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ECONOMIC ASSESSMENT OF TROPICAL LEMON AND LIME PRODUCTION IN THE KATHERINE AND DARWIN REGION

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Contents

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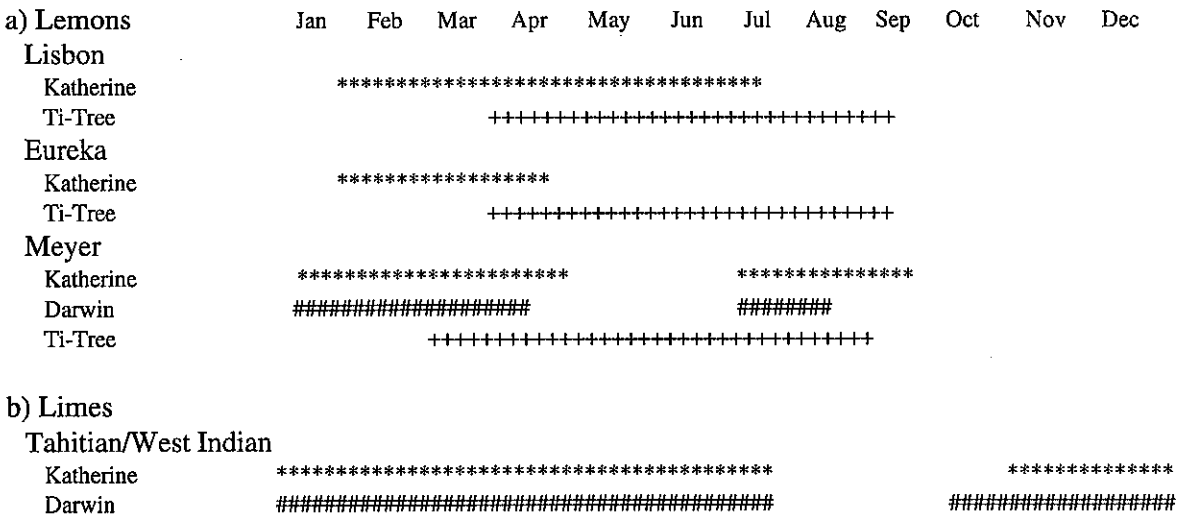
INTRODUCTION

Tahitian lime (*Citrus latifolia*), West Indian lime (*Citrus aurantifolia*) and tropical lemon (*Citrus limon*) are citrus fruit trees, mainly grown in the tropical regions of the Northern Territory and Queensland. The Tahitian/West Indian lime is green in colour, large, juicy and seedless. Skin colour usually turns yellow when the fruit is ripe. The tropical lemon, on the other hand, is large, has a mild and low acid flavour, with high juice content. Skin colour is light green.

Lemons and limes are used largely as summer fruit, in drinks, salad and summer food in the catering/restaurant trade. In the Katherine and Darwin regions, the harvesting season of green Tahitian/West Indian lime and tropical lemon is early, generally from October/November to June/July, compared to north Queensland, where it is between January/February to October.

Maturity times of limes and lemons in the NT are as follows -



Source: NT Citrus Industry Study (May 1995)

Domestic supply of lemons and limes is usually low during the period from July/August to December/January. Therefore, good prices can be obtained during this low supply period. However, prices of limes and lemons are usually low after February due to plentiful supplies from the main citrus growing regions in Australia (refer to the section on Industry Overview). Potential citrus growers in the NT should take this price factor into consideration when assessing the crops' profitability.

This Technical Bulletin provides estimates of the profitability of growing tropical lemons and limes in the Top End of the NT. It is designed to assist potential growers in making decisions on production planning. Intending growers are urged to carry out their own assessment based on these guidelines. Prices and costs need to be checked to make sure they are up-to-date and are relevant to the production system intended. The use of chemical names in the budget is for costing purposes only and does not imply endorsement by DPIF.

DPIF agricultural economists and private agricultural consultants can assist you with the preparation of detailed budgets to suit your own production system and your financial situation

OVERVIEW OF THE LIME AND LEMON INDUSTRY AND EXPORT/IMPORT SITUATION IN AUSTRALIA

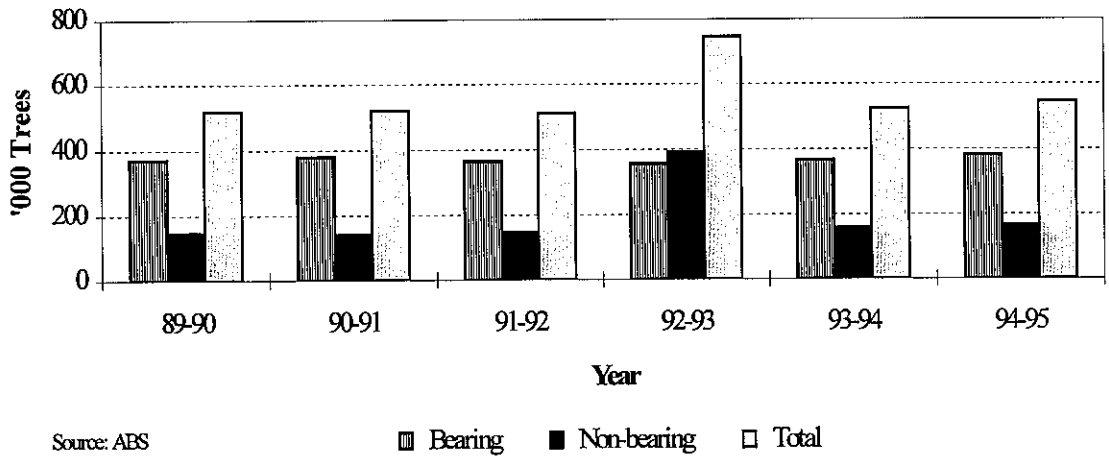
Unfortunately, there are no separate production statistics for limes and lemons. According to figures by the Australian Bureau of Statistics and the Agricultural Bureau of Agriculture and Resource Economics, the total number of lime and lemon trees planted in Australia and the NT in 1994 is around 546,000 and 4,000, respectively. A summary is given in Table 1.

Table 1: Number of Lemon and Lime Trees Planted in Australia and the NT.

