocoa	No project	0.45	0.96	1.00	0.43	0.4	0.2
	With project	0.96	1.00	1.00	0.96	0.5	0.5
Coffee	Arabica	0.95	0.96	1.00	0.91	0.5	0.4
	Liberica	0.20	0.96	1.00	0.19	1.1	0.2
Coconut	Copra	1.00	1.00	1.00	1.00	4,900.0	4,900.0
	Dry	0.15	1.00	1.00	0.15	4,900.0	735.0
	Jelly	0.15	1.00	1.00	0.15	4,900.0	735.0
Grapefruit	Agro	0.80	0.95	1.00	0.76	11.3	8.6
	CCGA	0.80	0.97	1.00	0.78	7.9	6.1
	Hucks	0.15	0.97	1.00	0.15	7.9	1.2
Lime		0.15	1.00	1.00	0.15	11.8	1.8
Orange	W. Navel	0.29	0.94	1.00	0.27	5.2	1.4
	Valencia	0.29	0.96	1.00	0.28	7.9	2.2
Mnago	Julie	0.45	0.96	1.00	0.43	6.8	2.9
Avocado		0.20	0.96	1.00	0.19	6.3	1.2
Passion fruit		0.90	1.00	0.75	0.68	4.9	3.3

Note: Units for coconuts is nuts; for coffee is parchment; and for cocoa is dried.

#### Frequency of Income.

A regular income makes household budgeting much easier. It is much more difficult to move away from a regular income crop to a seasonal crop. Bananas provide a regular income, as do coconut for copra. Both crops have maintained a loyal body of farmers despite periods of very low returns. Coconuts currently give less than \$50 per acre.

To try and allow for this it is necessary to devise some mechanism to penalize a crop the shorter the harvesting season. As a first attempt an

interest of 10% per annum is charged against the yield of a crop for each month it is not bearing. A crop that is harvested for 4 months in the year will have a yield equivalent of 93% to one that is harvested all the year round.

#### Husbandry Latitude.

This is a first attempt to quantify management risk where a crop requires continuous management throughout the year to attain its potential yield. It is a measure of the crops ability to stand neglect. The only crops discounted under the ones under review are banana and passion fruit.

Husbandry is defined as the loss of yield from a farmer leaving his plot for three weeks in the year. It is assumed that the farmer leaves the crop in the care of a relative or trusted friend but finds that the husbandry activities will result in an equivalent loss of income for the period he is away. In the case of passion fruit, the consequences tend to be more dire as when trellis poles rot, if immediate replacement is not done, there can be a domino effect and loss of vines when it comes to resurrecting the trellis.

Further survey work is required to define the probable loss more accurately but for the purpose of illustration banana is discounted by 5% and passion fruit by 10%.

Table 5 shows the returns to major tree crops in Dominica after the yields have been discounted. Banana looks one of the better crops. The large margin that oranges, avocado, mango and passion fruit offered over banana have slimmed. These latter crops still offer a better return to labor though. If a cocoa project is put in place, the returns are much higher than without a project. This is because a main component of such a project would be the provision of a central processing facility which would take out the main risk factor (a lack of markets).

Those in the business of trying to market Dominican produce overseas complain about the high prices demanded by farmers. These high prices are in great part to compensate for the expectation of not selling very much crop. A guaranteed market should be able to negotiate lower prices for product from the farmer, to both parties mutual benefit.

#### CONCLUSIONS

The aim here has been to give an economic value to some of the main risks that farmers in Dominica perceive. This has been done by determining values to risk factors identified as marketing, income frequency and husbandry latitude (management level required by the crop). These individual risk factors were then multiplied together to produce a total risk factor. This factor was then multiplied with the "potential" yield expected for the crop to produce a yield adjusted for risk. Associated costs in harvesting and selling were likewise reduced.

Table 5. Returns to main tree crops in Dominica, adjusted for risk

Crop		Factor discount	Gross margin per acre \$	Return per manday \$	Internal rate of return
Banana		0.95	1,831	41	83%
Cocoa	No project	0.43	23	22	neg
	With project	0.96	1,008	43	neg
Coffee	Arabica	0.90	996	33	8%
	Liberica	0.19	425	38	-6%
Coconut	Copra	1.00	46	24	neg
	Dry	0.15	(63)	0	neg
	Jelly	0.15	5	21	neg
Grapefruit	Agro	0.76	391	41	2%
	CCGA	0.76	110	24	neg
	Hucks	0.15	310	41	-4%
Lime		1.00	(218)	13	neg
Orange	W. Navel	0.28	1,272	80	24%
	Valencia	0.28	1,258	75	26%
Mango	Julie	0.43	3,030	156	45%
Avocado		0.19	1,646	73	24%
Passion fruit		0.68	2,926	73	neg.

