GREENHOUSE ECONOMICS

Chito F. Sace

(agricultural engineer and faculty member at Central Luzon State University
Science City of Muñoz, Nueva Ecija, Philippines)
(Email: cfsace@hotmail.com; cfsace227@yahoo.com)

ABSTRACT

Using various economic criteria, this paper discusses greenhouse economics using five common indicators. It describes how, by shifting from traditional extensive open field farming to intensive greenhouse production of high value crops, improved productivity and income from a small piece of land can be sustained. Experiences in the operation and management of the CLSU-ISRAEL-DA-SCP Demonstration Farm in Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines using Negev model greenhouses is also presented and used as basis of the financial analysis.

Results revealed that greenhouses are feasible to operate with in the locality. These modern agricultural techniques can be more profitable in growing high value crops.

INTRODUCTION:

Increased agricultural productivity is a primordial concern in many developing countries like the Philippines. As the challenge to produce more food for the ever-increasing population under a decreasing land resource base continues to mount, many agri-businessmen still believe that agriculture is the only way to recover the country's economy and pay its foreign debt. For a strong foundation of the country's economy, agriculture needs a more scientific approach to be developed and to be able to attain food security in the country. A particular concern on the development of advanced farming systems and the efficient use of resources, such as modern technologies, prove to be indispensable.

Agricultural productivity demands a revolutionary change in attitude to adopt advanced technologies to sustain, and greenhouse technology promises a solution. High yield of quality vegetables, flowers and fruits can be grown intensively out of season at year-round excellence that cannot be achieved in the open field. Climate, though sometimes hostile, will not interrupt and limit production. Space and water are efficiently utilized in its fullest resulting to the cutting cost of electricity, labor, time and water.

If appropriate attention is only given to high-technology farming and to the services required for the major phases of production, agriculture can assume that food problems and unemployment in the Philippines are manageable. Indeed, the need for adoption of modern technology to improve productivity cannot be overemphasized. The higher yield benefits from new technologies will only be realized if improved farming system is made available.

At this stage, it is indispensable to set up pilot demonstration farms where entrepreneurs, engineers and farmers can come and see the potential productivity and income that could be derived from this technology. In Silang, Cavite, Philippines, Netafim Phils had installed a demonstration farm for fruit and vegetable production. Sophisticated as it is, the farm has been an attraction in the area. In Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, the same company built two units of tropical greenhouse in a one-hectare demonstration farm. Successful in producing hybrid muskmelon, the farm is frequented by visitors who are curious of this Israeli technology.

The curiosity on the wonders of this high-technology farming draws interest and attention. Sooner or later, there is no doubt that more Filipinos will be aware of its adoption. Hence, a financial feasibility study of this venture is presented.

FEATURES OF THE GREENHOUSE MODEL

The Negev model greenhouses by Netafim of Israel is suitable to grow fruits, flowers and vegetables for tropical and warm climates. This model is structured in a way that balance of temperature and humidity will be possible. Table 1 illustrates the description of the greenhouses installed at CLSU, Muñoz, Nueva Ecija, Philippines.

Table 1. Description of the Israeli Greenhouse Structures at CLSU.

Type:	Tropical greenhouse for vegetable production
Model:	Negev
Dimension:	32 m x 36 m
Gutter height:	4 m
Side and roof covering:	Polyethylene plastic, 200 micron thick
Side ventilation:	Insect proof netting, mesh #17
Metal frame:	“Hot dip,” aluminum locking profiles
Anteroom dimension:	3.0 m x 2.5 m
Fertigation unit:	Complete set of automatic control fertigation system with Venturi injector and chemical tank
Cooling system:	5 sets of circulating fans and mist system

(Left), the Negev model greenhouses at the demonstration farm; (right), honeydew melons produced inside the greenhouses.

ECONOMIC ANALYSIS

Five basic methods were used to assess the financial feasibility of a unit of P1.7 M-greenhouse based on the experiences of the CLSU-ISRAEL-DA-SCP Demonstration Farm on muskmelon production. These methods are payback period, break-even analysis, benefit/cost ratio, net present worth and internal rate of return.