Year	Australia			NT		
	Bearing	Non Bearing	Total	Bearing	Non Bearing	Total
1990	379,000	140,000	519,000	75	72	147
1991	366,000	146,000	512,000	150	58	208
1992	356,000	391,000	747,000	2,970	186	3,156
1993	367,000	158,000	525,000	1,999	192	2,183
1994	383,000	163,000	546,000	3,430	490	3,920

Sources: ABS Agstats, ABARE Statistical Summary (1996)

Figure 1: Lemons/Limes, Number of Trees Planted, Australia-wide



Source: ABS

The break-down of production by states in 1994-95 and 1995-96 is shown in Table 2:

Table 2: Production of Limes and Lemons by States to 1995-96 (Unit: tonne)

State	1994-95	1995-96
NSW	7,000	5,528
Vic	7,000	4,849
Qld	9,000	5,830
WA	1,000	881
SA	12,000	13,491
NT	100	60
Tas	-	-
Australia	36,100	30,634

Source: ABS, Australian Citrus Growers Federation Annual Report.

Lemon and Lime Prices -

Figures 2 and 3 illustrate historical prices of lemon and limes at Sydney markets for the past 6 years.

Figure 2: Historical Lime Prices and Throughput at Sydney and Brisbane Markets, 1992 -1998

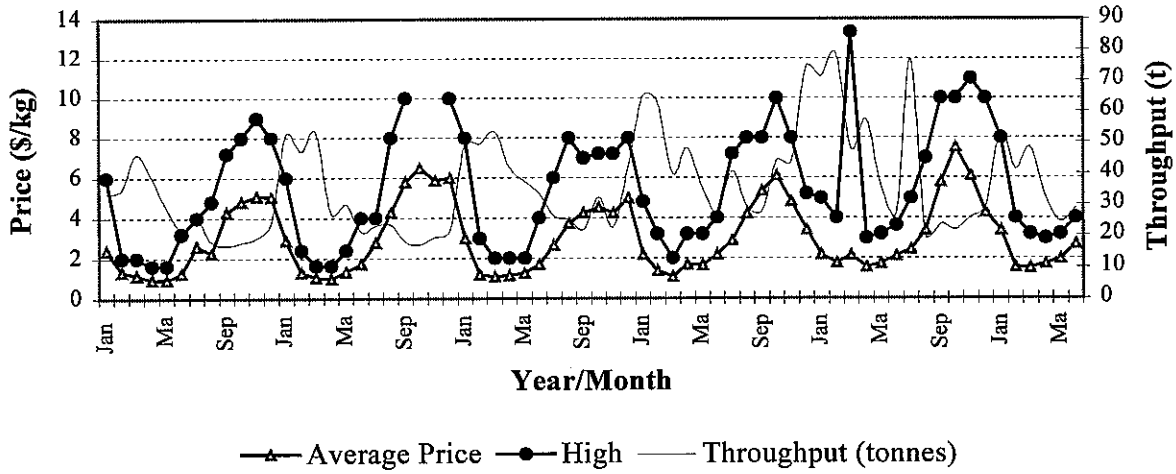
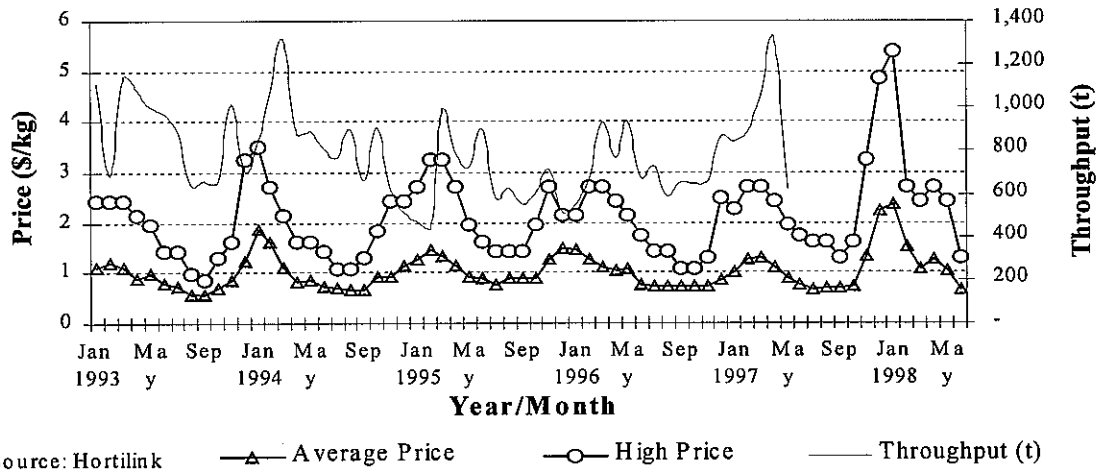


Figure 3: Historical Lemon Prices and Throughput at Brisbane and Sydney



Source: Hortilink

Markets, 1992-1998

As can be seen from the above graphs, average price for limes during the summer months is around $2-$4/kg. However, the total throughput (or market demand) is rather small at around 50-60 tonnes per month for these two main markets. Any major planting of limes, therefore, could have the potential to upset the market supply/demand situation and result in lower prices.

Average price for lemons during the summer months is around $1.00 to $2.00/kg. Market demand appears to be better than for limes at around 500 - 600 tones per month for the two main southern markets of Brisbane and Sydney.

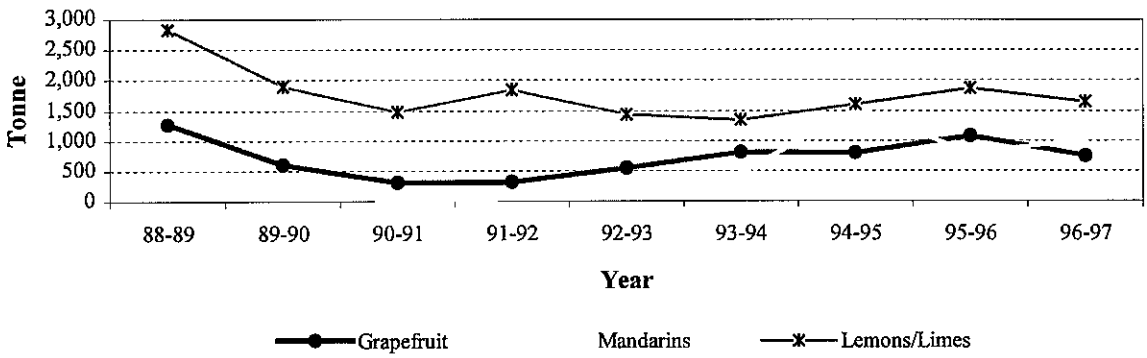
Australia's imports and exports of limes and lemons over the last seven years are summarised in Tables 3-5.

