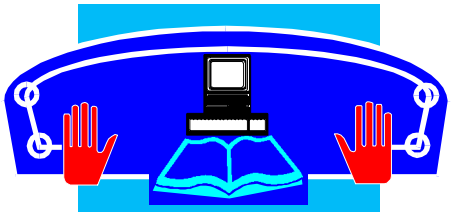

Study Of Vegetable Markets In Selected N.w.t. Communities

Type of Study: Analysis/review Agriculture, Nwt Agriculture

Date of Report: 1986

Author: Nichols Applied Management

Catalogue Number: 1-1-16

1-1-16 Dup.

NICHOLS APPLIED MANAGEMENT

1100 A E. LePage Building, 10130-103 Street, Edmonton, Alberta T5J 3N9 Telephone (403) 424-0091 Telex 037-2966

November 21, 1986

Our File #85-583

Mr. Syd Kirwan
Head, Renewable Resources
Economic Development and Tourism
Government of the Northwest Territories
Yellowknife, N.W.T. X1A 2L9

Dear Mr. Kirwan:

Attached is a copy of our budget breakdown for the detailed feasibility assessment of the waste heat greenhouse project in Frobisher Bay. On reviewing the detail of the budget I thought it may be appropriate to further break down the cost components of Task 1 as it clearly is the most significant contributor to the overall budget. This breakdown is presented below:

Task 1	PCN	SA	TE	JB
Site selection		.5	1.5	
Weather/climate/geotech data collection			1.0	.5
Transportation cost		.5		
Water assessment			1.0	
Soil/gravel assessment			1.0	.5
Labour cost determination		.5		
Utility cost determination		.5		
NCPC liaison		1.0	1.0	
Waste heat layout assessment			2.5	
Crop selection			2.0	1.0
Computer model of climate/growing conditions			4.0	
Conceptual design	.5	2.0	4.0	
Component costing of greenhouse and waste heat systems	.5	1.0	7.0	
TOTAL	1.0	6.0	25.0	2.0

I trust that this breakdown meets your requirements. If you require any further information please do not hesitate to call.

Yours truly,

Steve Adams
Senior Consultant

SA/ll

cc Tim Ellis
Noval Enterprises

Budget Estimate - Phase 2
NWT Greenhouse Project

	person-days									Total
	PCN	SA	TE	JB	Total Fees	Air Fares	Food & Lodging	Other	Total Expenses	Fees & Expenses
Task 1	1.0	6.0	25.0	2.0	19,300	3,300	1,000	200	4,500	23,800
Task 2	0.5	3.0	2.0		2,950	157	50	50	257	3,207
Task 3	0.5	3.0	4.0		4,150	157	50	50	257	4,407
Task 4	0.5	4.0	4.0	2.0	5,425			50	50	5,475
Task 5	1.0	3.0	5.0	2.0	5,875	1,000	350	200	1,550	7,425
Task 6		4.0			1,900	3,300	700	200	4,200	6,100
	3.5	23.0	40.0	4.0	39,600	7,915	2,150	750	10,815	50,415

PCN Peter Nichols 650
SA Steve Adams 475
TE Tim Ellis 600
JB Jahn Bouw 400

NICHOLS APPLIED MANAGEMENT

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
2.	ESTIMATION OF DEMAND	5
2.1	Market Demand - Frobisher Bay	8
2.2	Market Demand - Rankin Inlet	13
2.3	Market Demand - Cambridge Bay	17
2.4	Market Demand - Inuvik	19
2.5	Market Demand - Yellowknife	22
2.6	Summary -Market Demand	24
3.	OTHER ISSUES CONCERNING NORTHERN GREENHOUSES	27
4.	CONCLUSIONS	29
5.	RECOMMENDATIONS	31

* * *

APPENDICES

A. SUMMARY OF CANADIAN PER CAPITA CONSUMPTION
B. REQUIRED PROGRAM OF STUDY

1. INTRODUCTION

The Department of Economic Development ana Tourism of the Northwest Territorial Government is interested in the prospects for developing ana improving agricultural capabilities in the territories. Agriculture in the north offers a number of potential advantages to residents. These include:

- opportunities for local employment;
- avoidance of high freight rates;
- improved standards of freshness ana nutritional content; and
- diversification ana expansion of the regional economic base and business sector.

Within the agricultural sector, one of the specific areas of opportunity relates to greenhouse production ana it is this sub-sector which is aadressed in this study. Nichols Applied Management, in conjunction with Naval Enterprises, was commissioned to evaluate the market prospects for greenhouse production in the communities of Inuvik, YeUowknife, Cambridge Bay, Rankin Inlet ana Frobisher Bay. This report outlines the findings of that study and recommends additional initiatives that may be pursued in developing northern greenhouse agriculture.

The study undertakes to identify the size of the market for greenhouse production in each of the communities referenced earlier and to identify the potential opportunities and constraints that these individual markets may impose. To a large extent the definition of "greenhouse production" is market driven. Fresh tomatoes, for example, are readily

available from market gardens in California where they are grown outdoors on a year-round basis. In Alberta, however, greenhouse tomatoes are the norm for local production. The price structure of the market dictates that more costly production methods (greenhouse production) can replace less costly outdoor growing methods when factors such as transportation costs and in-transit quality deterioration are taken into consideration. What can be grown, in northern communities, is to a large extent not technologically determined but rather determines by the markets for the final products.

During the course of the study, the consultants defined potential greenhouse product profiles in wiser terms than are traditionally considered practical under commercial greenhouse standards and then examined the practicality of growing these crops having regard to the markets evaluated. Typical greenhouse crops in southern climates include tomatoes, long english cucumbers, peppers ana musk melons. The harainess of crops such as onions, potatoes, carrots and turnips have led to these crops being traditionally regarded as "field" crops. Accordingly, greenhouses tend to be reserved for the more fragile crops. The advantages of northern production relate primarily to the freight benefits from producing closer to the market and freight rates are independent of the type of product. The freight costs saved by growing 10 pounds of potatoes in the north are identical to the freight saved by growing a similar poundage of tomatoes. As a result, crops that are not practical to grow in greenhouses in the south may be eligible for consideration as greenhouse crops in the north.

