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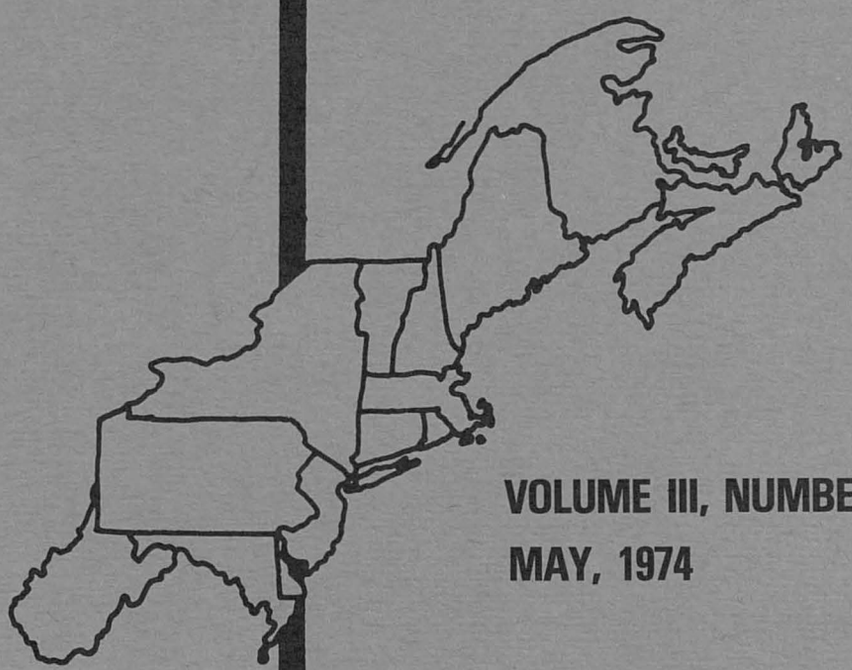

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VIABILITY OF DAIRY SETTLEMENT FARMS IN JAMAICA*

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In 1963 the government of Jamaica, in an effort to reconcile prevailing milk consumption levels with the volume of local production, initiated a Dairy Settlement Project as part of a Dairy Development Program. This project aimed at establishing a corps of new dairymen on 25 acre farms set up on lands acquired by the government under its land reform program. A pre-investment study indicated that the project was viable and a soft loan was obtained from the United States Agency for International Development to finance the project.

Young men with an agricultural background who were 18-30 years old and had at least a primary education were to be trained for a period of one year. At the end of training, they were to be equipped with a dwelling house, a dairy building and milking equipment, developed pastures, an irrigation system and 23 dairy cows. A lease-hold-cum-free-hold-system of tenure was planned in which the farmer was entitled to exercise the right of outright purchase in the fifteenth year of occupancy provided 60 percent of the value of all assets was repaid. The loan to the farmer represented the value of land and the total cost of development. Repayment was based on projected incomes and cost of living levels. It was phased over a period of 25 years at six percent interest and was to commence as soon as the farmer received all assets. Interest was not charged on land.

A multi-disciplinary administrative approach was adopted in which several agencies of the government were delegated specific responsibilities in the implementation of the project. This was a source of delay and resulted in a considerable gap between training and settlement. Fifty-seven of the farmers were settled at Rhymesbury and Vernamfield, between 1968 and 1971. These settlements are located on the Vere Plains on the south-central side of the Island.

The Problem

Few of the farmers in the project had met their repayment schedules at the time this study commenced in 1971. The primary purpose of this

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study was to determine if it was possible for the farmers to repay the money invested in the project. Specifically, the objectives were to:

1. Identify factors related to net farm income.
2. Identify factors related to repayment.
3. Determine if farms could generate an income which would enable their operators to maintain families, pay farm expenses and amortize debts.
4. Suggest ways of improving viability.

The method of analysis were:

1. A farm business survey of farmers settled for more than one year.
2. The collection of data from individuals and agencies associated with the project.
3. A regression analysis of net farm income and repayment.
4. A determination of debt paying abilities.
5. Computations of internal rates of return for the project.