Table 3: Imports of limes and lemons into Australia, 1989-1995 (Unit: tonne)

	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
Lemons/limes	1,896	1,482	1,850	1,443	1,347	1,610	1,870	1,653

Source: ABS

Figure 4: Imports of Fresh Citrus Fruit into Australia (tonnes)



During 1996-97, Australia imported around 1,650 tonnes of lemons and limes, mostly from the US, at an estimated value of $2.1 million.

Australia export of limes and lemons is summarised in Table 4.

Table 4: Exports of limes and lemons from Australia, 1989-1997 (Unit: tonne)

	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
Lemons/limes	837	1,046	1,974	1,862	2,735	4,577	5,363	3,135

Source: ABS

During 1995, main importers of Australian limes and lemons included Japan, Hong Kong, Singapore and Malaysia. Major suppliers who compete with Australia at these markets include the USA, New Zealand, South Africa, Argentina and others (Table 5).

Table 5: Major importers and sources of supply of limes and lemons, 1995 (Unit: tonne)

	Australia	USA	NZ	S. Africa	Argentina	Others	Total
Japan	3,552	87,852	347	1,683	0	1,378	94,812
Hong Kong	593	10,091	115	903	1,879	736	14,317
Singapore	550	719	0	0	55	3,972	5,296
Malaysia	449	276	5	136	1	493	1,360

Source: Australian Horticultural Corporation Statistics

From Table 5, it can be noted that Australia ranks second, after the US, in supplying lemons and limes to the main importing countries in the region.

DEFINITION OF FINANCIAL INDICATORS USED IN THE ECONOMIC ANALYSIS

Financial indicators used to assess profitability include the following:

. Internal Rate of Return (IRR) which is defined as the maximum interest rate the project can afford to pay and break-even. This real rate of return can then be converted into nominal term by adjusting for the long-term inflation rate in Australia. That is, the nominal interest rate is approximately equal to the real interest rate plus the long-term inflation rate. The nominal internal rate of return can then be compared

with returns from current long-term investment opportunities offered elsewhere to see if the project is financially attractive or not, taking account of the risks associated with the project. One such long-term investment option, which the nominal rate of return can be compared with, is the 10-year Government bond, which is currently paying approximately 6% and is virtually risk-free.

- **Gross Margin** is the difference between gross income and total variable costs for a farm activity. It is usually expressed as dollar returns per hectare.

Gross Margin = Gross Income - Total Variable Costs

The gross income is the total receipts from the sale of produce plus the value of any retained output.

Variable costs are costs, which vary with the size of farm activities (eg. seed, fertiliser, irrigation, harvesting and packing costs). Variable costs are distinct from overhead or fixed costs, which are not directly related to the size of farm activities (eg. permanent labour, accounting fee, rates, registration, insurance etc). Variable costs and overhead costs represent total farm costs. Subtracting total overhead costs from the total or whole farm gross margin gives gross farm profit, which shows the returns to the operator's labour and management, in addition to the returns on the capital invested in the farm business.

- Break-even Prices are minimum long-term prices, which will enable the income to just equal the production costs ie. fixed and variable costs.

- Peak Debt is the greatest amount of money that will be owed by the project during its establishment phase.

- Pay Back Period is the time required for the accumulated cash returns to equal the accumulated cash costs.

MAIN ASSUMPTIONS USED IN THE MODEL BUDGET

- The area planted with lemon and lime for production is assumed in this analysis to be 8 hectares. However, the total area needs to be much bigger than 8 hectares to allow for factors such as soil/land suitability and infrastructure such as roads, buildings and so on.
- A permanent part time farm manager/supervisor is required.
- Tree density is at 380 trees per hectare.
- All field establishment, harvesting and packing is by hired casual labour, while other field work (maintenance, irrigation) is assumed to be by permanent part time labour.
- In general, the citrus crop will be ready for the first commercial harvest after about 4 years from planting with mature yields stabilised after year 8. Projected yields are shown in Table 6.

Table 6: Estimated Yields of Limes and Lemons in Katherine and Darwin Region (380 trees/ha)

Year	Tahitian Lime Yield (t/ha)			Tropical Lemon Yield (t/ha)		
	Low	Medium	High	Low	Medium	High
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	4.90	6.40	8.50	7.30	12.80	16.00
4	9.73	12.77	17.02	14.59	25.54	31.92
5	12.16	18.24	24.32	18.24	36.48	45.60
6	15.20	22.80	30.40	23.37	45.60	57.00
7	19.00	25.00	38.00	28.50	52.00	71.25
8 onwards	19.00 (50 kg/tree)	28.50 (75kg/tree)	38.00 (100kg/tree)	28.50 (75kg/tree)	57.00 (150kg/tree)	85.50 (225kg/tree)

Source: Adapted from DPIF trial results, Katherine DPIF Research Station

Major capital costs include:

- land,
- bore, pump and irrigation system,
- planting materials,
- general/packing shed and cold storage facilities,
- grading and packing equipment; and
- machinery, including tractors, vehicles and other farm equipment.

For further details, refer to Appendix 6 on "Capital Investment Schedule".

Main direct/variable production costs include:

- Irrigation: Details are given in Appendix 2.
- Fertilisers: Based on complete NPK, sulphate of ammonia and zinc sulphate foliar sprays. Details are given in Appendix 3.
- Insect/Pest control: Major insects/pests attacking citrus in the NT include:
  a) Fruit piercing moth which is not a problem for limes and lemons, except for the Meyer lemon variety. Complete netting is the best way to control the fruit piercing moth but the cost is very high, amounting to around $20,000 per hectare. Baiting is an alternative. It is being studied in north Queensland. If successful, this method could offer a cheaper control option for the Meyer lemon. Strip picking can also be used, if attacks from the fruit piercing moth are severe.
  b) Citrus leaf miner can cause damage in young trees and often in mature trees. The leaf miner can be controlled with petroleum spray oil (PSO).
  c) Citrus red scale can also be controlled by PSO.

- Disease control:
  Although no major diseases have been found in citrus trees planted in the NT so far, hot and humid conditions in the Top End during the wet season could be favourable for a variety of diseases. Reasonable allowance for disease control is therefore necessary.
- Harvesting is assumed at the rate of 110kg/hour.
- Transport costs to Southern markets is assumed to be $315/t (refrigerated road freight).
- Commission is assumed at 12% of the wholesale value.
- Average combined price assumed for both limes and lemons is $1.60/kg (wholesale price).