For the purposes of this study, then, the study team has included a broad range of crops encompassing the traditional greenhouse crops but also including many other vegetables such as potatoes, carrots, and onions.

As a matter of convenience in discussing the market for vegetables, the potential products have been divided into four groups with like characteristics. These are:

- salad vegetables such as lettuce, tomatoes, cucumbers, etc.;
- table vegetables such as onions, carrots, beans, turnips, etc.;
- potatoes; and
- melons (honey dew and musk).

Appendix A to this report details the crops includes in each of these groups and presents the annual Canaaian per capita consumption of each crop.

Over the course of the project, the consultants visited each of the study area communities, including Inuvik, Yellowknife, Cambridge Bay, Rankin Inlet, and Frobisher Bay. These visits were carried out during March, April ana May of 1986. The purposes of the visits were threefoid, namely:

- to estimate the demana for fresh vegetables in each community based on discussions with local retailers, wholesalers, restauranteurs, and operators of institutional kitchens, in oraer to calculate the potential sales for local production and to understand the competitive alternatives to locally-grown produce;

- to gauge the degree of community acceptance that could likely be achi.eves by a new local agricultural venture; and
- to undertake some preliminary assessment of potential sites within each community giving consideration to terrain, availability of water, ana proximity to an adequate source of waste heat.

The finaings of these visits were integrate with our experience in other greenhouse aperations, a literature review, statistical analysis and other research in order to develop the conclusions and recommendations presented in this report.

2. ESTIMATION OF DEMAND

The demana for fresh vegetables in each of the communities visited was determines primarily through discussions with local fooa retailers, wholesalers, restauranteurs and institutions. In most instances interviewees were very co-operative ana often consulted historical records in order to estimate sales of various vegetable products. In some cases, though, there may have been a reluctance to provide complete disclosure for a number of reasons, including concerns about confidentiality, lack of readily available data, unwillingness to expena additional time to respond to our queries, etc. Therefore, it was necessary to make estimates of the sales of some products for certain outlets.

In order to estimate the sales of particular products for which information was not readily available, the consultants relied on the use of a number of statistical measures and indicators. Per capita disappearance estimates by Agriculture Canaaa (see Appendix A) were usea to determine the typical ratio of consumption of one vegetable to another. These ratios were then applied to the known sales levels for certain foodstuffs in order to estimate the volume of sales for other products. To use an example, Canadians consume on average four pounds of cauliflower and one pound of beets per year; expressed differently, the consumption of cauliflower is four times that of beets. If confronted with a particular outlet for which no information on beet sales was available, beet sales might be estimatea on the basis of one-quarter of the sales of cauliflower, a commodity for which sales information might be documented. This estimating procedure was

repeated using as a base the sales data of commodities for which we had information. Using this form of estimation, the study team was able to complete estimates of sales/usage by outlet for each product.

The estimates of potential markets for greenhouse production is premises on the assumption that local production will be competitive with existing extra-regional sources of fresh produce in terms of both quality and price. The extent to which indigenous production can exceea these expectations will depend on the additional penetration of the local market for frozen ana canned vegetable products or the expansion of the available fresh produce market because af improvements in product quality or availability. The methodology employed in this study focuses conservatively on the present consumption of fresh vegetables only. The substitution of fresh for frozen or canned products would serve to increase the aemana above the estimates developed in the report.

This procedure produces estimates for total annual market demand. It is unlikely that local production coula service total annual demana far a number of reasons, including:

- the high costs of growing vegetable products unaer artificial light in the winter;
- periodic "specials" in southern markets that can compete with local production;
- scheduling situations where crops have not matured in time with market demana; and
- ather competitive actions of southern wholesalers.

However, it is expected that local production could service a significant portion of the market. For our purposes, the total annual demand determines the extent of the commercial opportunity in each community. For the reasons cites above, actual levels of sales for a commercial greenhouse will be less than the levels of demand projectea by this stuay.

It should be noted as well that the market estimates are derived from the experiences of the commercial service sector establishments in the specific communities; they do not include the produce volumes shipped by individual households from southern communities. This form of "hidden market" is especially significant in the more remote communities of Cambridge Bay, Rankin Inlet and Frobisher Bay, but may still exist to some extent in Yellowknife and Inuvik. A number af interviewees mentioned that shopping services in southern communities, especially Montreal, accept orders from northern residents for. foodstuffs and other personal items, assemble the orders and ship them into northern communities. In adaition, it is common practice among northern residents who have occasion to visit southern locations on business or pleasure to return with a supply of fresh produce as checked baggage an the aircraft. These alternative sources of fresh vegetables represent a hidden demana for fresh vegetables, but it is unclear whether local production could displace these supply arrangements. The use of southern purchasing agents will retain its appeal due to the requirement far personal goods not readily available in the north, and travelers will in all likelihood continue to take advantage of the cost savings by bringing in fresh vegetables when they travel. In developing the estimates of market demand, the consultants have not included a factor to allow for this "hidden demand". While it is conceivable that local production may be able to reauce the size of this "hidden" market, no provision has been maae for the greenhouse penetration of that market.

In the interest of protecting the confidentiality of the interviewees, sales information has been summarize into the major vegetable categories discusses earlier. The estimated market for fresh vegetable products in each of the study area communities is discussed separately in the following sub-sections of the report.

2.1 MARKET DEMAND - FROBISHER BAY

The market demand for fresh vegetables in Frobisher Bay is projected as the summation of the sales or utilization of the following establishments:

- three retail grocers;
- three hotels;
- two restaurants; and
- three institutional users (jail, hospital ana school).

Utilizing the procedures outlines in the previous section, the market demand for fresh vegetables in Frobisher Bay is estimatea as follows:

Current Annual Market Demand - Frobisher bay

	Pounds	Pounds/Capita	% of Average Canadian Consumption
Potatoes	196,000	65	41%
Salad Vegetables	151,000	50	75%
Table Vegetables	88,000	29	60%
Melons	7; 000	2	28%
	442,000	146	

Other potential markets for greenhouse products in the Frobisher Bay area include additional small settlements in the Baffin Region and, possibly, Greenland. Based on conversations with the regional airline servicing Greenland, upwards of 5,000 pounds per week of vegetables are shipped out of Montreal and Ottawa to Greenland via Frobisher Bay. Clearly, if local greenhouse production can displace imports from southern centres in the Frobisher Bay market, the potential should exist for displacing sales out of Montreal ana Ottawa to Greenland. During the course of this study the consultants made no efforts to carry out market investigations in Greenland; it was felt that some initial contact between the Government of the N.W.T. and Greenland officials would be appropriate and that such market research, where necessary, should be carried out during a subsequent part of a full feasibility analysis.