These crop budgets are not definitive and further work will be required to refine them. The method in determining some of the risk factors is a little arbitrary, but as first step, it is hoped that the principle is demonstrated. In particular, it does help shed some light on farmers' response to the various diversification programmes that have been pursued in Dominica.

It is held that diversification in the 80's in Dominica has failed. From the planners perspective maybe, but has it from the farmers? Prices of banana have steadily risen in the eighties while the price of coconut (another regular earner) has halved as the price for grapefruit for the English fresh food market.

In looking for alternative crops to banana, we must take into account the farmer's perception of risk and try and evaluate the crop accordingly. In particular:

- \* That the uncertainty of markets for crops is the major risk in growing alternative crops.
- \* That farmers have become dependent on the regular income that banana offers.

APPENDIX A

Comparison of PRODUCTIVITY Parameters of Major Tree Crops in Dominica

PARAMETERS	COCOA		COFFEE		COCOSNUTS		SUGARPEPPER		ORANGE		JELITE		PASSION				
	Bushes No per Acre	Yield lbs/acre	Plants No per Acre	Yield cwt/acre	Copra No per Acre	Dry Yield cwt/acre	Agro No per Acre	CCA No per Acre	Sticks No per Acre	Lions No per Acre	Valencia No per Acre	Large No per Acre	Small No per Acre	Passion No per Acre			
Yield (tons/acre)	60	8.9	100	0.5	36	5.1	4,900	4,900	11.5	7.2	7.9	11.0	5.2	7.2	6.2	6.3	6.7
Harvesting Productivity (lbs picked/handay)	60	50	100	16	36	1000	1000	127	1500	1000	1000	276	600	600	675	350	350
Total Labour required per Year (handays)	97	61	60	66	95	37	37	66	24	41	41	118	56	56	44	48	70
Price in cents/lb	33	299	225	300	225	12	25	50	8	11	25	21	60	40	60	63	66
Cost in cents/lb	21	194	131	195	89	11	13	28	5	9	9	12	11	8	11	12	20
Gross margin (cts/lb)	12	96	94	105	136	1	12	22	2	1	16	9	49	32	49	51	46

NOTE: Coconut yield and productivity expressed in cwt not lbs.

COMPARISON OF YIELDS FOR MAJOR TREE CROPS IN DOMINICA  
 1950-1951

PARAMETERS	COCOA		COFFEE		COCOA BUT		COCOA BUT		COCOA BUT		COCOA BUT		Pension Fund					
	Income \$m	Per 60th Pr	Arabica Liberico	Cocoa But	Java But	Agro But	CCSA Buts	Line L. Bart	Valencia	Boape Bocade	Julie Boape	Aracade						
Sea invested apple breakdowns, \$0	53,728	54,075	53,399	54,528	53,817	54,779	51,391	51,272	52,397	53,461	52,834	54,324	52,299	52,299	51,547	52,645	54,194	
Year breakdown	1	0	0	0	0	0	0	7	0	0	0	6	5	5	4	4	4	1
Total seedings	92	61	66	86	95	17	17	46	24	41	41	41	118	50	56	44	48	79
Return per acre	58,064	5074	51,971	51,977	53,904	546	5410	51,846	5466	5226	52,797	52,310	55,473	55,421	57,371	57,189	54,718	
Return per acre/day	640	635	644	634	637	624	636	644	646	627	608	640	6124	6121	6189	6127	671	
Internal Rate of Return	762	22	52	366	372	609	372	262	162	-162	602	362	632	672	712	762	762	
DISCOUNT FACTOR																		
Return per acre	0.75	0.43	0.76	0.70	0.19	1.00	0.15	0.15	0.76	0.76	0.15	1.00	0.28	0.20	0.43	0.19	0.48	
Return per acre/day	51,553	525	51,066	5776	6425	646	6463	65	6391	6110	6310	6218	61,272	61,258	61,636	61,646	62,926	
Internal Rate of Return	641	627	643	633	638	624	60	621	641	624	641	613	600	675	6156	673	673	
Internal Rate of Return	622	609	62	62	-62	609	609	609	22	609	-62	609	262	262	632	762	609	

NOTE: The marketable yield for each crop has been adjusted to the light of:  
 1. the 2 of the crop the farmer was on average able to sell;  
 2. the regularity of income offered by the crop;  
 3. the effect on yield of a farmer's absence from the farm for 3 weeks in a year;  
 60 "Sea invested" is the net present value of the sea invested.