Economics of Stony Land Reclamation for Crop Production in South-Western Quebec

Randolph Seecharan, Kisan Gunjal and Gerard Millette

Linear programming model is used to investigate the economic feasibility of utilizing stony lands for crop production in South-Western Quebec where stoniness is the major constraint. Results for the representative farms indicate that income variations are due to economies of size, differences in crop yields (experimental or farm level) and type of reclamation method used. The market values for stony lands (determined by regression technique) are higher compared with the productive values. Analysis also indicates that crop production is feasible within the parameters denned and that it is more economical to develop unutilized stony land rather than purchase prime agricultural land at current market prices. Parametric programming procedures indicate that the solutions are more sensitive to crop yields and prices than reclamation costs.

Introduction

The steadily increasing loss of prime agricultural land to urbanization is becoming a major concern in North America. Concerns about the loss of agricultural land to urban development in Canada are expressed by Neimanis (1979), Gierman and Lenning (1980), and Marshall (1982). It is estimated that conversion of agricultural land to urban uses represents a loss of approximately 9 hectares for an increase in population of 100 (Nowland, 1975). If this rate was applied to the projected increase of urban population in Quebec, the permanent loss of farm land would amount to over 225 thousand hectares by 1991 and over 300 thousand hectares by 2001. This would amount to a loss of 9.6 and 12 percent of soil classes one to three for 1991 and 2001 respectively. This continued loss of farm land could have a serious impact on Canada's future increases in agricultural production and export potential.

The price of prime farm land in Quebec has increased from $336/ha in 1970 to $1010/ha in 1979, and $1269/ha in 1983 (Statistics Canada, 1980 and Agricultural Canada, 1984)[1]. As a result of this and the increasing pressure of urbanization in the long-run, the alternatives of bringing marginal lands into production is becoming more attractive. In this context, upgrading or reclaiming the stony lands[2] with good agricultural potential is one of the alternatives available.

According to the Canada Land Inventory (1974 and 1975), there are approximately 17.5 million hectares of land with various degrees of stoniness in Eastern Canada, including 1.45 million hectares in South-Western Quebec which is considered as the best agro-climatic zone in the province. It has been estimated that the area potentially suitable for agriculture (lying within the isotherm of 2500 degree days for corn) where stoniness varies from light to moderate, is approximately 391,495 hectares (Millette and Seecharan, 1984). However, the agronomic and economic feasibility of these lands for crop production has not yet been established.

Removal of stones from fields manually is a costly and time consuming operation. Due to

The authors are respectively, Resource Economist, Regional Associate Professor (at the time of the research), Department of Renewable Resources, McGill University. The authors gratefully acknowledge the comments of two anonymous reviewers.

[1] In response to the above concern the Quebec Government has enacted a land zoning legislation (December, 1978). At this time not enough data are available to establish the impact of this legislation, however, land prices in Quebec have increased just as fast as in the rest of North America.

[2] Stony land is defined as soils having loose fragments of stones scattered over the soil area as compared to rocky soils having fixed bedrock.

the relative scarcity of labour and the concomitant growth in farm mechanization, stone picking and stone crushing equipment has been developed to cope with the stone problems. However, previous studies (Epstein et al., 1966; Epstein and Grant, 1966; and Kemp and Saini, 1970) showed that the removal of stones resulted in increased soil erosion. On the other hand, less erosion and compaction with higher soil temperatures were recorded where stones were crushed and incorporated into the soil.

The objective of this paper then, is to examine the economic feasibility of reclaiming stony lands for crop production by two mechanical methods in South-Western Quebec. The specific objectives are:

1. to determine the economic feasibility of stony lands by estimating the net income under optimum crop production on two classes of stony soils under alternative methods of reclamation;
2. to estimate the production values (shadow prices) of these lands, under three different farm sizes, and compare them to the estimated market values; and
3. to examine the sensitivity of net farm incomes to changes in crop yields and prices and reclamation methods.

The Experiment

Field experiments were conducted on two sites with various degrees of stoniness and kinds of stones from 1981 to 1983. Site one was located on the Macdonald College Research Farm in Sainte Anne de Bellevue and the other on the Blair Research Farm in the township of Franklin in Huntingdon County (both sites located in Quebec, Canada). The soils at both sites are well-drained sandy loam. The field experiments were randomized complete block designs with three replicates and eight treatments per replicate. Each replicate included four levels of stone treatments: (1) stones removed, (2) stones crushed fine (0 to 0.64 cm), (3) stones crushed coarse (0.64 to 1.9 cm) and (4) stones left in the soil. Fertilizer treatment included plots with fertilizer and those without fertilizer (the experiment was designed to satisfy other objectives besides determining crop yields, refer to Seecharan, 1984). The yields of test crops—oats, grain corn and silage corn were recorded and converted to a hectare basis.

Model and Analytical Procedures

Linear programming (LP) was used to determine the optimum crop production plan at the farm level. The model's objective function is the maximization of net farm income subject to a set of linear resource constraints and alternative land reclamation method. It may be expressed as:

$$\text{Maximize: } Z = \sum_{j=1}^{m} C_j X_j \quad j = 1, 2, \ldots, m$$

$$\text{subject to: } \sum_{j=1}^{m} A_{ij} X_j \leq B_i \text{ for all } i, \quad i = 1, 2, \ldots, n$$

$$\text{and } X_j \geq 0 \text{ for all } j$$

where:

- Z is the net farm income composed of the sum of all activities multiplied by the net prices;
- X_i is the level of the jth activity (hectares of the jth crop);
- C_i is the net price per unit of the jth activ ity;
- A_{ii} is the amount of resource i required to produce one unit of activity j; and
- B_i is the given amount of ith resource or the activity restriction limit.