The market for fresh vegetables in other Baffin region settlements represents another potential market for Frobisher Bay production although the relative economics are less clear. Currently, there are favorable air cargo freight rates from Ottawa and Montreal into many settlements, and the added potential to use the postal service into eastern Arctic settlements out of Val d'Or, Quebec. Fooa products, including fresh vegetables, can be mailed out of Val d'Or at the 4th class postal rate and still receive the special handling necessary for perishable products. The net result is that mailing fresh vegetables out of Val d'Or or using through rates out of Ottawa and Montreal are often less expensive than air freight charges to some communities out of Frobisher bay. The freight advantage into the remaining communities is minimal. Given these rate comparisons, it is almost inconceivable that

Frobisher Bay production could compete with southern production on a cost basis. Unless relief from postal rates and more realistic air cargo rates out of Frobisher Bay can be negotiated, or a compensating subsidy arranged, it is unlikely that the economics will allow for the servicing of settlements out of Frobisher Bay. A comparison of relative freight advantages is presented in the following chart.

Analysis of Freight Advantage - Frobisher bay

	Air Cargo Via Ottawa/ Mtl.	(Postal) via Val d'Or	Least Cost Alter-native	Rate from Frobisher bay	Freight Advantage of Frobisher Bay Production	
	$/kg.				$/lb.	
Frobisher Bay	1.34	2.43	1.34	-	1.34	.61
Arctic Bay/ Nanasivik	2.64	2.43	2.43	2.36	.07	.03
Broughton Island	2.74	2.43	2.43	2.31	.12	.05
Cape Dorset	2.69	2.43	2.43	1.99	.44	.20
Clyde River	2.93	2.43	2.43	3.76	Nil	Nil
Grise Fiord	4.66	2.43	2.43	4.45	Nil	Nil
Hall Beach	1.83	2.43	1.83	1.80	.03	.01
Igloolik	2.60	2.43	2.43	2.57	Nil	Nil
Lake Harbour	2.65	2.43	2.43	.96	1.47	.67
Pangnirtung	2.58	2.43	2.43	1.63	.80	.36
Pond Inlet	3.09	2.43	2.43	4.28	Nil	Nil
Resolute	2.64	2.43	2.43	2.43	Nil	Nil

The market for fresh vegetables in other Baffin Region settlements was estimated using regression analysis. This procedure attempts to find the best determinant of demand through the analysis of a number of potential factors such as income, total population, population of natives, population of non-natives, price levels, and other indicators. Regressions were performed for each vegetable group in the five study area centres. Overall, the population of non-natives in a community was determined to be the best overall predictor of demand for each vegetable group.

Based on this finding, ana on estimates of the size of the non-native population prepared by the Northwest Territories Bureau of Statistics, the consultants assessed the demand for fresh produce in other Baffin Region settlements as follows:

Estimates of Annual Market Demand in Baffin Region Settlements (Excluding Frobisher bay)

	Pounds
Potatoes	70,000 - 115,000
Salad Vegetables	35,000 - 50,000
Table Vegetables	28,000 - 35,000
Melons	3,000 - 5; 000
Total	133,000 - 205,000

To summarize, the potential market demand for products of a Frobisher Bay greenhouse could reach a high of 800,000 to 900,000 pounds per year calculate as follows:

Estimates of Total Potential Market From Frobisher Bay

	Frobisher Bay	Settlements	Greenland	Total
		Pounds Per Year		
Potatoes	196,000	70,000 - 115,000	?	266,000 - 311,000+
Salad Vegetables	151,000	38,000 - 50,000	?	189, 000 - 201,000+
Table Vegetables	88,000	28,000 - 35,000	?	116,000 - 123,000
Melons	7,000	3,000 - 5,000	?	10,000 - 15,000
Total	442,000	133,000 - 205,000	260,000	841,000 - 907,000

As indicated earlier, significant uncertainties are associated with these estimates in respect of 1) the economics of shipping into the settlements from Frobisher Bay and 2) the size and characteristics of the Greenland market.

For the purposes of this study, the consultants have relied on a base market estimate of 442,000 pounds per year, while recognizing at the same time the possibility that favorable circumstances could virtually double the size of the potential market.

Expectations for this market over the next five years are for modest increases in volume tiea primarily to increases in the non-native population projected for Frobisher Bay. Projections by the Northwest Territories Bureau of Statistics call for an increase of only 28 people in the non-native population (2.5%). Based on the relationship between the non-native population and total demand, a five year forecast for fresh vegetables was developed and is presented below:

Projected Market Demand - Frobisher Bay
(000's pounds)

	1986	1987	1988	1989	1990
Potatoes	196	197	198	200	202
Salad Vegetables	151	151	152	153	153
Table Vegetables	88	"88	89	89	90
Melons	7	7	7	7	7
Total	442	443	446	449	452

In essence, the future growth in the market aemana for fresh vegetables is expected to be limited. During the discussions held in the northern communities, the retailers ana restauranteurs were asked as to whether there were discernible trends in the consumption of vegetables among the native community. While it is generally believes that natives are eating more vegetables than previously, it was not feit that the trend would have a significant result on market volumes over the next five years.

It is possible, however, that local production could serve to increase levels of consumption as a result of a number of factors. The publicity, curiosity, ana local interest associated with a greenhouse operation may serve to stimulate increased consumption. In addition, the potential for higher quality, lower-priced, and more readily available fresh produce may all serve to stimulate demand. It is possible then, that the consumption estimates could expana with the introduction of locally-grown produce.

2.2 MARKET DEMAND - RANKIN INLET

The market demana for fresh vegetables in Rankin Inlet is projected as the summation of the aemand of each of the following outlets:

- two retail graters;
- ane hotel (l); and
- one restaurant.