RESULTS AND DISCUSSION

The total investment cost required to meet all the capital expenditure and cashflow deficits during the establishment phase ranges from $565,000 to $ 582,000 for the whole 8 ha orchard of lemon and/or lime, equivalent to around $71,000 to $73,000 per hectare, including all capital costs and working capital to finance cashflow deficits during the early establishment years.

A summary of main financial indicators for an orchard of 8 hectare of limes or lemons in the Katherine region is as follows, based on an assumed medium 28.5t/ha (75 kgs/tree) for limes and 57 t/ha (150 kgs/tree) for lemon. The average southern wholesale price used is $2.50/kg for lime and $1.50/kg for lemon.

Table 7: Summary of Financial Indicators of an 8-ha. Lemon and/or Lime Orchard, Katherine Region (*without* fruit piercing moth netting).

Unit: $1

Financial indicators	Lime	Lemon
Internal rate of return (IRR) - real terms	18.0%	16.0%
Net present value @ 7% discount rate	850	663
Pay-back period (years) [1]	8 years	9 years
Break-even price ($/kg wholesale)	1.63	1.13
Gross margin ($'000/ha - year 10 onwards)	36.6	33.0
Total investment required (Peak debt/Cumulative cashflow deficit)	564,588 (yr.4)	581,506 (yr. 4)
Total investment cost/ha [2]	70,573	72,688

Notes: [1] assuming no borrowing.
[2] including capital expenditure and all cumulative cashflow deficits during establishment phase (first 4 years).

As a quick guide, table 7 below also gives a summary of the internal rates of return of an 8-hectare tropical lemon and lime development project at various prices and yields for the Katherine region.

Table 8: Sensitivity Analysis - Internal Rates of Returns (IRR) in real terms of an 8-ha Lemon or Lime Orchard at Various Yields and Prices.

a) For Lemon

	Prices ($/kg)						
Yield	1.00	1.25	**1.50**	1.75	2.00	1.75	2.00
75kgs/tree (66.5 t/ha)	-33.9%	-16.3%	-4.3%	4.5%	10.3%	16.4%	22.3%
150kgs/tree (57 t/ha)	-10.1%	6.7%	**16.0%**	22.8%	28.4%	37.3%	44.6%
225kgs/tree (38t/ha)	2.2%	15.9%	24.6%	31.4%	37.0%	41.0%	47.4%

b) For Lime

	Prices ($/kg)								
Yield	1.25	1.50	1.75	2.00	2.25	**2.50**	3.00	3.50	4.00
50kgs/tree (19 t/ha)	-30.2%	-18.3%	-8.7%	-1.7%	3.5%	7.7%	14.3%	19.5%	24.0%
75kgs/tree 28.5 t/ha)	-16.1%	-3.8%	4.0%	9.6%	14.1%	**18.0%**	23.3%	29.6%	34.2%
100kgs/tree (38t/ha)	-5.6%	5.1%	12.2%	17.7%	22.2%	26.1%	32.8%	38.4%	43.3%

For the Darwin region, IRR is found to be slightly lower than for Katherine (by about 0.25%). This is due to the fact that soils in the Darwin region require lime/dolomite application whereas no lime is required in Katherine, resulting in higher fertiliser costs in the Darwin region. Land cost in Darwin is also relatively higher than in Katherine

Figures 5 and 6 give an illustration of the IRR values at various prices and yields (without fruit piercing moth netting) for both crops.

Figure 5: IRR Values (in real terms) of an 8-ha Lemon Orchard, Katherine Region

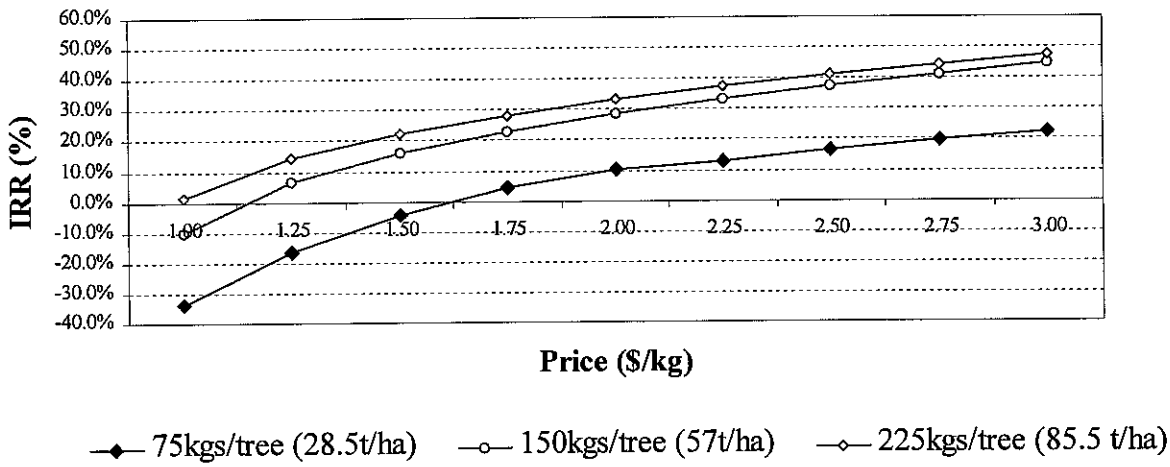
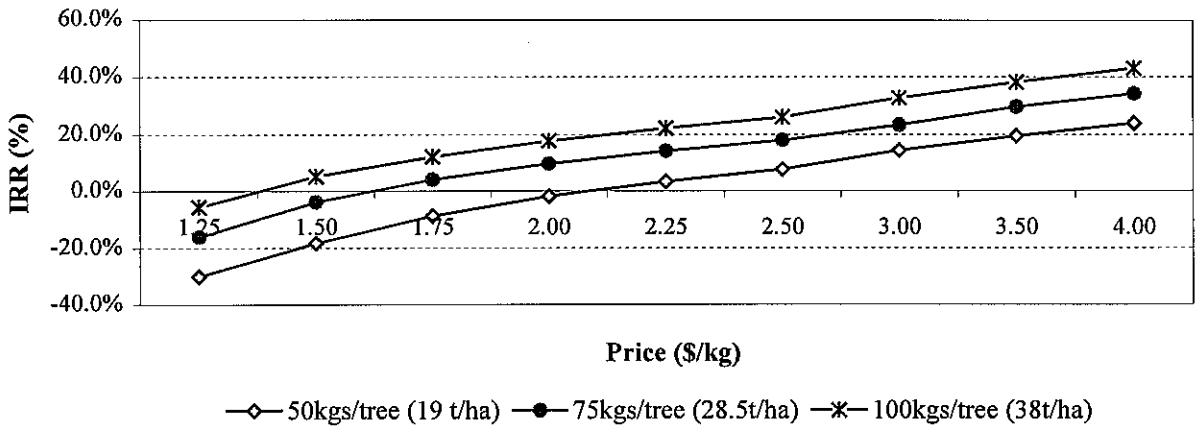