Six farm level models were set up to handle two stony land classes and three farm sizes. The major parameters in the model include:

(a) farm size
(b) stony land classes A and B[3]
(c) machinery reclamation costs (stone crushing and stone picking)
(d) pre-development costs
(e) crop prices (determined by a weighted average technique)
(f) crop yields (farm level and experimental crop yields)

Crop prices, crop yields, and machinery reclamation costs were varied in the above LP models to examine the sensitivity of the optimum cropping plan and the net farm income.

[3] Stony land A includes stone classes one (stones 10 to 30m apart) and two (stones 2 to 10m apart) and occupy 0.01 to 3 percent of the surface area. Stony land B refers to stone class three (stones 1 to 2m apart) and occupy 3 to 15 percent of the surface area. Stone classes at site one was denned as Stony land A and site two as Stony land B.

Resource Parameters

Farm Sizes

The farms were classified according to area and size distribution as defined by Statistics Canada. These size groups were then ranked on the basis of the largest number of farms and the first top three size groups were chosen (the size groups were 98 to 162 ha, 53 to 75 ha, and 29 to 52 ha). The mean value of each group was then chosen as being representative. Thus, the cultivated area for large, medium, and small farms were 108, 54 and 35 ha respectively, with each farm size divided equally between the two stone classes.

Labour

The labour supply is comprised mainly of the operator and the rest of the farm family (in Quebec the family farm is the predominant type of organization). Provisions are also made for hired labour in the LP model.

In this study, hours of available labour are divided into three periods (period 1: April to May; period 2: June to August; and period 3: September to November) based on an annual crop production cycle. On the basis of an eight and twelve hour work day, an individual operator could contribute 1,920 hours of labour for the three periods combined (assuming 24 work days/month; 8 hours/day for the months of April, June, July and August; and 12 hours/day for the other months) while the rest of the farm family could contribute an additional 29 percent (Statistics Canada, 1981) of the total operator labour hours.

Capital

Three major types of capital requirements were considered: a) capital requirements for land ownership and clearing of land which are pro-rated over a period of thirty years and per hectare costs determined for each representative farm; b) capital requirements for stone reclamation machines which are pro-rated over a period of ten years; and c) short-term capital which the farmer needs to cover immediate farm expenses such as seed cost, fertilizer purchases and other miscellaneous expenses.

The amount the operator can borrow is assumed to be ninety percent of the capital to cover long-term financial commitments whereas, the amount that is available for short-term needs is based on seventy-five percent of the average production cost. In addition, the operator has available to him, his own investment capital which is based on average gross income and size of farm.

Cropping Activities, Yields and Prices

The basic crop activities include grain com, silage corn, oats, barley and tame hay on stony land A and stony land B. Also, rotations of silage corn-silage corn-grain corn, and oats-barley-tame hay on stony land A were considered (for the treatment of rotation in the LP models refer to Beneke and Winterboer, 1973). These activities represent the general cropping practices in the area.

Crop yields from the experimental plots were used. These were augmented by data from other sources (Gouvernement du Quebec, 1980 and Statistics Canada, 1983). Owing to the differences in the experimental yields and published yields an alternate method was also used to calculate the expected yields at farm levels. The expected crop yields were based on the weighted average crop yields of the past six years and determined as follows:

$$Y_t = (6Y_{t-1} + 5Y_{t-2} + \ldots + Y_{t-6})/21$$

where:

Y_t = the expected yield in period t in the future; and

Y_{t-i} = crop yields in t —i th past year.

Similarly, the weighted average crop prices of the past eight years were used to calculate the expected prices.

Reclamation Activities

Two types of reclamation options—stone picking and stone crushing were considered. Stone removal or crushing is an annual activity with the cost in the first year being higher than subsequent years. Each type of reclamation activity was considered under the option of machinery ownership or using the services of a custom operator (machinery costs are amortized investment costs). Both options were evaluated since low annual use may make the use of a custom operator an attractive economic alternative.

production Costs

production costs for the crops considered are based on the data published by the Gouvernement du Quebec (1980 and 1983). Included in these costs are charges for use of machinery and the purchasing of seeds, chemicals, fertilizer and other inputs. The costs associated with stone crushing, stone picking, land ownership and land clearing were also determined for various farm sizes.

Suitable Field Time

The amount of suitable field time (defined as that period of time when the top soil layer is dry enough to support heavy farm machinery traffic without wheel slippage or damage to soil structure) is divided in three periods which coincides with the labour periods. In period one, there are 176 hours available to complete critical field operations, 223 hours in period two and 300 hours in period 3 (Mad-ramootoo, 1977). Suitable field time is based on a 7 am to 8 pm management system. No heavy farm machinery operations for the months of July and August (period 2) were considered in the model since reported information on the type of field machinery operations in Quebec for these two months were not identified. In period three, most of the field operations pertained to harvesting activities. The average field times required for various field operations were based on studies reported by the Gouvernement du Quebec (1983) and used to estimate machinery production costs.

Empirical Results and Interpretation

The net farm income for a representative farm in each of the three farm groups (small, medium and large) based on the optimum cropping plan are presented in Table 1. The results indicate that, in general, the larger the farm size the higher the net income generated under alternative reclamation and machinery acquisition options. This can be interpreted as economies of size as indicated in Figure 1 (the points in Figure 1 are joined by linear interpolation). Generated solutions based on the experimental crop yield results[4] indicate that average net income is much higher than other income results based on average crop yields under present levels of management (Table 1). The higher income is due to the higher crop yields obtained under experimental conditions. With these yields all farmers would recoup their investment capital.

Reclamation by stone picking and custom work option results in a higher income ($14,948) than owning the stone picker ($14,560) including stone crushing under custom work and ownership. This is a result of the lower reclamation costs associated with using the services of a custom operator to remove stones. These income figures do not include the value of stones removed since the price is significantly low in relation to its transportation cost to the crushing plant. Presently, the price of stones is approximately $0.16/t and this price depends on the amount and type of stones available.