Utilizing the procedures outlined in the previous section, the market demand for fresh vegetables in Rankin Inlet is estimated as fallows:

Current Annual Market Demand - Rankin Inlet

	Pounds	Pounds/Capita	% of Average Canadian Consumption
Potatoes	*43,000*	*32*	21%
Salad Vegetables	50,000	37	56%
Table Vegetables	22,000	16	33%
Melons	1,000	1	10%
	116,000	86	

1. Volumes related to institutional use are reflected in the estimates for the hotel, which caters meals for the local school.

Other settlements in the Keewatin Region also represent a potential market for greenhouse production in Rankin Inlet and the consumption volumes for those centres have been estimated utilizing the regression analyses describes in the previous sub-section. The estimates derivea for the various Keewatin Region settlements are as follows:

Estimates of Annual Market Demand in Keewatin Region Settlements (Excluding Rankin Inlet)

	Pounds
Potatoes	35,000 - 60,000
Salad Vegetables	20,000 - 25,000
Table Vegetables	14,000 - 19,000
Melons	1,000 - 2,000
Total	70,000 - 106,000

The inclusion of these settlements as potential markets is premised on an analysis of freight advantages. While in all instances it costs less to ship to the settlements in the region from Rankin Inlet vis-a-vis southern communities such as Winnipeg, the differences in freight rates vary by commodity and destination. It is reasonable to assume that the production costs of a greenhouse in Rankin Inlet will be greater than wholesale prices in Winnipeg and that there will be a reliance on the freight differential to give an economic advantage to production in Rankin. The freight differential, and production costs, then become important factors in determining how much of the market can be competitively accessed. An analysis of freight rates indicates that a freight advantage from Rankin is possible in respect of all the settlements although, due to the possibilities for routing freight through Churchill or Thompson, the cost advantage is

not always equal to the Winnipeg/Rankin Inlet freight rate. In addition, rate differences apply to various commodities with the alternative of shipping hardy vegetable products such as potatoes, carrots and onions to Churchill, Manitoba via railway and from there into the settlements via air cargo. Shipping times and other uncertainties make the latter routing a practical alternative only for hardy products. Salad vegetables, melons and most table vegetables generally must be transported by air cargo out of Winnipeg.

The following table summarizes the freight cost advantages of producing in Rankin Inlet as opposed to shipping vegetables out of Winnipeg, assuming an air cargo load of 200 kilograms or more.

Analysis of Freight Advantage - Rankin Inlet (Air Cargo)

Destination	via Wpg .- Thompson	via Wpg .- Churchill	via Wpg .- Kankin Inlet	Least cost Alter- native	Rate From Rankin Inlet	Freight Advantage of Rankin Inlet Production	
				$/kg,			/lb.
Rankin inlet	$2.09	2.03	1.63	1.63		1.63	.74
Eskimo Point	1.60	1.63	2.37	1.60	.74	.86	.39
Whale Cove	1.81	1.89	2.13	1.81	.50	1.31	.59
Chesterfield Inlet	2.35	2.27	2.17	2.17	.54	1.63	.74
Baker Lake	2.25	2.43	2.49	2.25	.86	1.39	.63
Coral Harbour	3.07	3.15	2.80	2.80	1.17	1.63	.74
Repulse Bay	3.14	3.23	2.84	2.84	1.21	1.63	.74

The freight advantage is reduces for vegetables that are hardy enough to withstand five to seven days shipping time. The following table summarizes these cost comparisons.

Analysis of Freight Advantage - Rankin Inlet (Rail/Air Cargo)

Destination	via Rail Wpg .- Churchill	Rate from Rankin Inlet	Freight Advantage of Rankin Inlet Production	
	$/kg		$/lb	
Rankin inlet	1.39		1.39	.61
Eskimo Point	.99	.74	.25	.11
Whale Cove	1.25	.50	.75	.34
Chesterfield Inlet	1.63	.54	1.09	.49
Baker Lake	1.79	.86	.93	.42
Coral Harbour	2.51	1.17	1.34	.61
Repulse Bay	2.59	1.21	1.38	.63

Clearly, there remains a freight advantage in terms of servicing these communities out of Rankin Inlet, although the advantage is not equal in respect of all communities. The pricing of greenhouse products will largely determine whether these markets are accessible. For the purposes of this study, it is assumed that these markets can be accessed in a competitive manner and that they can be largely served by a greenhouse facility in Rankin Inlet, with the exception of those markets for hardy vegetables in Eskimo Point and Whale Cove, for which there is a limited freight advantage.

Making the appropriate adjustments to reflect the relative economics of the various freight costs, the following summary of market demand is derived.

Estimates of Total Accessible Market - Rankin Inlet

	Rankin Inlet	Keewatin Settlements	(less) inaccessible market due to limited freight Advantage	Total
	lbs./year			
Potatoes	43,000	35,000 - 60,000	11,000 - 18,000	67,000 - 85,000
Salad Vegetables	50,000	20,000 - 25,000		70,000 - 75,000
Table Vegetables	22,000	14,000 - 19,000	2,000 - 3,000	34,000 - 38,000
Melons	1,000	1,000 - 2,000		2,000 - 3,000
Total	116,000	70,000 - 106,000	13,000 - 21,000	173,000 - 201,000

No significant volume changes are expected in this market over the next five years. The NWT bureau of Statistics estimates that the non-native population level in Rankin Inlet and elsewhere in the region will be stable over the period 1986 to 1990. Based on the strong relationship between the non-native population and consumption, it is not realistic to expect significant consumption increases.

As discussed earlier in Section 2.2, small increases in the consumption of vegetables by natives may be expectea but cannot be quantified. In the interests of reflecting a conservative estimate of the market demand, then, no increase in vegetable consumption is assumea over the next five years. As mentioned earlier, however, local production of fresh produce may increase interest and awareness levels within the community and result in some increases in consumption. Any consumption increases of this nature are unlikely to spill over to the outlying settlements.

2.3 MARKET DEMAND - CAMBRIDGE BAY

The market demand for fresh vegetables in Cambridge Bay is estimated on the basis of the current sales of the two retail outlets. The only other outlet for fresh vegetables in Cambridge Bay, the hotel restaurant, is owned by the Co-op and the consumption estimates for this outlet are capturea in the estimates of retail volumes collecteo at the Co-op retail store.