Figure 6: IRR Values (in real terms) of an 8-ha. Lime Orchard, Katherine Region



In practice, growers will probably grow some lemon and lime, together with other citrus fruits to spread risks. For an economic assessment on grapefruit, refer to the DPIF Technical Bulletin 270. If an orchard is a mixture of lemon and lime trees, the potential returns at medium yield and price is estimated to be between 16% and 18%.

In this analysis, no allowance has been made for borrowed funds to establish the tropical lemon/lime project. The IRR may then be interpreted as the highest interest rate that the project could pay on the total investment fund required and still break even. The median IRR in real terms is from 16% to 18%. This is roughly equivalent to from 19.5% to 21.5% in nominal terms, assuming a long term inflation rate of 3.5% per annum.

RISKS

The size of the domestic market for the off-season tropical lemons and limes is unknown. If the value of the imported lemon and lime is any indication, the market window/niche appears to be relatively small, at around 1,500 to 2,000 tonnes, worth a total of around $2.0 to $2.5 million per year. Any large planting of lemons and limes in northern Australia in the future would increase supply, hence reduce prices and profitability. As shown in Table 7, the internal rate of return is fairly sensitive to price variation. A price reduction of 10 cents/kg will result in a fall in IRR value of around 2%. Exports to overseas markets such as Japan, Hong Kong/China and other Asian markets could be an alternative option, provided that the product is competitive enough both in quality and price. Larger planting area and production volume is also required to be attract overseas importers.

No major diseases have been found in citrus trees planted in the NT so far. However, hot and humid conditions in the Top End during the wet season could result in a quick build-up of insects/pests and diseases, which would increase production costs. Unfavourable seasonal climatic conditions may also affect fruit set, yields and hence profitability. Any outbreak of exotic citrus diseases such as citrus canker could see the industry severely affected in terms of market access to other states and it might involve an expensive eradication program. (Note:

The recent citrus canker outbreak first appeared at Lambell's Lagoon in the NT in 1991, then re-appeared in 1993 at the same location. The eradication was completed in 1995).

CONCLUSION

Assuming a medium yield of around 57t/ha (or 150kg/tree) for lemon at maturity, at a long-term wholesale southern market price of $1.50/kg, the internal rate of return of an 8 hectare tropical lemon orchard is around 16% in real terms or 19.5% in nominal terms. This is assuming a long-term inflation rate of 3.5% per annum. These rates appear attractive compared to investment returns elsewhere in the current Australian economic climate, eg. 10 year Commonwealth Government bond rate of around 6% (but is risk free).

However, if tropical lemon prices are lower than $1.25/kg, the profitability deteriorates with IRR values being around 6.5% in real terms (ie. the project is considered very marginal, taking risks into account). Also, if yield is lower than 150 kg/tree or 57 t/ha, the profitability becomes marginal with the IRR becoming negative (ie. the project cannot recover capital investment costs) at yields of 75kgs/tree or 28.5t/ha and a medium price of $1.50/kg.

For lime, the rate of return is slightly better at 18% at medium yield and price. However, the major risk for lime could be the size of the domestic market, which is estimated to be not large. Any large planting of lime could upset the balance and price could fall quickly.

In general, the project's profitability could be improved if:

- average wholesale price of $1.50/kg for lemon and $2.50/kg for lime or higher can be achieved,
- yield is higher than 150 kg/tree for lemon and 75kg/tree for lime,
- cost of production can be reduced, especially picking and packing, freight and agents' commission

Larger planting may also result in better returns due to lower unit costs with a better economy of scale.

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Barnyard Trading, Darwin provided input prices. Ausmarket Consultants (Hortilink), Brisbane, provided market prices for tropical lemon, lime and other citrus.

APPENDIX 1: ESTABLISHMENT COSTS ($) for an 8 ha LEMON and/or LIME ORCHARD, KATHERINE REGION

OPERATION	TIMES REPLICATED	RATE	UNIT COST	AREA COST	TOTAL
1. LAND CLEARING AND PREPARATION:					
Ripping & stick raking (contract)	1		484.85	3,879	
Cultivation (own tractor)	2		90.00	1,440	
Row mounding @ $250/ha	1		250.00	2,000	7,319
2. PLANTING COST:					
Grafted trees (incl. extra 5% seed loss)	380		10.00	30,400	
Planting Cost					
(2 x 8 hr/ha casual @$10.50/hr)				2,280	
Tree guard @ $0.60 each	380		0.60	1,824	34,504
3. FERTILISER: (prior to planting)					
Single Super + trace elements	1	15	0.37	44	
Crop King 55	1	8	0.60	38	82
4. WEED CONTROL: (pre-emergence)					
Basta	1	0.80	17.98	115	
Application	1		3.21	26	141
TOTAL ESTABLISHMENT COSTS					42,143
ESTABLISHMENT COSTS/HA					5,268

APPENDIX 2: ESTIMATES OF IRRIGATION COSTS

ITEM OF EQUIPMENT	NEW PRICE ($)	EXPECTED R & M (%)	EXPECTED LIFE (HOURS)	OPERATING COST ($/HR)
Pump (12HP & incl. installation) - Power Cost @ $0.1505/KWH	7.630	30	20,000	0.11 1.31
Mains, Sub-mains & sprinklers (incl. fertilizer injection system & installation)	14,170	20	40,000	0.07
TOTAL	22,170			1.49

ESTIMATE OF ANNUAL IRRIGATION COST

System Block Size: 1 ha
No. of Shifts Required: 8
No. of sprinklers/ha 380
Sprinkler flow rate: 90 L/hr per sprinkler
Assume bore flow capacity (L/sec): 10 L/sec.
Period required irrigation:
Yr. 1 44 weeks
Yr. 2 onwards 30 weeks
Hourly pump running cost: $1.49