For a farm size of 108 ha under stone crushing with owned machinery, net income is higher ($11,152) than crushing stones using a custom operator ($9,707). However, for the representative farm sizes of 54 and 35 ha, av-

[4] For grain corn and silage corn there were significant differences (P = 0.05) in yields according to the new Duncan Multiple Range test between stone treatments. With oats however, there were no significant differences among stone treatments (refer to Seecharan, 1984 for details).

Table 1: Optimum Net Income for Farms of Various Sizes Under Different Reclamation Methods and Stone Machinery Acquisition Options.

Farm Size (ha)	Stone Crushing		Stone Picking	
	Ownership	Custom Work	Ownership	Custom Work
Small (35)	$-1464	$1924	$1140	$3622
	(4387)[a]	(7775)	(6991)	(9473)
Medium (54)	1281	3441	4120	6060
	(10273)	(12432)	(13112)	(15051)
Large (108)	11152	9707	14560	14948
	(28812)	(27692)	(32544)	(32931)

[a] Figures in parentheses indicate incomes based on the experimental crop yields. Others are incomes based on the expected farm level yields (i.e., weighted average of the past six years).

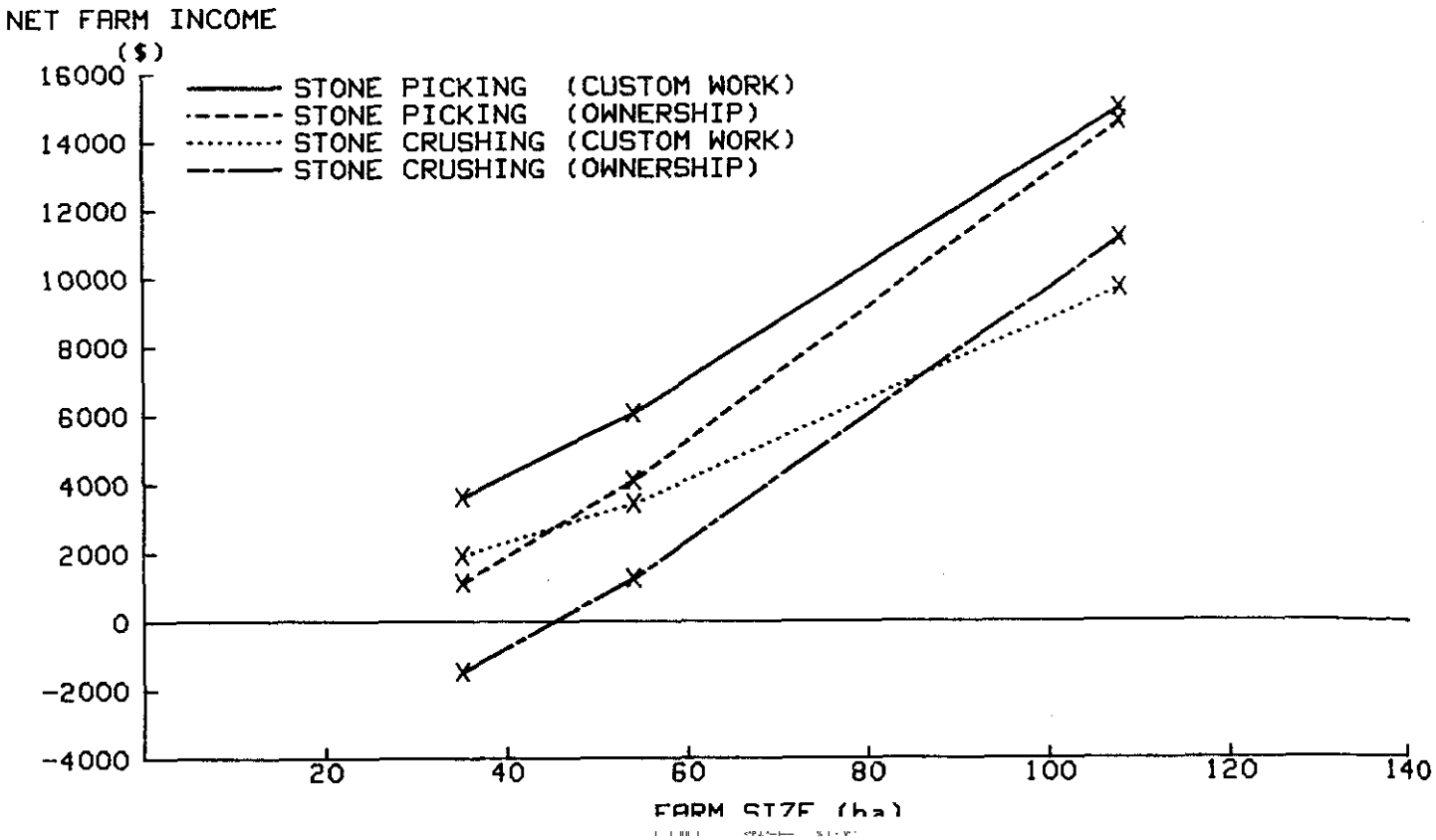

Figure 1. Average Net Income for Farms of Different Sizes Under Alternative Reclamation and Machinery Acquisition Options

erage net income is higher under the option of stone crushing and using the services of a custom operator.

For a farm size of 35 ha, a negative income (— $1464) is incurred under ownership option of a stone crusher and approximately 43 ha are required for the operator to break even (Figure 1). However, since the cost calculations are based on standard machinery and equipment size (much more cost efficient for larger than for smaller farms) it is possible that incomes could be improved if appropriate machinery and equipment are matched with the size of operation.