In order to respect the confidentiality of the two retailers, demand estimates presented in this report include volume estimates for the communities of Spence Bay, Gjoa Haven, and Pelly Bay. It should be notea that Coppermine is not included as the freight advantage is so minimal that it is

unlikely that Cambridge Bay production could economically be sold in Coppermine. The following table presents the analysis of relative freight costs.

Analysis of Freight Advantage - Cambridge Bay

Destination	From Edmonton	From Cambridge Bay	Freight Advantage from Producing in Cambridge Bay	
	----------$/kg.----------		----------$/lb.----------	
Cambridge Bay	1.60		1.60	.73
Coppermine	1.80	1.70	.10	.05
Gaa Haven	3.55	2.07	1.48	.67
Pelly Bay	5.19	2.75	2.44	1.11
Spence Bay	3.90	2.44	1.46	.66

Estimates of consumption volumes for the expanded market as defined by areas of significant freight advantage are summarized below:

Estimates of Total Accessible Markets
Cambridge Bay

	Pounds	Pounds/Capita	% of Average Canadian Consumption
Potatoes	30,000 - 36,000	11.05 - 13.25	7% - 8.5%
Salad Vegetables	29,000 - 31,000	11.68 - 11.41	16% - 17%
Table Vegetables	15,000 - 17,000	5.52 - 6.26	11% - 13%
Melons	2,000 - 3,000	.74 - 1.10	9% - 1.3%
Total	76,000 - 87,000	27.99 - 32.02	

As with Frobisher Bay and Rankin Inlet, significant expansion of the market for fresh vegetables is unlikely to occur without increases in the size of the non-native population. Projections for the Kitikmeot Region call for a static non-native population over the next five-years. Again, however, the interest and awareness provided by a community greenhouse may contribute to higher levels of local consumption, especially among natives.

2.4 MARKET DEMAND - INUVIK

The market demand for vegetables in Inuvik is based largely on discussions with two wholesalers, ana a retailer of vegetable products. One of the wholesalers aiso operatea a retail outlet but subsequent to the field visits has ceasea operations. It has been determined that virtually all of the vegetables consumed in Inuvik, incluaing institutional ana restaurant volumes, were captured by the operators interviewed.

Estimates of consumption in Inuvik for each of the groups of vegetable products are presented below.

Current Annual Market Demand - Inuvik

	Pounds	Pounds/Capita	% of Average Canadian Consumption
Potatoes	480, 000	148	95%
Salad Vegetables	180,000	57	86%
Table Vegetables	140,000	45	93%
Melons	25,000	8	92%
	825,000	258	

Consumption volumes on a per capita basis are very similar to Canadian averages, ana the factors contributing to this are discussed below:

- the availability of road transportation into Inuvik for most of the year allows for vegetables to be brought in at a much lower price than in the other Arctic communities discussea so far;
- the comparatively high percentage of non-native population (approximately 60%) influences the consumption of vegetables upwards;

- some industrial camps are serviced out of Inuvik with food products; however, their. employment figures have not been included in the population estimates used to derive per capita consumption; and
- the Canadian average per capita consumption as estimated by Agriculture Canada likely understates true Canadian consumption as it does not include the consumption of crops from personal gardens. Given that consumption from personal gardens is minimal in Inuvik, but much more prevalent in more densely populated southern regions, it is likely that Inuvik consumption corresponds less closely to the Canadian average than is suggestea by the market estimates.

A number of communities surrounding Inuvik would also offer potential markets for locally-produced vegetables. However, the limited freight advantage offered from an Inuvik basing-point infers that production costs in Inuvik would have to resemble those in southern climates and, particularly for non-typical greenhouse crops, this is unrealistic. The freight advantage into all of the settlements from Inuvik (except those on the highway into Inuvik) is estimated at $.18 per pound, which corresponds to the truckload rate for produce out of Edmonton. Produce for communities such as Tuktoyaktuk, Aklavik, Paulatuk, Sachs Harbour and Holman is currently trucked to Inuvik and re-shipped via air (or winter road). The cost from Inuvik to the communities would be the same whether the produce originated in Inuvik or Edmonton, and therefore, a freight advantage of $.18 per pound for the outlying communities is estimated.

A good deal of uncertainty is associated with the short-term prospects for economic activity in the Inuvik region. Historically, drilling rigs in the Beaufort Sea have been major consumers of vegetables. The recent downturn in oil prices has had a devastating impact on exploration activity in the region and the prospects for recovery are unclear. In the long term it is realistic to expect that exploration and increased economic activity will take place, but the three to five-year horizon cannot be preaicted with any aegree of certainty due to the potential for various energy-related market influences.

In the context of this market analysis, then, no provision is included for the consumption of fresh produce by industrial camps. The market estimates aerived from the methodology described earlier predicts consumption in the surrounding communities of Arctic Red River, Fort McPherson, Aklavik, Tuktoyuktuk, Holman, Sachs Harbour, Fort Franklin, Fort Norman, Norman Wells, Fort Good Hope and Paulatuk. These estimates are provided below.

	Annual Consumption (lbs.)
Potatoes	150,000 - 250,000
Salad Vegetables	80,000 - 108,000
Table Vegetables	50,000 - 75,000
Melons	5,000 - 10,000
Total	285,000 - 440,000

In summary, the total annual demand for fresh vegetables in the Inuvik region is estimated at 1,110,000 pounds to 1,265,000 pounds. These volumes do not include the consumption attributable to resource camps in the area.

A projection of volumes for the next five years suggests that only modest increases can be expected, based on the population estimates of the NWT Bureau of Statistics. Due to the dependence on oil activity for a significant portion of the economic activity in the region, a great seal of volatility in consumption is possible. If the present downturn in oil prices is viewed as temporary, the current population and consumption levels will likely prevail over the next few years. However, under a scenario of continuing energy price weakness, the regional population could arop significantly ana consumption of vegetables would be adversely affected. A return to higher oil prices could lead to a new "boom" and further increases in population and consumption. Any predictions of the outcome of the oil price aebate can only be speculative. For the purposes of this report, it is assumed that present levels of population and consumption will remain unchanged over the next five years.