Description of Farms

Of the 57 farmers settled, 35 were interviewed. Eleven were excluded because they were settled less than a year, one because of death, two because of lack of cooperation and eight because they could not be contacted. Examination of the data revealed several differences between the Rhymesbury and the Vernamfield farms (Table 1). Of these, the more important ones relate to the period of occupancy of the farms, the acreage, the number of cows, the percentage of cows in milk, the amount of concentrates fed per cow, net worth, net farm income, and repayment. Since such differences might lead to spurious results, it was decided to divide the farms into two groups and analyze them separately. In addition, one Vernamfield farm had so greatly exceeded the means of that group that it was deleted from the computations of means and the regression analysis. Thus, 20 Rhymesbury farms and 14 Vernamfield farms were analyzed separately.

The average period of occupancy of the Rhymesbury farms exceeded that of the Vernamfield farms by approximately nine months (Table 1). This may explain the significantly higher net worth, percentage of cows in milk, and hours devoted to subsidiary enterprises on the average Rhymesbury farm. In spite of the longer period of occupancy the average Rhymesbury farm had two cows less than the average Vernamfield farm. This is partly explained by the smaller average farm size at Rhymesbury which led to an allocation of one animal less per farm than at Vernamfield. The average milk price at Rhymesbury exceeded that at Vernamfield by three tenths of a cent. This price differential multiplied by mean milk production would account for only a difference of $131 in net farm income, but it underlines the greater marketing efforts undertaken by the Rhymesbury farmers.

Table 1
A Comparison of the Characteristics of a Group of 20 Farmers at Rhymesbury and a Group of 14 Farmers at Vernamfield, 1971

Items	RHYMESBURY		VERNAMFIELD	
	Mean	Standard Deviation	Mean	Standard Deviation
Years on Farm	3.20	.55	2.45	.14
Net Worth ($)	2,694	3,104	2,306	1,311
Net Farm Income ($)	1,941	1,866	3,030	1,423
Operator and Family Off-Farm Earnings ($)	2,342	2,274	1,577	1,836
Repayment	182	177	7.14	26.73
Expenditure on Luxury Consumption ($)	589	132	886	838
Acreage	24.73	3.70	28.38	6.06
Acres of Pasture	22.47	3.76	26.24	5.62
Number of Cows	21.90	3.47	24.04	5.30
Percent of Cows in Milk	68.87	7.65	61.67	10.43
Milk Production per Cow (quarts per year)	1,999	324	1,984	492
Milk Production per Farm (quarts per year)	43,708	9,483	48.013	17,772
Milk Price per Quart (cents)	11.76	1.88	11.46	.95
Acres of Pasture per Animal Unit	.81	.15	.84	.11
Hours of Labour per Animal Unit	85.71	14.31	84	13
Fertilizer Expense per Acre ($)	9.56	3.25	9.93	3.75
Concentrates Fed per Cow (lbs. per year)	1,588	466	1,251	406
Labour Spent on Subsidiary Enterprises (hours)	29.6	522	67	142
Family Size	4.25	1.80	3.71	1.59

The quantity of concentrates fed per cow in the average Rhymesbury farm was 337 pounds above that fed on the average Vernamfield farm. However, production per cow in 1971 at Rhymesbury exceeds that at Vernamfield by only 15 quarts. This indicates that a larger proportion of the concentrates were used to supplement poor pasture at Rhymesbury. The investigation revealed that the inefficiency of the irrigation system forced farmers in both areas to feed higher levels of concentrates than planned. The situation was most critical at Rhymesbury, where (a) water pressure was lower, (b) irrigation failure was more frequent, and (c) the less drought resistant guinea grass pastures were more prevalent.

Net Farm Income

Net farm income on the Vernamfield farms ranged from $1,280 to $6,145, had a mean of $3,030, and a standard deviation of $1,423. On the Rhymesbury farms it ranged from -$1,776, to $6,125, had a mean of $1,941, and a standard deviation of $1,866. It was hypothesized that net farm income was positively related to size of business, efficiency of resource use and product price.1/ Number of cows was used as a measure of size of the dairy enterprise and subsidiary enterprise labour was used as a size measure for other productive activities. Concentrates per cow, pasture per cow, and fertilizer per acre were hypothesized to be determinates of production per cow. Since auxiliary enterprises varied from farm to farm, no convenient measures of efficiency of resource use or of product prices for these activities were available. Milk price was the final variable hypothesized to effect net farm income.