The preferred cropping pattern is grain corn on stony land A and B. This result may not be surprising, since the amount of land under grain corn has been increasing while those of other crops, specifically oats, has been decreasing. Between 1976 and 1981, the acreage under oats was reduced by approximately 30 percent while grain corn increased by 70 percent in the study area (Statistics Canada, 1983). The activities not in the solution show that silage corn is the most profitable alternative cropping activity compared with other crops including those in the rotations. However, the amount of land used for silage corn has also decreased by approximately 20 percent between 1976 and 1981.

According to the optimum solutions the maximum amount of land the operator can reclaim and cultivate is 101 ha under the option of owning the stone crusher (the additional 7 ha is completed using the services of a custom operator). This is due to the fact that there are only 176 hours of suitable field time available in period one to complete critical field machinery operations. In practice, the work could also be completed through the purchase of an additional machine thereby adding to the overall cost of production. This, however, is not the case for farms hiring a custom operator to crush stones and for the use of a stone picker under the various machinery options considered.

Although farming of stony lands increases the amount of time spent in the field, this being dependent on the reclamation method and machinery option, there is still enough time available to seek additional sources of income, if this is the preferred option. Further, the time spent in land reclamation is concentrated in the spring. Thus, this kind of farm operation

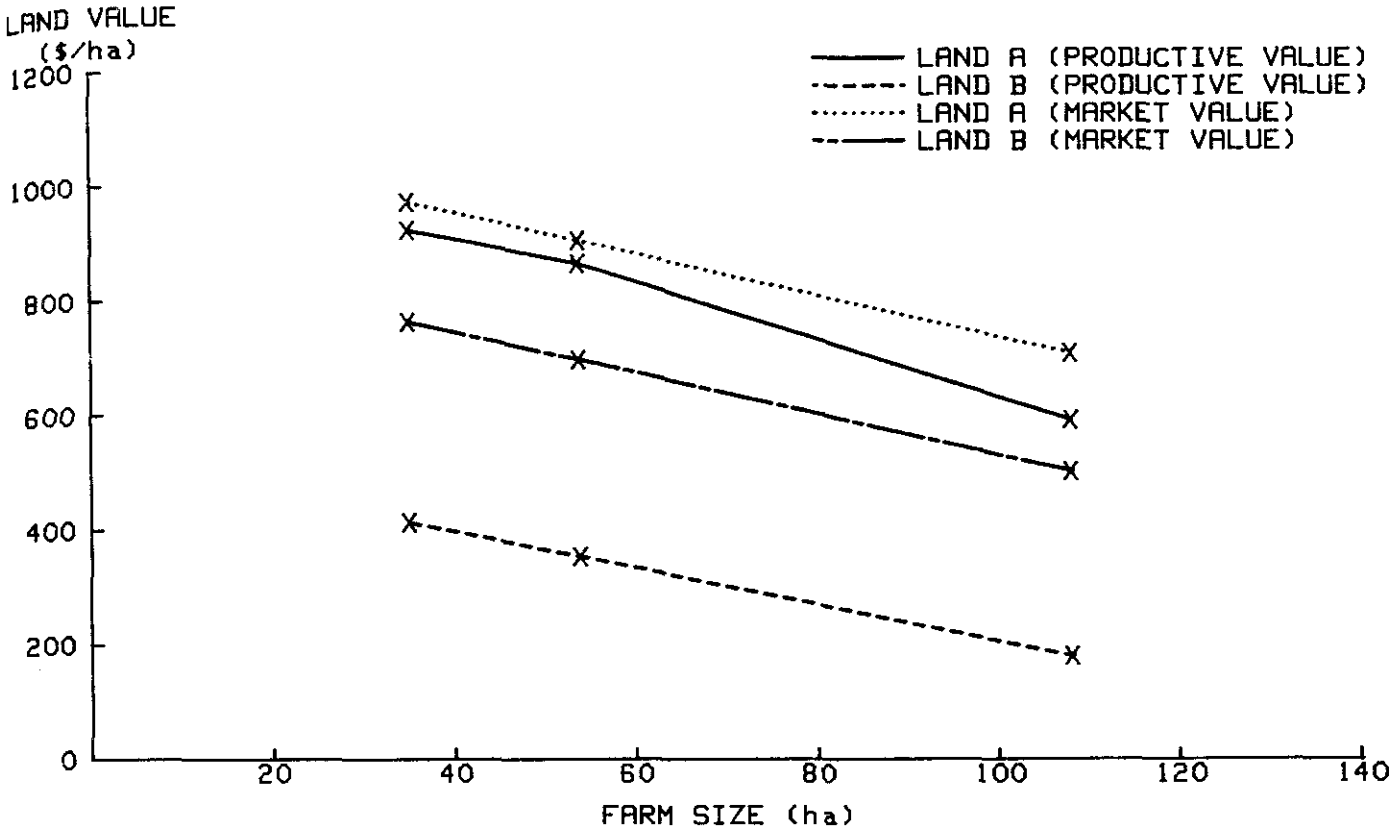

Figure 2. Comparison of Price Per Hectare Based on Productive and Market Values of Stony Lands

does not deter the operator from seeking income from other sources since off-farm employment is becoming increasingly important in Canadian agriculture.

Even though the LP model has a borrowing activity restraint, this is not an indication that capital supplied to the farmer is tight, since the amount of capital that can be borrowed is based on 75 percent of the cost of production. Conceivably, a point could be reached where the operator's own investment capital may not cover the additional 25 percent cost of production, however, funds from other sources are available. Among the provinces in Canada, Quebec has one of the most liberal credit schemes designed to provide support capital to farmers.