2.5 MARKET DEMAND - YELLOWKNIFE

The market demand for fresh produce in Yellowknife has been assessed on the basis of discussions with four retailers, which also operate as wholesalers to the hotels, restaurants, institutions and camp outfitters in the area.

Estimates of local consumption, based on the methodology discussed earlier, are presented in the table below:

Current Annual Market Demana - Yellowknife

	Pounds	Pounds/Capita	% of Average Canadian Consumption
Potatoes	1,450,000	130	83%
Salad Vegetables	775,000	69	105%
Table Vegetables	525,000	47	47%
Melons	60,000	6	64%
	2,810,000	251	

Consumption patterns in Yellowknife closely resemble those of most other cities in Canada. The apparently high level of consumption of salad vegetables probably is attributable to some of the same reasons discusses in relation to the Inuvik analysis.

No estimates have been made of produce consumption in other communities in the region. Due to the potential for field agriculture south of Great Slave Lake, the terms of reference for this study were restricted to the Yellowknife market only. Accordingly, the marketestimates are basea only on the demana served by Yellowknife wholesalers.

The local market for vegetables is projected to grow over the next five years as a result of population increases. The Northwest Territories Bureau of Statistics projects that the Yellowknife population will increase from 11,214 in 1986 to 11,703 in 1990, an increase of about 4% over that time perioa. Consumption patterns are expected to remain similar to those at present. Projections for consumption growth are presenteo in the following table.

Projected Market Demana - Yellowknife

	1985	1986	1987	1988	1989	1990
	(000 lbs.)					
Potatoes	1,450	1,468	1,486	1,504	1,519	1,532
Salad Vegetables	775	785	794	804	812	819
Table Vegetables	525	531	538	845	550	555
Melons	60	61	62	62	63	63
Total	2,810	2,845	2,880	2,915	2,945	2,969

2.6 SUMMARY - MARKET DEMAND

The available market for fresh produce in each of the communities examined is summarized below.

Estimated Annual Market Value

	Frobisher Bay	Rankin Inlet	Cambridge Bay	Inuvik	Yellowknife
			(000 lbs.)		
Potatoes	196	67-85	30-36	630 - 730	1,450
Salad Vegetables	151	70-75	29 - 31	260 - 285	775
Table Vegetables	88	34-38	15-17	190 - 215	525
Melons	7	2- 3	2- 3	30 - 35	60
Total	442	173 - 201	76 - 87	1,110 - 1,265	2,810

The market volume available to a greenhouse operation is an important factor in ascertaining commercial feasibility. It is important, however, to weigh those potential volumes against the revenues necessary to achieve a profitable level of operations.

Market forecasts can be analyzed jointly with freight advantages in order to measure the potential for a proposes greenhouse operation to achieve a profit-making level of operation. In simplistic terms, northern production can be sold at a price as high as the landed cost of southern production but if prices exceed the costs of southern products, sales of local products cannot be assured. As a measure of the potential for profitability, one can multiply volumes by the estimated freight advantage in order to determine the amount of freight that would be saved by producing in the north. This becomes a good indicator of profitability potential.

Freight advantage does not represent the only savings associated with production in the north. Savings can result from streamlining of the distribution process, because the greenhouse will be able to sell directly to the retailers, restaurants, and institutions. In addition, there is also likely to be some savings in terms of reduced spoilage, particularly in centres relying on air transportation. The value of these two advantages is difficult to quantify and will vary substantially for each product. For the purposes of this preliminary study, it is assumed that these advantages serve to partially offset the higher operating costs of growing vegetables in a greenhouse as comparea to the costs of growing vegetables in outdoor fields in the south.

In order for a greenhouse to operate successfully, however, the freight advantage will have to be sufficient to compensate for the remaining cost differentials between growing field crops in the south and greenhouse crops in the north. Volume estimates and freight advantages are presented in the following table.

	Volume (000's lbs.)	Freight Advantage ($/lb.)	Total Maximum Freight Advantage $)
Frobisher Bay	442	.61	27(J ,000
Rankin Inlet	173 - 201	.70 (avg.)	121,000 - 141,000
Cambridge Bay	76 - 87	.70 (avg.)	53,000 - 61,000
Inuvik	1,110 - 1,265	.18	200,000 - 228,000
Yellowknife	2,810	.08	225,000

Using this form of analysis, it is clear that Frobisher Bay is a preferred location to both Inuvik and Yellowknife because the total freight aavantage is higher and

required volumes are lower. In selecting a preferred location from among the remaining three alternatives, it is necessary to examine the minimum size of a greenhouse that could be operated effectively.

It is expected that an efficient northern greenhouse will require the services of a competent horticulturalist. Based on our understanding of typical salaries, northern and housing allowances and relocation costs, a horticulturalist willing to relocate could cost $80,000 - $100,000 per year. This is $40,000 - $60,000 more than the cost that would be incurred in a southern community. Clearly this indicates that the prospects for developing a profitable greenhouse in Cambridge Bay are slim, as the total freight advantage may only just cover the added cost associated with retaining a qualified manager. (Over time, it may be possible to train a local resident to fill the managerial position, and thereby reduce this cost somewhat.)

Rankin Inlet and Frobisher Bay appear to be communities most capable of supporting a greenhouse operation. However, a more detailed feasibility study is requires to place the market conditions into the context of a realistic operating approach and business plan.

3. OTHER ISSUES Concerning NORTHERN GREENHOUSES

In addition to the dominant question of market demand, there are a number of other issues of critical concern that require a thorough review prior to any final decision to build and operate a greenhouse operation in the north. These issues are presented in this section and their implications are discussed.

The commissioning of this study has been premised on waste heat being available from the Northern Canada Power Commission. It is understood that NCPC has a policy of making waste heat available to the territorial government, provided that the capital costs of the collection and distribution systems are not borne by NCPC. As a result, one of the overriding considerations in the siting of a waste heat-based greenhouse facility is the proximity to the local NCPC plant.

Other issues to consiaer in determining an appropriate site are related, to the terrain ana to the availability of water on a year-round basis. A greenhouse operation consumes large amounts of water and it would be essential that it be available throughout the year.