Though several crops can be planted, Sweet World variety of honeydew type muskmelon acquired from a reputed seed distributor in the country was selected and planted in a two-row plot with 150 hills. In this 32 m x 36 m greenhouse with an effective area of 1,110 square meters, 22 plots were laid out and planted that amounted to about 3,300 hills. One fruit is allowed to mature for every plant in order to maintain the quality of fruits. Harvesting was done after about 85 days of sowing the seeds. Conservatively, 90% of harvestable fruits of good quality were considered. This accounts for 2,970 pieces of fruits with an average weight of 1.6 kg each giving a total weight of 4,752 kg per cropping. From Table 2, a potential gross income of P285,120.00 is attained when fruits were sold at P60.00 per kg.

Table 2. Production Cycle Data

CROP GROWN:	Muskmelon
HARVESTING:	85 DAS
POTENTIAL PRODUCTION:	
Total area (32m x 36m):	1,154 sq. meters
Effective area cultivated:	1, 110 sq. meters
Total number of row:	22 rows
Total number of hills per row:	150 hills
Total number of hills:	3,300 pcs
Total potential number of fruits:	3,300 pcs [a]
POTENTIAL GROSS INCOME:	
Total potential number of fruits:	3,300 fruits
"Class A" (90%)	2,970 fruits [b]
Weight of fruit:	1.6 kg/fruit
Total weight:	4,752 kg
Cost /kg:	P 60.00/kg
Total Potential Gross Income:	**P 285,120.00**

[a] To maintain good quality fruits, one fruit is allowed to mature from each plant
[b] Some plants are not successful to produce good quality fruits

Depreciation and average interest on investment were considered as fixed costs amounting to P54,400.00 per cropping. The cost of materials and labor for replacement of some roof and side plastic covers is assumed by the repair and maintenance of P11,333.00, which are expected to wear and be replaced after three years. This cost plus the costs of inputs (seeds, labor, fertilizers, chemicals, electricity and other miscellaneous expenses) of P50,000.00 composed the variable cost that totaled to P61,333.00 per cropping. Adding these costs will give the total operating costs that is equal to P115,733.00 as shown in Table 3.

Table 3. Total Costs per Cropping Season

A. Fixed Costs		
A.1	Average interest in investment (AII)	P 37,400.00
A.2	Depreciation (Dep'n)	17,000.00
	Sub-total	**P 54,400.00**
B. Variable Costs		
B.1	Repair and Maintenance (R & M)	P 11,333.00
B.2	Seeds	17,600.00
B.3	Labor	20,000.00
B.4	Electricity	2,000.00
B.5	Chemicals	4,400.00
B.6	Fertilizers	4,000.00
B.7	Miscellaneous	2,000.00
	Sub-total	**P 61,333.00**
C. Total Costs		**P 115,733.00**

1. A.1 AII = 12% [(Initial cost + salvage value)] / 2
   = 12% [(P 1,700,000.00 + P 170,000.00)] / 2
   = P 112,200.00 / year
   = P 37,400.00 / cropping

2. A.2 Dep'n = (Initial Cost – Salvage value) / Life span
   = (P 1,700,000.00 – P 170,000.00) / 30 years
   = P 51,000.00 / year
   = P 17,000.00/cropping

3. B.1 R & M = 2% / year (Initial cost)
   = 0.02 (P 1,700,000.00) / year
   = P 34,000.00 / year
   = P11,333.00 / cropping

From these values, it is interesting to note that there are about 2.67 fruits per sq m of the greenhouse effective area or about 4.3 kg of fruits. This is equal to a gross income per sq m of about P257.00. Net return, computed when total costs are subtracted from the gross return, is equal to P169,387.00 while gross margin is about P223,787.00 when the total variable costs are deducted from the gross return. Unit price, which is computed by dividing total variable cost by the total weight of fruits per year, is only about P12.90.

FINANCIAL ANALYSIS

1. Payback Period

Payback period focuses on the length of time it will take for the investment to return its original cost or the number of years required for cash inflows to just equal cash outflows. It is often called simple payout method, which indicates the project liquidity rather than profitability

PP = IC / ANI
= P1, 700, 000.00 / P508, 161.00
= **3.34 years**

Where: PP = Payback Period
IC = Investment cost
ANI = Annual net income

NOTE: The project requires only 3.34 years or 3 years and 4 months to recover.

2. Break-even Analysis

Break-even analysis presents the point where there is just sufficient revenue to cover the costs. It is the point at which the total cost and the total gross revenue intersect. It is a method used more frequently to demonstrate the probable effects of change than to determine what those changes should be.