Land Values

The shadow prices of land A and B (marginal net return to land) estimated by the LP models are used to calculate the average productive values of these lands based on farm level crop yields. This was done by finding the capitalized value of the shadow price. The capitalized value was obtained by dividing the net return to land by the selected discount rate of 13.5 percent (Farm Credit Corporation long term interest rate). It represents the present value of an infinite stream of future benefits and allows a comparison with the market value. In addition, adjustments were made to the shadow price of land for management ($103/ha and constant in the range for farm size of 30 to 110 ha), land tax (3% of land value), family labour ($6.00/hr) and owner's capital (varied depending on farm size) to find the appropriate production value of land (Gouvernement du Quebec, 1983 and Seecha-ran, 1984). These costs were not considered in the objective function in the initial LP model. The market value of land is estimated based on the regression equation (Seecharan, 1984) which estimates market value as a function of farm size and various levels of stoniness. The market values, usually, reflect the sum of productive values and the speculative values. The comparison (Figure 2, the points in this graph are also joined by linear interpolation) reveals a higher market value for land compared with the productive value. This may be due to ex-

Table 2: *Crop Yield Sensitivity:* Optimum Net Income for Farms of Various Sizes Under Different Reclamation Methods and Machinery Acquisition Options.

Farm Size (ha)	Yield Levels[a]			Stone Picking	
				Ownership	Custom Work
35	Low	$-4236	$-848	$-1632	$850
	High	2176	5164	4780	7262
54	Low	-2952	-793	-114	1847
	High	6948	9108	9787	11727
108	Low	2564	1120	5971	6360
	High	22487	21044	25895	26283

[a] Based on the minimum and maximum average annual crop yields for the period 1977 to 1982.

pectations of higher capital gains from non-farm investors. On the other hand, the average productive values (land A $1900/ha and land B $!500/ha) based on experimental crop yield results are much higher than the market value.

Sensitivity Analysis

The average net income levels as determined by the LP models for the three representative farm sizes as per changes in crop yields, crop prices and reclamation costs are summarized in Tables 2, 3 and 4.

Under high crop prices, the preferred cropping pattern for farm sizes of 108, 54 and 35 ha is: grain corn on stony lands A and B in all cases. In response to low crop prices, the cropping pattern changes to a rotation of silage corn-silage corn-grain corn on stony land A and silage corn on stony land B. However, under high and low crop yields, the cropping activities are silage corn-silage corn-grain corn on stony land A and grain corn on stony land B for all farm sizes. Changes in reclamation costs do not result in any changes in the original cropping pattern.

The results also indicate that income changes are greater based on changes in crop yields (farm level) and prices rather than reclamation costs. For instance, under stone crush-

Table 3. *Crop Price Sensitivity:* Optimum Net Income for Farms of Various Sizes Under Different Reclamation Methods and Machinery Acquisition Options

Farm Size (ha)	Price Levels[3]	Stone Crushing		Stone Picking	
		Ownership	Custom Work	Ownership	Custom Work
35	Low	$-6970	$ - 3582	$-4365	$-1884
	High	2957	6622	5562	8043
54	Low	-7224	-5065	-4385	-2445
	High	8093	10680	10931	12872
108	Low	5850	5592	2450	2062
	High	24776	23333	28184	28572

[a] Based on the minimum and maximum average crop prices for the period 1975 to 1982.

Table 4: *Reclamation Cost Sensitivity:* Optimum Net Income for Farms of Various Sizes Under Different Reclamation Methods and Machinery Acquisition Options.

Farm Size (ha)	Reclamation Costs[3]	Stone Crushing		Stone Picking	
		Ownership	Custom Work	Ownership	Custom Work
35	Low	$-1008	$2127	$1478	$3742
	High	-1964	1719	802	3478
54	Low	1801	2168	4476	6245
	High	761	1554	3774	5875
			10342	14964	15319
			9075	14157	14577

[a] Based on the minimum and maximum average field capacities (ha/hr) for stone reclamation machinery (refer to Seecharan, 1984).

ing and ownership option, the changes in net farm income for a one percent change in both crop yields and prices for farm sizes of 108, 54 and 35 ha are, 8, 35 and 20 percent respectively. In comparison, the net income changes are 0.3, 2 and 1.6 percent respectively for similar farm sizes and changes in reclamation costs.

Conclusions

From the results, it can be concluded that based on the parameters defined and the financial situation outlined in the study it is economically feasible to utilize stony lands for crop production in Quebec. The amount of net income however, would depend on farm size, the option of buying stone reclamation machinery or the use of a custom operator, the method of reclamation and the amount of suitable field time available in period one. The results indicate that, in .general, it is less expensive to reclaim stony lands by a stone picker rather than a stone crusher. If, however, soil erosion is a problem, crushing stones and incorporating them in the soil would be a more appropriate management strategy than removing them completely from the soil surface. This may prove to be economical in the long run since this would help maintain the soil productive capability. The custom work option seems to be more profitable than machinery ownership. However, as farm size increases the ownership option becomes more attractive.

Presently, stony land is relatively less expensive than prime agricultural land and it would be more economical to develop such lands rather than purchase prime agricultural land. However, this may change once the development of these lands for crop production intensifies and/or land prices decline diastically. While the per hectare value of stony land based on market transactions is higher compared with its productive value it is still presently lower than the cost of prime agricultural land.

The LP results also indicate that larger farms achieve higher net income than smaller farms. For smaller farms, farming of stony lands is not economically attractive unless higher crop yields obtained under experimental conditions are achieved. The income results based on experimental crop yields (3 years of data) indicate that higher levels of income can be achieved compared with those based on average farm level (survey data) crop yields. However, care should be taken in using the experimental results as the high level of control and management of the experimental plots may not reflect farm level management practices.