Oecisions related to location, building materials selection, and greenhouse design should also give consideration to protection from vandalism. It was volunteered by a number of the people interviewed that the incidence of vandalism in the communities is quite high and that glass buildings may become an inviting target. The incidence of unaetectea damage under conditions of severe cola could very quickly destroy an entire crop.

Northern waste heat greenhouses will have a number of requirements in addition to a waste heat recovery system. These include:

- a complete back-up heating system that can replace the heat normally obtained from the waste heat source;
- an alarm warning system to alert officials of heat losses due to vandalism, storm damage, waste heat malfunctions or other causes; aria,
- supplementary lighting for extending the growing season.

Skills in marketing, shipping ana customer service, in addition to those of a horticulturalist, will also be important components of a successful northern greenhouse. While it may be realistic to expect to capture a significant portion of the market with local production, this will require service, responsiveness and an efficient business-oriented operation to be able to retain market share and, in some instances, to expand into other geographic areas.

4. CONCLUSIONS

This study identifies the market and market potential for local production of vegetables in selected northern communities. In simplest terms, the greatest market potential is held by those communities which are isolated from highway linkages to the south. The high cost of-transporting freight into isolated communities provides the opportunity for local production to compete even though it will undoubtedly be more expensive to grow produce in the north than in the south.

While this study identifies the potential for waste heat greenhouse production, it does not fully address numerous technical issues concerning the production of vegetables in the north. Appropriate technologies and growing techniques have been developed in greenhouses around the world for growing crops such as tomatoes, long english cucumbers, and other more fragile vegetables and plants. Until recently, however, limited attention has been paid to growing more hardy field crops such as potatoes, carrots and onions in greenhouses as field production is inexpensive and efficient in southern climates. The research efforts of a number of scientific projects in Rankin Inlet, Sanikiluaq, Ellsmere Island, and Pona Inlet have and are continuing to explore alternatives for northern vegetable production using combinations of indoor, outdoor and cold frame growing environments.

It is expected that the results of these projects will aid in the development of an operating configuration for northern waste heat commercial greenhouses. Development of such an operating configuration will require the exploration of a number of alternatives for various crops including:

- timing of the growing season for various crops;

- alternatives for indoor germination and outdoor and/or cold frame growing environments;
- optimal utilization of space, heat and lights with concern far minimizing operating costs; and,
- possibilities for underground heating of an outdoor growing environment.

In summary, an adequate market likely exists in Frobisher Bay and perhaps Rankin Inlet for further consideration of a commercial waste heat greenhouse operation. A series of technical questions remain as to how to efficiently grow certain crops in northern conditions. Some of these questions related to efficient growing techniques can be addressed during the development of a feasibility stuay ana business plan, but it is expected that there will still be a need for experimentation and development work during the first few years of operation.

5. RECOMMENDATIONS

Given the potential requirement for on-going experimentation and development during the first few years of operation of a northern greenhouse, it is recommended that efforts be concentrated an the investigation and possible construction of one pilot waste heat greenhouse in the most promising of the locations investigated. The greenhouse concept can be ultimately expanded to other communities if experience warrants this.

Based on market investigations to date, it is recommended that Frobisher Bay be selected for comprehensive evaluation as a potential site for a commercial waste heat greenhouse. This recommendation is based on the strength of the available market and the freight advantage afforded by the isolation of the community. The present market, as identifies in this study, is estimated to be in the order of 442,000 pounds per annum and offers the greatest potential of the communities evaluated. In addition, the Frobisher Bay location offers opportunities far expansion including:

- possibilities for negotiating more favorable air cargo rates into the surrounding settlements in order to improve regional freight advantages and thereby expand the potential market;
- the potential for penetrating markets in Greenland; and,
- anticipated consumption increases based on population projections.

Components of a comprehensive evaluation of Frobisher Bay as a potential waste heat greenhouse site should include:

- an evaluation of alternative sites;
- analysis of Frobisher Bay climatic conditions;
- development of an operating plan;
- capital cost estimation;
- operating cost estimation; and
- overall feasibility assessment.

With respect to site evaluation, the Northern Canada Power Commission currently operates two plants in different parts of Frobisher Bay; neither of these plants operates on a full-time basis. Site selection should consider whether waste heat might be gathered from one or both plants or whether there are alternatives for negotiating an agreement with NCPC to keep one plant in use at all times. Other site selection criteria would include consideration of topography, soil/gravel conditions, year-round availability of fresh water, ano sufficient acreage to satisfy production requirements.

The analysis of Frobisher Bay climatic conditions should include estimates of the following factors: average wind speed and direction, hours of sunlight, average temperatures, and number of frost free days. A comprehensive weather analysis will be critical to the configuration of cost efficient indoor/outdoor/cold frame growing strategies.

An operating plan based on site ana weather analysis, which addresses issues of square footage, type of construction, crop requirements, and indoor/outdoor/cold frame combinations, will be critical to the success of the venture. It is expected that alternatives that involve indoor germination in the spring and outdoor or cold frame growing in the summer will add to the

efficiency of the operation. Consideration should also be given to the potential for inducting a crop storage capability so that the hardy crops can be grown in the summer yet solo throughout the year.

Estimation of capital and operating costs and the overall assessment of feasibility should follow a typical model for feasibility studies. This process will likely be iterative in that alternative operating plans may be applied to tne base model in order to determine the impact on feasibility.

Based on the outcome of this comprehensive evaluation, a decision can be made with respect to proceeding to the detailed design and construction phases of the project.

In summary, the following action plan is recommended:

- designate Frobisher Bay as a potential test site for a commercial waste heat greenhouse;
- undertake a comprehensive evaluation of the feasibility of establishing a greenhouse in Frobisher Bay. This should include detailed estimates of revenue and costs ana a business plan. (Appendix b presents a work plan ana projected costs for this activity.);
- determine the preferred corporate structure (i.e. public vs. private) and financing alternatives for a waste heat greenhouse; and,
- assuming a favorable feasibility assessment and an appropriate organizational framework, the proponents of the project should proceea with the detailed design and construction of the project.