ANNUAL IRRIGATION COSTS ($)

Year	1	2	3	4	5	6	7	8	9	10
Litre/tree/week	46	153	280	509	636	835	835	835	835	835
Litres/ha required/week	17,480	58,140	106,400	193,420	241,680	317,300	317,300	317,300	317,300	317,300
Litres/8ha/week	139,840	465,120	851,200	1,547,360	2,538,400	2,538,400	2,538,400	2,538,400	2,538,400	2,538,400
Litres 8ha/irrigation (3 times/week)	46,613	155,040	283,733	515,787	846,133	846,133	846,133	846,133	846,133	846,133
Running hours req'ed per irrigation	1.4	4.53	8.30	15.08	18.84	24.74	24.74	24.74	24.74	24.74
Running hours req'ed per year	164	408	747	1357	1696	2227	2227	2227	2227	2227
Irrigation cost/8ha	244	608	1113	2023	2528	3319	3319	3319	3319	3319
Irrigation cost/ha	30	76	139	253	316	415	415	415	415	415

APPENDIX 3: FIELD MAINTENANCE - INPUT DATA

	Unit	Unit Cost $/kg or L	RATE OF APPLICATION/HA & NUMBER OF APPLICATIONS									
			YEAR									
			1	2	3	4	5	6	7	8	9	10 & after
FERTILISER												
NPK Complete (mixed)												
Rate of application	kg/tree		0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
No. of application			2	2	2	2	2	2	2	2	2	2
Total amount (per ha per yr.)	kg/ha	0.60	78.3	156.5	234.8	313.0	391.3	469.5	547.8	626.0	704.3	782.5
Total NPK costs (whole area)			751	1502	2254	3005	3756	4507	5258	6010	6761	7512
Ammonium sulphate												
Rate of application	kg/tree	0.41	0.125	0.25	0.375	0.50	0.63	0.75	0.88	1.00	1.13	1.25
No. of application			2	2	2	2	2	2	2	2	2	2
Total amount (per ha per yr.)			39.1	78.3	117.4	156.5	195.6	234.8	273.9	313.0	352.1	391.3
Total A.mm. sulphate costs			257	514	771	1028	1285	1541	1798	2055	2312	2569
Foliar sprays -Zinc sulphate												
Rate of application	kg/ha	0.90	0.31	0.94	1.57	1.88	2.50	2.82	3.13	4.38	5.63	6.26
No of applications			3	3	3	3	3	3	3	3	3	3
Total foliar spray costs			7	20	34	41	54	61	68	95	122	136
- Agricultural lime (*)												
Rate of application	t/ha	200	0	0	0	0	0	0	0	0	0	0
Total lime cost)			0	0	0	0	0	0	0	0	0	0
WEED CONTROL												
Diuron												
Rate of application	L/ha	14.88	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
No of application			2	2	2	2	3	3	3	3	3	3
Total Durion costs			833	833	833	833	1250	1250	1250	1250	1250	1250
Glyphosate												
Rate of application	L/ha	9.75	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
No of application			2	2	2	2	2	2	2	2	2	2
Total Glyphosate Costs			390	390	390	390	390	390	390	390	390	390
Slashing (own tractor)	$/hr	11.36	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39
No of application			5	5	5	5	5	5	5	5	5	5
Total slashing costs			632	632	632	632	632	632	632	632	632	632
PEST CONTROL												
Petroleum spray oil												
Chemical used per application	L/ha	2.50	12.21	12.46	12.97	13.66	14.38	16.91	19.90	23.41	27.54	32.40
No. of applications/yr			4	4	4	4	4	4	4	4	4	4
Total spray oil costs			977	996	1038	1093	1150	1353	1592	1873	2203	2592
Predator (ladybirds) (**)												
Predator cost/ha	$/ha		75	75	75	75	75	75	75	75	75	75
Labour (for distribution)	$/ha		109	109	109	109	109	109	109	109	109	109
Total predator cost			1475	1475	1475	1475	1475	1475	1475	1475	1475	1475
DISEASE CONTROL												
Copper oxychloride												
Chemical used per application	kg/ha	3.74	1.2	1.60	2.00	2.40	2.80	3.20	3.60	4.00	4.40	4.80
No. of application			2	2	2	2	2	2	2	2	2	2
Total copper oxychloride cost			72	96	120	144	168	192	216	240	264	288
Dithane M45												
Chemical used per application	kg/ha	7.44	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40
No. of application			3	3	3	3	3	3	3	3	3	3

Total Dithane cost			107	143	179	214	250	286	321	357	393	429
APPLICATION COSTS (total)			1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
Ferilizers			493	493	493	493	493	493	493	493	493	493
Weedicides			1506	1506	1506	1506	1506	1506	1506	1506	1506	1506
Pest/Disease control												
DESUCKERING/PRUNING												
Labour per hectare	hr/ha		0	16	21	23	26	26	26	26	26	26
Labour costs (whole area)	$/hr	10.50	0	1313	1750	1969	2188	2188	2188	2188	2188	2188

(*) not required for Katherine region (**) for the control of mealybugs

APPENDIX 4: FIELD MAINTENANCE - SUMMARY OF ANNUAL COSTS - (*Without* Fruit Piercing Moth Netting)

Year	1	2	3	4	5	6	7	8	9	10 onwards
Fertilizer	2116	3353	4591	5821	7059	8290	9520	10771	12022	13260
Weed Control	1716	1716	1716	1716	2256	2256	2256	2256	2256	2256
Slashing	632	632	632	632	632	632	632	632	632	632
Pest & Disease Control	4236	4316	4417	4531	4649	4911	5210	5550	5940	6389
Irrigation	244	608	1113	2023	2528	3319	3319	3319	3319	3319
Desuckering/pruning	0	1596	2128	2394	2660	2660	2660	2660	2660	2660
Sundries (5% of field costs)	447	531	623	736	856	970	1047	1126	1208	1293
TOTAL FIELD COSTS	9391	12752	15220	17854	20639	23037	24643	26314	28037	29808
FIELD COSTS/HA	1174	1594	1902	2232	2580	2880	3080	3289	3505	3726