Utilization of stony lands for crop production will undoubtedly add to the potential agricultural land resource base. Given Quebec's goal of self sufficiency in agricultural production, these lands could provide part of the land base for future agricultural expansion. To some extent, this would compensate for the loss of land to non-agricultural uses. The LP models developed could be used to evaluate the costs and benefits of certain government policies, such as the subsidy impact at the level of the individual farm rather than at the regional level. In general, this study reiterates the need to classify land according to economic criteria besides physical parameters.

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An Empirical Overview of the NAREA Membership Survey

Bruce E. Lindsay

During the period of transition that culminated in our professional organization being renamed the Northeastern Agricultural and Resource Economics Association (formerly the Northeastern Agricultural Economics Council), discussion centered upon such issues as the composition of the executive committee, the election procedures for officers, financial stability, and membership involvement. As a result of such discussions, a questionnaire was designed to ascertain Association members' attitudes towards the organization in three areas of interest: members' professional background, members' evaluation of the annual meeting, and attitudes towards our Journal. The objective of this survey was to establish attitudinal data for background information for future discussions concerning our Association.

In the spring of 1985, three hundred (300) questionnaires were mailed to members with one hundred forty-two (142) surveys returned for a response rate of approximately forty-seven percent. Cross tabulation tables and multivariate regression models were formulated for analytical purposes.[1] A partial presentation of the results is contained in this paper. For readers interested in more comprehensive survey information, contact the author.

This paper will be organized as follows. Membership cross tabulation results will initially be presented, followed by a section focusing upon multivariate regression models. The last section will contain summary and conclusions.

The author is Associate Professor of Resource Economics, Department of Resource Economics and Community Development, University of New Hampshire. Scientific Contribution No. 1459 of the New Hampshire Agricultural Experiment Station.

[1] A chi-square test was not used because there was not at least five observations in each theoretical frequency class. This avoided inflated chi-square values due to the division of the squared differences by a small size of expected frequency.

Cross Tabulation Results

Membership Analysis

Respondent data were organized to view members' professional interests and employment by type. Table 1 contains the results of this tabulation. Employment was broken into four categories: university, government, private, and student. Professional interests were denoted by four groupings: agricultural economics, resource economics, community development, and other. Of 142 respondents, 109 members or approximately 76.7 percent were associated with a university and 19 individuals or roughly 13.3 percent resided in government work.

Of 109 university members, about 64 percent or 70 individuals responded that agricultural economics was their main professional interest. Twenty-eight (28) percent of the university members emphasized resource economics as their specialty. Seven of the nine private sector respondents focused upon agricultural economics. Roughly 58 percent of the government respondents listed agricultural economics as the main focus of their work. Of the 142 total respondents, 90 members or about 63 percent had an agricultural economics interest.

Table 2 was organized to view respondent years of membership in the Association and employment by type. Of 142 respondents, 33 percent or 46 individuals were members for 1— 3 years. Forty-one (41) percent or 58 respondents were members for 10 years or more.

Of the university respondents, about 40 percent had been members for 10 years or more. Roughly 32 percent of university individuals had been members for 1-3 years. Approximately 63 percent of the government respondents had been members for 10 years or more. One-third of the private sector individuals were with the Association for 1-3 years with

Table 1. NAREA Membership Employment Compared With Professional Interests

Employment	Professional Interests: Agricultural Economics	Resource Economics	Community Development	Other	Row Totals
University	70 (64.22)*	31 (28.44)	8 (7.34)	0 —	109 (100.00)
Government	11 (57.89)	7 (36.84)	0 —	1 (5.26)	19 (100.00)
Private	7 (77.28)	1 (11.11)	0 —	1 (11.11)	9 (100.00)
Student	2 (40.00)	3 (60.00)	0 —	0 —	5 (100.00)
Column Totals	90 (63.38)	42 (29.58)	8 (5.63)	2 (1-41)	142 (100.00)

* Numbers in parentheses are row percentages.

one-third of the private members for over 10 years or longer.

Meetings Analysis

One aspect of the survey questions was the quality of papers presented at the Association's annual meeting. Table 3 contains respondent data organized to view member ratings of papers at meetings by employment type.

Interestingly, of the 142 total respondents to the survey, 104 of these individuals had attended at least one meeting and therefore responded to the qualitative questions regarding attitudes towards meetings. Of the university individuals who attended meetings, approximately 46 and 38 percent responded that the quality of papers presented at NAREA meetings were good and average, respectively. Roughly, 73 percent of government respondents who had attended past meetings felt that the paper quality was good. Over all employment categories, about 51 percent responded that the quality of papers presented was good with 35 percent emphasizing average.

Journal Analysis

A portion of the questionnaire focused upon respondent attitudes towards our Journal. Table 4 contains respondent data organized by employment type to view member ratings of our Journal as an outlet for publishing.

Of the 142 total respondents to the survey, 130 of these members responded to the questions that focused upon the Journal. Approximately 45, 28, and 20 percent of the university members stated that the Journal as an outlet for publishing was good, average, and excellent, respectively. About 63 percent of the government respondents felt that the Journal was good for publication purposes.

Over all employment categories, roughly 49 percent or 63 individuals rated the Journal as a good outlet for publication purposes. Approxi-

Table 2. NAREA Membership Employment Compared With Years of NAREA Membership

Employment	Membership Years: 1-3	4-6	7-9	10 & over	Row Totals
University	35 (32.10)*	20 (18.35)	11 (10.09)	43 (39.44)	109 (100.00)
Government	3 (15.79)	4 (21.05)	0 —	12 (63.14)	19 (100-00)
Private	3 (33.33)	1 (11.11)	2 (22.22)	3 (33.33)	9 (100.00)
Student	5 (100.00)	0 —	0 —	0 —	5 (100.00)
Column Totals	46 (32.39)	25 (17.60)	13 (9.15)	58 (40.81)	142 (100.00)

* Numbers in parentheses are row percentages.