BEP **= TFC / (sp – up) , kg/ year**
= P163, 200.00 / (P60.00 - P12.90) / kg
= 3,465 kg / yr

Where:
BEP = Break-even point; the volume where TR=TC
TFC = Total fixed cost per year
sp = Selling price per kg
up = Cost per kg
= TVC / (Total wt / yr)
= P183, 999.00 / 14,256 kg
= P 12.90 / kg

NOTE: The project needs only 3,465 kg per annum to reach a no-profit-no-loss situation.

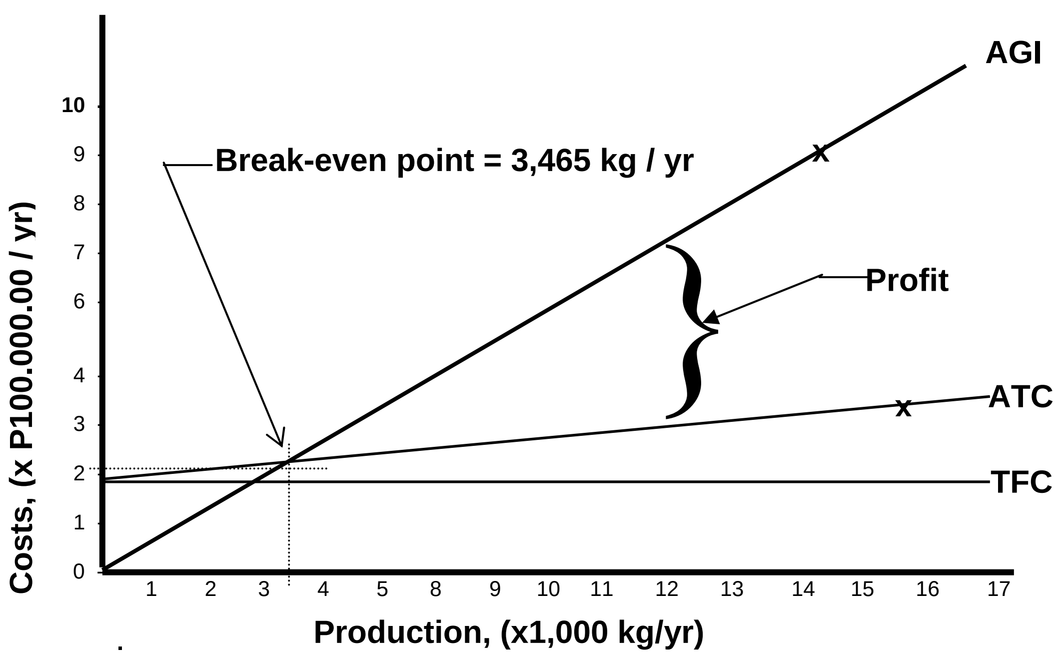

Figure 1. Break-even chart showing costs and volume of production.

3. Benefit/Cost Ratio (BCR) Method

Benefit-cost ratio (BCR) is a ratio of discounted benefits to discounted costs. It is an accepted procedure for making go/no-go decisions on projects as compared to alternatives. If the value of BCR > 1.0 the project is feasible.

BCR = PWB / (PWC + IC)

PWB = AGI (P/A, I%, N)
= P855, 360.00 (P/A, 12%, 30)
= P855, 360.00 (8.0552)
= **P6, 890, 096.00**

PWC = ATC (P/A, I%, N) – SV (P/F, I%, N)
= P347, 199.00 (P/A, 12%, 30) – P170, 000.00 (P/F, 12%, 30)
= P347, 199.00 (8.0552) – P170, 000.00 (0.0334)
= **P2, 791, 079.00**

Where:

BCR	=	Benefit/Cost Ratio
PWB	=	Present Worth Benefits
PWC	=	Present Worth Costs
IC	=	Investment Cost
ATC	=	Annual Total Costs
SV	=	Salvage Value of investment cost
I%	=	Interest rate in investment cost
N	=	Life Span of the project
AGI	=	Annual Gross Income
I2%	=	Interest rate in investment cost

BCR = PWB / (PWC + IC)
= P6, 890,096.00 / (P2, 791, 079.00 + P1, 700, 000.00)
= **1.53**

NOTE: Since BCR = 1.53 > 1.0, then the project is feasible.

4. Net Present Worth (NPW) Method

Net present worth method is based on the concept of equivalent worth of all the cash flows relative to some base or beginning point in time called the present. It is a measure of how much money an individual or a firm could afford to pay for the investment in excess of its costs. If the value of PW >1.0 then the project is feasible.