APPENDIX A

Summary of Canadian per Capita Consumption

Salad Vegetables	lbs/capita/year
Cabbage	14.2
Celery	9.4
Cucumber	4.0
Lettuce	20.5
Peppers	3.4
Radish	1.5
Tomato	12.8
	65.8
Table Vegetables	
Beans	1.5
Beets	1.0
Broccoli	2.2
Brussel Sprouts	.2
Carrots	18.5
Cauliflower	4.0
Onion	14.5
Parsnip	.3
Peas	.1
Rutabagos	6.1
	48.4
Potatoes	
All varieties	156.2
Melons	
Musk and honey dew	8.7
Grand Total	279.1

Source: Agriculture Canada

APPENDIX B

Required Program of Study

In order to implement the recommendations contained in this report it will be necessary to assess the overall technical and financial feasibility of the proposea greenhouse and prepare a recommended implementation ana business plan to guide the development of the project in Frobisher Bay. This Appendix details a program of study designed to accomplish these objectives.

Task 1. Development of Physical ana Production Parameters

This task should commence with a field trip to Frobisher Bay by engineering specialists skilled in the areas of waste heat systems and greenhouse requirements. over the course of the field trip the study team shoula examine alternative sites with respect to their suitability as a greenhouse site. Water availability, proximity to waste heat sources, adequacy of acreage and protection from vandalism will all be key parameters in site selection. (It is unaerstooa that Frobisher Bay is considering the construction of a new garbage incinerator. This may offer an alternative source of waste heat.)

In addition to site selection considerations, the study team will be required to examine the following:

- climate data including sunlight, temperature, precipitation, and wind conditions;
- geotechnical data for building construction;

- transportation costs, in relation to the delivery of construction materials and operating supplies;
- weather and other data relevant to possibilities of maturation of plants outdoors;
- year-round water supplies and quality;
- local soil and gravel characteristics for determination of appropriate growing meaiums;
- labour supply and costs - construction and operating phases; and
- utility costs of backup heating system and electrical requirements.

Based on the forgoing analyses ana the findings of the market study, the study team will be in a position to prepare a conceptual model of development for the Frobisher Bay greenhouse, encompassing:

- a description of the proposed facilities and ancillary services;
- size of facility;
- outdoor acreage requirements;
- proposed sites;
- proposed production model recognizing operating considerations, crop characteristics, climate, and market conditions; and
- operational requirements.

Critical to the development of a production model will be the thorough analysis of climatic conditions. If products can be grown outside, it will be necessary to have a

thorough understanding of average temperatures, precipitation, frost-free says and sunlight. Alternatives such as underground soil heating and/or removable covers may also be considered as a means of extending the outdoor growing season.

Task 2. Financial Feasibility

On the basis of the market, engineering, and technical analysis, the study team will be able to evaluate the financial feasibility of the proposed greenhouse operations in Frobisher Bay.

The capital and operating costs of the facilities should be estimated by engineers conversant with waste heat greenhouses. These data can then be incorporated with the revenue estimates based on the market analysis to derive pro forma profit and loss accounts covering the first five years of operation of the greenhouse.

Various sensitivity analyses are required in order to ascertain:

- the financial effects of changes in the production profile (i.e. changes in the product mix, capacity, and output);
- o effects of pricing variations on profitability;
- effects of changes in market penetration or volume of output on financial performance;
- breakeven levels of activity;
- effects on profitability of different capital financing alternatives; and,
- implications of changes in key operating parameters and costs.

The study team should then prepare a summary of the apparent financial feasibility of the greenhouse operations, the levels of risk associated with the development of the project, and the key variables on which the financial viability will rest. This summary report should be submitted for review by Economic Development and Tourism, Renewable Resources.

Task 3. operational and Financial Plan

Assuming that the findings of the financial feasibility analysis are positive, an operational ana financial plan will be required.

The operational plan should include:

- a recommended organizational framework and structure for the greenhouse operations, recognizing the operational requirements of the facilities and the unique characteristics of the host community;
- a manpower plan, with related job ascriptions ana required qualifications.

Hands-on operating experience with waste heat greenhouses will be extremely useful in developing the project operational plan.

The financial feasibility of the proposed project should be assessed on the basis of the most likely market, financial, and operating conditions, i.e., the “base case”. Various government and financial assistance programs (e.g.

E. D.A., energy conservation programs, etc.) should be investigated in the preparation of an appropriate financing plan for the greenhouse. The deliverables of this task include:

- profit and loss projections;
- pro forma balance sheets; and,
- source and application of fund statements, including the capital financing plan.

Task 4. Implementation Strategy

A business plan and implementation strategy will be required to serve as a guide to bringing the project to fruition. The plan should describe:

- the relative roles and responsibilities of the public and private sectors, including the local community, necessary to enhance the potential success of the greenhouse. It will be necessary to investigate the applicability of relevant government programs in other areas of Canada to potential greenhouse developments in the N.W.T. Recommendations regarding similar initiatives that might be undertaken to support these projects in the north should be formulated;
- a sequential schedule of activities to project start-up, including areas of further research ana analysis, negotiations for waste heat use, land acquisition, training and hiring, etc.

Task 5. Reporting

The findings from this program of study should be incorporated with the market research assessment into a draft report and presented to Economic Development and Tourism for review. The feedback from the Department will be considered in terms of revising the draft report and filling any gaps in the analysis.

Task 6. Public Consultation and Review

Subject to approval of the Department ana its review of draft findings, the study team may be requires to meet with community representatives in Frobisher Bay to:

- discuss the key findings of the report;
- assess the level of local interest in pursuing the greenhouse opportunity;
- identify community concerns ana issues related to the potential development of the project; aria,
- identify potential individuals, firms, or organizations that might become involvea in the operation of a greenhouse.

Following these meetings, the study team should undertake the necessary revisions to the draft report prior to submission to the Department.

The firms of Nichols Applies Management and Noval Enterprises Limited would be prepared to undertake this work plan as a joint venture. Based on the above-outlines work plan, it is estimated that activities could be completes for an approximate cost of $50,000, comprised of $40,000 for

professional fees and $10,000 for expenses. Precise cost estimates could be established following agreement on specific requirements in the areas of reporting, presentation of results and liaison with interested parties in Frobisher bay.

It should be stressed that it is essential that the initial visit to Frobisher Bay take place prior to the first snow fall in order that geophysical assessments of site alternatives can be conducted.