Table 3. NAREA Membership Evaluation of the Quality of Papers Presented at NAREA Meetings by Employment Categories

Employment	Ratings					Row Totals
	Excellent	Good	Average	Fair	Poor	
University	6 (7.32)*	38 (46,34)	31 (37.80)	7 (8.54)	0 —	82 (100.00)
Government	1 (6.67)	11 (73.33)	3 (20.00)	0 —	0 —	15 (100.00)
Private	1 (16.67)	3 (50.00)	2 (33.33)	0 —	0 —	6 (100.00)
Student	0 —	1 (100.0)	0 —	0 —	0 —	1 (100.00)
Column Totals	8 (7.69)	53 (50.96)	36 (34.62)	7 (6.73)	0 —	104 (100.00)

* Numbers in parentheses are row percentages.

mately, 25 percent or 33 individuals felt the Journal was average for their publication needs. Roughly, 16 percent or 21 individuals answered that the Journal was excellent.

Table 5 contains respondent data that relates membership years with quality ratings for the Journal. Of the individuals who rated the Journal good, 41 percent were members of 10 years or more and 28 percent were members for 1-3 years. About one-third of the members who responded that the Journal was average were members of 10 years or longer and one-third were involved in the Association for 1-3 years. Of the 21 individuals who responded with an excellent, 52 percent had been members for 10 years or more with 33 percent members for only 1-3 years.

The following section contains ordinary least-squares results for three linear model formulations based on the questionnaire data.

Multivariate Regression Estimations

Three different linear models were formulated to estimate the relationship between three distinct dependent variables and a selected group of independent variables.

Model I With Dependent Variable— Number of NAREA Journal Articles by Respondent

It was hypothesized that the following linear relationship holds as shown by equation (1):

$$(1) \quad NJA - bi + b_2\, MY + b_3\, PR + b_4\, IP$$

where, NJA refers to the number of NAREA journal articles by respondent, MY denotes the number of years the respondent has been a member of NAREA, PR refers to the respondent's percentage of appointment that

Table 4. NAREA Membership Evaluation of the NAREA Journal as an Outlet for Publishing by Employment Categories

Employment	Ratings					Row Totals
	Excellent	Good	Average	Fair	Poor	
University	20 (19.80)*	45 (44.55)	28 (27.72)	8 (7.92)	0 —	101 (100.00)
Government	1 (5.26)	12 (63.16)	4 (21.05)	1 (5.26)	1 (5.26)	19 (100.00)
Private	0 —	2 (33.33)	1 (16.67)	3 (50.00)	0 —	6 (100.00)
Student	0 —	4 (100.00)	0 —	0 —	0 —	4 (100.00)
Column Totals	21 (16.15)	63 (48.46)	33 (25.38)	12 (9.23)	1 (.77)	130 (100.00)

* Numbers in parentheses are row percentages.

Table 5. Membership Quality Evaluation of the NAREA Journal According to Years of Membership

Quality of Journal	Membership Years 1-3	4-6	7-9	10 & over	Row Totals
Excellent	7	2	1	11	21
	(33.33)*	(9.52)	(4.76)	(52.37)	(100.00)
Good	18	14	5	26	63
	(28.57)	(22.23)	(7.94)	(41.26)	(100.00)
Average	11	6	4	12	33
	(33.33)	(18.18)	(12.12)	(36.36)	(100.00)
Fair	3	2	3	4	12
	(25.00)	(16.66)	(25.00)	(33.32)	(100.00)
Poor	0	0	0	1	1
	—	—	—	(100.00)	(100.00)
Column Totals	39 (30.00)	24 (18.46)	13 (10.00)	54 (38.48)	130 (100.00)

* Numbers in parentheses are row percentages.

is research and IP depicts the number of institutional publications (regional bulletins, experiment station reports, . . .) that the individual has had published, bi, b_2, b_3, and b_4 designate estimated parameters.

A priori, it was assumed that the estimated parameters would be positive in sign. For instance, it was anticipated that the more years of membership (MY) for a respondent, the greater the number of NAREA journal articles. Also, it was felt that the higher the percentage of ones appointment in research (PR), the higher the number of NAREA journal articles. Lastly, a positive spillover was hypothesized to exist with the number of institutional publications (IP). With an increasing IP, it was hypothesized that experiment station reports and bulletins often have their variations published as NAREA journal articles.

Table 6A contains the ordinary estimated least-squares results for (1). All three independent variables (MY, PR, and IP) had corresponding estimated parameters (ba, b_3, and b4, respectively) that tested statistically significant at the one percent level and had positive signs.[2] An estimated parameter with a value of .0812 for membership years (MP) can be interpreted as meaning for each additional year of membership, the number of NAREA journal articles will increase by .0812 articles. The estimated parameter for percentage of research appointment denotes the interpretation that for each additional percent of appointment for research, the number of journal articles will increase by .0134. A similar interpretation holds for the estimated parameter for number of institutional publications (IP).

The adjusted coefficient of multiple determination has a value of about 31 percent, which refers to the collective linear influence of the independent variables of equation (1) in explaining the variation in the dependent variable (NJA).

Model II With Dependent Variable— Number of NAREA Meetings Attended

It was hypothesized that the following linear relationship holds:

$$(2) \quad NM = a, + a_2\,MY + a_3\,PR + a_4\,PT$$

where, NM depicts the number of NAREA meetings attended by the respondent, MY again refers to member's years in NAREA, PR again denotes respondent's percentage of research appointment, and PT refers to the percentage of respondent's appointment that is teaching. $a_{1?}$ a_2, a_3, and a_4 designate estimated parameters.