Ordinary least squares step-wise regression was used to measure the hypothesized relations. This method is suggested by Draper and Smith to eliminate variables whose regression coefficients are not significantly different from zero [2]. A regression is run with a set of independent variables. The variable with the lowest "t"-value is eliminated and another regression equation is run. This process is repeated until all remaining regression coefficients are significantly different from zero at a specified significance level, in this case the ten percent level [4]. The beginning and final equation for each area is shown in Table 2.

At Vernamfield the number of cows, concentrates fed per cow and acres of pasture per animal unit were all statistically significant at the 5 percent level. The R-Square reveals that 72 percent of the variation in net farm income was explained. The number of cows, a measure of size of business, was positively related to net farm income. The regression coefficient of the final equation shows that an additional

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1/ Since input prices were relatively constant, it was not thought that they were important in explaining changes in net farm income.

Table 2
Beginning and Final Equation for the Analysis of Variations in Net Farm Income Among 14 Vernamfield Farmers and 20 Rhymesbury Farmers, in 1971

	VERNAMFIELD			
	Beginning Equation		Final Equation	
Variables	Regression Coefficient	Student T Value	Regression Coefficient	Student T Value
Number of Cows	194.97	4.59	203.12	5.14
Subsidiary Enterprise Labour	-4.04	1.10		
Concentrates Fed per Cow	2.15	2.76	1.84	3.31
Acres Pasture/ Animal Unit	-22518.31	1.92	-4315.93	2.11
Labour per Animal Unit	162.62	1.62		
Fertilizer Expense/Acre	-96.28	1.07		
Milk Price	332.69	1.24		
Constant	1585.71	-.44	-522.29	-0.28
R-Square	.738		.719	

	RHYMESBURY			
	Beginning Equation		Final Equation	
Variables	Regression Coefficient	Student T Value	Regression Coefficient	Student T Value
Number of Cows	141.54	1.46	121.43	1.76
Subsidiary Enterprise Labour	1.89	4.01	2.03	4.98
Concentrates Fed per Cow	0.68	1.25		
Acres Pasture/ Animal Unit	-578.25	0.21		
Labour per Animal Unit	5.64	0.18		
Fertilizer Expense/Acre	56.58	0.74		
Milk Price	434.31	2.34	436.39	3.40
Constant	-7379.31	-2.57	-6452.11	4.18
R-Square	.737		.764	

cow increased net farm income by $203. This is only about 11 percent less than the value of production per cow. The cost of concentrates alone, if deducted from the mean value of production per cow would yield a balance of only $175. A satisfactory explanation could not be found for the size of this coefficient.

Concentrate fed per cow was positively related to net farm income. The regression coefficient of the final equation indicates that an additional pound of concentrates increased net farm income by $1.84. The marginal cost of concentrates, if subtracted from the marginal value of milk, gives an increase in net income of $1.85. The coefficient of $1.84 is therefore quite satisfactory.

The acres of pasture per animal unit, an inverse measure of stocking density, was inversely related to net farm income. The regression coefficient of the final equation reveals that, holding all other variables constant, an additional acre of pasture per animal unit reduced net farm income by $4,316. In effect, this indicates that net farm income is very sensitive to stocking density.

At Rhymesbury the number of cows, milk price, and hours of labour devoted to subsidiary enterprises were significantly related to net farm income. The number of cows was statistically significant at the 10 percent level while the other two variables were significant at the 5 percent level. These variables, as indicated by the R-Square, explained 76 percent of the variations in net farm income.

The regression results show that the number of cows was positively related to net farm income. An additional cow increased net farm income by $121. Milk price, unlike in the case of Vernamfield, was significantly related to net farm income. The regression coefficient in the final equation indicates that a one cent increase in the price of milk increased net farm income by $436. This value is very close to the product of the mean output of milk times a cent increase in price.