Sources: From Appendices 2 & 3

APPENDIX 5: HARVEST & FREIGHT COSTS – LEMON

YEAR	1	2	3	4	5	6	7	8 onwards
YIELD (t/ha)	0.00	0.00	12.80	25.54	36.48	45.60	52.00	57.00
Casual Labour -picking	0	0	4915	19549	27923	34903	39802	43629
Post harvest treatment @ $0.05 /carton			569	1135	1621	2027	2311	2533
Casual Labour -packing			28800	38400	43200	48000	48000	48000
Cartons @ $1.35 each (9kg)			15360	30648	43776	54720	62400	68400
Picking and packing			49644	89732	116520	139650	152513	162562
Freight @ $315/t	0	0	32256	64361	91930	114912	131040	143640
TOT HARV & FREIGHT	0	0	81900	154093	208450	254562	283553	306202
HARVEST & FREIGHT/HA	0	0	10238	19262	26056	31820	35444	38275

APPENDIX 6: HARVEST & FREIGHT COSTS – LIME

YEAR	1	2	3	4	5	6	7	8 onwards
YIELD (t/ha)	0.00	0.00	6.40	12.77	18.24	22.80	25.00	28.50
Casual Labour -picking	0	0	2458	9774	13961	17452	19136	21815
Post harvest treatment @ $0.05 /carton			284	568	811	1013	1111	1267
Casual Labour -packing			28800	38400	43200	48000	48000	48000
Cartons @ $1.35 each (9kg)			7680	15324	21888	27360	30000	34200
Picking and packing			39222	64066	79860	93825	98247	105281
Freight @ $315/t	0	0	16128	32180	45965	57456	63000	71820
TOT HARV & FREIGHT	0	0	55350	96246	125825	151281	161247	177101
HARVEST & FREIGHT/HA	0	0	6919	12031	15728	18910	20156	22138

APPENDIX 7: CAPITAL INVESTMENT SCHEDULE

Capital Item	Plant & Equipment Economic: Life & Trade-In Values				
	Initial Cost	Year first purchase & replacement (over a 20 year project life)	Est Life (Years)	Trade-In (%)	Salvage Value ($)
LAND & BUILDING	80,000	0	100	100	80000
Land	50,000	0	30	50	25000
Labour accommodation	30,000	0	30	50	15000
Packing shed/workshop	25,000	4	20	50	12500
Cold storage facilities					
TOTAL LAND & BUILDING	185,000				
PLANT & EQUIPMENT					
Truck/Utility (2nd hand)	25,000	0,5,10,15	5	30	7500
Tractor 1 (35hp, new)	30,000	0,10	10	30	9000
Tractor 2 (second-hand)	7,500	4,9,14,19	5	20	2250
Trailer	3,500	0,10	10	20	700
Grading and packing equipment	75,000	0	20	20	15000
Slasher	3,000	0,5,10,15	5	15	300
Fertilizer spreader	2,500	0,12	12	15	250
PTO boom spray unit	8,000	0,12	12	15	800
Air blast mister	15,000	0,10	10	15	1500
Fork lift	12,500	1,15	15	20	3750
Small tools	5,000	1,8,16	8	0	2500
Fencing material	3,500	0	25	0	0
Power connection (est)	8,000	0	0	0	0
Irrigation System:					
- Bore	8,000	0	50	0	0
- Motor & pump	7,630	0,10	10	20	1526
- Mains/sprinklers/valves (incl. fertigator & installation)	14,170	0,15	15	20	2834
TOTAL PLANT & EQUIPMENT COSTS	228,300				

APPENDIX 8: MACHINERY ASSUMPTIONS

		Tractor Details			Implement Details			Work Rate	Fuel Price	Repairs & Maintenance.		Expected Life		Fuel used	Fuel & Oil	Repairs & Maintenance		Cost
		Available Power		Price	Price	Speed	Field Op. Effic'y			Tractor	Implement	Tractor	Implement			Tractor	Implement	($/hr)
Name of Operation	Name of Implement	PTO(kW)	PTO(hp)	$	$	(kph)	(%)	(ha/hr)	(c/L) (*)	% PC	% PC	(hrs)	(hrs)	(L/hr)	($/hr)	($/hr)	($/hr)	
Slashing	Slasher	30		30000	3000	5.0	80.0	0.50	46.0	72.0	30.0	10000	1200	9.0	4.55	2.16	1.10	7.46
Fertilising	Spreader	30		30000	2500	4.0	60.0	050	46.0	72.0	30.0	10000	1200	7.0	3.54	2.16	0.75	6.33
Weed Control	Boom spray	30		30000	8000	2.5	60.0	0.67	46.0	72.0	30.0	10000	1200	7.0	3.54	2.16	2.00	7.70
Pest/Disease Control	Airblast Mister	30		30000	15000	3.5	60.0	0.50	46.0	72.0	30.0	10000	1200	9.0	4.55	2.16	3.75	10.46
Harvesting/Carting	Trailer	30		30000	3500	5.0	60.0	1.00	46.0	72.0	30.0	10000	2400	7.0	3.54	2.16	0.25	5.99

APPENDIX 9: 8 ha. LEMON DEVELOPMENT CASHFLOW BUDGET - Average Yield of 57t/ha (150kg/tree) and Price of $1.50/kg - Katherine Region , without FPM netting