A priori, it was assumed that the estimated parameters would be positively signed. It was felt that the longer a respondent was a member of the Association (MY), the higher the number of NAREA meetings attended. It was also assumed that the higher the percentage of a member's appointment for research (PR), the greater likelihood of attending Association meetings for an outlet to present research results. The hypothesis was also offered that the higher the percentage of member's appointment for teaching (PT), the greater the number

[2] The correlations between the independent variables were low in value (below .20) so as not to suggest multicollinearity. This was also true for models two and three in a latter portion of this paper.

Table 6. OLS Results for Three Linear Model Formulations Based on NAREA Questionnaire

A. Number of NAREA journal articles = f (membership years, percent of appointment research, number of institutional publications)

Independent Variables	Estimated Parameters	Standar Errors	t Values
constant (bj)	-.1788	.2671	-.67
MY	.0812	.0193	4.20*
PR	.0134	.0044	3.09*
IP	.0362	.0102	3.53*
R^2 - 30.6			
n = 142			

B. Number of NAREA meetings attended = g (membership years, percent of appointment research, percent of appointment teaching)

Independent Variables	Estimated Parameters	Standard Errors	t Values
constant (a,)	-2.6525	.5320	-4.99*
MY	.6559	.0322	20.39*
PR	.0207	.0085	2.44*
PT	.0253	.0112	2.26*
R^2 = 75.3			
n = 142			

C. Participation in NAREA meetings in capacity other than attendance = h (membership years, percent of appointment research, percent of appointment extension, number of institutional publications)

Independent Variables	Estimated Parameters	Standard Errors	t Values
constant (cj)	-1.3952	.4472	-3.12*
MY	.2208	.0306	7.22*
PR	.0251	.0069	3.66*
PE	.0069	.0098	.71
IP	.0535	.0163	3.28*
R- = 46.1			
n = 142			

* Denotes significance at one percent level.

of meetings attended for purposes of being exposed to new material as well as interacting with fellow professors.

Table 6B contains the ordinary least-squares estimations for equation (2). All three independent variables (MY, PR, and PT) have related positively signed estimated parameters a_2, a_3, and a_4, respectively that were statistically significant at the one percent level. Their interpretation is the same as stated for the previous model. The adjusted coefficient of multiple determination was roughly 75 percent.

Model III With Dependent Variable— Participation in NAREA Meetings in Capacity Other Than Attendance

The following linear relationship was formulated and tested:

$$(3) \quad PM - ci + c_2\,MY + c_3\,PR + c_4\,PE + c_5\,IP$$

where, PM refers to the number of times a member has participated in NAREA meetings other than just attending, MY, PR, and IP are defined as previously designated, and PE denotes the percentage of a member's appointment that involves extension activities. Ci, c_2, c_3, and c_4 depict estimated parameters.

A priori, it was assumed that the estimated parameters would be positively signed, except for PE where a negative estimated parameter was conjectured. It was hypothesized that as the number of membership years (MY) increased, the higher the likelihood that individuals would be more active in Association meeting activities. As one's research percentage (PR) increased, it was felt that there would be an increase in meeting participation (paper

presentations, symposia organization, . . .). This same logic also was applied to the independent variable, IP. The higher the percentage of a member's appointment that was extension oriented (PE), it was hypothesized the less participation there would be in NAREA activities. Extension activities were thought to be very time consuming and thus a distraction for active participation in NAREA meetings. Table 6C contains the ordinary least-squares estimations for equation (3). MY, PR, and IP had related positively signed estimated parameters (c_2, c_3, and c_5, respectively) that were statistically significant at the one percent level. The estimated parameter for the percent of an appointment that is extension (PE) tested statistically insignificant. The adjusted coefficient of multiple determination was roughly 46 percent.

Summary **and Conclusions**

The number of NAREA members that designated agricultural economics as their area of professional interest was roughly over double the number of respondents that denoted resource economics. This differential also held when viewing the University employment category. For the government sector, about fifty percent more of the members designated agricultural economics than resource economics as their area of specialty. A similar trend of dominance held for the private sector. In considering activities for NAREA sponsored events, this particular fact should be noted so that programs will appeal to the membership mainstream. In discussions that focus upon increasing membership, this information may be useful in designing strategies.

In terms of the distribution of years of membership, roughly one-third of our members are new to NAREA (one to three years) and about forty percent have been involved with NAREA for ten years or more. The mix of membership has the potential for an influx of new ideas in determining what NAREA should be as well as the potential for conflicts evolving around how much future change, if any, should take place. Those individuals involved in future NAREA decisions should be aware of this particular situation.

Roughly half of the membership respondents designated the quality of papers presented at NAREA meetings as good with about one-third referring to the papers as average. Disenchantment with the quality of papers presented seemed very minimal with only seven of one hundred four respondents rating the papers as fair and no respondents selecting the poor category.

With regards to our Journal as an outlet for publishing, about one-half and one-quarter of the respondents designated the categories of good and average, respectively. Roughly, sixty-five percent of the respondents, after combining the excellent and good categories, referred to the Journal as good or excellent. The response seems to imply a strong affirmation of support for our Journal.

In terms of being actively involved in NAREA by publishing in the Journal, the variables of length of membership, the percent of member's appointment that is research, and number of institutional publications are statistically significant. The length of membership, percent of appointment that is research, and percent of appointment that involves teaching were statistically significant in influencing the attendance at NAREA meetings. Participation in NAREA meetings other than attendance was significantly influenced by membership years, percentage of appointment that is research, and number of institutional publications. The percent of extension appointment was not statistically significant.

The ordinary least squares results should be interpreted as estimations for three explanatory models and not for predictive purposes. The adjusted coefficients of multiple determination for the three models ranged from roughly thirty-one to seventy-five percent.

The results and generalities derived from the NAREA members' responses should be used cautiously given the fact that the participation level in the survey was about fifty percent of the total membership. The information collected for NAREA is unique, given the fact that this was the first time that such a survey was distributed to our membership.