NPW = PW of Cash Inflows – PW of Cash Outflows
= PWB – (PWC + IC)
= P6, 890, 096.00 – P4, 491, 079.00
= **P2, 399, 017.00**

Where:

Cash Inflows = PWB
Cash Outflows = PWC + IC

NOTE: Since the computed value of PW = P2, 398, 050.00 > 1.0; then the project is feasible.

5. Internal Rate of Return

Internal rate of return (IRR) is another way of using discounted cash flow for measuring economic worth of a project. It is to find out whether the discount rate will make the net present worth of the cash flow equal to zero. The discount rate is termed the internal rate of return that represents the average earning power of the investment over the life of the project.

$$\textbf{IRR} = \sum_{K+0}^{N} \mathbf{R_k}\ (P/F, I\%, k) = \sum_{K+0}^{N} \mathbf{E_k}\ (P/F, I\%, k)$$

$$= \mathbf{30\%}$$

Where: R_k = Net revenues or savings for the kth year
E_k = Net expenditures including any costs for the kth year
N = Project life

Assuming that the minimum attractive rate of return (MARR) is 24%, then the project is feasible.

DISCUSSION

From Table 4, the payback period of 3.34 years connotes ten cropping seasons are needed to recover the costs. This means that greater net income can be realized after this period. The 3,465 kg per year break-even point indicates that the project only needs to produce this yield per year and sell them at P60.00 per kg to earn a revenue of about P207,900.00 in order to cover the costs of production. This also suggests that as the project produce more, the more will be the income.

Benefit cost ratio, net present worth and the internal rate of return obviously disclose that investing in this project is highly feasible.

Table 4. Summary of computations

Methods	Values	Remarks
1. Payback period	3.34 years	The project will take only about 3 years and 4 months or 10 cropping to recover the investment
2. Break-even point	3,465 kg / yr	The project needs only 3,465 kg weight of fruits to be sold in order to cover the cost
3. Benefit-cost ratio	1.53	Feasible
4. Net present worth	P2, 399, 017.00	Feasible
5. Internal rate of return	30%	Feasible

CONCLUSION

By adopting greenhouses, there is no doubt that in the near future, there will be more food and jobs for every Filipino. Sustained production of quality fruits, flowers and vegetables will eventually cause lesser importation as local farmers can produce these all season of the year. Farmer's income will be then be improved and sustained ultimately making our economy stable.

The need to adopt high-technology agriculture in the country is therefore not a choice anymore but a necessity.

REFERENCES

ANONYMOUS. 1995. "Facts about Israel". The Grolier Multimedia Encyclopedia.. Grolier Electronic Publishing, Inc., Novato, CA, USA.

DE GARMO, E.P. et. al. 1997. Engineering Economy. 10TH Edition, Prentice-Hall Inc. USA.

CABATBAT, D.D and MANANGU, I.S. 1999. "Water Management for Combined Ginger and Amargoso Crops under Micro-Sprinkler Irrigation". CLSU.

DELAYAHU E. and E. HADASS. 1996. Agricultural Production Forecast for the Years. General Planning Department, Ministry of Agriculture, Tel Aviv, Israel.

INTERNET HOMEPAGE. 2002. "Facets of the Israeli Economy". Jerusalem, Israel., http://www.mfa.gov.il

SACE, C.F. and DURAN, D. D.1982 "Performance and Cost Analyses of Different Harvesting and Threshing Practices in CLSU." CLSU.

SACE, C. F. and R.B. GAVINO. "Design and Evaluation of a Low-cost Automatic Control Device for Pressurized Irrigation Systems". Proceedings of International Commission on Irrigation and Drainage. 19th European Regional Conference. Ministry of Agriculture, Prague, Czech Republic, 4-8 June 2001

SACE, C. F., "Year End Report 2001 CLSU-ISRAEL-DA-SCP Demonstration Farm". CLSU, Muñoz, Nueva Ecija. January 2001

SMALL L. E. 1992. "Evaluating Irrigation System Performance with Measures of Irrigation Efficiencies". Irrigation Management Network. ODI. Network Paper 22

UNDAN, R. C. AND C. F. SACE. "Pressurized Irrigation Systems for Improved Water Management and Productivity". Proceedings of the 52nd PSAE Annual Convention, Puerto Princesa City, Palawan, April 22-26, 2002.