YEAR	0 planting	1	2	3	4	5	6	7	8	9	10	15	20
INCOME:													
1. Lemon/Lime yield (t/ha)	0	0	0	12.80	25.54	36.48	45.60	52.00	57.00	57.00	57.00	57.00	57.00
Production (t)	0	0	0	102.4	204.32	291.84	364.80	416.00	456.00	456.00	456.00	456.00	456.00
Equiv. no. of cartons (9 kg each)	0	0	0	11378	181617	32427	40533	46222	50666	50666	50666	50666	50666
Lemon/lime Price ($/kg)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Total Sales	0	0	0	153600	306480	437760	547200	624000	684000	684000	684000	684000	684000
2. Salvage value													300000
TOTAL INCOME	0	0	0	153600	306480	437760	547200	624000	684000	620160	620160	620160	984000
COSTS:													
1. VARIABLE COSTS													
Field Costs		11179	14541	17008	19642	22427	24826	26431	28103	29826	31596	32548	32736
Picking & Packing			0	49644	89732	116520	139650	152513	162562	162562	162562	162562	162562
Freight			0	32256	64361	91930	114912	131040	143640	143640	143640	143640	143640
Agents' Commission (12% of sale value)			0	18432	36778	52531	65664	74880	82080	82080	82080	82080	82080
TOTAL VARIABLE COSTS		11179	14541	117340	210513	283408	345052	384864	416385	418108	419878	420830	421018
2. OVERHEAD COSTS													
Permanent Part time Labour		30000	35000	40000	40000	45000	45000	45000	45000	45000	45000	45000	45000
General R & M		4000	4000	5000	6000	6000	6000	6000	6000	6000	6000	6000	6000
Power (household & cold storage)		2500	2650	3500	3500	3600	3600	3600	3600	3600	3600	3600	3600
Vehicle running costs		2664	2664	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080
Registration & Insurance		1500	1500	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Administration & Accounting		2500	2500	3000	3500	3500	3500	3500	3500	3500	3500	3500	3500
Communications		1200	1200	1500	2000	2000	2000	2000	2000	2000	2000	2000	2000
Contingencies/Sundries	5000	5000	5000	10000	5000	5000	5000	5000	5000	5000	5000	5000	5000
TOTAL OVERHEAD COSTS		49364	54514	68080	65080	70180	70180	70180	70180	70180	70180	70180	70180
3. CAPITAL & CAPITAL REPLACEMENT COSTS													
Establishment costs	42175												
Land & Building	160000	0	0	0	20000	0	0	0	0	0	0	0	0
Plant & Equipment	118800	0	0	15000	95000	20000	0	0	8804	5250	53700	31336	53700
TOTAL CAPITAL COSTS	320975	0	0	15000	115000	20000	0	0	8804	5250	53700	31336	53700
TOTAL COSTS	320,975	60,543	69,055	200,420	390,593	373,588	415,232	455,044	495,369	493,538	543,758	522,346	544898
NET CASHFLOW	-320,975	-60,543	-69,055	-46,820	-84,113	64,172	131,968	168,956	188,631	190,462	140,242	161,654	439,102
CUMULATIVE CASHFLOW	-320,943	-381,518	-450,573	-497,393	-581,506	-517,334	-385,366	-216,410	-27,779	162,683	302,924	1210000	2,406,444

Internal Rate of Return - Real terms: 15.98% (return to capital investment and management)

- Nominal terms: 19.48% (assuming long term inflation rate 3.5% p.a.)

Break-even Price - $/kg, wholesale southern markets $1.13 per kg ($10.20 per 9 kg tray)

Gross Margin ($/ha) $33,015

Net Present Value (at 7% discount rate) $663,014

Pay-back Period (assuming no borrowing): 9 years

Cumulative Peak Debt (or total investment capital required): $581,506 (peak debt in year 4)

APPENDIX 10: 8 ha. LIME DEVELOPMENT CASHFLOW BUDGET - Average Yield of 28.5t/ha (75kg/tree) and Price of $2.50/kg - Katherine Region , without FPM netting

YEAR	0 planting	1	2	3	4	5	6	7	8	9	10	15	20
INCOME:													
1. Lemon/Lime yield (t/ha)	0	0	0	6.40	12.77	18.24	22.80	25.00	28.5	28.50	28.50	28.50	28.50
Production (t)	0	0	0	51.20	102.16	145.92	182.40	200.00	228.00	228.00	228.00	228.00	228.00
Equiv. no. of cartons (9 kg each)	0	0	0	5689	11351	16213	20267	22222	25333	25333	25333	25333	25333
Lemon/lime Price ($/kg)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Total Sales	0	0	0	128000	255400	364800	456000	500000	570000	570000	570000	570000	570000
2. Salvage value													300000
TOTAL INCOME	0	0	0	128000	255400	364800	456000	500000	570000	570000	570000	570000	870000
COSTS:													
1. VARIABLE COSTS													
Field Costs		11179	14541	17008	19642	22427	24826	26431	28103	29826	31596	32548	32736
Picking & Packing			0	39222	64066	79860	93825	98247	105281	105281	105281	105281	105281
Freight			0	16128	32180	45965	57456	63000	71820	71820	71820	71820	71820
Agents' Commission (12% of sale value)			0	15360	30648	43776	54720	60000	68400	68400	68400	68400	68400
TOTAL VARIABLE COSTS		11179	14541	87718	146537	192028	230827	247678	273604	275327	277097	278049	278237
2. OVERHEAD COSTS													
Permanent Part time Labour		30000	35000	40000	40000	45000	45000	45000	45000	45000	45000	45000	45000
General R & M		4000	4000	5000	6000	6000	6000	6000	6000	6000	6000	6000	6000
Power (household & cold storage)		2500	2650	3500	3500	3600	3600	3600	3600	3600	3600	3600	3600
Vehicle running costs		2664	2664	3080	3080	3080	3080	3080	3080	3080	3080	3080	3080
Registration & Insurance		1500	1500	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Administration & Accounting		2500	2500	3000	3500	3500	3500	3500	3500	3500	3500	3500	3500
Communications		1200	1200	1500	2000	2000	2000	2000	2000	2000	2000	2000	2000
Contingencies/Sundries	5000	5000	5000	10000	5000	5000	5000	5000	5000	5000	5000	5000	5000
TOTAL OVERHEAD COSTS		49364	54514	68080	65080	70180	70180	70180	70180	70180	70180	70180	70180
3. CAPITAL & CAPITAL REPLACEMENT COSTS													
Establishment costs	42175												
Land & Building	160000	0	0	0	20000	0	0	0	0	0	0	0	0
Plant & Equipment	118800	0	0	15000	95000	20000	0	0	8804	5250	53700	31336	53700
TOTAL CAPITAL COSTS	320975	0	0	15000	115000	20000	0	0	8804	5250	53700	31336	53700
TOTAL COSTS	320,975	60,543	69,055	170,798	326,617	282,208	301,007	317,858	352,588	350,757	400,977	379,565	402,117
NET CASHFLOW	-320,975	-60,543	-69,055	-42,798	-71,217	82,592	154,993	182,142	217,412	219,243	169,023	190,435	467,883
CUMULATIVE CASHFLOW	-320,975	-381,518	-450,573	-493,371	-564,588	-481,996	-327,003	-144,861	72,551	291,794	460,817	1511799	2,852,149

Internal Rate of Return -	Real terms:	17.97% (return to capital investment and management)	
	- Nominal terms:	21.47% (assuming long term inflation rate 3.5% p.a.)	
Break-even Price	- $/kg, wholesale southern markets	$1.63 per kg ($14.70 per 9 kg tray)	
Gross Margin ($/ha)		$36,613	
Net Present Value (at 7% discount rate)		$849,613	