The number of hours devoted to subsidiary enterprises, a measure of diversification, was positively related to net farm income. The regression coefficient reveals that each hour of labour devoted to subsidiary enterprises increased net farm income by $2.03. An important implication here is that although the time devoted to subsidiary enterprises adversely affected milk production, the net effect was an increased net farm income.

Concentrates per cow was not significantly related to net farm income. Perhaps this is a result of much of the concentrate being used as a substitute for pasture during prolonged breakdowns in the irrigation system.

Variations in Repayment

Repayments were made by 14 of the 20 farmers surveyed at Rhymesbury and by only 3 of the 15 at Vernamfield. Therefore this analysis was confined to the Rhymesbury group. Repayment in this group ranged from $50 to $604, averaged $182 and had a standard deviation of $177. It was hypothesized that repayment would be positively related to net farm income and off-farm earnings, and negatively related to family size, enlargement of the dwelling and expenditures on consumer durables. The findings reveal that none of the variables was significantly related to repayment.

Repayment Problems

The loan to each farmer was the total value of all assets. Land investment was interest free but six percent interest was charged on the balance due for all other assets. The amortization period was 25 years for fixed assets and 8.5 years for moveable assets. Repayment schedules for each farmer were based upon projected farm income and cost of living levels.

By the end of 1971 the average arrears in repayment for the thirty-five farmers was $1427. Reasons given by the farmers for the arrears were:

1. The effects of an unreliable irrigation system.
2. Houses built during project development were too small and had to be enlarged to accomodate the family.
3. Accumulation of responsibilities during the long delay between training and settlement.
4. High operating costs.
5. Low fertility among cattle.
6. A repressive repayment schedule.

Although project officials admitted that some of these reasons were valid, they believed that other factors contributed significantly to the problem.

The prevalence of off-farm employment, particularly during the early period of settlement, brought about disparity in the levels of living among farm families. The consequent demonstration effect prevented many farmers from postponing the purchase of certain consumer durables until farm income had reached higher levels. At the same time the administrative machinery was urging farmers to relinquish their jobs and devote all their time to farming. Some of these farmers enticed other farmers to seek jobs in an effort to justify their contention that they could not survive without off-farm employment. A few followed suite, but others resisted. The full-time farmers were now determined to prove to their compatriots that the farm could provide them with comparable standards of

living. In their anxiety to accomplish this, expenditures on consumer durables were given priority over meeting repayment schedules.

An Examination of Viability

To be viable a farm must generate an income which enables the operator to pay his farm expenses, amortize his debts, and maintain his family. To assess viability answers to three questions were sought:

1. Could the farmers have met their scheduled repayments out of their 1971 income?
2. Are the farms profitable in the long run?
3. Were the repayment schedules repressive as the farmers claimed?

To answer the first question, estimates of money required for living expenses and debt repayment were compared with realized 1971 incomes. The second question required the projection of receipts and expenses and computing the internal rate of return. To answer the third question the projections of receipts and expenses were used to estimate net incomes. These were compared with the scheduled repayments plus the estimated cost of living.

Could Farmers Meet 1971 Payments

To determine if the farmers' 1971 income was great enough to meet repayment schedules an estimate of the income required to maintain an "adequate" standard of living is needed. The concept of opportunity income was used to determine this standard. Assumptions were made of what the average farmer could have earned in paid employment in 1971 had he not participated in the settlement scheme. The average earnings from off-farm employment were not considered an appropriate measure because exposure to the project and the location of the project has increased employment opportunities. A large number of farmers were employed at the bauxite mines only because they happen to be in close proximity. The average earnings of other Jamaicans with comparable qualifications were therefore used as a measure of what could be earned in the absence of the project.

An examination of the education of the 35 farmers surveyed revealed that 27 were either graduates of a Practical Training Centre or of the Jamaica Youth Corps, 3 had only primary school education, 3 had attended high schools and 2 were graduates from the Jamaica School of Agriculture. Before joining the project several farmers who were graduates of Practical Training Centres, Jamaica Youth Corps and, to a lesser extent, primary schools were employed as Field Assistants with the Ministry of Agriculture. In 1971 the minimum earnings of a Field Assistant was roughly $900 and that of a Jamaica School of Agriculture graduate was about $1400. The opportunity cost of the average farmer's labour was

therefore assumed to be within these limits, and a figure of $1000 was estimated. There was the further assumption that experience and background might have placed the average farmer at a higher level in the pay scale and that this would be off-set by the value of perquisites which average about $400 in 1971.

Thus $1000 was the estimate of what was required by the average farmer to maintain an "adequate" standard of living. To this was added $700 which was the average repayment required of the 35 farmers in 1971. Therefore, $1700 represents the break-even point. Having done this it was possible to examine net farm incomes and total incomes to see if they were adequate to meet living expenses and repayment schedules.2/

With respect to net farm income (a) two farmers operated at a loss, (b) two fell below the $1000 required for family living, but had one been a full-time operator employing one instead of two hired hands, he would have exceeded it by $200, (c) nine fell below the break-even point of $1700 and averaged $1376, and (d) twenty-three exceeded $1700. The conclusion is that based on this measure 23 farmers were viable and could have met the average loan commitment in full, three could not meet the living expenses of the farm family, and the remaining 9 were marginal in that they generated net farm incomes that covered family living expenses but could not meet the average loan commitment in full.

The use of net farm income to determine viability had the limitation of ascribing to the farm the full support of the family, whereas approximately 50 percent of the farmers shared their labor between the farm and off-farm employment. The total income available to the farm family (net farm income plus off-farm earnings) might be a more appropriate measure of viability. On examining the data it was found that only four of the 35 farmers had total incomes less than the $1700 required for viability and their total income averaged $1440.

Financial Rate of Return

Twenty year projections were used to simulate what was likely to happen on the average farm. Data from the establishment period and the first two years of operation were used as a basis for projections of investments, operating costs, income, and salvage values. The assumptions on which the financial projections of the average Rhymesbury and Vernamfield farm was based were as follows:

2/ In making these comparisons with the opportunity cost of the farmer's labour, the part of net farm income and total income which was due to increased farm inventories was not subtracted. On the other hand, the part of repayment that went into equity was not deducted from the $700.

(a) Development costs occur in year zero and settlement takes place in year one.
(b) A maximum carrying capacity of 1.7 animal units per acre will be attained.
(c) Daily yield per cow milked will rise from 7.5 quarts to the 8.4 quarts revealed by this study in the third year and maintained that level throughout the rest of the period.
(d) The proportion of cows in milk will increase from sixty percent in the first year to a maximum of seventy-five percent by the sixth year.
(e) The price of milk is 10, 11, and 11.38 cents per quart in the first, second and third year respectively, and will increase to 15 cents for years four through twenty. The large price increase reflects an increase in condensery price in November 1971, and increased sales to the more lucrative fluid milk market.
(f) Replacement of machinery and irrigation equipment will be made in the eleventh and fifteenth year respectively.
(g) Revenue from subsidiary enterprises will remain at the 1971 level.
(h) Salvage values of real estate, cows and equipment will total $16,500 at the end of 20 years.

The projections of investment, operating expense, income and salvage value were used to estimate a financial rate of return. The financial rate of return is the discount or interest rate which would equate the future streams of operating costs and replacement investments. The results revealed that the average farm has the capacity to generate a financial rate of return of 17.5 percent to the project capital invested in the farm.3/ A sensitivity test was made to measure the effect that a reduction to 1.4 animal units per acre would have on returns. It was found that this would reduce the financial rate of return to 13.6 percent. These results show that the projected return to investments in the project are greater than current interest rates, and furnish evidence supporting the long run viability of the project.

Scheduling of Repayments

The income and expense projections were used to compute projected net incomes. These were compared with the incomes needed to maintain an "adequate" standard of living and to meet the repayment schedules. The results indicate that farmers could meet their repayment schedules with one exception. The second year of repayment was a problem because the rise in schedule repayment was much greater than the increase in revenue.

3/ Details of the financial analysis can be found in Dunn [3].

Ways of Improving Viability

The farmer has at his command a number of factors by which he can improve productivity and returns. Size of subsidiary enterprises was positively related to farm income on Rhymesbury farms. Cow numbers were positively related to net farm income on both farms. Thus, expansion of farm size may be one way to improve viability.

Milk price is a most important factor in long run viability. The analysis of the Rhymesbury group of farms revealed a significant positive relationship between milk price and net farm income. The rise in the condensery price and the entry of farmers into the fluid milk market will have an important impact on long run viability.

In 1971 cash expenses represented 60 percent of cash receipts. Concentrates and hired labor accounted for 21 percent and 13 percent respectively of cash expenses. High expenditure on concentrates will continue unless there is improvement in irrigation. However, the farmer has little or no control over the performance of the irrigation system. Data collected from six of the thirty-five farmers at the end of a six week breakdown of the irrigation system at Rhymesbury during the summer of 1971 revealed that milk production dropped 40 percent during that period. An interview with the manager of the Mid-Clarendon Irrigation Scheme revealed that the inefficiency of the irrigation system resulted from (a) sub-standard pumps, most of which were over twenty years old; (b) frequent electrical power failures; (c) lack of standby pumps; (d) the great distance of the project from the sources of water, resulting in a 20 percent seepage and evaporation loss; (e) pipes too small in some sections; and (f) the actions of some farmers who worsened the situation by increasing the size of nozzles which should be uniform on all farms and others who wasted water by flooding their land. Breakdowns resulting from sub-standard pumps and electrical failure resulted in an average loss of ten hours per week. Electrical failures appeared to have been more serious at Vernamfield where the data indicated that an average of 300 quarts of milk per farm were spoiled in 1971.

The farmers at Vernamfield were also impeded by an inefficient domestic water supply for livestock and home use. One farmer reported making 9 trips per day to transport water from a distance of 2 miles over a period of 2 weeks. This one factor had increased costs by approximately $200. The farmers claim that an electrical pump was installed to pump water into the domestic line, but that there was undue delay in providing electricity. A diesel pump operated intermittently but its hours of operations did not conform to the farmer's needs.

Long run viability therefore requires not only the farmer's exploitation of his management capabilities and the productive potential of the farm but also that there should be harmony between his efforts and those exogeneous factors over which he has no control.

Implications

The factors that have emerged with the most important implications for success of project are (a) inefficiency of the irrigation system, (b) repayment, (c) milk price, and (d) the effect of size of business.

Irrigation

An inefficient irrigation system has induced over-feeding of concentrates and reduced milk production. This inefficiency was caused by substandard pumps, lack of standby pumps, electrical failures, distance of the project from the source of water, and earth canals and seepage. These problems suggest the need for public investment to modernize the Mid-Clarendon Irrigation Scheme. Interrelated with this was the inefficiency of the Jamaica Public Service Company. The general impression is that this service has improved, but it should be borne in mind that an efficient irrigation system demands an efficient electrical system.

Repayment

The situation in which arrears in repayment averaged $1427 for the group of thirty-five farmers studied in 1971 was unsatisfactory. This signals a very serious stage in the project life. One worried farmer coming to terms with his past financial mismanagement remarked, "We were young and inexperienced and needed someone to guide us in handling of money." The onus is now with the government to act to save the situation. Dozier provides very timely advice when he says that it is better to err on the liberal side than on the conservative side in the matter of recovery of costs, for there is almost a total loss when a settler gets in arrears on his payments, becomes discouraged and then abandons his farm [1].

Milk Price

The positive relationship between milk price and net farm income on the Rhymesbury farms indicates that farmers would gain by devoting more time to marketing. The highest price was almost double the lowest. The considerably higher prices on the fluid market suggest the existence of large returns to increased marketing efforts on the part of farmers.

Size of Business

Size of business was closely related to net farm income. Thus farmers can increase their income by expanding the intensity of use of their resources provided they have the ability to manage larger size businesses.

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